# Barangaroo Ferry Hub
## Environmental Impact Statement

December 2014

NSW GOVERNMENT | Transport for NSW

# Barangaroo Ferry Hub
# Transport for NSW

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# Contents

**Glossary and abbreviations** i

**Executive summary** v

The proposal v
Key features of the proposal v
Overview of construction activities vii
Need for the proposal vii
Barangaroo precinct vii
Predicted growth and demand viii
Options assessment and decision making process viii
Strategic assessment ix
Options assessment ix
Proposal definition x
Planning approval process x
Community and stakeholder consultation x
The Environmental Impact Statement x
Preparation of the EIS xi
Key findings of the EIS xi
Management of impacts xxii
Environmental risk analysis xxii
Justification and conclusion xxii
How to make a submission on the Barangaroo Ferry Hub proposal xxii

**1 Introduction 1**

1.1 Background 1
1.2 Location of the proposal 2
1.3 Barangaroo precinct 5
1.4 Overview of the proposal 7
1.5 Purpose and structure of this EIS 7
1.6 Secretary's requirements 9

**2 Planning and assessment process 16**

2.1 Assessment and approval process 16
2.2 State environmental planning instruments 19
2.3 Local environmental planning instruments 26
2.4 Additional NSW legislation 26
2.5 Commonwealth legislation 30
2.6 Additional environmental approvals/permits required 31

**3 Need and alternatives 32**

3.1 Strategic context 33
3.2 Project need 38

3.3 Options assessment 44

**4 Description of the proposal 55**

4.1 Overview 56
4.2 Scope of works 60
4.3 Design and justification 76

**5 Community and stakeholder consultation 82**

5.1 Consultation strategy and objectives 83
5.2 Overview of consultation undertaken to date 85
5.3 Stage 1 – EIS preparation 86
5.4 Stage 2 – EIS exhibition consultation 93
5.5 Ongoing consultation 97

**6 Environmental issues 98**

6.1 Noise and vibration 99
6.2 Traffic and transport 132
6.3 Ecology 159
6.4 Visual amenity and urban character 168
6.5 Built and non-Indigenous Heritage 186
6.6 Climate change 192
6.7 Air quality 199
6.8 Property and land use 203
6.9 Water quality and hydrology 207
6.10 Indigenous heritage 217
6.11 Socio-economic 221
6.12 Soils, geology and contamination 225
6.13 Ecologically sustainable development 232
6.14 Utilities and services 238
6.15 Waste and resource use 240
6.16 Hazards and risks 243
6.17 Cumulative impacts 246

**7 Environmental management 253**

7.1 Environmental management plans 253
7.2 Mitigation measures 253
7.3 Environmental risk analysis 270

**8 Strategic justification and conclusion 285**

8.1 Proposal justification 285
8.2 Conclusion 289

**References 290**

## Appendices (Volume 1)

**Appendix A** Secretary's environmental assessment requirements and Consideration of matters of national environmental significance

**Appendix B** Concept Design Drawings

**Appendix C** Photomontages

**Appendix D** Indicative Wayfinding Signage Plan and Design and Indicative Opal Card Ticketing Facilities and Location

## Appendices (Volume 2)

**Appendix E** Technical Paper: Noise and Vibration Impact Assessment

**Appendix F** Technical Paper: Traffic and Transport Impact Assessment

**Appendix G** Technical Paper: Aquatic Ecology Assessment

**Appendix H** Technical Paper: Landscape and Visual Impact Assessment

**Appendix I** Technical Paper: Statement of Heritage Impact (non-maritime)

**Appendix J** Technical Paper: Statement of Heritage Impact (maritime)

**Appendix K** Technical Paper: Climate Change Risk Assessment

**Appendix L** Technical Paper: Sustainability Initiatives Register

## Figures

Figure E–1 Key proposal features vi
Figure E–2 Barangaroo Ferry Hub options assessment process ix
Figure 1-1 Regional context 3
Figure 1-2 Proposal location in relation to other nearby major projects 4
Figure 1-3 Proposal location in relation to existing and future landside components 6
Figure 2-1 Approval process under Part 5.1 of the EP&A Act 18
Figure 2-2 Land zoning map around proposal area 22
Figure 3-1 Residential development within the vicinity of Meadowbank and Sydney Olympic Park Ferry Wharves 42
Figure 3-2 Residential development within the vicinity of Cabarita Ferry Wharf 43
Figure 3-3 Options assessment process 44
Figure 3-4 Summary of strategic assessment 46
Figure 3-5 Alignment options for new wharves 50
Figure 4-1 Key proposal features 58
Figure 4-2 Detailed cross section of proposal 59
Figure 4-3 Indicative construction timeline for the initial two wharves 61
Figure 4-4 Indicative vessel movements 75
Figure 5-1 Ongoing consultation process 84
Figure 5-2 Proposed Notification area 95
Figure 6-1 Noise catchment areas and monitoring locations 107
Figure 6-2 Existing road network 134
Figure 6-3 Public transport network 137
Figure 6-4 Pedestrian network 139
Figure 6-5 Inbound traffic routes to the construction site 143
Figure 6-6 Outbound traffic routes from the construction site 144
Figure 6-7 Walking isochrones from Barangaroo Ferry Hub 151
Figure 6-8 Pedestrian movements around Barangaroo Ferry Hub 152
Figure 6-9 Strategic cycleway network 154
Figure 6-10 Planned bus corridors 156
Figure 6-11 Aquatic ecology study area 161
Figure 6-12 Key viewpoints 170

Figure 6-13 Character images of the proposed Barangaroo Ferry Hub 177
Figure 6-14 Marine archaeology study area and proposal area 187
Figure 6-15 Barangaroo Ferry Hub and its interaction with the Barangaroo South water cooling system 211
Figure 6-16 Indigenous heritage sites in vicinity of the proposal area 219
Figure 6-17 Acid sulphate soils risk map 228

## Tables

Table E–1 Key impact and benefits of the Barangaroo Ferry Hub proposal xii
Table 1-1 Secretary's environmental assessment requirements 9
Table 2-1 Secretary's environmental assessment requirements relevant to planning and assessment process 17
Table 2-2 Objectives of the SREP SHC 23
Table 2-3 Objectives of the W1 Maritime Waters zone 24
Table 2-4 Matters for consideration 24
Table 2-5 Additional NSW legislation 27
Table 2-6 Commonwealth legislation applicable to the proposal 30
Table 2-7 Additional environmental approvals/permits required 31
Table 3-1 Secretary's environmental assessment requirements relevant to strategic context 32
Table 3-2 Barangaroo Ferry Hub proposal's contribution to meeting NSW 2021 33
Table 3-3 Key actions of the Barangaroo Integrated Transport Plan relevant to the proposal 38
Table 3-4 Previous patronage growth – Sydney Ferries 39
Table 3-5 Barangaroo Ferry Hub maximum passenger capacity (weekends) 40
Table 3-6 Options considered for the proposal 47
Table 3-7 Assessment of options 48
Table 3-8 Options assessment against navigation safety considerations 51
Table 4-1 Secretary's environmental assessment requirements relevant to the description of the proposal 55
Table 4-2 Construction staging and key activities 60
Table 4-3 Approximate duration of piling operations for each pile 67
Table 4-4 Electricity requirements for proposal 74
Table 4-5 Design elements of the proposed Barangaroo Ferry Hub 77
Table 5-1 Stakeholders briefed 87
Table 5-2 Key issues raised by stakeholders during preparation of the EIS 89
Table 6-1 Determination of noise management levels 99
Table 6-2 Noise management levels for other sensitive receptors 100
Table 6-3 Amenity Criteria – Recommended LAeq noise levels from industrial noise sources 103
Table 6-4 RNP criteria – residential 104
Table 6-5 Airborne light rail noise triggers for residential land use 105
Table 6-6 Airborne rail noise triggers for non-residential land use 105
Table 6-7 Background noise monitoring results 108
Table 6-8 Predicted noise levels at nearest receivers 110
Table 6-9 Summary of indicative out-of-hours works (OOHWs) 118
Table 6-10 Operational and screening criteria for sensitive receivers 119
Table 6-11 Summary of project specific noise criteria (INP) 120
Table 6-12 Sound power level of ferry terminal activities 120
Table 6-13 Predicted operational noise levels (INP) 122
Table 6-14 Operational and screening criteria for sensitive receivers – alternate 125
Table 6-15 Operation predicted noise levels (alternate) 126
Table 6-17 Additional vehicle trips generated by the Barangaroo precinct 135
Table 6-18 Peak hour ferry services to Barangaroo 146
Table 6-19 Barangaroo Ferry Hub weekend forecast maximum passenger capacity (weekends) 147
Table 6-20 Aquatic habitats and ecology identified during survey of study area 162

Table 6-21 Potential impact on aquatic habitats and ecology during construction 165
Table 6-22 Potential impact on aquatic habitats and ecology during operation 166
Table 6-23: Landscape character areas in the vicinity of the project area 171
Table 6-24 Summary of viewpoint assessment during construction phase 173
Table 6-25 Summary of landscape character assessment during construction phase 176
Table 6-26 Summary of viewpoint assessment during operation phase 179
Table 6-27 Summary of landscape character assessment during operational phase 184
Table 6-28 Items of State or local heritage significance in the vicinity of the project area 189
Table 6-29 Shipwrecks known to be within Darling Harbour 190
Table 6-30 Projections of mean sea level rise 194
Table 6-31 Projections of mean sea level rise to 2065 194
Table 6-32 Climate change risk assessment 196
Table 6-33 Darling Harbour water quality monitoring summary (April 2012 – June 2014) 209
Table 6-34 Tidal plane levels for Sydney Harbour (Australian National Tide Tables, 2014) 210
Table 6-35 Adherence with principles of ESD 232
Table 6-36 Emission types and probable sources 236
Table 6-37 Nearby projects with the potential of cumulative impact 248
Table 7-1 Proposed mitigation measures 254
Table 7-2 Summary of likelihood criteria used in the environmental risk analysis 271
Table 7-3 Summary of consequence criteria used in the environmental risk analysis 271
Table 7-4 Environmental risk rating matrix 272
Table 7-5 Summary environmental risk categories used in the environmental risk analysis 272
Table 7-6 Results of risk assessment 274
Table 8-1 The proposal’s adherence with and/or response to EP&A Act objectives 287

# Glossary and abbreviations

| | |
|---|---|
| **AHD** | Australian Height Datum |
| **AHIMS** | Aboriginal Heritage Information Management System |
| **ASS** | Acid Sulphate Soils |
| **Barangaroo Ferry Hub (or 'the proposal')** | The construction and operation of the Barangaroo Ferry Hub including the potential demolition of the King Street Wharf wave baffle and decommissioning of public transport elements from King Street Ferry Wharf |
| **BDA** | Barangaroo Delivery Authority |
| **BoM** | Bureau of Meteorology |
| **CBD** | Central Business District |
| **CEMP** | construction environmental management plan |
| **CHL** | Commonwealth Heritage List |
| **CIV** | capital investment value |
| **construction compound** | A temporary land based construction compound located on the Barangaroo precinct adjacent to the proposed wharves including hoarding, relocatable site sheds, amenities, and construction equipment (e.g. construction materials and tool boxes) |
| **construction work area** | Area in which construction activities would occur for the proposal including:<br>• works undertaken at the construction compound<br>• waterside works within Darling Harbour<br>• landside works for ancillary facilities<br>• the King Street Wharf wave baffle demolition area (potential)<br>• existing King Street Ferry Wharf<br>This area does not include a construction contractor's off-site facility. |
| **CSIRO** | Commonwealth Scientific and Industrial Research Organisation |
| **CTMP** | construction traffic management plan |
| **DCP** | development control plan |
| **DECC** | former Department of Environment and Climate Change (NSW) |
| **DECCW** | former Department of Environment, Climate Change and Water (NSW) |

| | |
|---|---|
| **DDA** | *Disability Discrimination Act 1992* (Commonwealth) |
| **DSAPT** | *Disability Standards for Accessible Public Transport Act 2002* (Commonwealth) |
| **DP&E** | NSW Department of Planning and Environment |
| **DP&I** | former NSW Department of Planning and Infrastructure |
| **DPI** | Department of Primary Industries |
| **DSI** | detailed site investigation (Phase II contamination investigation) |
| **EIS** | environmental impact statement |
| **EPA** | Environment Protection Authority |
| **EP&A Act** | *Environmental Planning and Assessment Act 1979* |
| **EP&A Regulation** | *Environmental Planning and Assessment Regulation 2000* |
| **EPBC Act** | *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) |
| **EPI** | environmental planning instrument |
| **EPL** | environmental protection licence |
| **Ecologically sustainable development (ESD)** | Development that uses, conserves and enhances the resources of the community so that ecological processes on which life depends are maintained, and the total quality of life, now and in the future, can be increased (refer to Section 6.13) |
| **FM Act** | *Fisheries Management Act 1994* |
| **FWPDAC** | Foreshore and Waterways Planning and Development Advisory Committee |
| **GHG** | Greenhouse gas |
| **Global Sydney** | is made up of the Sydney CBD, its adjacent precincts and the CBD or North Sydney |
| **HCF** | Harbour City Ferries |
| **Heritage Act** | *Heritage Act 1977* |
| **ICNG** | *Interim Construction Noise Guideline* |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **ISCA** | Infrastructure Sustainability Council of Australia |

| | |
|---|---|
| **ISEPP** | *State Environmental Planning Policy (Infrastructure) 2007* (NSW) |
| **ISLW** | Indian Spring Low Water |
| **King Street Ferry Wharf** | Public ferry wharf located at King Street Wharf, also known as King Street Wharf 3 |
| **King Street Wharf** | Mixed use development including commercial premises, pedestrian promenade and wharves located to the south of the proposed Barangaroo Ferry Hub |
| **King Street Wharf wave baffle** | Existing maritime structure located at the northern end of King Street Wharf originally designed to reduce waves and wash from vessels. |
| **LEP** | local environmental plan |
| **LGA** | local government area |
| **LTTMP** | *Long Term Transport Master Plan* (NSW, 2012) |
| **LoS** | level of service |
| **MNES** | Matters of national environmental significance |
| **MP SEPP** | *State Environmental Planning Policy (Major Projects) 2005* (NSW) |
| **MD SEPP** | *State Environmental Planning Policy (Major Developments) 2005* (NSW) |
| **NCA** | noise catchment area |
| **NEPM** | National Environment Protection Measures |
| **NHL** | National Heritage List |
| **Noxious Weeds Act** | *Noxious Weeds Act 1993* |
| **NPW Act** | *National Parks and Wildlife Act 1974* |
| **NSW** | New South Wales |
| **OEH** | Office of Environment and Heritage (NSW) |
| **Opal card** | A new electronic ticketing system accessed with a smartcard, which is being introduced across many public transport services in NSW. |
| **PAH** | Polycyclic Aromatic Hydrocarbons |
| **PA system** | public address system |
| **Pedestrian promenade** | public walkway along the foreshore |
| **PID** | public information display |

| | |
|---|---|
| **POEO Act** | *Protection of the Environment Operations Act 1997* |
| **RAP** | remediation action plan |
| **RING** | Rail Infrastructure Noise Guideline |
| **RNP** | Road Noise Policy |
| **Roads and Maritime** | Roads and Maritime Services |
| **SEARs** | Secretary's Environmental Assessment Requirements |
| **SEPP** | State environmental planning policy |
| **SEPP 55** | *State Environmental Planning Policy No. 55 – Remediation of Land* (NSW) |
| **SHFA** | Sydney Harbour Foreshore Authority |
| **SHR** | State Heritage Register |
| **SRD SEPP** | *State Environmental Planning Policy (State and Regional Development) 2011* (NSW) |
| **SREP SHC** | *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (NSW) |
| **SSD** | State significant development |
| **SSI** | State significant infrastructure |
| **SSIA** | State significant infrastructure application |
| **Sydney LEP** | *Sydney Local Environmental Plan 2012* |
| **TfNSW** | Transport for NSW |
| **the guidelines** | *TfNSW Sustainable Design Guidelines version 3.0* |
| **the proposal** | see Barangaroo Ferry Hub above |
| **TPH** | total petroleum hydrocarbon |
| **TPD** | Transport Projects Division (TfNSW) |
| **TSC Act** | *Threatened Species Conservation Act 1995* |

# Executive summary

## The proposal

The Barangaroo Ferry Hub proposal comprises the construction and operation of three new ferry wharves and ancillary landside facilities. The proposal is located immediately north of King Street Wharf on the harbour side boundary of Barangaroo South (formerly known as East Darling Harbour) in Sydney's CBD (refer to Figure E-1).

Initially two wharves would be constructed (subject to planning approval). The third wharf would be constructed in the future when the demand for ferry services necessitates.

## Key features of the proposal

The key infrastructure elements of the Barangaroo Ferry Hub proposal are detailed in Figure E-1. The proposal includes the following key features:

- Establishment of a construction work area and a temporary construction compound
- Construction of three new ferry wharves (two wharves would be constructed initially with the third wharf being constructed when demand necessitates) and ancillary landside facilities
- Potential demolition of the King Street Wharf wave baffle
- Site clean-up and opening of the new wharves
- Operation of three wharves including ferry layover, pump-out facilities and minor maintenance activities
- Decommissioning and removal of the public transport elements of King Street Ferry Wharf such as ticket vending machines and signage
- Landside ancillary facilities included as part of the proposal would comprise wayfinding signage and ticketing including Opal card facilities.

Transport for NSW (TfNSW) is the proponent for the Barangaroo Ferry Hub proposal, delivering the planning, concept design and construction of the Barangaroo Ferry Hub.

Ownership and maintenance of the ferry hub asset would be the responsibility of NSW Roads and Maritime Services, while ferry operations would be delivered by Sydney Ferries.

## Figure E–1 Key proposal features

## Overview of construction activities

The construction of the first two wharves and the ancillary facilities would take around 14 months. Construction would normally be undertaken during the following recommended standard hours:

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

Most construction works would be waterside works. Some work outside of standard hours are likely to be required for certain waterside activities requiring calm water conditions, such as piling and intricate lifts from the barge mounted crane.

The majority of construction plant, equipment, materials, and personnel would access the construction work area via Sydney Harbour, being transported by boat and/or barge from the construction contractor's off-site facility. Land access for some sub-contractors and concrete trucks travelling to and from the construction work area would be via Lime Street.

The majority of the wharf components would be pre-fabricated and would also be transported to the site from the off-site facility via boat or barge.

## Need for the proposal

The Barangaroo Ferry Hub proposal would address the unique transport needs of the Barangaroo precinct and provide a move forward in ferry transport capability and capacity. The Barangaroo Ferry Hub proposal is designed to address key transport challenges facing the Barangaroo precinct and Sydney central business district (CBD), including predicted growth and increasing demand for public transport options.

## Barangaroo precinct

Barangaroo is a 22 hectare site along the Sydney Harbour foreshore, between King Street Wharf and Walsh Bay. The site is owned by the NSW Government and falls within the City of Sydney LGA. The precinct is divided into three sections:

- Barangaroo South
- Central Barangaroo
- Barangaroo Point (formerly known as Headland Park).

The Barangaroo precinct is expected to accommodate up to 23,000 office workers, include a residential community of about 2,500 people and attract up to 33,000 visitors per day when complete.

The need for the proposal is based on the anticipated demand for transport services to the precinct. The Barangaroo Ferry Hub proposal addresses a number of the transport challenges for Barangaroo and the Sydney CBD and would be a significant contribution in the delivery of an integrated and modern transport system for both Barangaroo and Sydney CBD.

## Predicted growth and demand

Growth in employment across Sydney is predicted to include at least an additional 114,000 jobs within Sydney CBD by 2031 (NSW Government, 2013). Based on figures presented in the *NSW Long Term Transport Master Plan* (LTTMP) (NSW Government, 2012), around 43,500 of these jobs are expected to be provided in the northern part of the CBD, including at Barangaroo.

The *Draft Metropolitan Strategy* for Sydney also recognises the importance of Parramatta as Sydney's second CBD and major employment area and it is anticipated that Parramatta will be the fastest growing centre outside Global Sydney over the next 20 years. A high level of residential growth is also expected along the Parramatta River corridor through urban renewal projects. The Parramatta River route is served by Sydney Ferries which would use Barangaroo Ferry Hub.

The capacity and complexity of Sydney CBD's transport system is constraining Sydney's ability to function as a liveable, modern and productive city (NSW Government, 2012). Patronage on Sydney ferry services increased from 14.34 million annual journeys in 2010/2011 to 14.94 million annual journeys in 2012/2013.

With forecast high employment and residential growth along the Parramatta River corridor, and constraints associated with the existing road and public transport networks, the need for additional transport options has been recognised in the LTTMP. A ferry hub at Barangaroo would enable a high level of connectivity between Global Sydney and Parramatta as well as relieve existing capacity constraints at both Darling Harbour and Circular Quay.

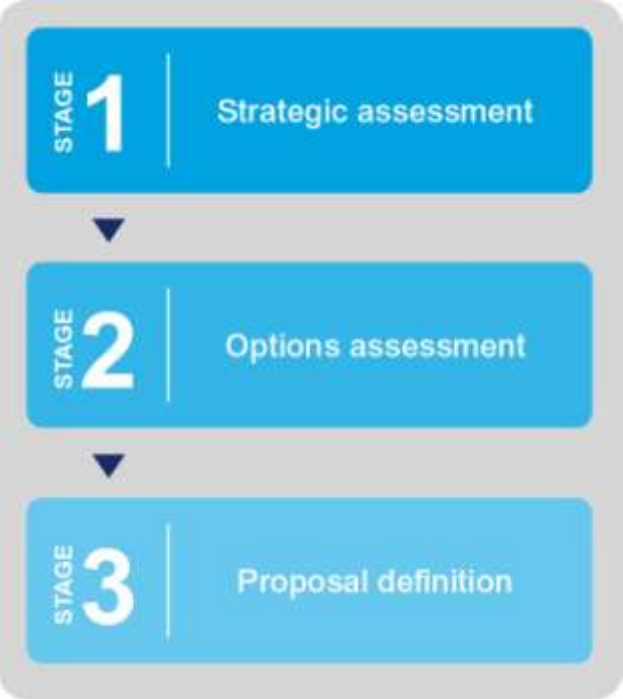
## Options assessment and decision making process

The development of the Barangaroo Ferry Hub proposal has taken into account relevant transport plans for NSW and Sydney, issues identified through stakeholder and community consultation, and the results of the environmental investigations undertaken as part of the preparation of the Environmental Impact Statement (EIS).

The proposal was developed as part of a comprehensive options assessment process, undertaken in three key stages (refer Figure E-2 below). This process involved developing and assessing the feasibility of alternative options to deliver the necessary transport proposal at Barangaroo.

The planning and design process is ongoing and the proposal may be subject to further refinement as a result of submissions received in response to the public exhibition of this EIS and further consultation during the detailed design phase (should project approval be granted).

Figure E–2 Barangaroo Ferry Hub options assessment process




## Strategic assessment

The strategic assessment of the need for a ferry service at Barangaroo was initiated as part of the broader Barangaroo Review undertaken by the NSW Government in 2011.The review resulted in the establishment of the Barangaroo Transport Taskforce and the findings of this taskforce were presented in the *Barangaroo Integrated Transport Plan*, which was released in August 2012. This plan considers the short and longer term transport requirements for Barangaroo within the context of the forecast demand for transport in the northern CBD. A further three strategic planning documents, *Sydney's Ferry Future* (TfNSW, 2013b), the *Sydney City Centre Access Strategy* (TfNSW, 2013a) and the *NSW Long Term Transport Master Plan* (NSW Government, 2012) all addressed the need for a ferry service at Barangaroo. The key finding from *Sydney's Ferry Future* was for TfNSW to determine operational and customer requirements of the new ferry hub over the coming years.

## Options assessment

Following the strategic assessment of the need for a ferry hub at Barangaroo, TfNSW undertook an options identification and assessment (stage two). Stage two involved identifying a long list of potential ferry wharf improvements including the base case or 'do nothing' option and the development and operation of a ferry hub at Barangaroo (the proposal). The key considerations in assessing the long list of options included the alignment of the strategic assessment (stage one), demand for additional transport arising from growth in development, employment and housing across Sydney, and customer experience.

Based on the outcomes of stage one and two, a preferred option was selected for further refinement.

## Proposal definition

Following stage 2, the preferred option was further assessed against design and operational considerations in order to further define the proposal. Key aspects of the proposal considered were wharf alignment, addressing issues such as manoeuvrability and navigational safety, and the inclusion of layover and pump-out facilities within the proposal. The preferred option, as a result of the options assessment process comprised the construction of three new wharves at Barangaroo and ancillary landside facilities.

## Planning approval process

The Barangaroo Ferry Hub proposal is a State significant infrastructure (SSI) project. The proposal is SSI as defined under the State Environmental Planning Policy (State and Regional Development) 2011, as it proposes 'wharf or boating facilities' with a capital investment value over $30 million. As SSI under Part 5.1 of the EP&A Act, an EIS is required.

The Secretary's Environmental Assessment Requirements (SEARs) for the proposal were issued on 10 November 2014.

Part 5.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) establishes an assessment and approval regime for SSI. Under Part 5.1 of the EP&A Act, the planning and approvals process includes the following key steps:

- Submission of an SSI application with the accompanying supporting document to the Secretary of the NSW Department of Planning and Environment (DP&E) under section 115X of the EP&A Act, to seek SEARs for the proposal (Section 115Y)
- Preparation and submission of an EIS under Section 115Y(2), addressing the matters outlined in the SEARs (this document)
- Public exhibition of the EIS for a minimum of 30 days
- Assessment of the application by the DP&E and preparation of the Secretary's environmental assessment report (Section 115ZA).

## Community and stakeholder consultation

Consultation with stakeholders and the community has been undertaken throughout the development of the proposal. The activities have been selected to provide timely and proactive communication of information about the proposal to stakeholders and the community. TfNSW has prepared a stakeholder and community engagement strategy to guide consultation activities throughout the proposal. Opportunities for further consultation are also identified to help develop the proposal in line with key planning, design and construction milestones. Community liaison plans would be prepared to support the goals and objectives of this strategy during different phases of project delivery.

## The Environmental Impact Statement

This EIS has been prepared to assess and document the potential environmental impact of the construction and operation of the Barangaroo Ferry Hub proposal. It also documents the key features of the proposal, including the likely construction method and operation. The Barangaroo Ferry Hub would be constructed and operated in accordance with the mitigation measures proposed in this EIS, any submissions report and/or Secretary's report with recommendations, and the Minister's conditions of approval.

The EIS has been prepared in accordance with the SEARs for the proposal (Appendix A), which incorporate the requirements of Part 3 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) (refer Appendix A).

## Preparation of the EIS

Preparation of the EIS involved both community and stakeholder consultation and detailed specialist assessment of key environmental issues, including surveys, data analysis and predictive modelling, where appropriate. The EIS process included a detailed environmental risk analysis to scope the level of assessment required, identify the key risks and confirm those issues that are likely to require the most focus in terms of management and mitigation.

## Key findings of the EIS

Potential environmental impacts during construction and operation of the Barangaroo Ferry Hub proposal are summarised at Table E-1.

Table E–1 Key impact and benefits of the Barangaroo Ferry Hub proposal

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Noise and vibration | Recommended standard construction hours (-ve): During standard construction hours potential 'high impact' exceedances (up to 26 db) are predicted for impact piling (scenario 2) at NCA-01.<br>Potential 'moderate impact' exceedances are predicted at NCA-01 (up to 11 dB) during landside construction works (scenario 7) and at NCA-03 (up to 11 dB) during impact piling (scenario 2).<br>Potential 'low impact' exceedances during standard hours (of between 1 dB and 9 dB) are predicted at NCA-01 and NCA-04 during such construction works including pile drilling (scenario 1), impact piling (scenario 2), pile finishing (scenario 3), intricate lifts (scenario 4), the potential demolition of the wave baffle (scenario 5) and pile extraction (scenario 6).<br>Other receptors (i.e. hotel) and commercial sensitive receivers would be subject to 'moderate impacts', with NML exceedances of up to 13 dB and 17dB respectively during impact piling works.<br>Outside of recommended standard construction hours (-ve): Potential 'high impact' exceedances are predicted during impact piling (scenario 2) at NCA-01 (up to 37 dB) and at NCA-03 (up to 28 dB).<br>Potential 'moderate impact' exceedances are predicted at NCA-01 during pile driving (up to 19 dB for scenario 1) and intricate lifts (up to 16 dB for scenario 4), at NCA-03 (up to 10 dB) during pile driving, at NCA-04 (up to 24 dB) during impact drilling and at NCA-05 (up to 14 dB) during impact drilling (scenario 2).<br>Potential 'low impact' exceedances outside of standard hours are predicted for activities such as intricate lifts and pile drilling (e.g. at NCA-03 and NCA-04).<br>Other receptors (i.e. hotel) and commercial sensitive receivers would be subject to 'moderate impacts', with NML exceedances of up to 13 dB and 17dB respectively during impact piling works. | Operational noise impacts of the Barangaroo Ferry Hub proposal (-ve): Operational noise levels associated with the proposal have been predicted for maximum (21 vessels per hour), off-peak (10 vessels per hour) operations,<br>Predicted noise levels of vessel movements during peak (scenario 1) and off peak (scenario 2) periods comply with daytime noise levels (for both LAeq(1hour) and LAmax).<br>An exceedance of up to 3 dB during nigh time peak periods has been predicted at receivers at NCA-01 and NCA-03. Potential impacts are likely caused by the proximity of receivers to proposed routes of ferries entering and leaving Barangaroo Ferry Hub. The predicted noise levels of night-time off-peak operations show compliance with night-time noise levels.<br>An exceedance of up to 11 dB above the sleep disturbance screening criterion has been predicted for the receivers located at NCA-01, up to 10 dB at NCA-03 and up to 5 dB at NCA-04 for both scenario 1 and 2. The peak noise events for peak and off-peak ferry movements are identical due to the use of warning horns, which are the likely cause of these exceedances.<br>Predicted noise levels of maintenance works (scenario 3) would exceed noise levels by 6 dB and 16 dB at NCA-01 for maintenance works undertaken in daytime and night-time periods respectively. Predicted noise levels also indicate an exceedance of up to 2 dB at NCA-03 during maintenance works undertaken at night-time.<br>An exceedance of up to 9 dB above the sleep disturbance screening criterion has been predicted for the residential receivers in NCA-01. The exceedance for Scenario 3 is due to the use of use of high pressure water cleaning equipment and the close proximity to receivers. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| | Construction sleep disturbance impacts (-ve): It is predicted that sleep disturbance is likely to occur with the use of high noise activities such as impact piling (scenario 3) which would cause exceedances at residential receivers of up to 35 dB, 26 dB, 22 dB and 12 dB within NCA-01, NCA-03, NCA-04 and NCA-05 respectively.<br>Lower noise activities such as pile drilling (scenario 1) and intricate lifts (scenario 4) are predicted to cause exceedances at residential receivers of up to 17 dB, 8 dB and 4 dB at NCA-01, NCA-03 and NCA-04 respectively. | Operational sleep disturbance impacts (-ve): For ferry movements exceedances of the sleep disturbance screening criteria of up to 11 dB, 10 dB and 5 dB are predicted for scenario 1 and scenario 2 for residences within NCA-01, NCA-03 and NCA 04 respectively. Short-term external noise levels of up to 72 dBA are anticipated at residences within NCA-01 for these scenarios during the sounding of ferry horns.<br>While the night-time vessel movements would likely decrease in the night time periods (5 am to 7 am and 10 pm to 12 am midnight), the maximum noise level due to horn usage is unlikely to decrease.<br>For maintenance works (scenario 3) exceedances of the sleep disturbance screening criteria of up to 9 dB are expected at NCA-01 only. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Traffic and transport | Marine construction transport impacts (-ve): The majority of construction plant, equipment, materials and personnel would access the construction site via Sydney Harbour generating minor increases in water traffic. During the construction period some minor detours may be required however this is unlikely to have a significant impact to other users of the waterway and access to other ferry wharves would not be restricted.<br>A 130 metre wide navigation channel would be maintained throughout the work wherever possible to minimise disturbance to other vessel movements.<br>Due to the proximity of the proposal to King Street Wharf, a management plan with appropriate measures would be prepared to manage vessel manoeuvring near King Street Wharf during construction work. | Navigation and safety impacts (-ve): Darling Harbour is an extremely busy waterway with a high level of commercial and recreational vessel traffic and the second highest maritime incident rate on Sydney Harbour (Roads and Maritime, 2012). The proposal would introduce into the area additional vessel traffic movements as a result of ferries manoeuvring to and from the wharves.<br>Ferry operational impacts (+ve): The Barangaroo Ferry Hub would initially include two operating ferry wharves catering for most vessel classes. A third wharf would be constructed as demand for services increases. As a result of the proposal potential operational impacts of the proposal include greater public ferry patronage and improved travel time on ferry services.<br>King Street Wharf (+ve): The proposal transfers all public transport trips from King Street Ferry Wharf to the Barangaroo Ferry Hub, thereby releasing capacity at the King Street Ferry Wharf for private and commercial operations. |
| | Construction vehicular impacts (neg): Construction of the proposal would require a small number of light and heavy vehicles to transport materials to and from the construction compound located on the foreshore. The estimated construction vehicle movements could easily be accommodated by the surrounding road network with ample capacity, and therefore the proposal would result in negligible road network impacts. | Operation vehicular impacts (neg): The Barangaroo Ferry Hub would not impact on the local road network. |
| | Pedestrian impacts during construction (neg): Depending on Barangaroo South construction activities and hoarding locations, access along the Barangaroo foreshore would be reduced to about 12 metres in width due to the location of the temporary construction compound, and therefore the proposal would result in negligible pedestrian impacts. | Pedestrian impacts during operation (neg): The proposal would be well served by a number of existing and future pedestrian connections (e.g. Wynyard Walk). There would be sufficient capacity for passengers alighting from the ferry hub to be accommodated along with other pedestrian traffic. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Ecology | General construction impacts (-ve): Potentially hazardous materials would be transported to and from the site (via barges on Sydney Harbour) and used and stored on site during the construction period. Spills and leaks during transportation could potentially result in the contamination of waterways and any potential marine vegetated habitats surrounding the Barangaroo Ferry Hub proposal.<br>Manoeuvring of construction vessels (neg): Given the water depths (between about 9.5 to 11.5 metres ISLW) at the site, there is low risk of bottom sediment disturbance from construction related vessel movements.<br>Water based construction impacts (neg): Disturbed sediments would be highly localised in the bottom waters during the construction of the proposal (e.g. pile works) and any mobilisation of sediments (including the potential for contaminated sediments) would rapidly re-settle, therefore excessive turbidity it is not expected as a result of the proposal. | Water based operational impacts (neg): The removal of the King Street Wharf wave baffle (if it proceeds) would eliminate shading impact on the adjacent seawall, which would be recolonised by algae in the shallow sub-tidal zone and remove hard substratum habitat. This impact would be balanced by the installation of the new wharves at Barangaroo which would cause additional shading but provide new hard substratum habitat.<br>Manoeuvring of vessels (neg): The overall depth at the site is between about 9.5 to 11.5 metres ISLW), therefore the risk of bottom sediment disturbance from ferries manoeuvring in and out of the berths at the Barangaroo Ferry Hub is considered to be low.<br>Manoeuvring of vessels (+ve): Propulsion from ferries manoeuvring in and out of the berths would be unlikely to dislodge attached biota from the walls or dislodge cryptic fauna. Residual wash currents would likely provide a beneficial impact in dislodging loose silts that can accumulate on these habitats in still waters. |
| | Land based construction impacts (neg): It is not anticipated that the proposal would impact on any terrestrial flora or fauna during construction. | Land based operational impacts (neg): There would be no impacts to terrestrial flora or fauna as a result of the operation of the Barangaroo Ferry Hub proposal. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Visual amenity and urban character | Visual amenity impacts during construction (-ve): As a result of the proposal, on-water construction works would replace the view of open water and landside works (including a temporary construction compound) would be visible along the harbour edge about 420 square metres in area.<br>The proposal would result in visual impacts from views at a distance, views at close proximity and from higher sensitivity viewpoints. Impacts would range from negligible to high adverse, depending on the viewpoint.<br>Visual impacts would be temporary in nature and would be seen as part of a range of construction activities on the Barangaroo Peninsula | Visual amenity impacts during operation (-ve): Views from the promenade and restaurants at Kings Street Wharf, Barangaroo South, and the future Wynyard Walk and adjacent footpaths would be reduced due to the proposal. This would result in a moderate adverse visual impact. Night time views from Barangaroo South would result in a noticeable reduction in the amenity of these views, resulting in a moderate adverse visual impact, however views from the lower levels of development at Barangaroo South, including residences, are also expected to be affected by trees that are likely to be planted between the residences and the water at the Barangaroo foreshore.<br>Visual amenity impacts during operation (neg): There would be a negligible visual impact on views from the north-west, west and south during the day, while at night, from locations to the north-west, west and south-west, the proposal would be viewed against a brightly lit urban environment. In these views there would be no perceived reduction or improvement in the amenity of these views, resulting in a negligible visual impact. |
| | Urban character impacts (-ve): During construction on-water construction works would replace the view of open water. From the land the construction work area and the temporary construction compound (of around 420 square metres in area) would be visible along the harbour foreshore. | Urban character impacts (neg): Operation of the Barangaroo Ferry Hub proposal would be compatible with the urban character of the surrounding landscape character areas. The proposal would not result in a perceived reduction in the quality of the landscape character of these areas. |
| Built and non-Indigenous heritage | Construction impacts (neg): The construction of the Barangaroo Ferry Hub proposal would not result in any impacts upon any identified heritage items near the project area. | Operational impacts (neg): The operation of the Barangaroo Ferry Hub proposal would not result in any impacts upon any identified heritage items near the project area. |
| Climate change | Construction climate change risks (neg): Construction of the Barangaroo Ferry Hub proposal would not result in adverse future climate change risks. | Operational climate change risks (-ve): Operational climate change risks (e.g. adverse storm events) would have low to moderate consequence on the operation of the Barangaroo Ferry Hub proposal. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Air quality | Air quality impacts during construction (neg): Construction of the Barangaroo Ferry Hub proposal would not result in any adverse impacts associated with dust particles at the site. | Operational air quality impacts (neg): As a result of the proposal existing ferry services at King Street Wharf would be relocated to the Barangaroo Ferry Hub. Moving ferry services, including the addition of extra ferry services is not considered to cause an impact to the local air quality due to the already large number of public and commercial vessels operating in the Darling Harbour area. |
| Property and land use | Land based construction impacts (-ve): Construction of the proposal would require the temporary use of land outside of the permanent proposal footprint. A construction compound about 420 square metres would be established on the foreshore of the Barangaroo site, reducing public access along the foreshore to a corridor about 12 metres in width during construction.<br>Waterside construction impacts (neg): Work situated within the Darling Harbour waterway would not result in any property impacts to private land owners. | Operation of the Barangaroo Ferry Hub proposal (-ve): There would be a change in land use (both waterside and landside) as a result of the proposal. The proposal would result in an increase in the number of ferry services to the area, resulting in a minor impact within Darling Harbour and would gradually increase over time.<br>Landside operational impacts may result in some encroachment into surrounding pedestrian areas from ferry users queuing to board services during special event times. These impacts would be temporary and minor in nature.<br>Operation of the Barangaroo Ferry Hub proposal (+ve): Once the public transport elements at King Street Ferry Wharf are removed, additional space allocation would be returned for use by commercial vessels which would have a positive impact to commercial operators. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Water quality and hydrology | Construction water quality impacts (-ve): Potential impacts on water quality would include marine sediment disturbance and the potential for spills and/or leaks from construction plant or equipment, as well from transporting of waste from the proposal area.<br>Drainage and flooding impacts (neg): The construction phase of the proposal should not result in additional flow velocities or volumes. Consequently, no impacts on the drainage network or flooding issues are expected as a result of the proposal.<br>Tide level, tidal flows, currents and water levels construction impacts (neg): The proposal does not involve any construction work that would affect tide levels, tidal flows, currents or water temperature. The use of barges in the harbour may result in a localised minor reduction in wave energy in the inshore area. This impact would be temporary and contained to areas where the barges are anchored.<br>Water temperature construction impacts (neg): The construction of the Barangaroo Ferry Hub is not expected to alter the temperature of the harbour water in the vicinity of the proposal. | Operational water quality impacts (-ve): There is a potential for accidental spills of chemicals and other hazardous materials into Pyrmont Bay and Darling Harbour, such as hydraulic fluid and fuel used in ferries or sewage during pump-out operations as a result of the operation of the Barangaroo Ferry Hub.<br>Operational water quality impacts (neg): During operation the potential for marine sediment disturbance is low, given the depth at the site is between about 9.5 to 11.5 metres ISLW.<br>Drainage and flooding impacts (neg): The addition of structures within the waterway would marginally increase stormwater run-off within the harbour. However, given the stormwater would enter the waterway directly from the wharf the proposal should not result in any change to existing flow velocities or volumes.<br>Tide level, tidal flows, currents and water levels (neg): A minor reduction in wave energy in the inshore area during operation of the wharves is expected as a result of the proposal. The impact would be relative to the size of the pontoon and the location of the berthing area further away from the shoreline.<br>Water temperature operational impacts (neg): The operation of the proposed Barangaroo Ferry Hub is not expected to alter the temperature of the harbour water in the vicinity of the proposal. |
| | | Maintenance water quality impacts (-ve): Maintenance work undertaken at the proposed Barangaroo Ferry Hub has the potential to result in spills and leaks of chemicals and other hazardous materials into Pyrmont Bay and Darling Harbour.<br>Cleaning of wharves is typically carried out by use of high pressure spray without use of chemicals and therefore it is not expected that this would contribute to run-off of chemicals into the harbour. |
| Indigenous heritage | Construction impacts (neg): There are no identified Aboriginal objects in the proposal area. As such there is no identified risk of harm to Aboriginal objects during construction of the proposal. | Operational impacts (neg): As there are no identified Aboriginal objects in the proposal area, there is no identified risk of harm to Aboriginal objects during operation of the proposal. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Socio-economic | Other socio-economic impacts (-ve): Expected impacts as a result of the proposal include a reduction in visual amenity, noise and vibration and traffic, access and parking, including a reduction in pedestrian access along the foreshore.<br>Construction of the Barangaroo Ferry Hub proposal (+ve): The local economy at the site would increase due to the incoming workforce utilising at nearby commercial outlets (such as food and beverage retailers) throughout the construction works. | Barangaroo Ferry Hub proposal operational benefits (+ve): As a result of the proposal those who will live, work or access Barangaroo and the surrounding area would have greater accessibility to Barangaroo and connection into the CBD. There would be no property acquisition required or businesses or residents relocated as result of the proposal.<br>Relocation of public transport services at King Street Wharf (-ve): The relocation of the ferry wharves from King Street Wharf to Barangaroo may result in minor impacts to businesses which currently benefit from passing trade from ferry passengers. Existing wharf infrastructure could be made available for new commercial opportunities at King Street Wharf. |
| Soils, geology and contamination | Land based construction impacts (neg): Excavation works are not expected for the installation of wayfinding signage and ticketing and/or utility connections.<br>Water based construction impacts (-ve): Sediment contamination, including the potential presence of acid sulfate soils within the proposal area presents a potential contaminant source to surface water and aquatic ecology. Potential impacts are expected to be localised and of a temporary nature. | Operational impacts (-ve): There is the potential for silt and sediment mobilisation as ferries enter and exit the Barangaroo Ferry Hub, particularly on structures higher in the water column more so than the seabed, however, water depths are considered sufficient to avoid any significant propeller or jet wash mobilisation of seabed sediments. |
| Ecologically sustainable development | Construction impacts (neg):Construction of the proposal would result in increased greenhouse gas emissions associated with the materials required to construct the wharves, the transport of materials to site, and the fuel consumption of construction plant and equipment, however due to the scale of the construction works, greenhouse gas emissions are not expected to be significant. | Operational impacts (neg): Operation of the proposal would result in minor additional greenhouse gas emissions associated with the ongoing electricity requirements for the new ferry wharves and increase of ferry services overtime, however, given the nature and scale of the proposal, operational greenhouse gas emissions would be relatively minor and would not represent a substantial increase in energy usage.<br>Operational impacts (+ve): The delivery of the proposed Barangaroo Ferry Hub with additional ferry services would encourage public transport use. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Utilities and services | Construction impacts (-ve): Existing and future proposed services and utilities may be impacted during construction, as a result of scheduled stoppages during connection works or accidental damage during construction activities.<br>Construction impacts (neg): Construction activities (such as operation of the compound site or use of machinery) are not expected to place a large demand on existing utility use within the proposal area. Therefore any impacts to utility operation within the area during construction are expected to be minor. | Operational impacts (neg): The operation of the proposal, including maintenance work carried out at the Barangaroo Ferry Hub would require the ongoing provision of all services. The proposal would be designed to operate in an energy efficient manner with minimum drawdown on local power.<br>Data and telecommunications connections would also be provided, with no anticipated impact on those networks. |
| Waste and resources | Construction waste impacts (neg): The construction of the Barangaroo Ferry Hub is not expected to generate large volumes of construction waste. This is due to there being limited demolition of the proposal area, such as the proposed demolition of the King Street Wharf wave baffle.<br>Construction resources impacts (neg): The volume of resources required during construction of the proposal is not expected to be significant and all the resources are commonly available therefore the proposal is unlikely to affect supply and demand. | Operational waste impacts (-ve):Waste generating activities during the operation of the proposal would include cleaning and maintenance of the Barangaroo Ferry Hub, including waste products from the cleaning of wharf facilities and rubbish from public waste bins. Public toilet facilities on board the Sydney Ferries fleet operating at the Barangaroo Ferry Hub proposal would need to be emptied at regular intervals at the Barangaroo Ferry Hub.<br>Operational resources impacts (neg): The Barangaroo Ferry Hub would require the use of electricity resources as part of ongoing routine operations. The Barangaroo Ferry Hub is expected to require an increase in the use of resources in the local area, however this demand is expected to be minor and is unlikely to affect the local supply and/or demand of these resources. |

| Issue | Impacts during construction – positive (+ve), negative(-ve) and negligible (neg) impacts | Impacts during operation – positive (+ve), negative(-ve) and negligible (neg) impacts |
|---|---|---|
| Hazards and risks | Construction environmental hazards and risks (-ve): Potentially hazardous materials would be transported to and from the site via barges on Sydney Harbour and stored at the temporary construction compound, as well as on barges. Spills and leaks within the proposal area and during transportation could potentially result in the contamination of land based areas and within and/or outside of the Barangaroo Ferry Hub proposal area.<br>Construction environmental hazards and risks (neg): It is not anticipated that land based works would require any excavation, therefore the probability of encountering acid sulfate soils and/or contaminated soils/groundwater as a result of landside works is low.<br>Construction occupational hazards and risks (-ve): Occupational health and safety hazards (e.g. trips and slips and falls) would potentially arise throughout construction, when inadequate hazard/risk identification, reporting and monitoring systems are not implemented and/or maintained. | Operational environmental hazards and risks (-ve): Potential environmental hazards as a result of the operation of the Barangaroo Ferry Hub includes spills and leaks from a ferry or pump-out waste entering the waters of Darling Harbour.<br>Operational occupational hazards and risks (-ve): Potential occupational hazards as a result of the operation of the Barangaroo Ferry Hub includes passengers or staff falling from the promenade or vessels in Darling Harbour.<br>Operational occupational hazards and risks (-ve): Injury to staff and the public and damage to Barangaroo Ferry Hub infrastructure caused by an impact from a ferry. |

## Management of impacts

A comprehensive suite of management and mitigation measures is proposed to be implemented to reduce the potential adverse impacts of the proposal (refer Chapter 7 of the EIS). These measures would be incorporated into the Construction Environmental Management Plan (CEMP) to be developed and approved prior to construction, including any relevant environmental management sub-plans for the proposal and subsequently (if necessary), into the future operator's environmental management system.

## Environmental risk analysis

Environmental risk analysis is used to identify potentially significant environmental impacts associated with development proposals. Evaluating a project's construction and operating characteristics, and the baseline environmental conditions, helps to derive potential issues and impact assessment needs. For the Barangaroo Ferry Hub proposal, an environmental risk analysis was used to define the environmental issues requiring assessment as part of the EIS. It also helped to define mitigation measures for the proposal to assist in minimising potential risks.

A preliminary environmental risk analysis was undertaken for the purposes of scoping the EIS and the preliminary environmental assessment prepared as part of the Barangaroo Ferry Hub State significant infrastructure (SSI) application. This analysis was updated with technical specialist input, once the EIS specialist studies had commenced. The analysis was further revised once the EIS studies were mostly completed and mitigation measures had been partially defined. Finally, a residual risk analysis was completed to identify the potential residual impacts likely to remain after application of proposed mitigation measures.

Key finding are summarised in Section 7.3

## Justification and conclusion

There is strong justification for the Barangaroo Ferry Hub proposal in relation to its need, its anticipated benefits, and its compliance with the objectives of the EP&A Act and matters of ecologically sustainable development (refer Chapter 6.13 of the EIS).

Provided the measures and commitments specified in the EIS are applied and effectively implemented during the design, construction and operational phases of the project, the identified potential environmental impacts are considered to be acceptable and manageable.

## How to make a submission on the Barangaroo Ferry Hub proposal

The EIS will be placed on public exhibition by the Department of Planning and Environment (DP&E). During the exhibition period, government agencies, interested individuals, groups and the community will be invited to make written submissions to the Department on the Barangaroo Ferry Hub proposal. Further consultation will be undertaken by TfNSW during the exhibition period to enable the community to comment on the proposal, and TfNSW to respond to questions about the proposal.

Written submissions should be sent to the DP&E before the end of the exhibition period and should be addressed to:

Department of Planning and Environment
23-33 Bridge Street
Sydney NSW 2000

(GPO Box 39)
Sydney NSW 2001

Or online via the Department of Planning and Environment website

Copies of all submissions received by the Secretary will be provided to the proponent, the Department responsible to the Minister of Planning and Environment and relevant public agencies. Submissions will also be made available on the DP&E's website. Submitters can request that personal details be withheld from publication; however, the content of all submissions will be publicly available.

# 1 Introduction

## 1.1 Background

In May 2011, the Minister for Planning and Infrastructure commissioned an independent review of the proposed Barangaroo precinct's compliance with the planning approval process (the Barangaroo Review). On 8 August 2011, the New South Wales (NSW) Government confirmed its commitment to the Barangaroo precinct following the Barangaroo Review which found that the project was worthwhile and had valid planning consent.

In response to the Barangaroo Review, the NSW Government established a Transport Taskforce for Barangaroo to develop an integrated transport plan for the development.

The need to provide a ferry hub to support development at Barangaroo was subsequently identified in the *Barangaroo Integrated Transport Plan* (TfNSW, 2012a) prepared by the Barangaroo Transport Taskforce, in August 2012.

The *NSW Long Term Transport Master Plan* (LTTMP) (NSW Government, 2012), released in December 2012 identified both short and medium to longer term actions related to ferry patronage to support Barangaroo. The medium to longer term option involved building a new ferry hub at Barangaroo to support commercial development, with new services from the Lower North Shore, Manly, Parramatta and inner harbour.

In May 2013, *Sydney's Ferry Future* (TfNSW, 2013b) was released by the NSW Government. This document identified that Transport for NSW (TfNSW) would develop a ferry hub at Barangaroo, although a timeframe for delivery was not specified. *Sydney's Ferry Future* also identified that in the longer term, the facility at Barangaroo would relieve capacity constraints at Circular Quay by providing space for more terminating services.

In December 2013, the *Sydney City Centre Access Strategy* (TfNSW, 2013a) reinforced these actions, and identified the need to connect Barangaroo ferry customers with the western and central parts of the Central Business District (CBD) via the high quality pedestrian link, Wynyard Walk (currently under construction). It also identified the need for new ferry routes to provide more opportunities to access Barangaroo and the mid-town precinct by public transport.

The construction and operation of the ferry hub identified in the above strategic documents is the subject of this Environmental Impact Statement (EIS). It is referred to as the proposed Barangaroo Ferry Hub (Barangaroo Ferry Hub or the proposal). The proposal incorporates waterside components of the Barangaroo Ferry Hub and ancillary landside facilities such as ticketing including Opal card facilities and wayfinding signage. Provision for some landside transport related facilities' (including 300 square metres of floorspace) has been made in the Barangaroo South approvals Concept Design Modification 4 (MP06-162 (MOD 4)) and therefore those landside elements do not form part of the proposal. Section 1.4.1 provides an overview of the proposal.

TfNSW is aiming to commence construction of the Barangaroo Ferry Hub by mid-2015, and deliver the project in 2016 to provide high quality public transport options for new residents and building tenants.

## 1.2 Location of the proposal

The proposal is located immediately north of King Street Wharf on the harbour side boundary of Barangaroo South (formerly known as East Darling Harbour) in Sydney's CBD (refer to Figure 1-1). The proposal is situated within the City of Sydney local government area (LGA). Figure 1-2 shows the proximity of the proposal to other nearby projects currently under construction.

## Figure 1-1 Regional context

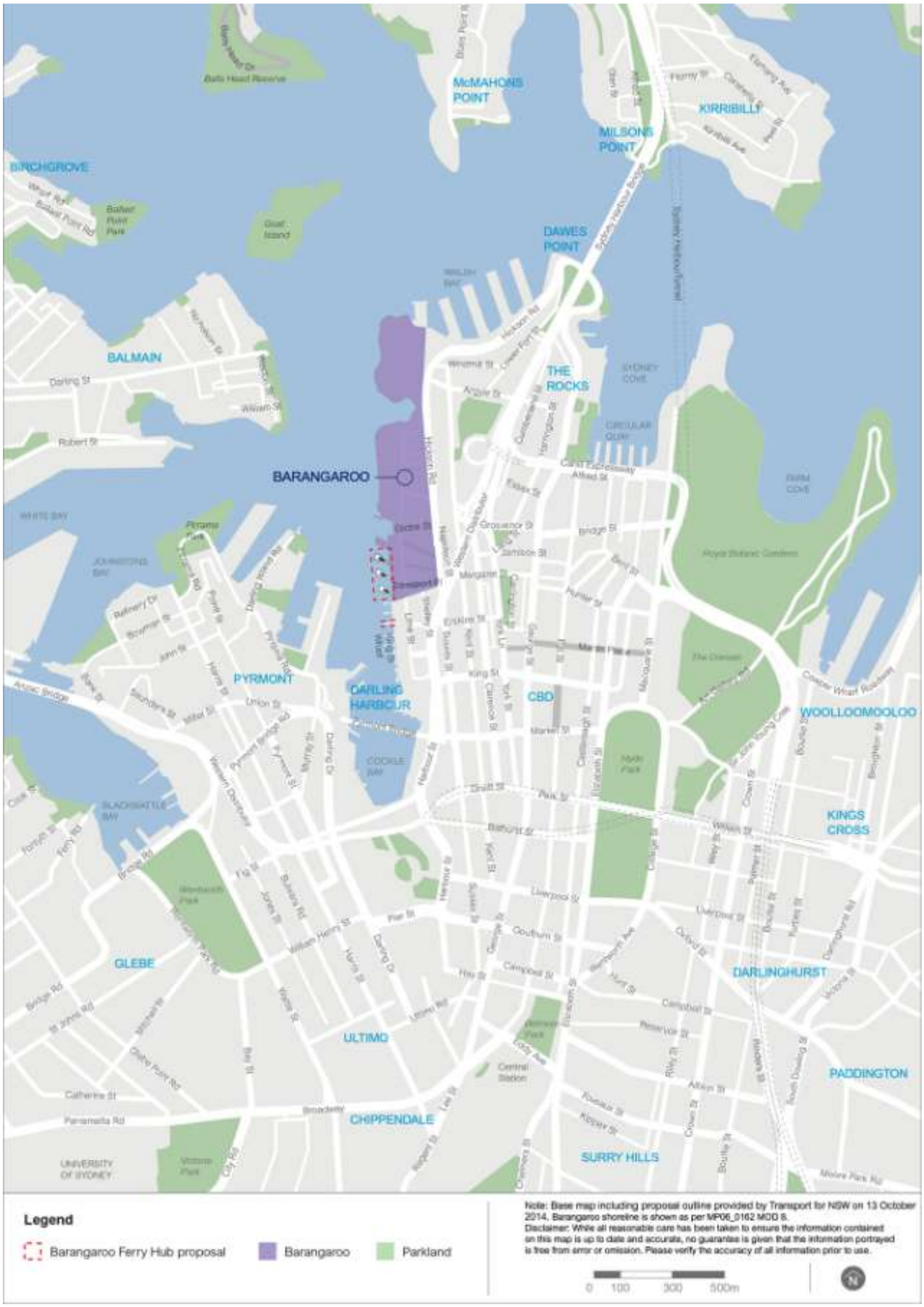
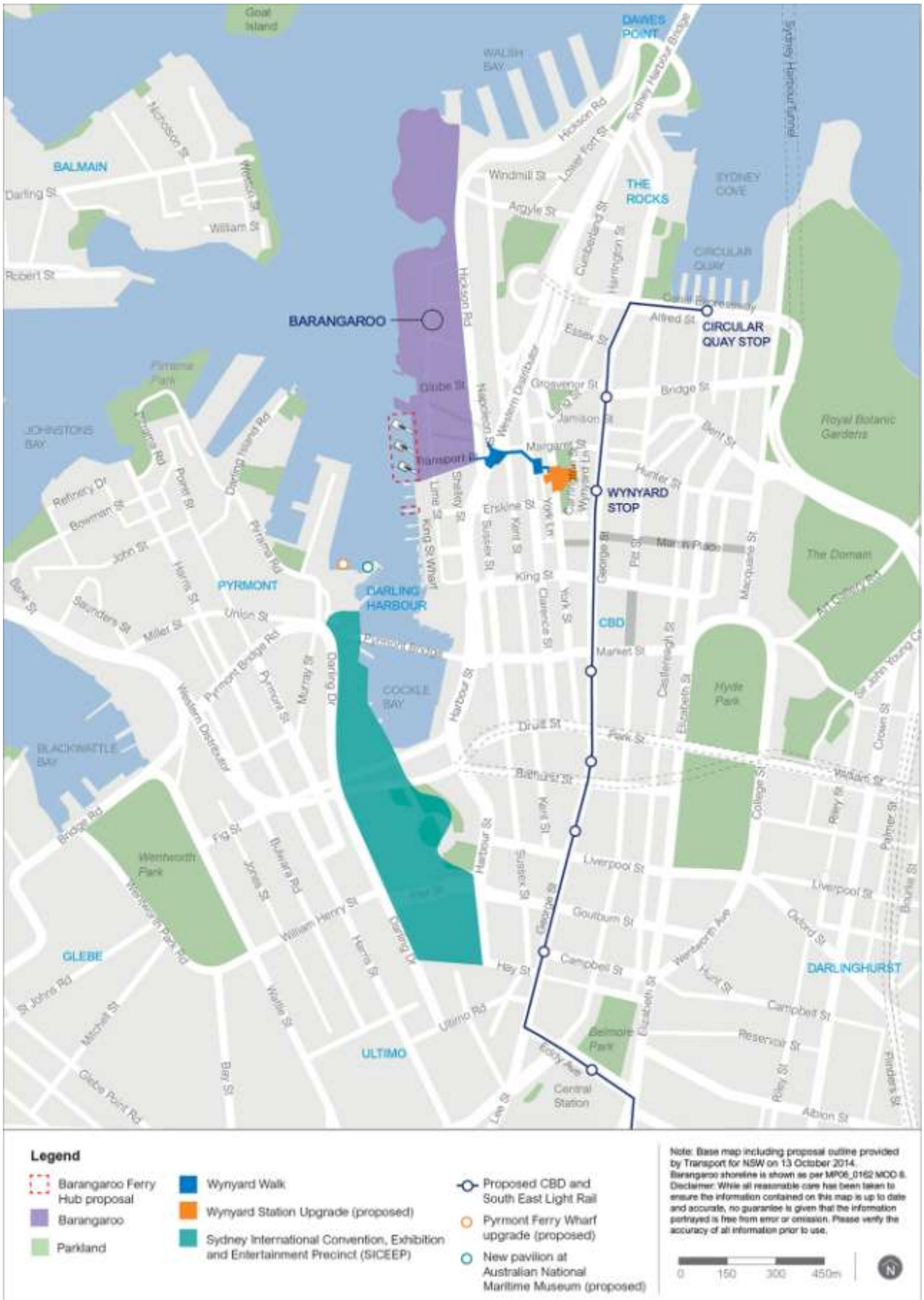


Figure 1-2 Proposal location in relation to other nearby major projects



## 1.3 Barangaroo precinct

Barangaroo, formerly known as East Darling Harbour, is a 22 hectare site along the Sydney Harbour foreshore, between King Street Wharf and Walsh Bay. The site is owned by the NSW Government and falls within the City of Sydney LGA.

The Barangaroo precinct was historically used for shipping and stevedoring but the NSW Government is transforming the space into a public, residential and commercial precinct over the next decade. Based on the most recent development approval for Barangaroo, the precinct is expected to accommodate up to 23,000 office workers, include a residential community of about 2,500 people and attract up to 33,000 visitors per day when complete.

The precinct is divided into three sections:

- Barangaroo South – a major new business, tourism, residential and retail precinct opening onto a public waterfront promenade. This is the area in which the Barangaroo Ferry Hub would be located
- Central Barangaroo – a cultural and civic focal point for recreation, relaxation, events, festivals, entertainment and leisure activities as well as recreational, residential, retail and commercial facilities
- Barangaroo Point – a six hectare open space precinct designed to complement the neighbouring headlands of Sydney Harbour.

The Barangaroo Delivery Authority (BDA) is a State Government-owned agency established to manage and develop Barangaroo on behalf of the NSW Government. Lend Lease has the development rights for Barangaroo South.

Many of the transport related elements of Barangaroo South have linkages to the proposal, such as pedestrian connectivity and the extension of Lime Street. The elements of the proposal that interface with these components are shown in Figure 1-3.

The provision of utilities to service the Barangaroo Ferry Hub would be provided during works for Barangaroo South Public Domain as further discussed in Section 6.14.

Relevant development approvals and current proposals are discussed at Section 2.1.3.

Figure 1-3 Proposal location in relation to existing and future landside components

## 1.4 Overview of the proposal

### 1.4.1 Key features

The proposal comprises the construction and operation of a ferry hub at Barangaroo (refer to Chapter 4). The key features of the proposal include:

- Establishment of a construction work area and a temporary construction compound
- Construction of three new ferry wharves (two wharves would be constructed initially with the third wharf being constructed when demand necessitates) and ancillary landside facilities
- Potential demolition of the King Street Wharf wave baffle
- Site clean-up and opening of the new wharves
- Operation of three wharves including ferry layover, pump-out facilities and minor maintenance activities
- Eventual decommissioning and removal of the public transport elements of King Street Ferry Wharf such as ticket vending machines and signage
- Landside ancillary facilities included as part of the proposal would comprise wayfinding signage and ticketing including Opal card facilities.

### 1.4.2 The proponent

TfNSW is the proponent for the Barangaroo Ferry Hub. As the proponent, TfNSW would deliver the planning, concept design and construction of the Barangaroo Ferry Hub.

It is expected that ownership and maintenance of the ferry hub asset would be the responsibility of NSW Roads and Maritime Services (Roads and Maritime), while ferry operations would be delivered by Sydney Ferries (most likely through a contract operator such as Harbour City Ferries).

### 1.4.3 Capital investment value

The proposal is above the threshold capital investment value (CIV) of $30 million which triggers the need for an EIS (refer to Section 2.2.1).

## 1.5 Purpose and structure of this EIS

This EIS has been prepared to document the key features of the proposal, including the likely construction method and operation, and assess its potential environmental impacts. The EIS has been prepared in accordance with the requirements issued by the Secretary of the Department of Planning and Environment (DP&E) on 10 November 2014 and the relevant provisions under Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

Volume 1 of this EIS comprises the main EIS document, the Concept Design drawings (Appendix A) and Photomontages (Appendix B) and Volume 2 contains the technical papers on which the EIS is based.

**Volume 1:**

- Introduction – provides a broad overview of the proposal, its objectives and the purpose of the EIS (Chapter 1)
- Assessment process – outlines the statutory requirements and explains the steps in the assessment and approval process (Chapter 2)
- Strategic justification and project need – provides the strategic context, explains the need for the project and identifies the project objectives (Chapter 3)
- Proposal description (construction and operation) – provides a detailed description of the proposal, key design features and construction methodologies and staging (Chapter 4)
- Consultation – outlines the consultation activities carried out, issues raised and how these have been addressed (Chapter 5)
- Assessment of general requirements and key issues – identifies the key environmental issues, assesses the impact, and proposes environmental management measures (Chapter 6)
- Summary of environmental management measures – collates all of the environmental management measures for the project identified through the impact assessment (Chapter 7)
- Project strategic justification and conclusion – presents the justification for the project, including consideration of the principles of ecologically sustainable development and the objectives of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (Chapter 8)
- References
- Appendix A – Secretary's environmental assessment requirements and Consideration of Matters of National Environmental Significance checklist
- Appendix B – Concept Design drawings
- Appendix C – Photomontages
- Appendix D – Indicative Wayfinding Signage Plan and Design and Indicative Opal Card Ticketing Facilities and Location.

**Volume 2:**

- Appendix E – Technical Paper: Noise and Vibration Impact Assessment
- Appendix F – Technical Paper: Traffic and Transport Impact Assessment
- Appendix G – Technical Paper: Aquatic Ecology Assessment
- Appendix H – Technical Paper: Landscape and Visual Impact Assessment
- Appendix I – Technical Paper: Statement of Heritage Impact (Non-Maritime)
- Appendix J – Technical Paper: Statement of Heritage Impact (Maritime)
- Appendix K – Technical Paper: Climate Change Risk Assessment
- Appendix L – Technical Paper: Sustainability Initiatives Register.

## 1.6 Secretary's requirements

The Secretary's environmental assessment requirements (SEARs) for the environmental assessment of the proposed Barangaroo Ferry Hub were issued on 10 November 2014, and a copy is provided in Appendix A. The SEARs reflect the development of the proposal and this EIS which has been prepared to address:

- The concept design for the proposal for the Barangaroo Ferry Hub
- Site construction works and operation of the Barangaroo Ferry Hub.

Table 1-1 provides a summary of the SEARs as they relate to the above two matters, and identifies where in the EIS individual matters are addressed.

Table 1-1 Secretary's environmental assessment requirements

| Key Issue | SEARs | Where addressed |
|---|---|---|
| General requirements | The Environmental Impact Statement (EIS) must address the Environmental Planning and Assessment Act 1979 and meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000. | Chapter 2 and as cross referenced within this table. |
| | Notwithstanding the key issues specified below, the EIS must include an environmental risk assessment to identify the potential environmental impacts associated with the development. | Section 7.3 |
| | Where relevant, the assessment of the key issues below, and any other significant issues identified in the assessment, must include:<br>• Adequate baseline data;<br>• Consideration of potential cumulative impacts due to other development in the vicinity; and<br>• Measures to avoid, minimise, and if necessary, offset the predicted impacts, including detailed contingency plans for managing any significant risks to the environment. | Chapter 6 |
| | The EIS must be accompanied by a report from a qualified quantity surveyor providing:<br>• A detailed calculation of the capital investment value (as defined in clause 3 of the Environmental Planning and Assessment Regulation 2000) of the proposal, including details of all assumptions and components from which the CIV calculation is derived;<br>• An estimate of the jobs that will be created by the development during the construction and operational phases of the development; and<br>• Certification that the information provided is accurate at the date of the preparation. | A report from a qualified quantity surveyor is provided with this EIS.<br>Section 6.11 |

| Key Issue | SEARs | Where addressed |
|---|---|---|
| Environmental Planning Instruments, Policies and Guidelines | Address the relevant statutory provisions applying to the site contained in the relevant EPIs, Including:<br>• *State Environmental Planning Policy (State and Regional Development) 2011;*<br>• *State Environmental Planning Policy (Major Development) 2005;*<br>• *State Environmental Planning Policy (Infrastructure) 2007;*<br>• *State Environmental Planning Policy No. 55 – Remediation of Land; and*<br>• *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.* | Chapter 2 |
| | Address the relevant provisions, goals and strategic objectives in the following:<br>• *NSW 2021;*<br>• *Draft Metropolitan Plan for Sydney 2031;*<br>• *Draft Sydney Sub-Regional Strategy NSW*<br>• *Barangaroo Integrated Transport Plan;*<br>• *Sydney City Centre Access Strategy;*<br>• *NSW Long-term Transport Master Plan 2012; and*<br>• *Sydney's Ferry Future 2013.* | Chapter 3 |
| Transportation and Operation | An assessment and modelling of the traffic and transport impacts of the development during construction and operation including consideration of:<br>• Estimated ferry arrivals and departures and impacts on the waterway (weekdays, weekends and public holidays);<br>• Access route identification;<br>• Estimated ferry passenger numbers (weekdays, weekends, public holiday and per year);<br>• Hours of operation;<br>• Estimated vehicle trips, type and frequency associated with ferry operations and maintenance;<br>• Vehicle access;<br>• Car parking and bicycle parking requirements.;<br>• Truck movements on the foreshore for the delivery of materials during construction; and<br>• Cumulative impacts of all projects at Barangaroo. | Sections 3.2.2, 6.2 and 6.17 and Appendix F |
| | Impacts on cyclist and pedestrian access and safety, including consideration of opportunities to integrate cycling and pedestrian elements with the public domain. | Section 6.2.2 and Appendix F |

| Key Issue | SEARs | Where addressed |
|---|---|---|
| Design and Justification | Details on the proposed design of all structures, including construction plans and drawings and methods of construction. | Section 4.2 and Appendices B, C and D |
| | The adequacy of wharf design in accordance with any relevant Australian Standards, industry best practice policies and guidelines. | Section 4.3 |
| | Design quality with specific consideration to the footprint, proposed materials and colours, waterfront interface (e.g. edge treatments and apron sizing), reflectivity, infrastructure impacts (e.g. harbour heat rejection plant), setbacks and tidal and wave action impacts. | Sections 4.2, 4.3, 6.4 and 6.9 and Appendices B, C and D |
| | Justification for the development and assessment of the suitability of the site for the development, in particular the number of wharves, the size of occupation of the waterway, ferry lay over, proposed sewage pump out refuelling and maintenance activities. | Sections 3.2 and 3.3 |
| Public Access/Domain | Consideration of landside ancillary facilities and impacts on the public domain including those associated with day-to-day operations. | Section 6.8 |
| | Address queue management and adequacy of pedestrian circulation space and facilities (e.g. public toilets, awnings and/or landscaping for shade etc.) around the wharves. | Sections 4.2, 6.2 and 6.8 |
| | Address measures available to manage wharves and ferry capacity and congestion issues during major events. | Sections 6.2 and 6.8 |
| | Details on the interface between the proposed wharfs, public domain, and the relationship to and impact upon the existing public domain. | Sections 4.3 and 6.8 |
| | Identification of proposed open space, public domain and linkages with and between other public domain spaces, including the waterfront. | Sections 6.2 and 6.8 and Appendix F |
| | Consideration of existing and future opportunities/benefits for public access to and along the foreshore and waterfront, including pedestrian linkage improvements and the interrelationship with Wynyard Walk. | Sections 6.2 and 6.8 and Appendix F |
| Navigation and Safety | A review of existing boating activities in the area and an assessment of the impacts of the development in water-based traffic and the existing users of Sydney Harbour and nearby ferry operations at King Street Wharf, Sydney Aquarium and Pyrmont Bay. | Section 6.2 and Appendix F |
| | Consideration of measures to ensure the safety of any recreational users of Sydney Harbour. | Section 6.2 and Appendix F |

| Key Issue | SEARs | Where addressed |
|---|---|---|
| Visual impacts | Including an assessment of the visual impacts of the proposal, particularly on the scenic quality of Sydney Harbour. | Section 6.4 and Appendix H |
| | The visual impact assessment should consider (but not be limited to) the potential impacts on future residential and retail development currently under construction at Barangaroo South, as well as impacts of ferry layover, pump out and maintenance facilities on Sydney Harbour and the public domain. | Section 6.4 and Appendix H |
| Noise and Vibration | A Noise and Vibration Impact Assessment during construction, operation (loading, unloading and ferry layover) prepared in accordance with the relevant Environment Protection Authority guidelines shall be submitted. This assessment must consider any potential impacts on adjoining residential receivers. | Section 6.1 and Appendix E |
| | This assessment shall consider all noise sources including mechanical plant, public address and other amplified sound systems (including those installed on any vessels operating from the terminal) and vessel maintenance. The assessment should also be prepared in the context of existing construction activities at Barangaroo South. | Section 6.1 and Appendix E |
| Water Quality and Contamination | Undertake an assessment of the potential impacts on water quality of Darling Harbour. Relevant consideration should be given to the National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ), the ANZECC Guideline and Water Quality Objectives in NSW (OEH) and Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (OEH). | Section 6.9 |
| | Assess the potential impact of the wharves and ferry operations including the approved district cooling system at Barangaroo South, potential impacts on heat dissipation outflows from the harbour heat rejection plant and the potential for short-circuiting of outfall discharges back to the intake. | Section 6.9 |
| | Assess the impacts of the proposal in surface and groundwater quality and hydrology. | Section 6.9 |
| | The assessment must include details of proposed erosion and sediment controls (during construction) and management and mitigation measures for the containment of pollutant (e.g. fuel and sewage) and prevention of potential water quality impacts during construction and operation. | Section 6.9 |
| | Assess the potential impact of the development in groundwater flow paths and discharge flows and water discharge from the harbour heat rejection plant. | Section 6.9 |

| Key Issue | SEARs | Where addressed |
|---|---|---|
| Water Quality and Contamination (continued) | Identification of any water licensing requirements or other approvals required under the *Water Act 1912* or *Water Management Act 2000*. | Section 2.4 |
| | Assess the geotechnical and contamination issues (including Acid Sulfate Soils) associated with the construction of the development including the contamination status of the sediments to be disturbed, the impacts associated with disturbance of sediment, and the management and mitigation measures to be employed during marine works. | Section 6.12 |
| | Include a suitable water quality monitoring program. | Section 6.9 |
| | As assessment of potential cumulative impacts on water sources and mitigation measures to manage the cumulative impacts. | Section 6.17 |
| Flora and Fauna | Assessment of potential impacts on any flora and fauna, including threatened species, populations or communities (e.g. Psodonia seagrass) or their habitats. | Section 6.3 and Appendix G |
| | Recommendations of appropriate mitigation measures during construction and operation, including potential impacts of shading from fixed structures. | Section 6.3 |
| Heritage | The EIS is to include a Heritage Impact Statement (HIS) which must assess the likely impacts of the proposal on significance of heritage items in the vicinity of the site. | Section 6.5 and Appendices I and J |
| | The EIS should include an assessment of any potential maritime heritage including shipwrecks, previous maritime infrastructure, archaeological items and/or relics (both above and below water and under historical reclamation areas) that may be impacted by the proposal, including strategies and procedures to be followed in the case of an unexpected discovery of heritage items and/or relics. The maritime heritage component of the EIS should be undertaken by a suitably qualified maritime archaeologist. | Section 6.5 and Appendix J |
| Air Quality and Odour | An Air Quality Impact Assessment during construction and operation prepared in accordance with relevant Environment Protection Authority guidelines shall be submitted. | Section 6.7 |
| Waste Management | Identify all potential sources of liquid waste and non-liquid wastes as defined in the EPA's Waste Classification Guidelines 2008. The EIS should identify any waste that will be stored, separated or processed on the site and identify the procedures to be adopted to minimise, manage, dispose of this waste in accordance with the relevant standards and guidelines. | Section 6.15 |
| Sea Level Rise | The EIS must assess the risks associated with sea level rise on the proposal. | Section 6.6 and Appendix K |

| Key Issue | SEARs | Where addressed |
|---|---|---|
| Infrastructure Servicing | Detail the existing infrastructure on site and identify possible impacts on any such infrastructure from the proposal including the harbour heat rejection plant outfalls. | Sections 4.3, 6.9 and 6.14 |
| | Identify and provide for appropriate servicing of the site. | Section 4.2 and Appendix B |
| | Detail measures to mitigate the impacts of the proposal on any infrastructure items, including proposed relocation. | Sections 6.9 and 6.14 |
| | Detail of water supply, consideration of water sensitive urban design and water conservation measures. | Sections 6.9, 6.13 and 6.14 |
| | Detail of appropriate easements to allow access to and maintenance of infrastructure services for the ferry terminal that are not on land owned by Roads and Maritime Services. | Chapter 4 and Section 6.8 |
| Construction Impacts | Identify measures to ameliorate potential construction impacts, including to vehicular, pedestrian and maritime access, noise and vibration, air quality, erosion and sediment control, water quality and waste management. | Chapter 6 |
| Staging | Details regarding the staging of the proposal development. | Section 4.2 |
| Ecologically Sustainable Development (ESD) | Identify how the development will incorporate ESD principles in the design, construction and ongoing operation phases of the development. | Section 6.13 |
| | Identify opportunities to minimise water and energy use. | Section 6.13 and Appendix L |
| Lighting and Signage | The EIS shall include consideration of lighting impacts. | Section 6.4 and Appendix H |
| | The EIS shall include details of all signage proposed including identification signs, wharf numbering, wayfinding signage etc. | Chapter 4, Appendices C and D |
| Consultation | Undertake an appropriate and justified level of consultation in accordance with the Departments' Major Project Community Consultation Guidelines October 2007. | Chapter 5 |

| Key Issue | SEARs | Where addressed |
|---|---|---|
| Consultation (continued) | During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with:<br>• City of Sydney Council<br>• Transport for NSW<br>• Roads and Maritime<br>• Port Authority of NSW<br>• Environment Protection Authority<br>• Office of Environment and Heritage<br>• Sydney Water Corporation<br>• Department of Primary Industries<br>• Barangaroo Delivery Authority<br>• Lend Lease.<br>The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided. | Chapter 5 |
| Further consultation after 2 years | If you do not lodge a development application and EIS for the development within 2 years of the issue of these SEARs, you must consult further with the Secretary in relation to the preparation of the EIS. | Noted |

# 2 Planning and assessment process

## 2.1 Assessment and approval process

The EP&A Act and the EP&A Regulation provide the framework for development and environmental assessment in NSW.

The EP&A Act contains a number of different planning approval pathways for the assessment of development proposals in NSW, including Part 4 (typically private developments), Part 4.1 (State significant development (SSD)), Part 5 (typically public infrastructure developments), and Part 5.1 (State significant infrastructure (SSI)). The approval pathway that applies to a proposed development is determined by relevant environmental planning instruments (EPIs) such as local environmental plans (LEPs) and State environmental planning policies (SEPPs).

### 2.1.1 State significant infrastructure

Section 115U of the EP&A Act provides that a SEPP can declare any development to be State significant infrastructure (SSI) that is:

(a) infrastructure

(b) other development that (for Part 5.1 or within the meaning of Part 5) would be an activity or which the proponent is also the determining authority and would, in the opinion of the proponent, require an EIS to be obtained under Part 5.

Pursuant to *State Environmental Planning Policy (State and Regional Development) 2011* (the SRD SEPP), the proposal qualifies as SSI (see Section 2.2.1 of this report) and the SEARs were produced on 10 November 2014 (SSI 14_6727).

Table 2-1 lists the SEARs relevant to the planning and assessment process and where they are addressed in this section.

Table 2-1 Secretary's environmental assessment requirements relevant to planning and assessment process

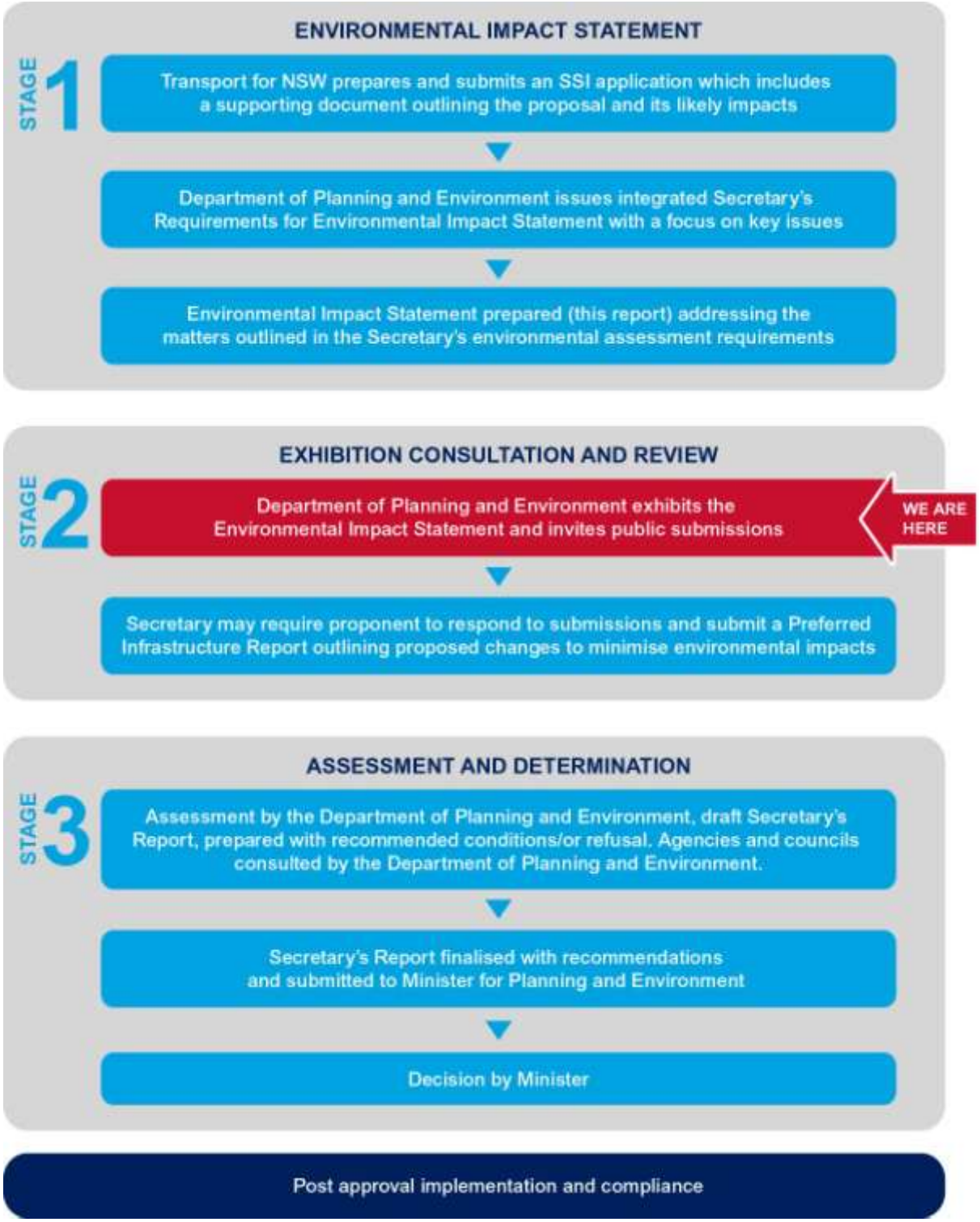
| Key Issue | SEARs | Where addressed |
|---|---|---|
| General Requirements | The Environmental Impact Statement (EIS) must address the *Environmental Planning and Assessment Act 1979* and meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000. | Chapter 2 and as identified in Table 1-1 |
| General requirements | The EIS must be accompanied by a report from a qualified quantity surveyor providing:<br>• A detailed calculation of the capital investment value (as defined in clause 3 of the Environmental Planning and Assessment Regulation 2000) of the proposal, including details of all assumptions and components from which the CIV calculation is derived;<br>• An estimate of the jobs that will be created by the development during the construction and operational phases of the development; and<br>• Certification that the information provided is accurate at the date of the preparation. | A report from a qualified quantity surveyor is provided with this EIS. |
| Environmental Planning Instruments; Policies and Guidelines | Address the relevant statutory provisions applying to the site contained in the relevant EPIs, Including:<br>• *State Environmental Planning Policy (State and Regional Development) 2011;*<br>• *State Environmental Planning Policy (Major Development) 2005;*<br>• *State Environmental Planning Policy (Infrastructure) 2007;*<br>• *State Environmental Planning Policy No. 55 – Remediation of Land; and*<br>• *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.* | Chapter 2 |
| Water Quality and Contamination | Identification of any water licensing requirements or other approvals required under the *Water Act 1912* or *Water Management Act 2000*. | Section 2.4 |

### 2.1.2 Key approval process

Under Part 5.1 of the EP&A Act, the planning and approvals process includes the following key steps, as identified in Figure 2-1:

- Submission of an SSI application with the accompanying supporting document to the Secretary of DP&E under Section 115X of the EP&A Act, to seek SEARs for the proposal (Section 115Y)
- Preparation and submission of an EIS under Section 115Y(2), addressing the matters outlined in the SEARs (this document)
- Public exhibition of the EIS for a minimum of 30 days
- Assessment of the application by the DP&E and preparation of the Secretary's environmental assessment report (Section 115ZA).

Figure 2-1 Approval process under Part 5.1 of the EP&A Act



### 2.1.3 Relationship with the Barangaroo approvals process

A request for the development of Barangaroo was submitted to the Minister for Planning in February 2006. The proposal included the development of 22 hectares of city foreshore land between King Street Wharf and Walsh Bay.

On 22 March 2006, the Minister for Planning agreed to consider Barangaroo as a potential State Significant Site under the *State Environmental Planning Policy (Major Projects) 2005* (MP SEPP). The Minister declared Barangaroo a major project and subject to Part 3A of the EP&A Act and authorised the submission of a concept plan for the site.

The original 'Concept Plan' (06_162) for Barangaroo was first approved by the Minister for Planning in February 2007. Since the original approval there have been six amendments to the Concept Plan. The original Concept Plan noted that the southern part of the site is convenient to Wynyard rail station and bus interchange as well as the ferry stop at King Street Wharf (Masson, Wilson and Twiney, 2006).

In February 2010, an amendment to the original Concept Plan was proposed (MP06_0162 (MOD 4)) and included a hotel development, additional ground floor space and height amendments. Changes also included about 300 square metres of transport related office space, and facilitated the future provision of ferry wharves with an indicative location for these provided at the southern end of the site. The construction of the wharves and the provision of associated waterside infrastructure were proposed to be undertaken by others. These are now the subject of this application.

An SSD application (SSD 13_6303) was submitted to the Department of Planning and Infrastructure (now DP&E) in November 2013 seeking approval for all public domain works within Stage 1A of Barangaroo South. One of the key features of the proposed works is the waterfront promenade which would interface with the Barangaroo Ferry Hub. It also includes services, including power, water, sewerage and communications, which would extend to the harbour edge to provide for future connections to the Barangaroo Ferry Hub (JBA Planning, 2014). The Proponent has responded to issues raised in submissions and the responses are being considered by DP&E.

Modification to the Concept Plan (MP06_0162 (MOD 8 and MOD 9)) is currently proposed. The modification to Barangaroo South (MOD 8) includes changes to the form of the buildings, increases and redistribution of gross floor area, redistribution of uses and public domain areas across Barangaroo South, and a reduction in the area of Southern Cove (the cove to the north of the proposal area), while modifications to Barangaroo Central and Barangaroo Point (MOD 9) includes changes to the form of the buildings, increases in gross floor area, redistribution of gross floor and land uses across development blocks, and a redistribution of public domain areas. The Proponent was issued the Director General's Requirements for the environmental assessment for these proposals on 15 April 2014.

## 2.2 State environmental planning instruments

A review of SEPPs was undertaken as part of the preparation of this EIS. The SEPPs which have relevance to the proposal are discussed in further detail below.

It should be noted that with the exception of the SRD SEPP, the SEPPs listed below do not apply to the proposal by reason of Section 115ZF(2). However, the SEARs require that they be considered as part of this EIS.

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

The SRD SEPP identifies development that is SSI. The parameters for the declaration of SSI, are:

*'Development is declared, pursuant to Section 115U (2) of the Act, to be State significant infrastructure for the purposes of the Act if:*

*the development on the land concerned is, by the operation of a State environmental planning policy, permissible without development consent under Part 4 of the Act, and*

*the development is specified in Schedule 3.'*

As discussed below, *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP) is also relevant to the proposal. Pursuant to the provisions of ISEPP, the proposal is permissible without development consent under Part 4 of the EP&A Act.

Clause 2 Schedule 3 of the SRD SEPP includes a definition for *'Port facilities and wharf or boating facilities', being 'Development for the purpose of port and wharf facilities or boating facilities (not including marinas) by or on behalf of a public authority that has a capital investment value (CIV) of more than $30 million'*.

As at October 2014, the CIV for the proposal exceeds this threshold and therefore, the proposal is SSI and falls under Part 5.1 of the EP&A Act, requiring approval from the Minister for Planning.

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

ISEPP is the key environmental planning instrument which determines the permissibility of the proposal.

Clause 68(4) of the ISEPP allows for the development of wharf or boating facilities by or on behalf of a public authority without consent on any land. However, as the proposal is declared to be SSI it requires the approval of the Minister for Planning.

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Chapter 5 of this report discusses the consultation undertaken with Council and other public authorities during the development of the proposal.

The proposed southern wharf is located above the Interim Metro Corridor for Sydney Metro identified in the ISEPP. Clause 88A of the ISEPP requires that a consent authority must:

- Give written notice of an application for consent to major development on land to which this clause applies to Sydney Metro within 7 days of receiving the application
- Before determining the application, take into account any submissions made by Sydney Metro within 21 days after giving the notice.

The responsibilities of Sydney Metro (now abolished) have since been vested in TfNSW under the *Transport Administration Act.* Therefore any notice required under Clause 88A of the ISEPP should be given to the Secretary of TfNSW.

A consent authority must not grant consent to major development on land to which Clause 88A applies if the development would have an adverse effect on the viability of the proposed metro, including by increasing the likely cost of developing the proposed metro.

The Interim Metro Corridor has been considered in the design. To ensure that the above provisions are met, an appropriate design solution would be selected during the detailed design stage.

### 2.2.3 State Environmental Planning Policy (Major Developments) 2005

The proposed temporary construction compound and the landside ancillary facilities are located on land which is subject to *State Environmental Planning Policy (Major Developments) 2005* (MD SEPP). The proposed landside ferry facilities are subject to the relevant provisions of the MD SEPP which have been considered during the preparation of this EIS.

The proposed landside ferry facilities would be located within the land use zone RE1 Public Recreation of the Barangaroo site as shown in Figure 2-2. The proposed facilities would support the objectives of this zone particularly by:

- Allowing land to be used in conjunction with the transportation of passengers by water
- Contributing positively to, and not dominating, the primary use of the land for public open space or recreational purposes.

Development for the purposes of passenger transportation facilities may be carried out with consent on land within Zone RE1 Public Recreation. There are no other provisions within the MD SEPP which are relevant to the proposed ancillary landside facilities.

As the proposal is declared to be SSI by the SRD SEPP as discussed in Section 2.2.1, the aspects of the proposal that are subject to the MD SEPP will be assessed under Part 5.1 of the EP&A Act as part of this EIS.

## Figure 2-2 Land zoning map around proposal area

### 2.2.4 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

The *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (the SREP SHC, now a deemed SEPP) applies to all the waterways of Sydney Harbour, the foreshores and its wider catchment. The SREP SHC aims to protect, enhance and maintain the catchment, foreshores, waterways and islands of Sydney Harbour. The SREP SHC also aims to establish a balance between promoting a prosperous working harbour, maintaining a healthy and sustainable waterway environment and promoting recreational access to the foreshore and waterways.

Although the Barangaroo Ferry Hub proposal falls within W1 Maritime Waters to which the SREP SHC applies, it is not considered to impact on any of the strategic foreshore sites identified within the SREP SHC. Nevertheless, the potential impact on the Sydney Harbour Catchment is considered below and at Section 6.8.

The objectives of the SREP SHC are considered in Table 2-2 below.

The proposal has been considered in respect of the objectives of the SREP Sydney Harbour Zone W1 Maritime Waters in Table 2-3.

Table 2-2 Objectives of the SREP SHC

| Objective | Response |
|---|---|
| (a) to ensure that the catchment, foreshores, waterways and islands of Sydney Harbour are recognised, protected, enhanced and maintained as an outstanding natural asset and as a public asset of national and heritage significance for existing and future generations | The proposal would ensure that the foreshore and waterways of Sydney Harbour are protected as a public asset by considering the environmental impact of the proposal within this EIS and through the implementation of mitigation measures as identified in this EIS to manage potential impacts. |
| (b) to ensure a healthy sustainable environment on land and water | The proposal would ensure a healthy sustainable environment by considering the environmental impact of the proposal within this EIS and through the implementation of mitigation measures as identified in this EIS to manage potential impacts. |
| (c) to achieve a high quality and ecologically sustainable urban environment | The proposal aims to achieve high quality ecologically sustainable urban environment as detailed in Section 6.13. |
| (d) to ensure a prosperous working harbour and an effective transport corridor | The proposal would ensure the harbour is used as an effective transport corridor as detailed in Section 3.1.4. |
| (e) to encourage a culturally rich and vibrant place for people | The proposal would encourage the use of the Barangaroo precinct as a new vibrant cultural hub. |
| (f) to ensure accessibility to and along Sydney Harbour and its foreshores | The proposal would ensure accessibility to Darling Harbour and surrounding foreshores. |

Table 2-3 Objectives of the W1 Maritime Waters zone

| Zone W1 Objectives | Response |
|---|---|
| (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 | The proposal would give preference to the effective movement of public water transport. |
| (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 industries | The proposal would not adversely affect the effective movement of commercial shipping or maritime industries as outlined in Chapter 6. |
| (c) to promote equitable use of the waterway, including use by passive recreation craft | The proposal would not adversely impact the equitable use of the waterway for passive recreation craft. |

The matters for consideration listed in Part 2, Division 2 of the SREP SHC are addressed in Table 2-4.

Table 2-4 Matters for consideration

| Objective | Response |
|---|---|
| Clause 21 Biodiversity, ecology and environment protection | The proposal would not adversely impact on any aspect of biodiversity and ecology and would ensure environmental protection throughout the construction and operation of the proposal as detailed in Chapter 4 and 6.3. |
| Clause 22 Public access to, and use of, foreshores and waterways | The proposal would ensure public access to the foreshore and waterway surrounding the proposal is maintained as well as providing access for the use of the harbour. |
| Clause 23 Maintenance of a working harbour | The proposal would enhance the character and function of Sydney Harbour as a working harbour for current and future demand. The proposal would be compatible with adjoining land uses at Barangaroo. |
| Clause 24 Interrelationship of waterway and foreshore uses | The construction and operation of the proposal aims to provide equitable use of the waterway including for commercial and recreational uses. The proposal would not create excessive congestion of traffic in the waterways or along the foreshore. |
| Clause 25 Foreshores and waterways scenic quality | The proposal aims to maintain, protect and enhance the unique visual qualities of Darling Harbour and its foreshore as detailed in Section 6.3. |
| Clause 26 Maintenance, protection and enhancement of views | The proposal would alter the views to Sydney Harbour however urban design objectives for the project aim to minimise this impact as detailed in Section 6.3. |
| Clause 27 Boat storage facilities | The proposal would allow for ferry layover facilities which would therefore increase the number of public boat storage facilities within Sydney Harbour. |

Clause 31 of the SREP SHC requires that the Foreshore and Waterways Planning and Development Advisory Committee (FWPDAC) be given notice of proposals that fall within Schedule 2 and that any comments be taken into consideration. Schedule 2 includes public water transport facilities. Service providers are also required to be notified of the proposal. Chapter 5 of this report discusses the consultation undertaken during the development of the proposal.

Clause 59 of the SREP SHC requires the impact of a proposal on the significance of heritage items to be assessed. There are no items listed within Schedule 4 of SREP SHC that are within or in the vicinity of the site. This is further discussed in Section 6.5.

Part 6 of SREP SHC relates to wetland protection. The site is not identified as being within wetland protection areas. Nevertheless, the potential impact of the proposal on these areas is discussed at Section 6.3.

As the proposal falls within the foreshores and waterways areas under SREP SHC, it has been considered in the context of the *Sydney Harbour Foreshores and Waterways Areas Development Control Plan 2005* (DCP). It is considered that the proposal is consistent with the relevant planning principles and requirements of the DCP.

### 2.2.5 State Environmental Planning Policy No. 55 – Remediation of Land

*State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55) provides a statewide approach to the remediation of contaminated land for the purpose of minimising the risk of harm to the health of humans and the environment. In accordance with Clause 7(1) of SEPP 55, a consent authority must not consent to the carrying out of development on any land unless:

*(a) 'it has considered whether the land is contaminated.*

*(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or would be suitable, after remediation) for the purpose for which the development is proposed to be carried out.*

*(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land would be remediated before the land is used for that purpose.'*

The proposal would involve the disturbance of land on the harbour bed as a result of piling works. Contamination has been identified in the seabed and a phase 2 contamination assessment has been carried out, as outlined in Section 6.12.

The proposed ancillary landside facilities would not involve the disturbance of the land surface beyond the installation of wayfinding signage and ticketing including Opal card facilities. Any potential disturbance of soils would be minor and could be managed through appropriate management measures. This has been further discussed in Section 6.12.

## 2.3 Local environmental planning instruments

### 2.3.1 Sydney Local Environmental Plan 2012

The majority of the proposal is located adjacent to land which is subject to the *Sydney Local Environmental Plan 2012* (the Sydney LEP). It is largely located on land that is the subject of the SREP SHC and to a lesser extent the MD SEPP. These instruments have been considered in Section 2.2.4 and Section 2.2.3 respectively.

The removal of signage and other relevant public transport elements associated with the King Street Ferry Wharf would be carried out within zone RE1 Public Recreation of the Sydney LEP. These works are very minor and would be consistent with all relevant objectives and provisions of the Sydney LEP.

As the proposal will be assessed under Part 5.1 of the EP&A Act, the permissibility and consent provisions of the Sydney LEP do not apply.

## 2.4 Additional NSW legislation

Section 115ZG of the EP&A Act provides that a number of additional approvals, permits and licences that would otherwise be triggered for development under NSW legislation are either not required for SSI projects, or cannot be refused and must be substantially consistent with the Part 5.1 approval:

*(1) The following authorisations are not required for approved State significant infrastructure (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):*

*(a) the concurrence under Part 3 of the Coastal Protection Act 1979 of the Minister administering that Part of that Act,*

*(b) a permit under Section 201, 205 or 219 of the Fisheries Management Act 1994,*

*(c) an approval under Part 4, or an excavation permit under Section 139, of the Heritage Act 1977,*

*(d) an Aboriginal heritage impact permit under Section 90 of the National Parks and Wildlife Act 1974,*

*(e) an authorisation referred to in Section 12 of the Native Vegetation Act 2003 (or under any Act repealed by that Act) to clear native vegetation or State protected land,*

*(f) a bush fire safety authority under Section 100B of the Rural Fires Act 1997,*

*(g) a water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than an aquifer interference approval) under Section 91 of the Water Management Act 2000.*

*(2) Division 8 of Part 6 of the Heritage Act 1977 does not apply to prevent or interfere with the carrying out of approved State significant infrastructure.*

*(3) The following directions, orders or notices cannot be made or given so as to prevent or interfere with the carrying out of approved critical State significant infrastructure:*

(a) *an interim protection order (within the meaning of the National Parks and Wildlife Act 1974 or the Threatened Species Conservation Act 1995*),

*(b) an order under Division 1 (Stop work orders) of Part 6A of the National Parks and Wildlife Act 1974, Division 1 (Stop work orders) of Part 7 of the Threatened Species Conservation Act 1995 or Division 7 (Stop work orders) of Part 7A of the Fisheries Management Act 1994,*

*(c) a remediation direction under Division 3 (Remediation directions) of Part 6A of the National Parks and Wildlife Act 1974,*

*(d) an environment protection notice under Chapter 4 of the Protection of the Environment Operations Act 1997,*

*(e) an order under Section 124 of the Local Government Act 1993.*

Section 115ZH of the EP&A Act provides that a number of additional approvals, permits and licences cannot be refused for SSI projects, and that they must be in substantially consistent with the Minister for Planning's approval under Part 5.1 of the EP&A Act. In accordance with Section 115ZH(1), the approvals legislation that must be applied consistently comprise:

*(a) an aquaculture permit under Section 144 of the Fisheries Management Act 1994,*

*(b) an approval under Section 15 of the Mine Subsidence Compensation Act 1961,*

*(c) a mining lease under the Mining Act 1992,*

*(d) a production lease under the Petroleum (Onshore) Act 1991,*

*(e) an environment protection licence under Chapter 3 of the Protection of the Environment Operations Act 1997 (for any of the purposes referred to in Section 43 of that Act),*

*(f) a consent under Section 138 of the Roads Act 1993,*

*(g) a licence under the Pipelines Act 1967.'*

These approvals, permits or licences would not be required for this project however; consultation will be undertaken with the relevant agencies where relevant to the proposal, as summarised in Table 2-5.

Table 2-5 Additional NSW legislation

| Legislation | Purpose | Application to the proposal |
|---|---|---|
| *Coastal Protection Act 1979* | To provide for the protection of the coastal environment for the benefit of both present and future generations. | The proposal is not located within the coastal zone, therefore this Act has not been considered further. |
| *Contaminated Land Management Act 1997* | To promote the better management of contaminated land and establish a process for investigating and (where appropriate) remediating land which the Environment Protection Authority (EPA) considers to be contaminated significantly enough to require regulation. | The proposed activity is expected to be carried out on contaminated land (waterside). Refer to Section 6.12 for further details. |

| Legislation | Purpose | Application to the proposal |
|---|---|---|
| *Crown Lands Act 1989* | To provide for the administration and management of Crown land in NSW. | The landside works for the project would be undertaken on Crown land managed by BDA. The waterside works for the project would be undertaken on Crown land managed by Roads and Maritime. Land would be managed in accordance with the objectives of this Act. |
| *Fisheries Management Act 1994* | To conserve key fish habitats including permanent and semi-permanent freshwater habitats. | The proposal would not significantly impact key fish habitat as further discussed in Section 6.3. |
| *Heritage Act 1977* | To encourage the conservation of the heritage of NSW. | The proposal would not directly affect any heritage listed item including items listed on the State heritage register (SHR) or any listed shipwrecks. Heritage impacts as a result of the proposal have been detailed in Section 6.5. |
| *Marine Pollution Act 1987*<br>*(Marine Pollution Regulations 2006)* | To protect the sea and waters from pollution by oil and other noxious substances discharged from vessels. | The proposal would not significantly impact the marine environment. Water quality impacts have been detailed in Section 6.9. |
| *National Parks and Wildlife Act 1974* | To establish, preserve and manage national parks, historic sites and other areas of conservation value and protect significant fauna, native plants and Aboriginal objects. | The proposal would not affect any area declared as a National Park, historic site, nature reserve or Aboriginal area nor would it impact any historic Aboriginal object or place, threatened species, population or endangered ecological community. Impact to ecology and Aboriginal heritage are discussed further in Sections 6.3 and 6.10 respectively. |
| *Native Title (NSW) Act 1994* | To provide for native title in relation to land or waters. | The proposal would not affect land subject to native title or to which an Indigenous Land Use Agreement applies. Therefore this Act has not been considered further. |
| *Noxious Weeds Act 1993* | To ensure that the Act is complied with and within their boundaries, the landholder has an obligation under the Act to control any declared weed on their property. | The project is not located in an area subject to noxious weeds and therefore this Act has not been considered further. |

| Legislation | Purpose | Application to the proposal |
|---|---|---|
| *Protection of the Environment Operations Act 1997* | To protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development. To reduce the risks to human health and prevent the degradation of the environment by the use of mechanisms that promote pollution prevention and cleaner production. The reduction to harmless levels of the discharge of substances likely to cause harm to the environment.<br>The POEO Act requires environment protection licences (EPLs) be obtained for the carrying out of 'scheduled activities' or to pollute waters. | The proposal is not a scheduled development or a scheduled activity under Schedule 1 of the Act and therefore does not require an environment protection licence (EPL). |
| *Rural Fires Act 1997* | To prevent, mitigate and suppress bush and other fires in local government areas (or parts of areas) and other parts of the State constituted as rural fire districts. | The proposal is not located on, or near bushfire prone land therefore this Act has not been considered further. |
| *Threatened Species Conservation Act 1995* | To provide a framework for the listing of threatened species, populations and ecological communities, and key threatening processes in NSW, and the preparation and implementation of recovery plans and threat abatement plans. | The proposal would not affect any threatened species or ecological communities listed under the Act. Refer to Section 6.3 for further details. |
| *Waste Avoidance and Resource Recovery Act 2001* | To provide a legal framework concerning the minimisation, recycling and reuse of waste in NSW. | All wastes generated by the proposed activity would be collected, classified and removed from site for recycling or disposal at a licensed waste facility if required. Given the short term nature of the construction, only minor quantities of waste would be produced. Refer to Section 6.15. |
| *Water Act 1912* | To regulate water extraction for any temporary or permanent works in areas not yet defined in a gazetted water sharing plan under the *Water Management Act 2000*. | The proposal would not require water extraction. Therefore this Act has not been considered further. |
| *Water Management Act 2000* | To provide for the sustainable and integrated management of the State's water for the benefit of both present and future generations. | Section 38 of the Water Management (General) Regulation 2011 provides that TfNSW is exempt from all requirements under the Act for controlled activities that it carries out in, on or under waterfront land. |
| *Work Health and Safety Act 2011* | To secure the health, safety and welfare of persons at work. | The proposed activity would be carried out in accordance with all health and safety requirements. |

## 2.5 Commonwealth legislation

Commonwealth legislation that applies to the proposal is presented in Table 2-6 below.

Table 2-6 Commonwealth legislation applicable to the proposal

| Legislation | Purpose | Application to the proposal |
|---|---|---|
| *Environment Protection and Biodiversity Conservation Act 1999* | The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the protection of certain Matters of National Environmental Significance (MNES) listed under the Act, which include:<br>• World Heritage Areas<br>• National Heritage Places<br>• Ramsar wetlands of international importance<br>• Commonwealth listed threatened species and ecological communities<br>• listed migratory species<br>• Commonwealth marine areas<br>• Great Barrier Reef Marine Park<br>• Nuclear actions.<br>Under the EPBC Act a referral is required to the Commonwealth Minister for Environment for proposals that have the potential to significantly impact on MNES or the environment of any Commonwealth land. | The Sydney Opera House is a declared World Heritage property. The proposal is not located within the buffer zone of the Sydney Opera House and therefore is not expected to impact on this buffer zone.<br>No impact on Commonwealth land or any other MNES is anticipated.<br>An EPBC Act referral is not required as part of this proposal as outlined in Appendix A. |
| *Disability Discrimination Act 1992* | This Act aims to eliminate as far as possible, discrimination against persons on the ground of disability in areas including access to premises and the provision of facilities, services and land. | The proposal has been designed to be independently accessible and in compliance with the objectives and requirements of the *Disability Discrimination Act 1992*. |
| *Disability Standards for Accessible Public Transport 2002* | Clause 33.1 of this Act requires all new public transport premises, infrastructure and conveyances to be compliant with the requirements of the standard and referenced to the Australian Standards and Design Rules therein, unless unjustifiable hardship is incurred by implementation. | The proposal would be designed to be compliant for no less than 80 per cent of all tides.<br>There would be times where the proposal would not comply due to tidal variance which would affect the gradient of the gangway. |

## 2.6 Additional environmental approvals/permits required

Following consideration of the full scope of work for the proposal, the applicable environmental legislation and the expected environmental impact, the following environmental approvals/permits would be required to commence and carry out the proposal.

Table 2-7 Additional environmental approvals/permits required

| Approval/permit | Details |
|---|---|
| Harbour Master approval | The written approval of the Harbour Master is required for any proposed works that would disturb the bed of the Special Port Areas of Botany Bay and Sydney Harbour. In this context, 'Special Port Areas' means the Port of Sydney and the Port of Botany Bay, and any managed land adjoining or adjacent to such port. |
| Roads and Maritime construction approval | Written approval from Roads and Maritime would be sought prior to construction of the proposal. |
| TfNSW Secretary approval | Piling works within the Interim Metro Corridor would require TfNSW Secretary approval prior to construction. |

# 3 Need and alternatives

The proposal would assist in addressing the public transport needs of the Barangaroo precinct, together with providing an overall improvement in Sydney's ferry transport capability and capacity. Specific benefits that would result from the development include:

- Improved quality of service to customers travelling by ferry to the Sydney CBD
- Reduced capacity constraints on nearby ferry terminals such as Circular Quay
- Allowing for growth in ferry services to respond to the demand caused by the Barangaroo precinct as well as residential growth along the Parramatta River (as outlined in Sydney's Ferry Future, refer to Section 3.1.4)
- Improved transport access to the western and central parts of the CBD, through linkages with rail and bus services at Wynyard (via Wynyard Walk), and facilitation of access to other modes such as light rail, walking and cycling
- Improved resilience of ferry services for special events and for maintenance activities.

Table 3-1 lists the Secretary's environmental assessment requirements relevant to strategic context and where they are addressed in this section.

Table 3-1 Secretary's environmental assessment requirements relevant to strategic context

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Environmental Planning Instruments; Policies and Guidelines | Address the relevant provisions, goals and strategic objectives in the following:<br>• *NSW 2021;*<br>• *Draft Metropolitan Plan for Sydney 2031;*<br>• *Draft Sydney Sub-Regional Strategy NSW*<br>• *Barangaroo Integrated Transport Plan;*<br>• *Sydney City Centre Access Strategy;*<br>• *NSW Long-term Transport Master Plan 2012; and*<br>• *Sydney's Ferry Future 2013.* | Section 3.1 |
| Design and Justification | Justification for the development and assessment of the suitability of the site for the development, in particular the number of wharves, the size of occupation of the waterway, ferry lay over, proposed sewage pump out refuelling and maintenance activities. | Sections 3.2 and 3.3 |

## 3.1 Strategic context

The context of and need for the Barangaroo Ferry Hub proposal in relation to the overall Barangaroo precinct was outlined in Chapters 1 and 2. The proposal is assessed in this chapter in the context of key government strategies and policies, including *NSW 2021: A Plan to Make NSW No 1* (NSW 2021) (NSW Government, 2011), the *draft Metropolitan Strategy for Sydney to 2031* (NSW Government, 2013), and the LTTMP (NSW Government, 2012).

The proposal is consistent with *Sydney's Ferry Future* (TfNSW, 2013b), the *Sydney City Centre Access Strategy* (TfNSW, 2013a) and the more specific *Barangaroo Integrated Transport Plan* (TfNSW, 2012a). It responds to the overarching strategic aim of growth in ferry patronage by facilitating convenient access to the western and central parts of the CBD for ferry passengers, as well as relieving congestion pressure at Circular Quay and meeting expected future demand for public transport at Barangaroo.

The proposal is specifically assessed against each of these strategies below.

### 3.1.1 NSW 2021

NSW 2021 is the NSW Government's strategic business plan, setting priorities for action and guiding resource allocation over the 10 years from September 2011. It sets out five strategies including rebuilding the economy, returning quality services, renovating infrastructure, strengthening our local environment and communities and restoring government accountability.

The goals, targets and actions in this plan set the NSW Government's priorities for funding, guiding decisions and focusing the day to day work of the public sector.

The expected contribution of the proposal to the NSW 2021 plan is outlined in Table 3-2.

Table 3-2 Barangaroo Ferry Hub proposal's contribution to meeting NSW 2021

| NSW 2021 target | Expected achievement of the Barangaroo Ferry Hub proposal |
|---|---|
| **Goal 1: Improve the performance of the NSW economy** | |
| • Grow gross state product (GSP) per capita by an average 1.5 per cent per year to 2020 | The proposal would:<br>• Provide improved transport access solutions for the western and central parts of the CBD and integrate with Wynyard rail and bus services via Wynyard Walk, as well as support other modes such as light rail, walking and cycling<br>• Support jobs over the life of the proposal<br>• Provide direct access to Barangaroo which will provide for up to 23,000 office workers. |
| **Goal 2: Rebuild State finances** | |
| • Improve efficiency and effectiveness of expenditure | The main economic benefits would come from improved transport access solutions for the western and central parts of the CBD and the provision of direct public transport access to Barangaroo, reducing travel times. |

| NSW 2021 target | Expected achievement of the Barangaroo Ferry Hub proposal |
|---|---|
| **Goal 7: Reduce travel times** | |
| • Improve the efficiency of the road network during peak times on Sydney's road corridors<br>• Minimise public transport waiting times for customers | The proposal would:<br>• Provide direct ferry access to Barangaroo for passengers which may otherwise travel to Barangaroo using the road network<br>• Relieve travel demand for and associated congestion on rail, bus and other ferry services thereby reducing wait times. |
| **Goal 8: Grow patronage on public transport by making it a more attractive choice** | |
| • Consistently meet public transport reliability targets<br>• Increase the share of commuter trips made by public transport | • The proposal would relieve congestion and capacity constraints at Circular Quay and support the achievement of the target of 98.5 per cent of ferries running on time<br>• The design of the wharf would facilitate efficient movement of ferry passengers at Barangaroo<br>• The proposal would relieve travel demand for and associated congestion from rail, bus and other ferry services, thereby improving reliability of these modes of transport<br>• The proposal would increase mode share of public transport by providing improved transport access solutions for the western and central parts of the CBD. Ferry services at Barangaroo would integrate with Wynyard rail and bus services via Wynyard Walk. |
| **Goal 9: Improve customer experience with transport services** | |
| • Improve customer satisfaction with transport services<br>• Increase real–time travel information to customers | • The proposal would provide a high quality public transport service to the western and central parts of the CBD that would ensure a positive whole of journey experience, including comfortable and timely travel. |
| **Goal 19: Invest in critical infrastructure** | |
| • Increase expenditure on critical NSW infrastructure | • The Barangaroo Ferry Hub is identified in the LTTMP as an action that would expand capacity on NSW's most constrained corridors. |

### 3.1.2 NSW Long Term Transport Master Plan

The LTTMP (NSW Government, 2012) is a 20 year plan to improve the transport system in NSW. It sets the framework for the NSW Government to deliver an integrated, modern transport system that puts the customer first.

The plan also:

- Identifies the challenges that the transport system (including buses, heavy rail, light rail, ferry and private vehicles) in NSW needs to address to support the State's economic and social performance
- Guides decision-makers to prioritise actions which address the most pressing challenges
- Identifies a planned and coordinated set of actions (reforms, service improvements and investments) to address the challenges

- Provides a map of future service and infrastructure developments which future decisions will be required to support, and against which proposed investments can be evaluated
- Guides the NSW Government's transport funding priorities, providing the overall framework for how our transport system develops, whether it is the services that are delivered or the infrastructure that underpins them.

A key element of the plan is the need to address congestion in the Sydney CBD. The plan notes that over the next 20 years, trips into the Sydney CBD are forecast to grow by 31 per cent. This represents an additional 56,500 trips, the equivalent of 942 standard buses (NSW Government, 2012). This growth cannot be accommodated on the existing CBD road network, which would compound congestion and affect economic growth. An integrated public transport solution is therefore needed to ease congestion in the CBD.

Other challenges identified by the plan include an increased demand for transport connections to growth precincts within the CBD, such as Barangaroo, and the need to expand the transport network to meet this demand.

The plan acknowledges the significant forecasted population at Barangaroo and commits to delivering a new ferry hub to provide direct services to Barangaroo and relieve congestion and capacity constraints at Circular Quay.

The proposal realises the plan by constructing a new ferry hub at Barangaroo. The delivery of two wharves by the middle to end of 2016 would assist in meeting the increased demand for transport connections generated from the initial stages of the Barangaroo precinct. A third wharf would provide additional ferry services when demand necessitates.

The *Sydney City Centre Access Strategy* (TfNSW, 2013) which integrates the various transport initiatives proposed for the CBD, including the Barangaroo Ferry Hub, is a key action of the plan and is outlined at Section 3.1.5.

### 3.1.3 Draft Metropolitan Strategy for Sydney to 2031

The *draft Metropolitan Strategy for Sydney to 2031* (NSW Government, 2013) sets the management framework for Sydney's growth over the next two decades. The draft Strategy supports the key goals, targets and actions contained in NSW 2021 and has been prepared in conjunction with the LTTMP (refer to Section 3.1.2) to fully integrate land use and infrastructure outcomes.

One of the five key focuses of the strategy is accessibility and connectivity. It aims to encourage the growth of centres that have access to transport and improve access to major employment hubs and global gateways.

The proposal supports the strategy by providing a new ferry hub that would:

- Improve transport access to and within the western and central parts of the CBD
- Provide direct access to the Barangaroo precinct, which will be a major employment hub.

#### Central Subregion

Barangaroo is located within the Central Subregion under the strategy, and this subregion is identified as Sydney's global economic driver. The strategy recognises the importance of Sydney Harbour as an icon that will continue to drive investment in and around the

subregion. The vision for Sydney Harbour is to plan to protect and enhance Sydney Harbour and its environs and improve public access.

It is a metropolitan priority to strengthen transit connections throughout the global economic corridor, particularly around the CBD, in line with the LTTMP (refer to Section 3.1.2). The proposal achieves this by introducing a new ferry hub at Barangaroo which connects with Wynyard train and bus services via Wynyard Walk thereby improving transport access to and within the western and central parts of the CBD.

### 3.1.4 Sydney's Ferry Future

*Sydney's Ferry Future* (TfNSW, 2013b) is an integral part of the LTTMP (refer to Section 3.1.2). It provides a 20 year plan to improve the ferry transport experience for customers and grow the Sydney Ferries service offering as part of a well-integrated transport system.

The development of Barangaroo will act as a large generator of extra trips to the western part of the CBD. Integrated land use and transport planning for Barangaroo is targeting a very high proportion of trips to be undertaken by public transport. To meet this demand *Sydney's Ferry Future* identifies the need for a new ferry hub at Barangaroo as part of Stage 3 of a four stage plan. It recognises that the hub would also connect ferry customers to the western and central parts of the CBD including Wynyard Walk and Wynyard rail and bus services, and relieve congestion and capacity constraints at the Circular Quay terminal.

As well as delivering a specific action, the Barangaroo Ferry Hub Proposal would also help to meet the aims of the plan. In particular it would:

- Relieve capacity constraints on nearby ferry terminals, including Circular Quay
- Improve resilience of ferry services for special events or maintenance activities
- Provide modern ferry wharves that are safe, comfortable, efficient and accessible.

### 3.1.5 Sydney City Centre Access Strategy

The *Sydney City Centre Access Strategy* (TfNSW, 2013a) is a 20 year strategy which provides initiatives designed to reduce congestion, provide for future growth and improve the customer experience of different transport modes within Sydney's city centre. It has been developed in response to the LTTMP (refer to Section 3.1.2) commitments that relate to improving access within and to Sydney's city centre.

The strategy considers all transport modes and their key networks and takes on a multi-modal approach to unlocking additional capacity within the Sydney CBD.

Key features of the integrated network include:

- Light rail on George Street between Central and Circular Quay
- Pedestrianisation of George Street between Bathurst Street and Hunter Streets
- Improved pedestrian connections throughout the city centre including Wynyard Walk
- Redesigned bus services with priority routes on Elizabeth/Castlereagh, Park Street/Druitt Street and Clarence/York Street
- New interchange precincts at Town Hall, Wynyard, Central and Circular Quay Railway Stations, and also at Martin Place and Museum

- An integrated cycleway network
- A new ferry hub at Barangaroo
- A new rapid transit railway line and train stations for the city centre
- New designated traffic routes through and around the city centre.

The Barangaroo Ferry Hub proposal delivers one of the key components of the strategy while also supporting the overall aims of the strategy by providing a ferry hub which would improve the range of travel options available to commuters. It also has convenient pedestrian linkages to Wynyard train and bus services via Wynyard Walk.

### 3.1.6 Barangaroo Integrated Transport Plan

The *Barangaroo Integrated Transport Plan* (TfNSW, 2012a) was released by TfNSW in 2012 to consider the transport requirements for Barangaroo in the context of the forecast demand for transport in the western and central parts of the CBD. A Taskforce, led by TfNSW, developed the plan. Members of the Taskforce included the Director General of TfNSW and representatives from the Department of Planning and Infrastructure, Department of Premier and Cabinet, Infrastructure New South Wales, the BDA, City of Sydney and Lend Lease.

The plan recommends 28 short and long term actions to:

- Address transport issues by delivering Wynyard Walk; improving bus routes and services, ferries, and light rail; and undertaking the Wynyard Station upgrade
- Address existing capacity issues in the western and central parts of the CBD relevant to Barangaroo
- Support the principle of high usage of public transport, walking and cycling to and from the site, and low usage of private vehicles
- Provide accessibility between Barangaroo and the City Centre and to the other foreshore attractions located between Circular Quay and Darling Harbour.

These actions focus on two elements:

- Transport connections to enable Barangaroo to achieve all-day accessibility for the following modes:
  - Walking
  - Cycling
  - Ferries
  - Buses
  - Light Rail
  - Traffic and Taxi Access
  - Delivery and Service Vehicles
  - Coaches

- Network capacity improvements to be applied to the existing transport system to achieve peak period capacity for the northern CBD with regard to:
  - Trains approaching Wynyard Station
  - Wynyard Station itself
  - Wynyard Bus Interchange.

The plan recognises that Barangaroo is constrained by its topography and that it needs to achieve significantly higher mode share targets for public transport than presently experienced across the CBD. The plan provides a 4-8 per cent mode share target for ferries, however it notes that with new wharves at Barangaroo and more ferry services, there is the potential for much higher usage while relieving capacity constraints at Circular Quay.

Key actions specifically relevant to the proposal are considered in Table 3-3.

Table 3-3 Key actions of the Barangaroo Integrated Transport Plan relevant to the proposal

| Action | Expected achievement of the Barangaroo Ferry Hub Proposal |
|---|---|
| **Action 12**<br>Continue existing ferry services in the short term to King Street Wharf similar to current Parramatta River and Darling Harbour/Balmain East services: approx. every 15 minutes in peak and 30 minutes in off-peak | During construction, ferry services to King Street Ferry Wharf would be maintained. Once Barangaroo Ferry Hub is operational, the public transport elements of the King Street Ferry Wharf would be decommissioned and services relocated to Barangaroo Ferry Hub. |
| **Action 14**<br>Commence detailed planning by early 2013 for a ferry interchange at Barangaroo. The detailed planning should include forecasting of the potential ferry patronage at initial occupancy in 2015. | This action has been achieved. The Barangaroo Ferry Hub proposal is the result of this action. King Street Ferry Wharf would remain operational during construction to meet the demand generated during initial occupation of Barangaroo in 2015. In operation, the proposal would meet increasing demand as the occupancy of Barangaroo also increases. |

## 3.2 Project need

### 3.2.1 Barangaroo precinct

Once fully occupied, it is expected that the Barangaroo precinct will add to the CBD's existing congestion and capacity constraints by accommodating up to 23,000 office workers and 2,500 residents, with public facilities at the site also estimated to attract around 33,000 visitors per day when complete. The need for the proposal is based on the consequent expected demand for transport services to the precinct with a focus on employment and attractions within the walking catchment of the Barangaroo precinct.

The Barangaroo Ferry Hub proposal addresses a number of the transport challenges for Barangaroo and the Sydney CBD. It would be a significant contributor to the delivery of an integrated and modern transport system for both Barangaroo and the Sydney CBD by addressing the congestion and capacity constraints of King Street Ferry Wharf and Circular Quay in peak periods.

### 3.2.2 Predicted growth and increasing demand

#### Transport

The capacity and complexity of Sydney CBD's transport system is constraining Sydney's ability to function as a liveable, modern and productive CBD (NSW Government, 2012). Congestion across metropolitan Sydney is estimated to cost up to $5 billion per annum (TfNSW, 2013). Train and bus services, stations and stops are, at times, operating above their intended capacity during peak periods. The cost of this is regular overcrowding and longer commuting times. The existing transport network within the Sydney CBD has limited capacity and the challenge is to increase the capacity, reliability and quality of public transport services to the Sydney CBD. The Sydney CBD is a hub of activity with more than 630,000 trips made to the area each weekday. This is expected to grow to 775,000 trips over the next 20 years, with congestion costs forecast to increase to around $8 billion per annum (TfNSW, 2013a).

#### Ferry patronage

Patronage on Sydney ferry services has increased from 14.34 million annual journeys in 2009/2010 to 14.94 million annual journeys in 2012/2013. Annual journeys are estimated to grow at up to 8 per cent per year through to 2026.

Table 3-4 Previous patronage growth – Sydney Ferries

| Year | 2007/8 | 2008/9 | 2009/10 | 2010/11 | 2011/12 | 2012/13 |
|---|---|---|---|---|---|---|
| Annual patronage (million) | 13.16 | 13.92 | 14.34 | 14.50 | 14.77 | 14.94 |

Patronage for both leisure use and commuter access is currently growing at the King Street Ferry Wharf and Circular Quay has limited wharf capacity for vessels in peak periods (TfNSW, 2013a). A ferry patronage survey (2014) estimated 650 passengers boarding and alighting ferry services at King Street Ferry Wharf during the weekday morning (AM) peak period. The current facilities at King Street Wharf are close to capacity to accommodate this level of patronage. A ferry hub at Barangaroo would relieve some of the existing capacity constraints and would facilitate the expected increase in ferry patronage, as outlined below.

Based on ferry patronage survey results for King Street Ferry Wharf (650) there is expected to be a substantial growth in demand by 2016 (year of opening) with a projected patronage level of around 3000 in the weekday morning (AM) peak period. Estimated increases in ferry patronage from the year of opening (2016) to 2026 show a predicted growth in patronage to about 5,000 trips during the morning (AM) peak period on weekdays. This growth is based on strong passenger demand along the Parramatta River and up to 26,000 jobs within the Barangaroo precinct by full occupation.

The maximum ferry passenger capacity per hour which can be utilised on weekends and public holidays from the year of opening (2016) is described in Table 3-5. This does not apply for special events, which could see higher passenger movements for short periods subject to development of a special events overlay plan.

Table 3-5 Barangaroo Ferry Hub maximum passenger capacity (weekends)

| Services | Capacity | Vessels per hour | Maximum passenger capacity per hour |
|---|---|---|---|
| Parramatta River Services | 230 | 6 | 1,380 |
| Darling Harbour Services | 400 | 8 | 3,200 |
| **Total** | **630** | **14** | **4,580** |

### Employment and housing

The predicted growth in employment and housing across Sydney specifically within the transport corridors to be serviced by ferry services using the proposed Barangaroo Ferry Hub is outlined below.

### Global Sydney

'Global Sydney' is considered the most internationally visible area of Sydney and is made up of the Sydney CBD, its adjacent precincts and the CBD of North Sydney. It is thought to represent Australia's most significant concentration of economic, educational, medical, creative and cultural activity. The d*raft Metropolitan Strategy for Sydney to 2031* (NSW Government, 2013) identifies the plan to provide for at least an additional 114,000 jobs within the Global Sydney area by 2031. Based on figures presented in the LTTMP, around 43,500 of these jobs are expected to be provided in the northern part of the CBD, including at Barangaroo.

An additional 45,776 new dwellings are forecast to be provided in the City of Sydney LGA between 2015 and 2036, with about 8000 of these expected to be developed in the next two years. The CBD and harbour area is expected to have an increase of 6765 new dwellings, which would include 800 apartments at Barangaroo South (City of Sydney, 2014).

With this level of predicted future growth comes the demand for infrastructure and services, including public transport such as ferry services, which is currently at or near capacity and would require improvements to meet this predicted increase in demand.

### Parramatta River Corridor

The *Draft Metropolitan Strategy for Sydney 2031* recognises the importance of Parramatta as Sydney's second CBD and major employment area. Parramatta currently has the largest concentration of employment outside of Global Sydney and is anticipated to be the fastest growing centre outside Global Sydney over the next 20 years. The d*raft Metropolitan Strategy for Sydney to 2031* forecasts an additional 21,000 new jobs in the Parramatta CBD by 2031. The Parramatta Economic Strategy 2011-2016 (Parramatta City Council, 2011) aligns with the Draft Metropolitan Strategy to intensify employment within the Parramatta CBD and also identifies Rydalmere and Camellia, both located on the Parramatta River, as additional strategic centres to be renewed as high volume employment zones.

There is a high level of residential growth expected along the western portion of the Parramatta River through urban renewal projects. At Wentworth Point, the number of dwellings is expected to increase by an average of 371 dwellings per annum to 10,786 in 2036 (Auburn Council, 2014). This includes the Wentworth Point Urban Activation Precinct which was rezoned in June 2014 to provide for two new residential neighbourhoods, with a total of about 2300 apartments expected to be built by 2030

(Department of Planning and Environment, 2014a). Adjacent to this is the Homebush Bay West DCP site which allows for the development of around 8,349 dwellings and the SOPA 'Site 115' which could provide 256 new dwellings by 2020 (Auburn Council, 2014). These developments are all proximate to the Sydney Olympic Park ferry wharf, as shown in Figure 3-1.

The Shepherds Bay area along the Parramatta River at Meadowbank has been rezoned for conversion into a mixed use, high density residential area (City of Ryde, 2014). It is expected that development at Shepherds Bay will cater for about 2,000 new apartments. The Shepherds Bay area is adjacent to the Meadowbank ferry wharf, as shown in Figure 3-1.

Across the river, the Rhodes Peninsula is also being redeveloped. The western portion, known as Rhodes West, has now almost completely been transformed from industrial land into a new community containing residential and commercial developments. The remaining development of the Rhodes Station Precinct is expected to contribute an additional 1400 new dwellings to the Rhodes West community. Rhodes East currently comprises low density residential development. Canada Bay Council is currently looking at rezoning opportunities to provide for high density residential development within this precinct, with an additional 3500 new dwellings forecast to be provided in the next 10-15 years.

Breakfast Point has also recently been redeveloped as a master-planned high density residential area. A modification to the master plan was approved in April 2014 to allow the provision of an additional 500 new residences, for a total of 1589 dwellings within the development (Department of Planning and Environment, 2014b). The Breakfast Point development is located near the Cabarita ferry wharf, as shown in Figure 3-2. A modification to the Majors Bay development at Mortlake is also currently being assessed to provide for a new total of 466 mixed development apartments (an additional 75 apartments) (Department of Planning and Environment, 2014c).

### Balmain

The former 12,375 square metre Nutrimetics industrial site at 100 Elliot Street, Balmain has recently been sold to a developer and plans to develop 121 apartments on the site have been approved (Business Review Weekly, 2014). The site is near existing Balmain and Balmain East ferry services.

### Better access to the CBD and Parramatta

The need for a high level of connectivity between Global Sydney and Parramatta has been recognised in the LTTMP. The need to better connect people from their place of residence to their place of employment has also been a consistent long term goal of the NSW government. It has been recognised that people who catch a ferry to work generally live within a 10 minute walk (or 800 metres) catchment area (TfNSW, 2013b). With forecast high employment and residential growth along the Parramatta River Corridor, and the high constraints associated with the existing road and public transport networks along Parramatta and Victoria Roads, additional transport options are needed.

The Parramatta River services currently account for four per cent of AM peak passenger demand, and by 2026 this proportion is set to rise to 18 per cent of all ferry customers. Therefore, any improvements to ferry services need to respond to the predicted growth expected along this corridor.

Figure 3-1 Residential development within the vicinity of Meadowbank and Sydney Olympic Park Ferry Wharves

Figure 3-2 Residential development within the vicinity of Cabarita Ferry Wharf

## 3.3 Options assessment

### 3.3.1 Overview

The options assessment process for the proposal was undertaken in three stages as shown in Figure 3-3 below. Stage one was a strategic assessment undertaken as part of the development of the relevant transport plans for NSW and Sydney. Stage two involved consideration of options to meet the agreed commitments as part of the strategic assessment and stage three was proposal definition. These stages are outlined in the subsequent sections.

Figure 3-3 Options assessment process

### 3.3.2 Strategic assessment

The strategic assessment has been summarised in Figure 3-4.

The strategic assessment of the need for a ferry solution at Barangaroo was initiated as part of the broader Barangaroo Review undertaken by the NSW Government. The review resulted in the establishment of the Barangaroo Transport Taskforce (August 2011).

Barangaroo has no comparable project in Australia. This is due to the scale of the project and its unique combination of urban renewal, property development, creation of cultural and entertainment areas, mixed use deployment, creation of large scale passive and active recreational areas in a harbour side CBD location. When completed, more than 23,000 people are expected to work at Barangaroo, 2,500 people will live there, and another 33,000 people will visit every day. A project of this scale requires innovative transport solutions.

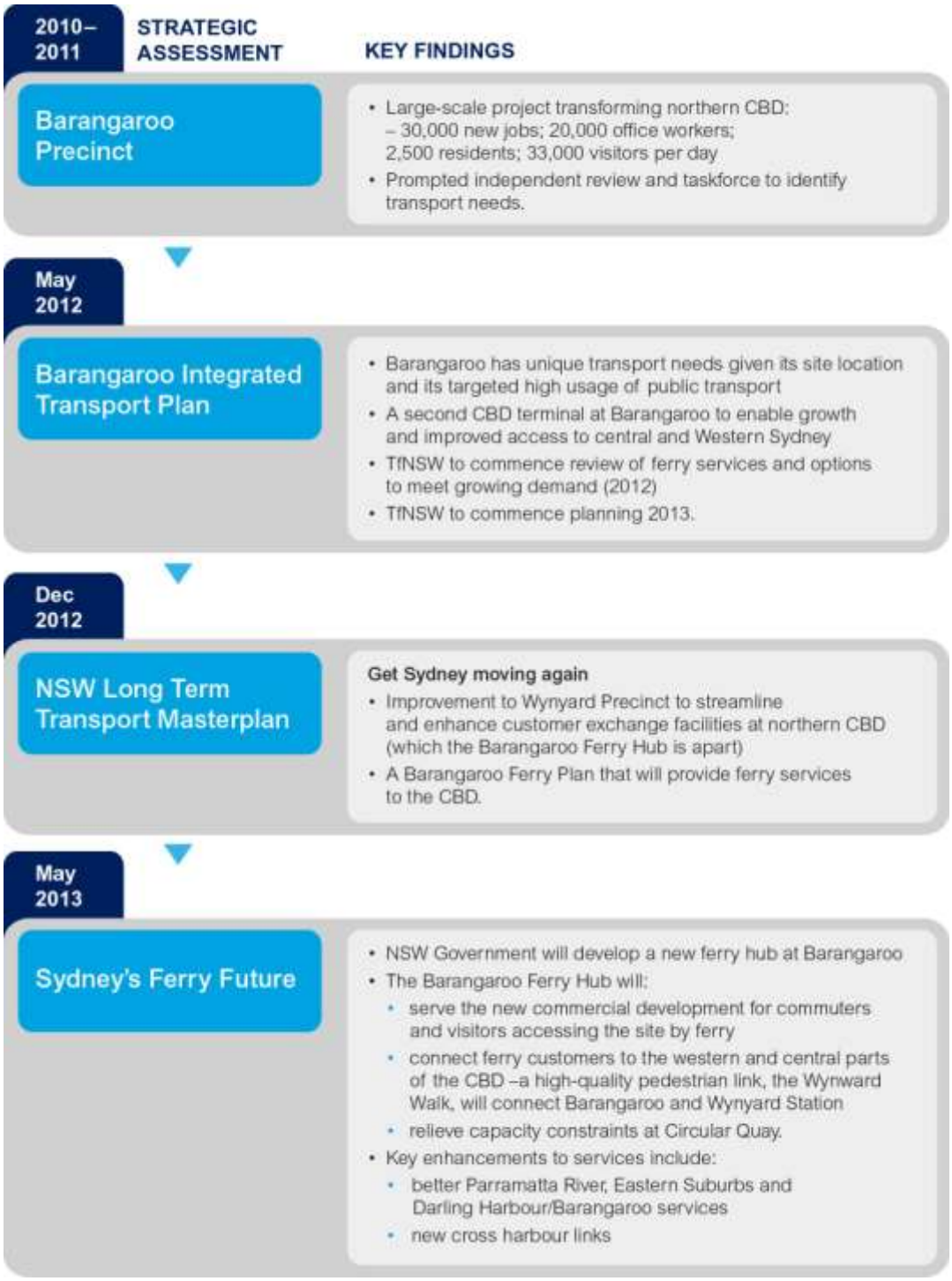
From the findings of the Barangaroo Transport Taskforce, the *Barangaroo Integrated Transport Plan* (TfNSW, 2012a) was released in 2012. This plan considers the short and longer term transport requirements for Barangaroo within the context of the forecast demand for transport in the northern CBD.

There is a commitment within the LTTMP to develop a Barangaroo Ferry Plan that will improve ferry services to the CBD. This commitment is re-enforced within the *Sydney's Ferry Future* (TfNSW, 2013a) document launched in May 2013. The commitment made in *Sydney's Ferry Future* is to develop a new ferry hub at Barangaroo to:

- Serve the new commercial development at this site with plans for a significant proportion of commuters and visitors to access the site by ferry
- Connect ferry customers to the western and central parts of the CBD – a high quality pedestrian link, Wynyard Walk, will connect Barangaroo and Wynyard
- Relieve capacity constraints at the Circular Quay ferry terminal.

The key finding from *Sydney's Ferry Future* was for TfNSW to determine operational and customer requirements of the new ferry hub over the coming years.

Figure 3-4 Summary of strategic assessment



### 3.3.3 Options identification and assessment

#### Options identification

Following the strategic assessment of the need for a ferry hub at Barangaroo, TfNSW undertook an options identification and assessment (stage two). Stage two involved identifying potential ferry wharf improvements including the base case or 'do nothing' option and the development and operation of a ferry hub at Barangaroo (the proposal). A wide range of options were identified and assessed by TfNSW and a short list of the most highly ranked options were selected for further detailed analysis.

#### Options identification

The short-listed options evaluated in detail by TfNSW are outlined in Table 3-6.

Table 3-6 Options considered for the proposal

| Option reference | Options description |
|---|---|
| Option A | Option A is the base case as it describes the 'do nothing' option where ferry services continue to operate using the existing King Street Ferry Wharf. It includes the potential for the Aquarium wharf to be used for any timetable 'overflow' (for example where there are increased services during events). |
| Option B | Option B is a short to medium term measure whereby the existing facilities at King Street Ferry Wharf would be supplemented by the construction and operation of an additional ferry wharf at Barangaroo.<br>This option anticipates that the King Street Ferry Wharf would cater for the Parramatta River services while the additional wharf at Barangaroo would service the Darling Harbour route. |
| Option C | Option C (the proposal) involves both short term and long term measures. In the short term two ferry wharves would be constructed at Barangaroo to address immediate and forecast demand generated largely as a result of the Barangaroo precinct. In the long term, and when demand within the targeted transport corridors, such as Parramatta River necessitates, a third wharf would be constructed and operated at Barangaroo. This option, in both the short and long term, would also provide greater flexibility to address capacity constraints at Circular Quay. |

#### Assessment of options

The options to improve the Sydney ferry services outlined above were assessed against key considerations, including:

- Alignment with the findings of the strategic assessment (Stage one above)
- Effectiveness in servicing the public transport demands arising from the predicted growth in commercial development, employment and housing across key centres within Sydney
- Opportunities to provide enhanced customer experience.

The findings of this assessment are summarised in Table 3-7 below.

Table 3-7 Assessment of options

| Option | Assessment |
|---|---|
| A (base case) | The base case or 'do nothing' option fails to respond to the findings of the LTTMP, the *Barangaroo Integrated Transport Plan*, and *Sydney's Ferry Future* as it would not improve access to ferry services at the Barangaroo precinct nor would it provide a second CBD terminal for the Sydney ferry network. The base case option would also not provide the required network and operator flexibility to respond to the predicted levels of growth in ferry patronage as a result of the future growth expected in employment and housing along key transport corridors such as Parramatta.<br>As a result of the predicted growth in ferry patronage along corridors such as the Parramatta River, ferry network improvements are required to relieve capacity constraints at Circular Quay. Option A would not address this requirement.<br>Furthermore, Option A would not provide any improvements to the customer experience from the current level of service. Option A would result in longer waiting times at wharves and increased over crowding during events. |
| B | Option B would provide short to medium term improvements to ferry services by adding a single wharf at Barangaroo. Although this option would provide an additional ferry wharf, it would not fully address the key findings of the strategic assessment (Stage one) as a single wharf would not fully service the projected increased demand for ferry services. Patronage for both leisure use and commuter access is currently growing at the King Street Ferry Wharf and Circular Quay has limited wharf capacity for vessels in peak periods (TfNSW, 2013a)). A ferry patronage survey (2014) estimated 650 passengers boarding and alighting ferry services at King Street Ferry Wharf during the weekday morning (AM) peak period. The current facilities at King Street Wharf are close to capacity to accommodate this level of patronage. A ferry hub at Barangaroo would relieve some of the existing capacity constraints and would facilitate the expected increase in ferry patronage, as outlined below.<br>Based on ferry patronage survey results for King Street Ferry Wharf (650) there is expected to be a substantial growth in demand by 2016 (year of opening) with a projected patronage of around 3,000 in the weekday morning (AM) peak period.<br>This option would also not offer the full integration of the ferry hub with the Wynyard precinct development, nor would it address the deficiencies of the existing King Street Ferry Wharf, particularly the lack of suitable disabled access.<br>While it is unlikely that the increase in capacity provided by Option B would meet the predicted growth in ferry patronage and demand, it would address some of the service constraints that have arisen from recent growth and it would offer some improvements to the customer experience as a result of increased ferry capacity and services. At present King Street Ferry Wharf is supporting ferry services, however would have future capacity issues for year of opening 2016, together with the need for ongoing maintenance given the age of the wharf, which means future reliance on King Street Ferry Wharf for public ferry services is undesirable. |
| C | Option C aligns most favourably with the key findings of the strategic assessment, in particular *Sydney's Ferry Future* in which the NSW Government has committed to provide a ferry hub at Barangaroo, to service the Barangaroo precinct, improve services to central and western parts of the CBD and relieve capacity constraints at Circular Quay. This option would also enable Sydney's ferry services to respond to predicted growth over time (by including future provision of a third wharf as demand necessitates), while giving operators improved flexibility with regard to scheduling of ferry services and managing wider network constraints.<br>Option C would enhance the customer experience by offering new ferry services to and from Barangaroo (and hence central and western parts of the CBD), a new facility with improved amenity including greater ticketing convenience, improved wayfinding and accessibility, direct access via Wynyard Walk to Wynyard station and city buses and the opportunity for integrated timetabling across these modes (ferries, trains and buses). |

Based on the assessment above, Option C was selected as the preferred option for further refinement.

### 3.3.4 Proposal definition

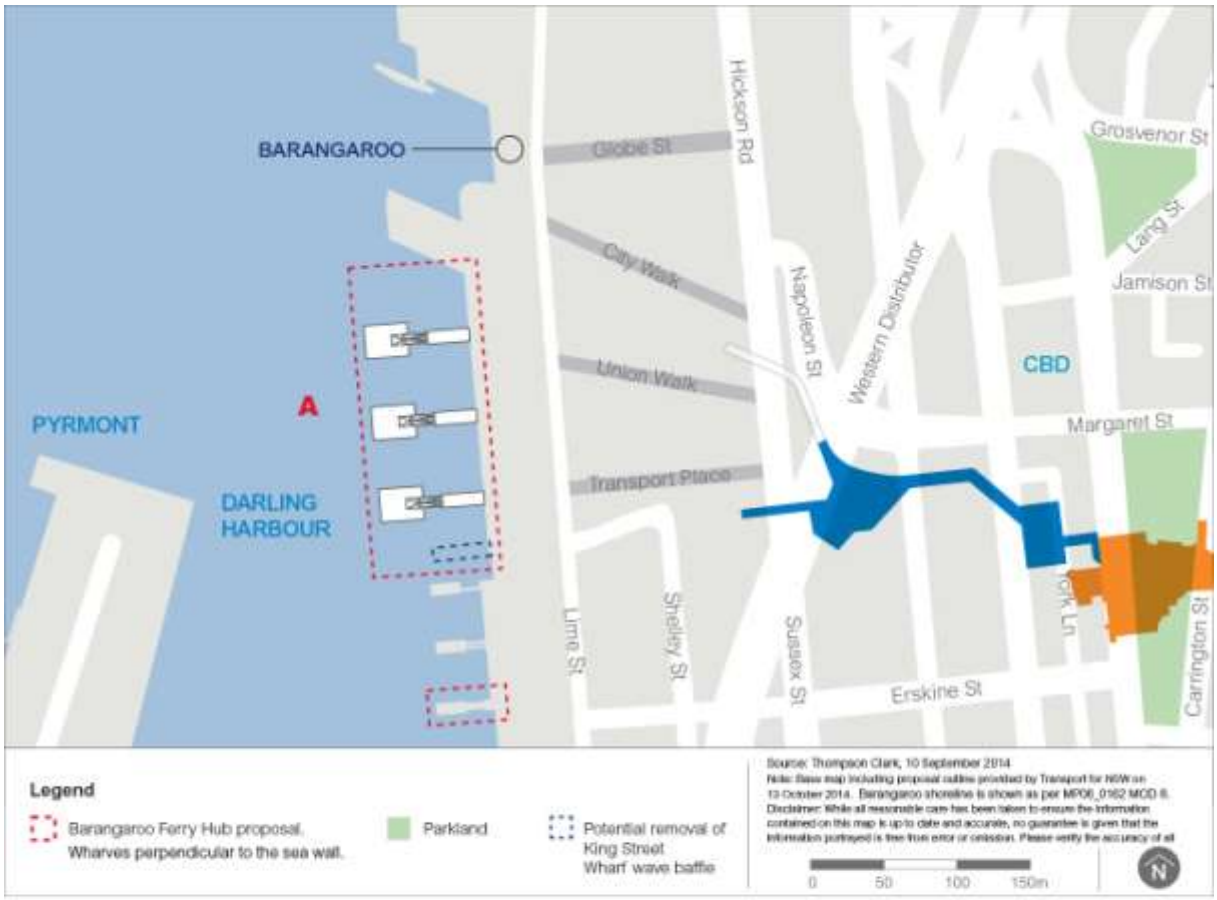
Option C, the preferred option, was further assessed against design and operational considerations in order to further define the proposal. Key aspects of the proposal considered as part of proposal definition were wharf alignment, vessel manoeuvrability and navigational safety, and the inclusion of berthing, layover and pump-out facilities within the proposal.

#### Alignment options

Two potential alignments for the new wharves were considered as shown in Figure 3-5.

- Alignment A – this option provides for the new wharves to be constructed perpendicular to the sea wall.
- Alignment B – this option provides for the new wharves to be constructed at an angle to the sea wall at a north-west slanted orientation of between 30 – 40 degrees.

## Figure 3-5 Alignment options for new wharves



### Assessment considerations

The above design options were assessed against a set of considerations related to navigational safety. These included:

- Ease of manoeuvrability and berthing
- Channel width
- Number of berths
- Impact on navigation of other vessels
- Lines of approach.

### Assessment of alignment

An assessment of option C in terms of the navigational and safety considerations listed above is provided in Table 3-8 below. The assessment is based on the findings from a navigations issues workshop held by TfNSW in June 2012. In summary, it was considered that alignment B would provide for a higher degree of navigational safety in the Darling Harbour waterway.

Table 3-8 Options assessment against navigation safety considerations

| Consideration | Comments |
|---|---|
| Ease of manoeuvrability and berthing | Wharves perpendicular to the sea wall would require ferries to alter their course to port through 90 degrees while wharves angled to the north-west provide an orientation which limits the degree to which the vessel must turn to port (Roads and Maritime, 2012). Therefore, alignment B would reduce the extent of ferry manoeuvring required on arrival at and departure from the ferry hub. |
| Channel width | Channel width is defined by the distance between the eastern most point of Pyrmont and the western most end of the new Barangaroo wharves. The current channel width is about 130 metres. The optimum solution for navigational safety is to maximise the available channel width at all times and maintain the existing width of 130 metres where possible. The length of the wharves and the angle to the sea wall would impact on the channel width (Roads and Maritime, 2012). Alignment B would allow for a larger channel width. |
| Number of berths | The greater the angle of the wharf to the perpendicular, the longer the transition zone and the more berthing and layover space available (Roads and Maritime, 2012). A perpendicular wharf, as in alignment A, would potentially provide more space for layover berths (depending on the wharf length). |
| Impact on navigation of other vessels | The manoeuvring zones for vessels operating from perpendicular wharves would require more space within the Darling Harbour channel. Whereas vessels operating from north-west slanted wharves would only need to access the eastern side of the channel (Roads and Maritime, 2012). Therefore, alignment B would provide for better coordination of vessel traffic in the Darling Harbour waterway. |
| Lines of approach | Lines of approach concern the direction and angle at which ferries approach and depart the wharves and the side of the vessel (port or starboard) that makes fast to the wharf to enable passengers to embark and disembark (Roads and Maritime, 2012). Wharves slanted at an angle to the sea wall in a north-westerly direction, as in alignment B, would enable ferries departing Barangaroo to join the lane of traffic at a smaller angle than wharves aligned perpendicular to the seawall. |

### Provisions of ancillary operational facilities (berthing, layover and pump-out facilities)

The development and use of a new ferry hub at Barangaroo presents opportunities for the provision of ancillary facilities such as berthing, layover and vessel waste pump-out facilities. The existing ferry layover facilities at Circular Quay and Balmain do not have sufficient capacity to effectively accommodate future fleet numbers and as a result the option of including these facilities at Barangaroo Ferry Hub was considered. To include these facilities at Barangaroo would require additional infrastructure such as secure access and vessel waste pump-out facilities.

### Berthing and layover

The Sydney Ferries fleet consists of 31 vessels. *Sydney's Ferry Future* plans for modernisation and expansion of the ferry fleet, which would increase the need for berthing capacity (including layover capacity).

Based on the proposal to initially construct two wharves at Barangaroo there may be an opportunity for layover facilities to be provided for up to four vessels per wharf, depending on timetabling of services. If berths at Barangaroo are offered for layover of vessels, the following facilities would need to be accommodated within the design of the wharves:

- Potable water
- Power
- Fire suppression
- Vessel waste pump-out
- Vessel waste bins.

### Pump-out facilities

Should berths at Barangaroo be used for layover of vessels, waste pump-out facilities would be required. The additional infrastructure required to support pump-out of vessel wastes was identified as including:

- Pumps and filters
- Pipes, reels and valves
- Electrical and control facilities
- Additional security such as CCTV.

### Assessment of inclusion of ancillary facilities (berthing, layover and waste pump-out)

The main benefit of berthing and layover facilities is to reduce time spent re-positioning vessels to commence services or to complete services (this is known as 'dead running'). Layover facilities in close proximity to services offer customer and operational benefits to on-time running and vessel availability. From a network and operator perspective, the current layover capacity (at Circular Quay and Balmain Shipyards) is limited and additional facilities are required. In consideration of the benefits of providing this facility at Barangaroo the main advantage would be the close location of the proposed Barangaroo Ferry Hub to key service routes and to Circular Quay, allowing time and cost efficiencies to be better realised. On this basis layover facilities at the proposed Barangaroo Ferry Hub have been included in the scope of the proposal (refer Chapter 4).

All vessels in operation have restroom facilities with waste holding tank capacities of 550 to 1000 litres. Pump-out of waste holding tanks to land based receival facilities is required daily and this is generally undertaken while vessels are in layover. However, during periods of heavy passenger demand, pumping out may need to occur while vessels are in service. If pump-out receival facilities were not provided at the proposed Barangaroo Ferry Hub, vessels could use the existing pump-out facility at White Bay. However, this would increase vessel 'dead running' with reduced operational efficiencies moving to and from

layover facilities to White Bay. In assessing the merits of providing pump-out facilities at the proposed Barangaroo Ferry Hub, the main advantage would be the reduced 'dead running' of vessels either during service or when out of service. The main disadvantage is the marginal increase in project cost to include the necessary infrastructure for the pump-out facilities and potential amenity impacts at Barangaroo. On balance, the network and operational flexibility offered by including pump-out facilities at the proposed Barangaroo Ferry Hub outweighed any disadvantages and pump-out facilities have therefore been included in the scope of the proposal (refer Chapter 4). It is noted that potential environmental/amenity impacts associated with the proposed pump-out facilities are assessed at Sections 6.4.3 and 6.9.2.

### 3.3.5 Preferred option

The preferred option, as a result of the options assessment process described above, comprises the following:

- Construction and operation of three new ferry wharves at Barangaroo (Option C) –with two wharves to be constructed initially and the third wharf being constructed when demand necessitates.
- Construction of the wharves at a north-west slanted orientation (Alignment B)
- Provision of layover and vessel waste pump-out facilities at the Barangaroo Ferry Hub.

Specific design details were evaluated during design development including the construction methodology for the southern most wharf which straddles the CBD Metro Tunnel alignment, desired pontoon size, design of roof structures and provision of facilities such as wayfinding and ticket vending machines.

The proposal is further described in Section 4.1.

#### Key benefits

The proposal is expected to deliver the following key benefits:

- Accessibility benefits – improvements in access for passengers with a disability as well as direct access to the Barangaroo precinct and connection to the western and central parts of the CBD.
- Customer benefits – improved and more reliable journeys for public transport users, including through the provision of new facilities with better ticketing and wayfinding signage.
- Operating benefits – improving the resilience of ferry services for special events or maintenance activities.

These are discussed further in the sections below.

#### Accessibility benefits

By introducing an accessible transport mode to the area, the Barangaroo Ferry Hub proposal would serve a significant proportion of commuters and visitors to the Barangaroo precinct. It would also attract customers from existing modes of travel by providing improved access to the western and central parts of the CBD, including for passengers with a disability.

The integration of the proposed Barangaroo Ferry Hub would respond directly to customer needs linking with accessible connections to existing bus and rail transport modes, including Wynyard Walk, and would create a more efficient operating environment for public transport users travelling into the Sydney CBD.

### Customer benefits

The Barangaroo Ferry Hub proposal would provide a direct and efficient service for commuters travelling to the Barangaroo precinct and western and central parts of the CBD from residential areas along the Parramatta River corridor and inner harbour. It would more than double the capacity of the existing King Street Ferry Wharf and would provide much better facilities in terms of ticketing facilities, wayfinding signage and access for disabled passengers.

### Operating benefits

The integration of the Barangaroo Ferry Hub proposal with the existing ferry network, including routes from the Lower North Shore and residential areas along the Parramatta River would create additional network capacity for existing and future commuters and visitors travelling into the Sydney CBD, including during special events. Additional operating benefits associated with the proposal include reduced operating hours for vessels due to the provision of facilities to enable minor maintenance and vessel waste disposal to occur at the Hub.

### Broader community benefits

The proposal provides new ferry infrastructure that meets the substantial projected growth in ferry patronage in 2026 (refer Section 3.2.2).

By providing additional efficient public transport options for commuters travelling to Barangaroo and the Sydney CBD, the proposal would help to reduce the use of private vehicles which contribute to air and noise pollution.

Similarly the Barangaroo Ferry Hub proposal would also assist in generating health benefits due to an expected net increase in active transport modes (e.g. walking) between the Ferry Hub and the western and central parts of the CBD (via Wynyard Walk).

# 4 Description of the proposal

This chapter describes the Barangaroo Ferry Hub proposal and outlines the key activities expected to occur during the construction phase and operation of the Barangaroo Ferry Hub. The construction methodology described in the following sections is indicative only and may change as a result of design development. Detailed construction environmental management plans (CEMPs) would be prepared by the contractor(s) prior to commencement to manage potential adverse construction impacts (as discussed in Chapter 7).

The proposal is illustrated within the architectural drawing package accompanying this EIS. The drawings detail the proposal and its physical interface at the edge of the Barangaroo foreshore. Beyond this, the Barangaroo precinct, including the adjacent Barangaroo foreshore and Barangaroo South, is under development and as such, subject to change. Therefore information such as detail of the buildings, structures and landscaping proposed at Barangaroo should be sourced from the DP&E.

Table 4-1 lists the Secretary's environmental assessment requirements relevant to the description of the proposal and where they are addressed in this section.

Table 4-1 Secretary's environmental assessment requirements relevant to the description of the proposal

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Design and Justification | Details on the proposed design of all structures, including construction plans and drawings and methods of construction. | Section 4.2 and Appendices B, C and D |
| Design and Justification | The adequacy of wharf design in accordance with any relevant Australian Standards, industry best practice policies and guidelines. | Section 4.3 |
| Design and Justification | Design quality with specific consideration to the footprint, proposed materials and colours, waterfront interface (e.g. edge treatments and apron sizing), reflectivity, infrastructure impacts (e.g. harbour heat rejection plant), setbacks and tidal and wave action impacts. | Sections 4.2, 4.36.4 and 6.9 and Appendices B, C and D |
| Infrastructure and Servicing | Identify and provide for appropriate servicing of the site. | Section 4.2 and Appendix B |
| Infrastructure and Servicing | Detail of appropriate easements to allow access to and maintenance of infrastructure services for the ferry terminal that are not on land owned by Roads and Maritime Services. | Section 4.2 |
| Staging | Details regarding the staging of the proposal development. | Section 4.2 |
| Lighting and Signage | The EIS shall include details of all signage proposed including identification signs, wharf numbering, wayfinding signage etc. | Section 4.2 and Appendics C and D |

## 4.1 Overview

The proposal, as shown in Figure 4-1 and Figure 4-2, comprises the construction and operation of a ferry hub and would include:

- Establishment of a construction work area and a temporary construction compound
- Construction of three new ferry wharves (two wharves would be constructed initially with the third wharf being constructed when demand necessitates) and ancillary landside facilities
- Potential demolition of the King Street Wharf wave baffle
- Site clean-up and opening of the new wharves
- Operation of three wharves including ferry layover, pump-out facilities and minor maintenance activities
- Decommissioning and removal of the public transport elements of King Street Ferry Wharf such as ticket vending machines and signage
- Landside ancillary facilities included as part of the proposal would comprise wayfinding signage and ticketing including Opal card facilities.

Initially two wharves would be constructed. The third wharf would be constructed in the future when the demand for ferry services necessitates.

Ancillary landside facilities included as part of the proposal would include wayfinding signage, ticketing including Opal card facilities and bicycle racks.

Barangaroo approval Concept Design Modification 4 (MP06_162 (MOD 4)) has made provision for about 300 square metres of transport related office space. This space is to be delivered by BDA and/or Lend Lease, and therefore does not form part of the proposal.

Telecommunications, electricity, water and sewerage would be available at the foreshore edge. This would also be constructed by Lend Lease as part of Barangaroo South. The proposal includes connection into the landside service infrastructure.

It is anticipated that each wharf would be self-supporting and would comprise:

- A prefabricated steel covered pontoon about 38 metres long and 22 metres wide, which includes:
  - two berthing faces on each pontoon
  - ancillary facilities on each wharf to provide for passenger safety, comfort and security and to display ferry service information
  - a roof structure which incorporates a glazed rooflight, with a ceiling height of about 3.5 metres above the pontoon surface and 4.5 metres above sea level and an overall roof height of up to about 6.5 metres above sea level.
- A fixed covered link structure between the gangway and the land (comprising two ramps and a landing) up to about 30 metres long, between about 13 metres to 37 metres wide. The link structure would be level with the built quay line (+RL 2.9 metres at northern wharf and +RL 2.5 metres at southern wharf) and ramps down to around +RL 1.9 metres for each wharf

- A prefabricated aluminium gangway about 15 metres long and 10 metres wide between the link structure and the pontoon
- Crew access to vessels in layover on both sides of each wharf
- Ticket barriers, wayfinding signage (as indicated at Appendix D), public announcement system (PA system) and Opal ticketing infrastructure (as indicated at Appendix D)
- About 30 piles per wharf (including steel pontoon restraint piles, steel support piles, crash barrier piles and fender piles)
- Ferry crash barrier comprising cross beam attached to the crash barrier piles. On the southern side this would be installed adjacent to the sea wall, on the northern side this would be in front of the link structure
- Connection of power, telecommunication and data communications and potable water services (including fire hydrant services)
- A sewage pump-out facility comprising pump, filters, reels, valves, electrical and control facilities. It is anticipated that the pump-out facilities would be located in an enclosed space on the link structure and be about 3 metres by 2 metres by 1.5 metres in size
- A small gateline ‘kiosk’ (office) would also be located on the link structure for staff activities (no ticket sales), as well as a bin storage space.

Design elements including surface treatments and transition features would be designed to be compatible with Barangaroo South.

## Figure 4-1 Key proposal features

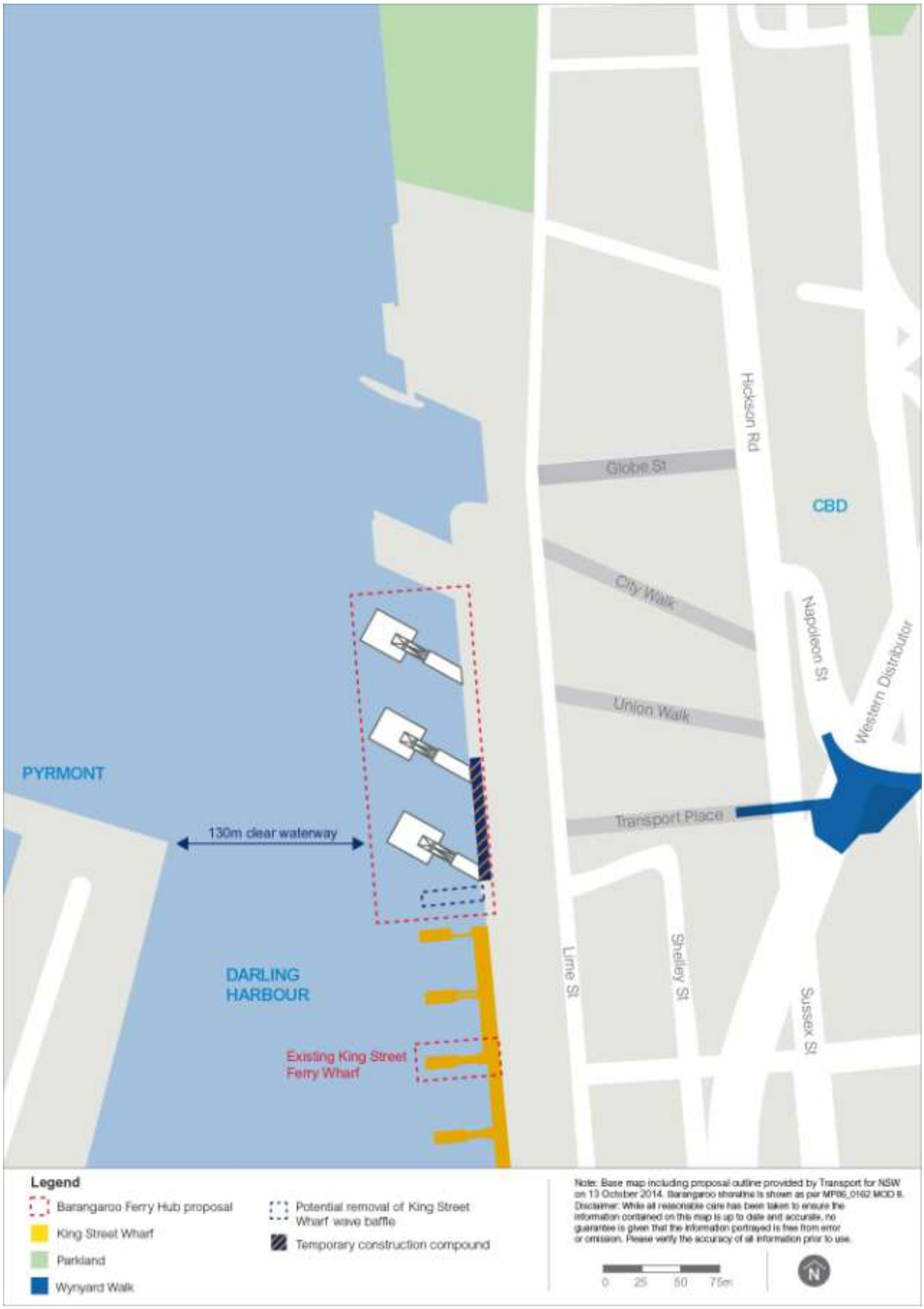
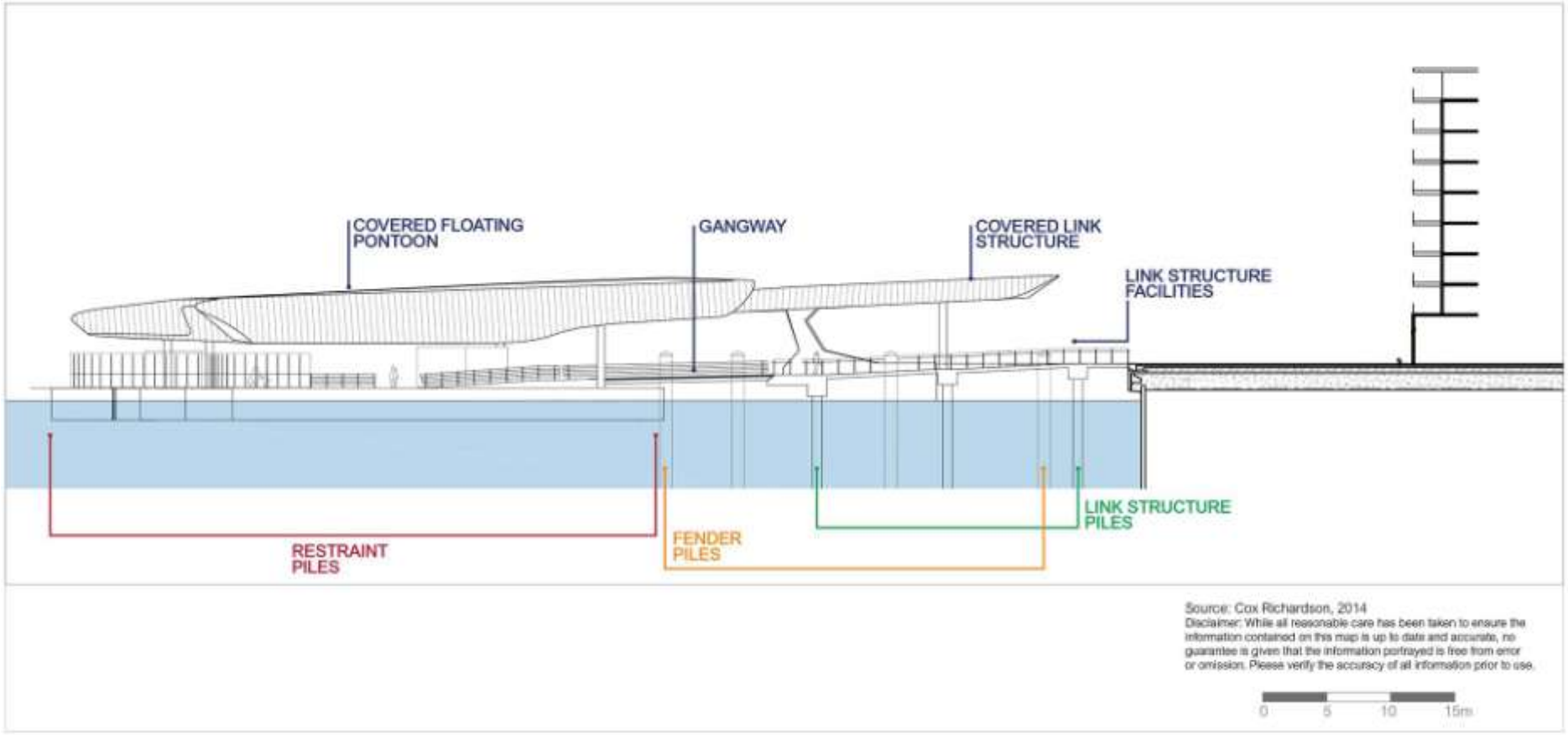


Figure 4-2 Detailed cross section of proposal



## 4.2 Scope of works

The scope of works for the proposal would include construction and operation of the Barangaroo Ferry Hub and ancillary facilities and activities as described in this section.

### 4.2.1 Construction

#### Construction program

It is anticipated that it would take about 14 months to construct the first two wharves, including the ancillary landside facilities. The construction of the third wharf would take up to 12 months to construct when demand necessitates.

#### Staging and key activities

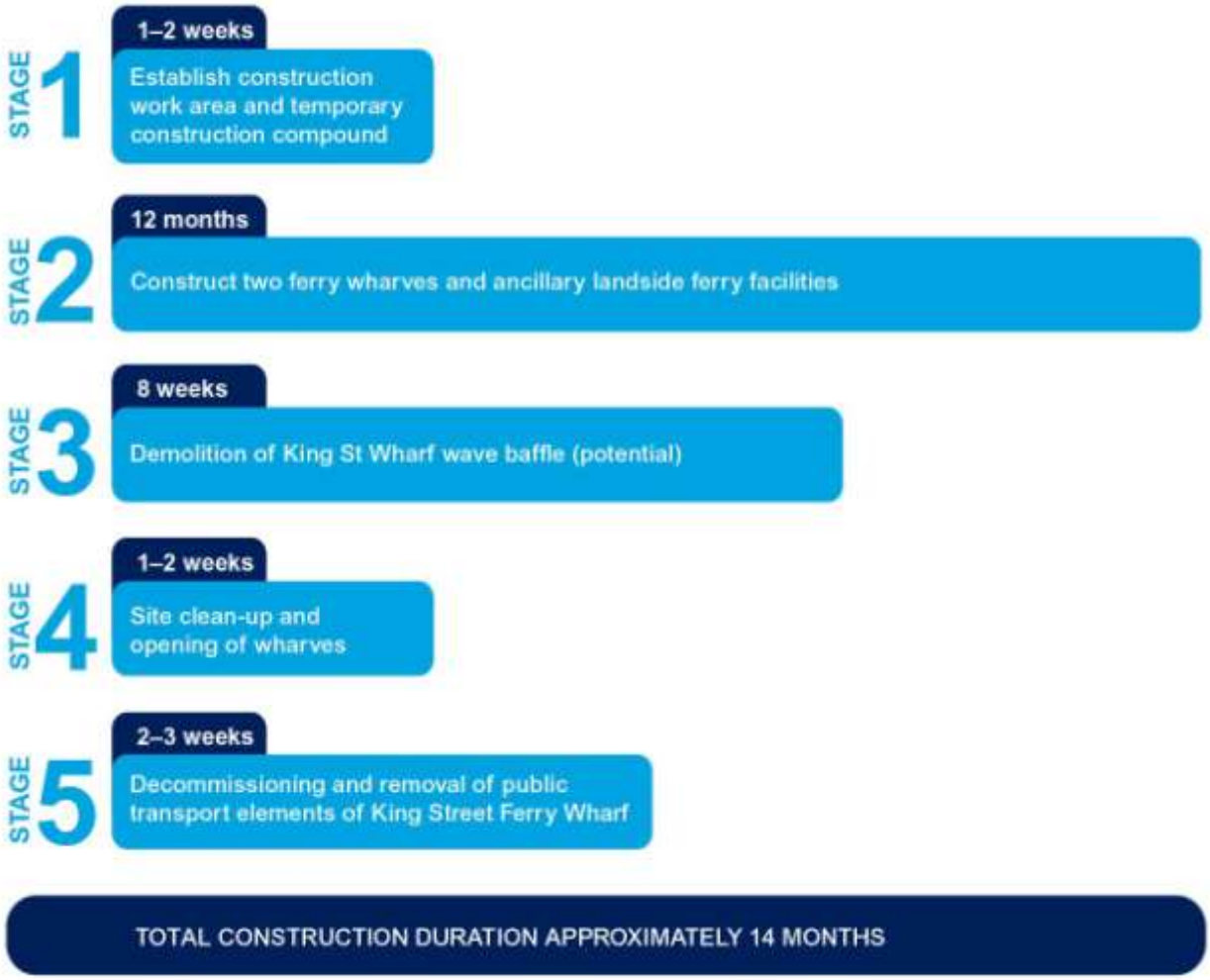
It is anticipated that the main construction activities would be undertaken in five stages, as shown in Table 4-2 and Figure 4-3. The proposed staging is based on the current preliminary design and may change once the detailed design methodology is finalised.

Table 4-2 Construction staging and key activities

| Stage | Works | Key activities |
|---|---|---|
| 1 | Establish construction work area and temporary construction compound | • Installation of silt curtains around the perimeter of the site within the waterway<br>• Installation of a temporary construction compound along the foreshore at the location of the proposed wharves. |
| 2 | Construct the initial two new ferry wharves and ancillary landside facilities | • Installation of piles<br>• Construction of link structure<br>• Installation of pontoon, gangway (constructed off-site)<br>• Construction of ancillary facilities. |
| 3 | Demolition of King Street Wharf wave baffle (potential) | • Demolition of the King Street Wharf wave baffle with all materials taken to an off-site facility by barge. |
| 4 | Site clean-up and opening of wharves | • Clean-up of the site to its intended state<br>• Removal of all construction fencing, hoarding, silt curtain and signage. |
| 5 | Decommissioning and removal of public transport elements of King Street Ferry Wharf | • Removal of all ferry related infrastructure from King Street Ferry Wharf. |

When demand necessitates, the third ferry wharf would be constructed. This would involve a repetition of Stages 1, 2 and 4 above.

Figure 4-3 Indicative construction timeline for the initial two wharves




## Work methodology

*Establishment of a construction work area and temporary construction compound*

The construction work area would be established by installing hoarding along the foreshore at the location of the proposed wharves, erecting construction signage identifying the work area, and installing silt curtains around the perimeter of the site within the waterway. Silt curtains would contain any accidental spills, as well as the potential disturbance of harbour sediments from construction and demolition activities such as vessels manoeuvring and piling.

It is anticipated that the temporary construction compound within the work area would be located on the Barangaroo foreshore and adjacent to the location of the Barangaroo Ferry Hub proposal (refer to Figure 4-1). The temporary construction compound would measure about six metres wide and 70 metres long (420 square metres in area). Depending on Barangaroo South construction activities and hoarding locations, access along the Barangaroo foreshore may be reduced to about 12 metres in width due to the location of the temporary construction compound. This would provide ample space for pedestrians to pass through the area. Pedestrian detours are unlikely to be required during the construction of the proposal as site clean-up would be within the proposal area and the installation of ancillary landside facilities would be isolated.

The establishment of the temporary construction compound would involve the installation of relocatable site sheds, temporary toilets and bunding to prevent accidental spills entering the waterway. Construction equipment (e.g. construction materials and tool boxes) would be stored within the compound. Based on similar projects within Sydney Harbour, the size of the temporary construction compound would be sufficient for these items. The indicative location would be within the area shown at Figure 4-1. The final position and layout would be subject to detailed design.

The majority of construction plant, equipment, materials and personnel would access the construction work area via Sydney Harbour, including components fabricated off-site (including pontoons, gangways and roofs), being transported by boat and/or barge from the construction contractor's main off-site facilities to the proposal area.

A 130 metre wide navigation channel would be maintained throughout the works wherever possible to minimise disturbance to vessel movements and safety of vessels travelling to and from Darling Harbour during construction. There may be instances where some movement of plant occurs within the navigation channel such as during the positioning of construction barge(s) and when barge equipment needs to be moored in close proximity to the work area. Any encroachment into the navigation area would be for short periods of time and would be managed in accordance with the Harbour Master (Port Authority of NSW) requirements.

### *Construction of new ferry wharves and ancillary landside facilities*

For each wharf, the majority of the components such as the piles, pontoon and gangway would be fabricated off-site and transported to the construction site via barges. These components would generally arrive at the site at the time of installation. In-situ work and pre-cast components would be required for the link structure.

The piles for each wharf would be installed using a combination of screwing, vibrating and hammering techniques from a barge using a crane with a piling rig attachment. It is not anticipated that piling works would happen concurrently. Once the piles are installed and concrete filled by concrete trucks, precast concrete beams would be installed. Concrete would then be poured in-situ to form the suspended link structure slab.

Intricate lifting and placement of components of each wharf would be carried out using a barge mounted crane. This method would be used to install the gangway and pontoon components. It is anticipated that specific components of work for each wharf may need to be undertaken out-of-hours (i.e. during the evening and night time periods). Piling and intricate lifts typically need to be undertaken during calm environmental conditions (e.g. still water and minimal wind) to enable accurate pile installation. Calm conditions are also required to provide safe conditions for the construction crew. Out-of-hours activities, if required, would be expected to take up to two months in total during the early stages of construction.

Further detail on these activities is provided below:

### *Installation of piles*

About 30 piles (including steel pontoon restraint piles, steel support piles, crash barrier piles and fender piles) would be installed into bedrock for each wharf. These piles would be transported by barge to the site from the off-site facility.

Constructing pile foundation systems in bedrock consists of three components:

- Phase 1 Pitching, vibrating and drilling piles into sediment and rock during calm water conditions
- Phase 2 Hammering piles to refusal during calm water conditions
- Phase 3 Cutting, levelling and plugging of piles with concrete.

As noted above, Phase 1 and Phase 2 require calm water conditions so that the floating barge used for the piling can remain still for the piles to be installed accurately and to also provide safe conditions for the construction crew. The waterway is usually calmer during the night and early morning with wind and wind chop increasing throughout the day. Accordingly, the conditions required for piling usually occur during the night and early morning. As such, the proposal may require night works over about two months to complete the installation of piles. This timeframe provides some allowance for construction to be programmed to minimise the number of consecutive nights that impact on the same receptors and unfavourable conditions from weather, seas, swell, wind, and boat wash.

#### *Phase 1*

Each pile would be lifted from the barge and put into place (pitching) using a barge mounted crane, taking up to three hours. A vibrating hammer attached to the crane would be used to stabilise the pile within the sediment layer prior to drilling, taking around one hour.

Drilling into sediment and rock would take about three hours per pile plus setup time and pack up time (with continuous noise from the diesel generator and large electric motors only occurring during drilling of the pile). A barge mounted crane with a pile drill would screw the pile into the bedrock to a depth of up to about three metres.

#### *Phase 2*

The piles would be hammered to refusal using the barge mounted crane with a piling hammer attachment and pile helmet fitting. Hammering of piles would take place at least one day after the drilling of piles. It is anticipated that each pile would be hammered for about one minute (about 10 hits with the hammer within one minute). For each pile this activity is likely to occur five times over a period of one hour. There are about 30 piles to be hammered for each wharf.

#### *Phase 3*

About one third of the steel piles would be filled with concrete. Large structural piles would require concreting and different finishing. Some smaller piles would be cut to level and have caps installed. The method applied to each pile would be decided during detailed construction planning.

### Construction of pontoon, gangway and ancillary facilities for each wharf

Following the completion of piling activities, the link structure and gangway would be constructed. Most of the structure (e.g. beams, headstocks, gangway and roofs) would be pre-fabricated/pre-cast then transported to site from the off-site facility. Temporary walkways would be installed down each side of the structure. For each wharf, in-situ works would include concrete pours (involving about 48 concrete trucks per wharf) to construct the link structure and to fill the piles. Concrete would be transported to site either by land or the harbour depending on construction planning.

Intricate lifting and placement of components of the new wharf such as the gangway and roofs would be carried out using a barge mounted crane. This activity needs to be undertaken during calm environmental conditions (i.e. still water and minimal wind). Intricate lifts and placement can take up to about six hours per gangway and up to about four days per roof. For lifting and placement to be completed while the environmental conditions are appropriate, intricate lifting and placement may need to be undertaken during the night-time/early morning period between about 11 pm and 7 am.

The pontoon structures would be constructed at an off-site facility and floated into place. Prior to its placement, piles on one side would be completed. Following placement, the remaining piles would be completed. Each pontoon would be attached to its associated gangway.

Once the structural elements are in place, electrical power and communication lines, and sewer and water pipes would be installed and connected to the existing services at the land/water interface which are to be constructed by Lend Lease. Fit out of the Barangaroo Ferry Hub, including the installation of pump-out, and minor modifications to the wharves would also occur at this stage of the construction program.

Ancillary landside facilities such as Opal card ticketing facilities and wayfinding signage (as indicated at Appendix D) and bicycle racks would also be installed at this stage. This involves installation of ticket machines, customer information facilities and signage. TfNSW would be aiming to provide for a minimum of 20 bicycle rack spaces (10 Urails) near the interchange entrance for ferry customers. These may be provided along the promenade and would be designed and located to integrate with the other street furniture (trees, rubbish bins and benches) to be developed by Lend Lease. Final bicycle rack numbers, design and location would be subject to discussions with BDA/Lend Lease.

It is expected that the fit out of the Barangaroo Ferry Hub and the installation of the landside facilities would take up to about two months.

### Potential demolition of King Street Wharf wave baffle

The King Street Wharf wave baffle is a Roads and Maritime asset. The potential demolition of the wave baffle is being discussed with Roads and Maritime. If the demolition of the wave baffle proceeds, it would make available additional space to enable full utilisation of the southern berthing face of the southernmost wharf.

The King Street Wharf wave baffle is irregular in shape and about 40 metres long, eight metres wide at the eastern end and six metres wide at the western end. It is comprised of a timber deck supported by timber girders, steel wash barrier substructure and about 26 concrete piles, 25 timber fender piles and a single steel pile at the western end of the jetty.

If demolished, the following works would be involved:

- Removal of all timber decking, supporting timber girders, underlying wash barrier steel substructure using hand tools and barge mounted crane. It expected that this phase of demolition would take up to about one month.
- Removal of the piles using a vibratory hammer to extract the piles. The hammer would be placed over the pile using a barge mounted crane. If the pile is unable to be pulled out, it would be cut level to the harbour bed to remain in situ. Divers would cut the pile at seabed level using appropriate underwater equipment. It expected that this phase of demolition would take up to about one month.
- Moving all of the materials to the off-site facility by barge.

The components of the wave baffle would be reused, where possible, or eventually be removed to a licensed waste management facility for recycling or disposal.

### Site clean-up and commissioning of the new wharves

The site would be cleaned up and brought to its intended state. Controls and temporary structures would be removed in order to open the wharves for operation. A safety assessment of the structure would be carried out to identify any risks and rectify any safety hazards resulting from the construction before opening areas to the public.

Following the removal of construction controls and site clean-up the wharves would be commissioned for operation, which is expected to take about two weeks to complete. Minor adjustments may occur at this time.

### Decommissioning and removal of the public transport elements of King Street Ferry Wharf

The existing King Street Ferry Wharf services would be relocated to the Barangaroo Ferry Hub and the public transport elements of King Street Ferry Wharf would be decommissioned. This would involve the removal of components such as ticket vending machines and signage no longer required. Where possible, these components would be reused or eventually transferred to a licensed waste management facility for recycling or disposal.

### Resources and materials

The selection of appropriate materials to the usage and the marine environment would underpin the design.

The proposal does not require the importation of fill material or disposal of materials from the seabed as no reclamation or filling is required.

Natural resources for construction include aggregate for use in concrete batching and sand, aggregate and select material for the production of cement and glass. Manufactured items, including steel, pre-cast components and pipes and utilities would also be required.

The in situ volume of concrete required for the link is about 140 cubic metres. The in situ volume of concrete fill required for the piles is about 100 cubic metres.

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

#### *Plant and equipment*

The equipment to be used would be confirmed during the construction planning process. Typical plant and equipment likely to be used during construction would include:

- barge
- boat
- chain saw
- compressor
- concrete pump
- concrete truck

- crane (35 tonnes, barge mounted) including use of the following attachments:
  - pile drill
  - pile hammer
  - vibratory hammer
- excavator
- generator
- hand tools
- light vehicles
- lighting tower
- small grinder and drill/power hand tools
- water pump (high pressure water).

#### *Construction workforce*

It is anticipated that the construction workforce would comprise a maximum of approximately 15 people on site at any one time. It is expected that there would be about 60 people over the duration of the construction period for the first two wharves.

### Working hours

Construction would normally be undertaken during the following recommended standard hours:

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

Some work outside of standard hours is likely to be required in order to carry out piling activities and intricate lifts from the barge mounted crane, due to these construction activities requiring still water. Activities that have the potential to be undertaken outside of standard work hours are outlined below.

#### *Intricate lifting activities*

It is anticipated that the construction of each wharf would involve two lifts per wharf (for the gangway and roof) throughout the duration of the construction period.

Intricate lifting and placement of components of each new wharf would be carried out using a barge mounted crane. This activity needs to be undertaken during calm environmental conditions (still water and minimal wind), which are typically night time conditions. Intricate lifts and placement is expected to take up half a day for the gangway and about four days for the roof for each wharf.

#### *Piling activities*

Piling work is expected to take up to about two months to complete. Each pile is expected to take about eight hours to complete as shown in Table 4-3. Larger piles may take longer to complete than smaller piles.

Table 4-3 Approximate duration of piling operations for each pile

| Activity | Approximate timeframe (per pile) |
|---|---|
| Pitching | 3 hours |
| Vibrating hammer | Around five one minute periods over 1 hour |
| Drilling | 3 hours |
| Hammering | 1 hour (hydraulic) or 30 minutes (diesel) |
| Finishing – cutting, levelling, welding | 1 hour |
| Finishing – concreting | 1.5 hours |

Piling works are highly sporadic. There may be significant noise from the hammering and drilling of a pile for around 10 minutes or so and then only lower noise activities for 30 minutes or more.

Installation of the piles would require calm environmental conditions (still water and minimal wind) so that the floating barge used for the piling can remain still for the piles to be installed accurately. Calm conditions are also required to provide safe conditions for the construction crew. The waterway is usually calmer early in the morning, with wind and wind chop increasing throughout the day. Generally finishing works can be done in a wider range of conditions and would not require out of hours work.

#### *Respite nights*

Where out of hours work cannot be feasibly or reasonably avoided there would be at least two respite nights per scheduled during periods of significant construction noise (i.e. installation of piles).

### Pump-out facilities

A sewage pump-out facility would be provided at each of the new wharves to service the ferries. Each pump-out facility would comprise a direct pumping system as opposed to a pump-out collection system. Direct pumping systems are closed systems that do not emit odours and they are relatively small in size compared to other systems.

The proposed sewage pump-out facility at each wharf would include:

- A pump-out user point with a pump, filters, reels, valves, electrical and control facilities. It is anticipated that the pump-out facilities would be located in an enclosed space on the link structure with approximate dimensions of 3 metres by 2 metres by 1.5 metres high
- Hose reels on the pontoon (for connection of vessels)
- Service pipes (water and sewerage) connecting the pump-out user point to the public utility services which will be provided to the edge of the Barangaroo foreshore by Lend Lease
- Monitoring and spill prevention devices
- Direct pumping into the recycled water plant within the Barangaroo precinct.

### Public utility adjustments

Public utilities would be delivered to the edge of the Barangaroo foreshore under the public domain works for Barangaroo South (Concept Design Modification 4) including:

- Electricity (100 kilo-volt amperes)
- Telecommunications and data communications
- Water
- Sewerage.

Wharf services would connect to these utilities. It is not anticipated that any public utility adjustments would be required.

### Emergency access

Emergency access would be part of access planning during the construction phase, and would be adapted as the site and surrounding construction area changes to ensure emergency access routes are available throughout the construction period.

### Construction traffic access and vehicle movements

The majority of construction plant, equipment, materials, and personnel would access the construction work area via Sydney Harbour, being transported by boat and/or barge from the construction contractor's off-site facility.

The majority of the wharf components would be pre-fabricated and would also be transported to the site from the off-site facility via boat or barge.

The proposal would generate minor increases in water traffic during the construction period. Water-borne construction plant may also be operated and docked within the proposal area during the construction period. Non-construction related vessels may be required to take minor detours during this time.

Land access for some sub-contractors and concrete trucks travelling to and from the construction work area would be via Lime Street. It is anticipated that up to 10 construction vehicles per day would access the site (around one vehicle per hour). Construction vehicles would utilise existing loading zones located within Lime Street or surrounding streets. Concrete trucks may park within the temporary construction compound (if possible) or use pumping equipment if parking more remotely.

From the north and north-west:

- Harbour Bridge – Western Distributor – Bathurst Street – Liverpool Street – Harbour Street – Shelley Street – Erskine Street – Sussex Street (inbound)
- Hickson Road – Napoleon Street – Kent Street – Western Distributor – Harbour Bridge (outbound).

This southbound vehicle activity would occur during peak hours as there is no access for general traffic from the Harbour Bridge to York Street between 6.30 am – 9.30 am (Monday – Friday).

From the west and south-west:

- Anzac Bridge – Western Distributor – Sussex Street – Hickson Road (inbound)
- Hickson Road – Sussex Street – Western Distributor – Anzac Bridge (outbound).

From the south and east:

- Eastern Distributor – Cross City Tunnel – Western Distributor – Wattle Street – Western Distributor – Sussex Street – Hickson Road (inbound)
- Sussex Street – Harbour Street – Cross City Tunnel (outbound).

During the construction period, pedestrian access along the Barangaroo foreshore would be reduced to about 12 metres in width due to the location of the temporary construction compound. Pedestrian detours may be required at times during site establishment and site clean-up.

Construction vehicle traffic would be separated from pedestrian and bicycle routes where possible. Where this is not possible, for example during set up or removal of the temporary construction compound, traffic movements would be carried out in accordance with a traffic management plan (TMP).

Traffic and transport impact associated with the proposal are assessed in detail in Section 6.2.2 of this EIS.

### 4.2.2 Operation

The Barangaroo Ferry Hub would include three operating ferry wharves catering for most vessel classes (with the exception of the larger Manly Freshwater Ferries). Ferry services and routes expected to use Barangaroo include services travelling from eastern and lower North Shore suburbs, suburbs adjacent to the Parramatta River and the Balmain peninsula. The wharves would operate primarily for ferry services rather than commercial vessels which would continue to use King Street Wharf and other facilities.

At the year of opening (2016) of the first two wharves, the Barangaroo Ferry Hub is expected to have patronage of up to 11 vessels per hour during weekday AM peak period and 14 vessels per hour all day Saturday and Sunday. Patronage throughout is expected to increase to 15 vessels per hour for the weekday AM peak period by 2026.

Further details on the operation of the proposal are provided below.

#### Wharf operations

Roads and Maritime would be responsible for the management and maintenance of the new ferry wharves. Negotiation between TfNSW and Roads and Maritime would confirm management responsibilities of the Barangaroo Ferry Hub.

Operating hours would typically be between 5 am and 12 am Monday to Friday and between 7 am and 12 am Saturday, Sunday and public holidays.

The Barangaroo Ferry Hub may be required to operate outside of the hours detailed above during peak events such as New Years Eve, Vivid and Australia Day. The timetabling of services at the Barangaroo Ferry Hub may also require adjustment to accommodate other events that take place in the metropolitan area.

#### Manoeuvring of vessels

Figure 4-4 provides indicative vessel movements around the ferry wharves and shows the likely manoeuvring requirements for vessels arriving at and departing from the wharves. A 130 metre wide navigation channel would be maintained where possible during operation and be restricted to non-ferry related vessels to ensure safe navigation of ferries and other vessels in transit within the waterway.

The navigation and manoeuvring paths of ferries shown within the ferry manoeuvring area are indicative and would be refined once operation commences.

Currently no permanent navigation markers are proposed (temporary buoys only). The need for navigation aids is being considered by navigation safety workshops. Should longer term permanent markers need to be installed this would be subject to separate approval.

### Workforce

Each wharf would typically require two staff on an ordinary shift – one at the gateline, and one wharf hand.

There is likely to be two shifts per day to cover operational hours, plus an overnight maintenance shift.

Additional staff would be required during special events as discussed further below.

### Layover of vessels

Each wharf would support layover during both operations and overnight.

During extended layover the vessels would run on shore power. It is expected that there would be up to three vessels moored at each wharf overnight.

Layover during daytime breaks would typically be between 15 and 45 minutes depending on timetable requirements.

### Start up procedure

Vessel start-up procedures are performed by the vessel master, engineers and a general purpose hand prior to operation of a vessel each day. Start-up procedures would usually commence from about 5.30 am, though potentially from 4.30 am for certain services, and normally include checking of fuel, safety equipment, mechanical equipment and the starting of engines.

Depending on timetabling, layover vessels may need to disembark from the wharf and travel to another location prior to the wharf operating times outlined above. Vessels are required to sound the horn three times prior to reversing.

### Maintenance of vessels

Minor maintenance of ferries would take place at the Barangaroo Ferry Hub on a daily basis.

This would be limited to ferries that layover and would include activities such as minor repairs, pump-out of sewage, cleaning of vessels and updating passenger information displays. Ferries would only be cleaned with low pressure hoses (fresh water using wharf water connection) to get the salt off. Noise generated by this activity would be negligible. There would be no water blasting done on vessels at wharves.

Ferry maintenance at the wharf would only be internal to the vessel (e.g. within soundproofed engine rooms, or changing light bulbs etc.). No noisy maintenance works on vessels are anticipated.

This is similar to the maintenance activities that currently occur at Circular Quay.

Major scheduled maintenance would take place at Balmain Shipyard.

Pump-out of sewage from layover vessels would typically occur once per day per layover vessel. During periods of heavy passenger demand, pumping may need to occur more frequently.

### Maintenance of wharf

Minor maintenance and aesthetic improvements of the wharves such as cleaning and removal of rubbish, would typically take place every 2-3 days. Other routine maintenance activities would likely take place during scheduled maintenance cycles on a less frequent basis.

High pressure cleaners would be used both for regular cleaning and monthly maintenance jobs as detailed below:

- Cleaning – once every 2-3 nights; higher frequency in windy/rough conditions and holidays; lower frequency in still conditions and less busy times. It is anticipated that cleaning would be done overnight when services have stopped.
- Maintenance – once monthly water blasting on ladders. This would usually be done with a petrol driver water blaster and access by maintenance vessel.

### Use of horns

It is a requirement of the *Uniform Shipping Laws Code* (Australian Maritime Safety Authority, 1993) (in NSW compliance managed by Roads and Maritime) that ferries use their horns in certain ways (similar to indicators in a car). At berth it is expected that ferries would sound the horn three times prior to reversing, and as approaching wharves and crossing the channel would let out one or two blasts (depending if turning to port or starboard). This is consistent with the same protocols that are currently followed at King Street Ferry Wharf.

### Interchange with other public transport systems

The proposal would form part of an overall improved public transport network within the western CBD which includes a planned bus corridor along Hickson Road and Wynyard Walk (currently under construction) which would connect Wynyard Station (planned to be upgraded) with Barangaroo and the proposal. The planned bus routes and Wynyard Walk are the subject of separate approvals.

### Passenger weather protection

Weather protection would be provided to passenger circulation and waiting areas where possible via a combination of roof structures and glazed screens. The ability to achieve full coverage to all areas would be subject to constraints such as integration with a range of vessel types and clearance required from roof structures.

Glazed screens would be highest to the south and south-west to improve protection to the dominant inclement weather directions. Screens to the north east would be lowest to permit beneficial north east breezes. The use of glazed screens to all sides would maximise transparency to improve amenity, sightlines to approaching ferries, and passive surveillance.

Passenger amenity would be improved via inclusion of rooflight glazing, predominately over circulation paths. Rooflight glazing would be selected to preserve comfort in summer using an appropriate shading coefficient.

### Lighting

Lighting to all functional areas would be designed to meet relevant standards. It would be consistent with precinct lighting in terms of colour theme where possible, while maintaining compliance with standards.

Public area lighting is likely to be provided within a continuous integrated services slot recessed into soffit linings.

Light sources would be LED where possible, and fittings and luminaires would be consistent with established types used in recent wharf developments within Sydney Harbour, such as the Ferry Wharf Upgrade Program (refer to Section 6.4.3), where possible.

### Ticketing system

About three Opal card ticketing facilities would be installed near the wharves on the public foreshore promenade as indicated at Appendix D. The final number, design and location of the Opal card facilities are yet to be developed and would be subject to negotiation with BDA and Lend Lease. Ticket barriers would be Opal compliant.

### Passenger information

'Plan Your Trip' information boards would be located on the waterfront promenade near the wharves as indicated at Appendix D. The final design and location of wayfinding signage is subject to detailed design and would be subject to negotiation with BDA.

Each pontoon would display ferry service information to provide up-to-date information to passengers on transport related matters.

PA systems would be provided on each pontoon to provide transport related audio announcements.

### Operation access

Entrance to the wharves would be unrestricted to ferry passengers. Once on the pontoon, passenger areas and staff only operational areas would be separated by glazed barriers and/or gates.

The street and pedestrian network for the Barangaroo precinct would create several key routes for pedestrians to use when complete. The primary routes for customers to access the Barangaroo Ferry Hub would be from the pedestrian promenade via Wynyard Walk and Transport Place, Union Walk, City Walk or King Street Wharf.

Maintenance vehicle access would be provided to the wharves from Lime Street, which is to be extended as part of the Barangaroo precinct, via the waterfront promenade. Maintenance vehicles would temporarily park within the waterfront promenade during their activities. Service access arrangements to the Barangaroo Ferry Hub over land not owned by Roads and Maritime would be subject to negotiation with BDA.

Personnel would generally access the site using public transport. Those personnel using the transport offices to be located within Barangaroo South would access the site via the public domain.

Each gangway would be designed to comply with relevant *Disability Discrimination Act 1992* (DDA) gradient standards but there would be times when gangway gradients exceed the standard due to extreme tidal variance (e.g. during spring and king tides). This would be the case less than 20 per cent of the time.

## Emergency access

Emergency access requirements would need to be accommodated at all times. It is likely that emergency vehicles would access the Barangaroo Ferry Hub using the pedestrian promenade via Lime Street at its intersection with Transport Place and/or Union Walk. Final arrangement of emergency access and congregation points would be subject to negotiation with BDA and Fire and Rescue NSW.

Various pieces of emergency equipment such as fire response equipment (including fire hydrants installed on each wharf) would be required to be kept at the Barangaroo Ferry Hub. Periodic testing and maintenance of emergency equipment would be required.

## Special event management

During special events such as New Years Eve, Vivid and Australia Day, temporary arrangements would be made to ensure the safety and efficient movement of larger than normal number of passengers. This may include, but not be limited to, the following:

- Erection of temporary wayfinding signage.
- Erection of temporary marshalling infrastructure such as removable bollards.
- Erection of temporary Opal/ticketing facilities.
- Additional staff (security, ticketing, customer service etc.)
- Fencing along the water's edge in a special event queuing area to prevent falls into the harbour, if required in addition to permanent barriers.
- Permanent provision for removable queue management systems.
- Adequate lighting for a special event queuing space.

Additional ferry services (compared to timetable) and/or extended hours of operation.

A special event management plan would be prepared by the operator prior to operations commencing.

## Safety in design

Security and information systems would be integrated into the design of the wharves. CCTV cameras and emergency help points would be provided.

The need for an after-hours security shutter would be reviewed during detailed design and could be incorporated into roof and link structures if required.

Design of ground plane elements such as screens and columns would discourage climbing.

Life-saving apparatus would be housed in conjunction with services pods located on the wharves.

Ladders would be provided from the water to the pontoon for access from the water.

## Electricity requirements

The anticipated power requirements for each wharf are described in Table 4-4 below.

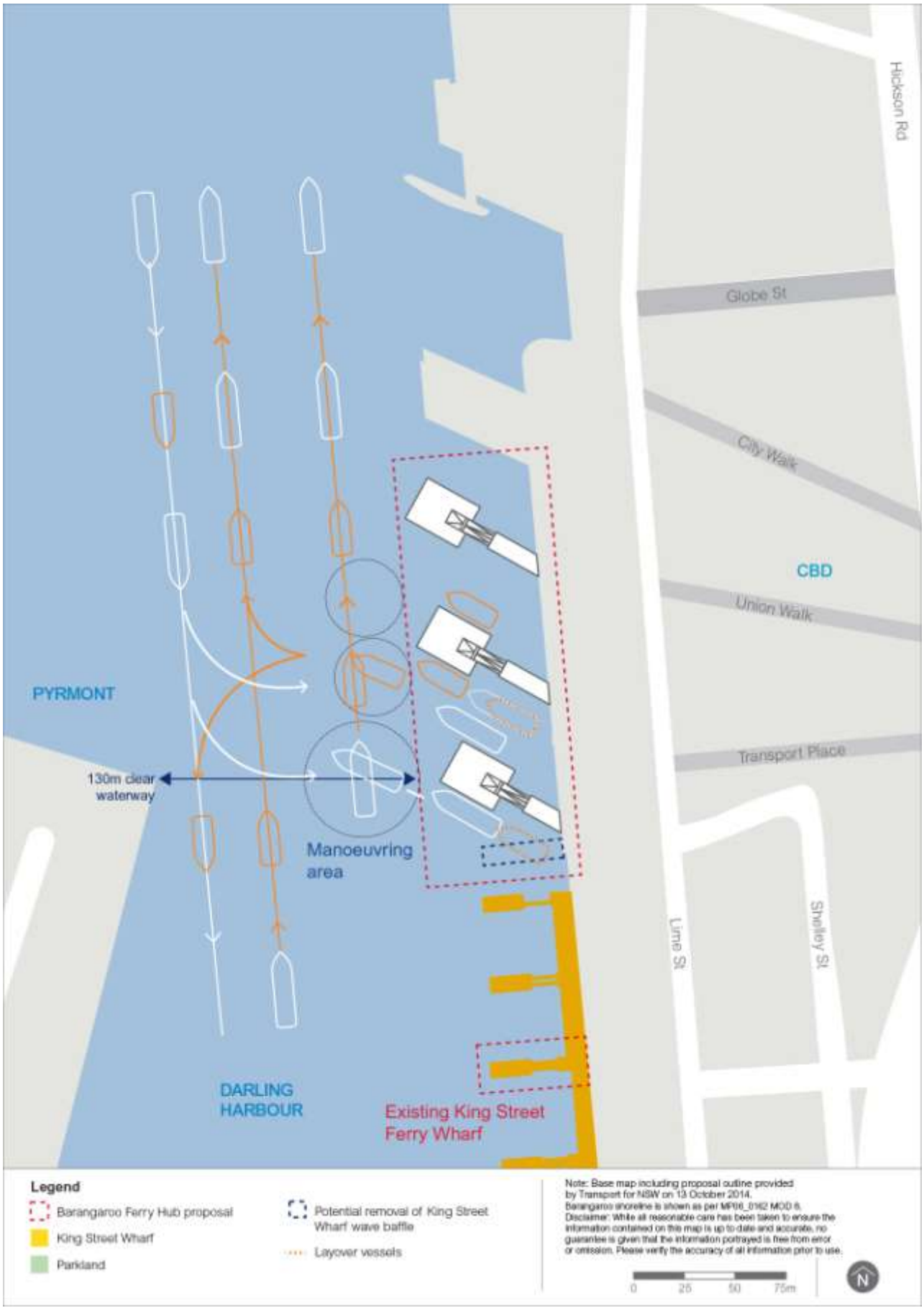
Table 4-4 Electricity requirements for proposal

| Item | Demand per wharf (kW) | Total demand (kW) |
|---|---|---|
| Pump-out facilities | 8 | 24 |
| Lighting and other ancillary facilities | 5 | 15-20 |
| **Total** | **13** | **39 – 44** |

These requirements are approximate and are subject to detailed design.

A 100 kilo-volt amperes supply is to be delivered to the Barangaroo Ferry Hub by Lend Lease as discussed at Section 4.2.1. This supply would be adequate to service the demand generated by the wharves.

## Figure 4-4 Indicative vessel movements



## 4.3 Design and justification

The concept design of the proposed Barangaroo Ferry Hub provides an appropriate response to the following in terms of scale and expression:

- A new transport gateway to the CBD corresponding with its high-profile location
- A new ferry hub as opposed to a suburban wharf, resulting in a defined urban character
- Architecture that responds to the harbour context, both built and natural, resulting in a restrained curvilinear expression
- A destination terminal as well as a commuter facility, with an important tourist, Sunday and event function. The design is to be corresponding with its high profile location.
- View lines to the new facility particularly from above, from the water and from the Barangaroo precinct

The concept design developed and presented contains a number of key features including:

- An appropriate response to and building on the design themes of the Wharf Upgrade Program
- A roof form and a shaping to the promenade structure which aids wayfinding and visual orientation
- Light and shelter provided via central rooflight, as well as enhancing wayfinding and sense of entry to each wharf
- Roof form and pontoon screening which responds to prevailing weather conditions
- Roof form which enhances the sense of enclosure to pontoon and transition structures
- Material selection consistent with the Wharf Upgrade Program, as well as for robustness and low maintenance
- Segregation of alighting pedestrian flow and passengers waiting to board.
- Pontoon size and the overall wharf geometry which responds to predicted passenger numbers and a number of site and navigational constraints
- A visually transparent ground plane to maximise amenity and security
- A suite of ground plane elements and finishes which are consistent with the Wharf Upgrade Program
- Minimised on-wharf structures and services in lieu of a remote staff and control facility
- A safe design for construction, operation, maintenance and demolition phases throughout the project's lifecycle.

Table 4-5 provides additional design elements of the proposed Barangaroo Ferry Hub.

Table 4-5 Design elements of the proposed Barangaroo Ferry Hub

| Design element | Comment |
|---|---|
| Footprint | • The footprint of the proposed Barangaroo Ferry Hub had been determined by a number of constraints including:<br>– navigational requirements for Darling Harbour (including maintenance of a 130 metre clear navigation channel)<br>– minimum berth lengths of 30 metres<br>– minimum clearance between vessels at adjacent wharves<br>– existing infrastructure (particularly King Street Wharf to the south)<br>– foreshore height, requiring a minimum link and gangway length sufficient to achieve DDA compliant ramp gradients<br>– sufficient pontoon size to safely accommodate passengers (including allowance for access/egress sufficient for operational movements and emergency evacuation)<br>• The wharf geometry identified in the concept design responds to a number of site and navigational constraints. A trapezoidal pontoon design has been selected to maximise useable pontoon area while not encroaching on the Darling Harbour navigational channel<br>• The layout of customer facilities and furniture, signage and wayfinding will be developed in subsequent design phases but has been indicatively shown to maximise free and logical circulation and wayfinding in conjunction with the TfNSW wayfinding team. |

| Design element | Comment |
|---|---|
| Materials and colours | • The selection of materials and finishes will be further refined during the detailed design process. Finishes will be integral to the material (not applied) wherever possible. Materials would be selected for continuity with the Wharf Upgrade Program and compatibility with Barangaroo South<br>• In developing the design, 'lessons learnt' sessions have been held with ferry operators (Harbour City Ferries) and wharf maintenance staff (Roads and Maritime Services). Input on wharf construction materials has been sought through these sessions. Materials would be chosen for robustness and low maintenance (such as zinc, reconstituted rubber and concrete flooring, stainless steel and glass)<br>• The concept design drawings at Appendix B include a finishes legend identifying key materials anticipated to be used in the construction of the proposed Barangaroo Ferry Hub including:<br>– glass reinforced concrete<br>– glazed screens<br>– stainless steel<br>– zinc (standing seam) roofing<br>– glazed rooflights<br>– tactiles<br>– cementitious topping – wood float<br>– rubber flooring<br>– timber decking<br>– fibre cement cladding.<br>• Glazed screens would provide weather protection while maximising transparency to improve amenity, sightlines to approaching ferries, and passive surveillance<br>• Rooflight glazing would be selected to preserve comfort in summer using an appropriate shading coefficient<br>• Reconstituted rubber and concrete flooring would provide a slip resistant and hard wearing flooring finish<br>• High grade stainless steel would provide a corrosion resistant material appropriate for an exposed maritime environment. Stainless steel can also be electropolished to minimise corrosion and tea staining. |

| Design element | Comment |
|---|---|
| Waterfront interface (including edge treatments and apron sizing) | • The major interface of the proposal is the Barangaroo South landside development. Thus the design aims for consistency with the evolving Barangaroo South masterplan and foreshore design (wherever possible). The interface design relationship has been managed through consistent meetings and presentations to BDA and Lend Lease throughout the concept design process (see Chapter 5 for additional information). This consultation process would continue during detailed design<br>• In considering the link structure design (including the apron size) the following were key considerations:<br>– predicted pedestrian demand<br>– accessibility in accordance with DDA and other requirements<br>– width of the link structure as it meets the foreshore promenade influences customer circulation and queueing, particularly during special events<br>– the need to accommodate ticket gates, pump-out facilities, a staff 'kiosk' adjacent to the gateline, queueing space to aid in control of special event passenger loads, access and egress for maintenance equipment<br>– compatibility with Barangaroo South design and reducing special event queueing on Barangaroo South land.<br>• The concept design drawings at Appendix B identify that the link structure apron would have edge treatments to match Barangaroo South Stage 1A design (i.e. waterfront edge treatment with balustrade). The opportunity to use timber decking on the link structure to match the Barangaroo South foreshore promenade is being considered. |
| Reflectivity | • Reflectivity will be considered further in detailed design, including in the selection of materials and finishes. The key component of the design which influences reflectivity is the roof selection. The zinc material recommended in the concept design is dull with a matte finish. Over time this material develops an oxide layer, which would further reduce reflectivity. Selection of glazed materials (including the rooflight and balustrades) would consider the lustre and surface finish to manage reflectivity<br>• As the wharves will operate at night similar principles have been adopted in relation to lighting. Lighting on and around wharves would be designed not to reflect or to be shielded from vessel masters' direct view as much as possible, while maintaining amenity and safety. Lighting is to comply with Australian Standards and to be compatible with the Barangaroo South precinct lighting master plan. |

| Design element | Comment |
|---|---|
| Infrastructure impacts | • The design of the proposal has considered existing and future infrastructure (particularly the Barangaroo South development) including utilities, King Street Wharf (including the King Street Wharf wave baffle) and the Barangaroo South cooling system (heat rejection).<br>• No impact on existing utilities is anticipated (there is no landside excavation proposed). Public utilities would be delivered to the edge of the Barangaroo foreshore under the public domain works for Barangaroo South (Concept Design Modification 4).<br>• The King Street Wharf wave baffle is a Roads and Maritime asset. The effectiveness of the wave baffle is the subject of a study, and the potential demolition of the wave baffle is being discussed with Roads and Maritime. The wharf design has considered options for retention or demolition of the King Street Wharf wave baffle. No impact on wharves south of the wave baffle are anticipated.<br>• The Barangaroo South cooling system includes seven outfall pipes (heat rejection system) located about two metres below the water surface along the waterfront within the area of the proposed Barangaroo Ferry Hub. The approved design of the Heat Rejection System has considered the Barangaroo Ferry Hub (refer to MP10_0023 (MOD 5)). The proposal's interface with the heat rejection system would be further considered during detail design and in collaboration with BDA and Lend Lease. Further consideration of this issue is provided in Section 6.9. |
| Setbacks | • As the Barangaroo Ferry Hub is not a building but transport infrastructure, setbacks in the standard usage are not relevant. The Barangaroo Ferry Hub has been designed adjacent to, in order to connect directly to, the Barangaroo South foreshore. |
| Tidal and wave action impact | • In detailed design of the pontoon, tidal and wave action impacts will be further considered. Particular consideration would be in relation to pontoon design elements such as depth and internal structure. In additional to the relevant Australian Standards references identified in Section 6.9, a review of the following additional references was carried out during concept design:<br>– ISO2631-1:1997 – Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration<br>– Proceedings of the 15th, 16th and 17th International Ship and Offshore Structures Congresses<br>– Nordforsk Seakeeping Criteria (1987)<br>– NSW Maritime – Engineering-guidelines – 2005<br>• Limits on acceleration will be adopted as the design guidelines during normal operation of the terminals (considering operational wind, wave and normal berthing). These limits will guide the detailed design process. |

The Barangaroo Ferry Hub design and construction is to be carried out in accordance with all relevant legislation and the latest edition of applicable Australian Standards (or other relevant Standards and Codes). In the event that relevant Australian Standards do not exist, then the most recent ISO, British or DIN Standards would be applied. Key standards and their applicability to design elements include (but are not limited to):

| Designation | Title | Usage |
|---|---|---|
| AS 1170 (Parts 1 to 4) | • Minimum design loads on structures<br>• (SAA Loading Code – Australian Standard) | • General loadings including walkway live load, wind load and earthquake load<br>• Load Combinations |
| AS 1428 (Parts 1 and 2) | • Design for access and mobility | • Access requirements for all areas with disabled access |
| AS 1554 (Parts 1 to 6) | • Structural Steel Welding (Australian Standard) | • Design of welds |
| AS 1657 | • Fixed Platforms, Walkways, Stairways and Ladders (Australian Standard) | • Access requirements for non-public access areas |
| AS 1664.1 | • Aluminium structures Part 1: Limit state design | • Structural design of aluminium |
| AS 2159 | • Piling—Design and installation | • Design of piled foundations |
| AS 3000 | • Wiring Rules (Australian Standard) | • All electrical works |
| AS 3600 | • Concrete Structures (Australian Standard) | • Design of all concrete and prestressed concrete components |
| AS 3679 | • Hot rolled structural steel bars and sections | • Reference for requirements of rolled steel sections |
| AS 3962 | • Guidelines for design of marinas | • Design of pontoon and some access (in conjunction with other relevant standards) |
| AS 4041 | • Pressure Piping | • Design of pressure piping |
| AS 4100 | • Steel Structures (Australian Standard) | • Design of all steel components (including fixings and fastening chains) except for piling |
| AS 4997 | • Guidelines for the Design of Maritime Structures | • Marine structures design, where appropriate |
| ANSI/API RP 2A-LRFD | • Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Load and Resistance Factor Design | • Structural design of piling<br>• Geotechnical design of pile foundations |
| BS 6349 | • British Standard Code of Practice for Maritime Structures | • Mooring loads |
| DSAPT (2002) | • Disability Standards for Accessible Public Transport 2002 | • Access and other requirements for all disabled access areas |
| PIANC | • Guidelines for the Design of Fender Systems, 2002 | • Berthing energy calculation for fender design |

# 5 Community and stakeholder consultation

This chapter summarises the stakeholder and community consultation undertaken during preparation and exhibition of this EIS. It includes details of consultation methods and a list of the stakeholders and government agencies consulted.

This chapter also provides an overview of the key issues raised by stakeholders and the community and where relevant, how these concerns have been addressed through the design of the proposal and/or through the EIS process. Further details of issues raised and how these have been addressed in the EIS are detailed below. The assessment responds to the relevant SEARs as outlined in the table below.

| Key issue | SEAR | Where addressed |
|---|---|---|
| Consultation | Undertake an appropriate and justified level of consultation in accordance with the *Departments' Major Project Community Consultation Guidelines October 2007*. | Chapter 5 |
| Consultation | During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with:<br>• City of Sydney Council;<br>• Transport for NSW;<br>• Roads and Maritime Services;<br>• Port Authority of NSW;<br>• Environment Protection Authority;<br>• Office of Environment and Heritage;<br>• Sydney Water Corporation;<br>• Department of Primary Industries;<br>• Barangaroo Delivery Authority; and<br>• Lend Lease.<br>The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided. | Section 5.2 |
| Further consultation after 2 years | If you do not lodge a development application and EIS for the development within 2 years of the issue of these SEARs, you must consult further with the Secretary in relation to the preparation of the EIS. | Noted |

## 5.1 Consultation strategy and objectives

A Stakeholder and Community Engagement Strategy was developed to guide the consultation process. The strategy is linked to key planning, design and construction milestones to ensure timely and proactive communication of important information to stakeholders, the community and the media. The strategy also identifies opportunities for further community consultation to help develop the proposal. Community liaison plans would support the strategy through each phase of project delivery.

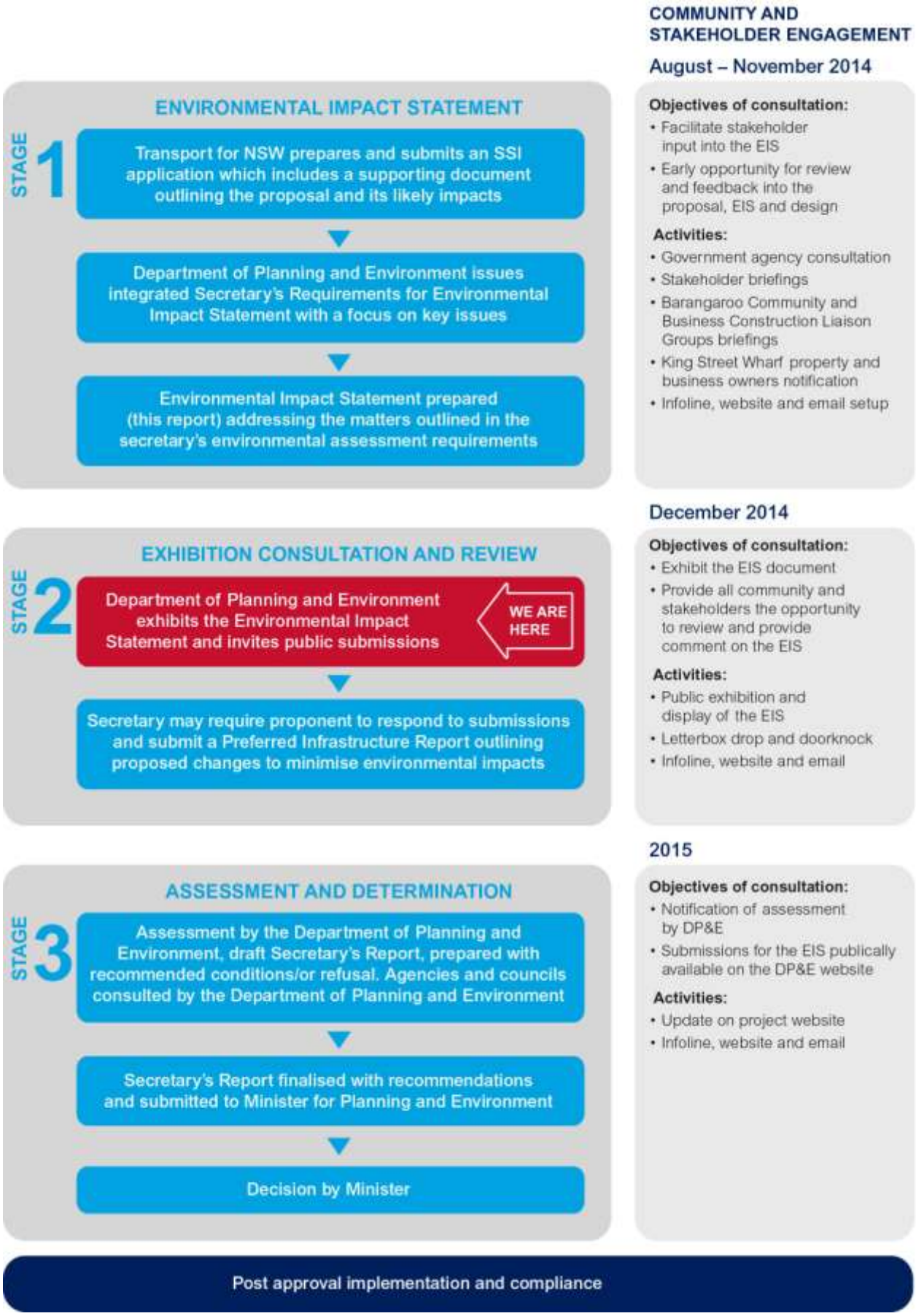
The objectives of the stakeholder and community engagement strategy are to:

- Identify and engage a wide range of stakeholders and interested parties
- Increase community and stakeholder understanding of the project, its objectives and benefits
- Keep people informed about the project phases and ensure that project information is communicated to the community and stakeholders in an effective and timely manner
- Provide the community and stakeholders with an opportunity to participate in the development of the project through feedback and input
- Record, review, comment on and record project responses to feedback
- Identify concerns and address them where practical and appropriate
- Ensure that community and stakeholder enquiries regarding the project are managed and resolved effectively.

These objectives are in line with TfNSW's Community Engagement Policy and are supported by TfNSW's fundamental communications principals, which are to:

- Consult early and often
- Encourage community and other stakeholder participation
- Listen to feedback, investigate suggestions and report back
- Be transparent
- Keep the general and local community and other key stakeholders informed of project progress
- Engage in a manner that is collaborative, innovative, adaptive and sustainable.

Figure 5-1 Ongoing consultation process



## 5.2 Overview of consultation undertaken to date

### 5.2.1 Consultation approach

Consultation with stakeholders and the community has been undertaken progressively throughout the development of the proposal and has been supported by public consultation activities. The consultation approach has been designed to inform key stakeholders about the proposal and encourage participation to allow the development of the proposal to benefit from stakeholder knowledge and understanding of specific needs. Consultation activities would continue as the proposal progresses to detailed design and construction.

### 5.2.2 Overview of stakeholder and community groups

Community groups and stakeholders who are potentially impacted by, or have an interest in the proposal were identified. These include members of the community, special interest groups and organisations, businesses, government agencies and other authorities. Stakeholders have been categorised under the following headings:

- Elected representatives
- Government agencies and departments
- Property owners and tenants (business and residential)
- Transport operators
- Peak bodies and associations
- Community bodies and associations
- Utility companies and service providers
- Media
- Other.

#### Stakeholders

Consultation occurred throughout the strategic planning phase of the proposal with a number of organisations associated with the Barangaroo precinct, including BDA, Lend Lease, Harbour City Ferries, City of Sydney, NSW Port Authority and Roads and Maritime.

#### Community

Following the announcement of the Barangaroo Ferry Hub proposal by the NSW Minister for Transport in May 2014, community consultation and information activities began in August 2014. A briefing was provided to the Barangaroo Community and Business Construction Liaison Groups. Door knocking of businesses along King Street Wharf was undertaken in September to provide information about the start of site investigations.

In October 2014, a Transport Infoline (1800 684 490), project email address (projects@transport.nsw.gov.au) and project website (www.transport.nsw.gov.au/projects) were publicised and made available to enable stakeholders and community members to provide feedback on the proposal and ask questions of the project team.

Community consultation will continue to be undertaken during Stage 2, the public exhibition of the EIS. During this time stakeholders and the community will be encouraged to make formal submissions on the proposal.

## 5.3 Stage 1 – EIS preparation

### 5.3.1 Stakeholder consultation

Stage 1 stakeholder consultation was undertaken between August 2014 and November 2014. The consultation was designed to facilitate stakeholder input into the EIS. It provided an early opportunity to review and provide feedback on the proposal, EIS and the design development process. All feedback received was logged in the Barangaroo Ferry Hub consultation database to enable the identification of issues that were raised most frequently. Stage 1 consultation activities for stakeholders are outlined below.

#### Government agencies consultation

Government agencies and authorities were consulted before and throughout the EIS preparation. Many of these agencies were consulted on a one-on-one basis.

As the approval authority for the proposal, DP&E has coordinated input on issues to be addressed by government agencies and authorities that have an interest in the proposal through the development of the SEARs for the EIS.

#### Barangaroo community and business construction liaison groups

A briefing was held on 5 August 2014 with Barangaroo Community Construction Liaison Group representatives. Barangaroo Business Construction Liaison Group representatives were also provided briefings on 14 August 2014 and 9 October 2014. A general overview of the proposal was given, as well as details of the proposed construction methodology and project interface with other development plans. Attendees at the Business Construction Liaison Group briefing included representatives of:

- American Express
- Ausdev Realty Pty Ltd
- Brookfield
- EXCEL Building Management
- KPMG
- Langham Hotels
- EXCEL Property Management
- Lend Lease
- Macquarie
- Maritime Trade Towers
- Mirvac
- NBC Universal
- Soneco
- Westpac.

#### Stakeholder briefings

Comprehensive stakeholder briefings and presentations regarding the proposal were held between August and November 2014. Representatives from the Barangaroo Ferry Hub project team attended the briefings allowing stakeholders to discuss areas of interest to them, ask detailed questions, and to understand views about the proposal. Comments were considered as part of the EIS. Table 5-1 provides a list of stakeholders briefed since August 2014.

Table 5-1 Stakeholders briefed

| Stakeholder | |
|---|---|
| **Barangaroo Ferry Hub Landside and Waterside Working Groups** | |
| • TfNSW | • BDA |
| • Roads and Maritime | • Lend Lease |
| • Harbour City Ferries | • Department of Primary Industries |
| **Government agencies** | |
| • Office of Environment and Heritage | • Sydney Water |
| • Sydney Harbour Foreshore Authority | • Department of Primary Industries |
| • Port Authority of NSW | |
| **Local Government** | |
| • City of Sydney | |
| • Leichhardt Municipal Council | |
| **Public Groups** | |
| • Committee for Sydney | |
| • Sydney Business Chamber | |
| • Tourism and Transport Forum | |
| **Resident groups** | |
| • Darling Island Apartments Executive Committee | • Millers Point Residents Action Group |
| • Sydney Wharf Apartments Executive Committee | • Pyrmont Action Group |
| **Tourism groups** | |
| • Australian National Maritime Museum | |
| • Merlin Entertainments (Madame Tussauds Sydney, Sea Life Sydney Aquarium and Wild Life Sydney) | |
| • Sydney Fast Ferries | |
| • Sealink Travel Group | |
| • Sydney Showboats | |
| • Captain Cook Cruises | |
| • Magistic Cruises | |
| • Starship Sydney and The Pontoon | |
| **Business** | |
| • Brookfield | • Barangaroo Business Construction Liaison Group |
| • KPMG | |

### 5.3.2 Community consultation

#### Barangaroo Ferry Hub contact points

A Project Infoline (1800 684 490) and email address (projects@transport.nsw.gov.au) were established to enable all stakeholders to provide feedback on the proposal and ask questions of the project team. These details were included in all written communications distributed to the community or made available online. Feedback received has been considered during the preparation of the EIS.

The translating and interpreting service phone number (131 450) and symbol were also provided on Barangaroo Ferry Hub communications to assist community members who do not speak English.

#### Proposal website

Information about the proposal was made available on the Transport Projects pages of the TfNSW website (www.transport.nsw.gov.au/projects). The website was used to provide an overview of the proposal and details on how to provide feedback on the proposal.

#### Door knocking

Door knocking of businesses along King Street Wharf, Lime Street and Shelley Street was conducted on 24 September 2014. Door knocking was undertaken by community engagement specialists to canvass businesses potentially impacted by the early work involving marine geotechnical investigations.

Door knocking was also used to build the Barangaroo Ferry Hub contact database for future communications.

### 5.3.3 Summary of issues raised and responses

Community and stakeholder consultation has resulted in the identification of key issues across a broad range of communities and stakeholders.

The key issues raised by government agencies, authorities and stakeholders and the community are listed in Table 5-2 with a cross-reference to where they are addressed in the EIS. These issues are in addition to the formal requirements set out in the SEARs.

Table 5-2 Key issues raised by stakeholders during preparation of the EIS

| Category | Key issue/concern raised | Response |
|---|---|---|
| Design of the proposed Barangaroo Ferry Hub | Requirement for layover facilities for the ferry operators. | The existing ferry layover facilities at Circular Quay and Balmain do not have sufficient capacity to effectively accommodate future fleet numbers and as a result the option of including these facilities at Barangaroo Ferry Hub was considered. Refer to Section 3.3.4. |
| | Will there be concessions, kiosks or toilets included in the design of the new wharfs? | Toilets and kiosks would not be incorporated within the Barangaroo Ferry Hub proposal. The approved design for Barangaroo South is being developed by Lend Lease and will include cafe kiosks, retail kiosks, pavilions, and public convenience (toilet facilities) (MP06_162 MOD 4). |
| | Design to include protection for the sharp corners of the wharf structures to avoid damage to vessels as they are moored at the wharf. | The detailed design of the wharves is being progressed and would consider suitability of design in order to avoid damage to vessels. |
| | Rationale for building only two wharfs initially and which two of the three wharfs will be constructed? | Two wharves would be constructed initially in response to projected increase in ferry demand. The third wharf would be constructed at a later date when demand necessitates. |
| | Future proofing the design of the proposal to incorporate new vessels of differing lengths. | The concept design has taken into account the specifications for the new ferry vessels. The concept design drawings are provided in Appendix A. |
| | Lighting design for the proposal. | Lighting to all functional areas would be designed to meet relevant standards. It would be consistent with precinct lighting in terms of colour theme where possible, while maintaining compliance with standards. |
| | Integration of the Heat Rejection System with the proposal. | Details of the approved design of the Heat Rejection System are provided in MP10_0023 MOD 5 on the Department of Planning and Environment website. |
| | Emergency services access to the wharves. | Emergency services would access the Barangaroo Ferry Hub using the pedestrian promenade via Lime Street at its intersection with Transport Place and/or Union Walk. Final arrangement of emergency access and congregation points would be subject to negotiation with BDA and Fire and Rescue NSW. Refer to Section 4.2.2. |
| | Location of ticketing facilities. | Indicative locations of Opal card ticketing facilities are discussed at Section 4.2.2 and shown at Appendix D. |

| Category | Key issue/concern raised | Response |
|---|---|---|
| Navigation | Navigational access and safety during construction and operation.<br>Managing the increase in vessel traffic in the narrow channel. | Navigational safety and vessel management requirements arising from the proposal are discussed in Section 6.2.2. |
| Construction impacts | Length of construction period and cumulative impacts with current Barangaroo precinct and the proposed Pyrmont Wharf upgrade. | Cumulative impacts associated with construction activities within the harbour are discussed in Section 6.17. |
| | Exact number of piles and the method of construction. | Details of piling and the broader construction methodology are provided in Section 4.2.1. |
| | Noise effects on residents (Millers Point and Balmain East) from piling during construction – in particular out of hours works to be undertaken. | Potential noise and vibration impacts on surrounding noise sensitive receivers are detailed at Section 6.1. |
| | Vibration impacts and the potential effects on aquatic life in the Sydney Aquarium. | Further meetings and investigations would be carried out by TfNSW with the operators of the Aquarium prior to construction. |
| | Timeframe for construction of the proposal and Barangaroo. | The construction program is estimated to be about 14 months. Further details on construction program and methodology are provided in Section 4.2.1. |
| | Potential light spill impacts from the construction area for Balmain East residents. | Potential impacts from lighting during construction are discussed at Section 6.4. |
| | Maintain the navigational channel during construction.<br>How will the landside construction compound be maintained? | Details on construction methodology are provided in Section 4.2.1. |
| Operational impacts | Operation of the wharves to be consistent with the current timetable or more vessels per hour. | Operational details including hours of operation are provided at Section 4.2.1. |
| | Hours of operation of the proposed ferry hub.<br>Will Balmain West wharf be reinstated? | No changes are proposed to Balmain West wharf as result of this proposal. |
| | Will the Pyrmont Bay wharf be required after the new Barangaroo Ferry Hub is commissioned? | No physical changes are proposed to Pyrmont Bay wharf as a result of this proposal. |

| Category | Key issue/concern raised | Response |
|---|---|---|
| | Responsibility of maintenance of the wharf.<br>Future impact on Darling Harbour and King Street Wharf due to the relocation of the proposed ferry hub away from these destinations. | Details of the operation of the proposal and its interface with King Street Ferry Wharf and Darling Harbour are provided in Section 4.2.2. |
| | Potential for increase in noise due to additional ferry traffic as a result of the increased capacity of the proposed ferry hub.<br>Noise impacts of ferry related maintenance activities such as pump-outs and cleaning of the vessels. | The potential noise and vibration impacts associated with the operation of the proposed Barangaroo Ferry Hub are provided in Section 0. |
| | Environmental impacts of vessel waste in the harbour. | Consideration of waste and waste management from ferry vessels is outlined in Section 6.15. |
| | Increase in ferry traffic may cause contaminated sediment to be disturbed along the seabed. | An assessment of potential contamination impacts during construction and operation of the proposal is provided in Section 6.12. |
| | Impacts from the wave environment caused by vessels, in particular the Parramatta River vessels. | TfNSW would continue to work closely with stakeholders regarding specific property or asset concerns they may have regarding the operation of the proposal. |
| Integrated transport | Proposed ferry hub to relieve capacity constraints at Circular Quay. | Sydney's Ferry Future identified that in the longer term, the facility at Barangaroo would relieve capacity constraints at Circular Quay by providing space for more terminating services. Refer to Section 3.1.4. |
| | How will the proposed ferry hub at Barangaroo integrate with Wynyard Walk project and the broader Barangaroo transport strategy? | The Barangaroo Ferry Hub is located directly west of Wynyard Walk. It is within the general locations identified in the Barangaroo Integrated Transport Plan (2012a). Refer to Section 3.1.6. |
| | The proposed ferry hub will be operational potentially 12 months after the first residents of Barangaroo move in, how will this be managed? | King Street Ferry Wharf would remain operational throughout the duration of the construction of the Barangaroo Ferry Hub and available for new occupants of Barangaroo South. Refer to Section 4.2.1. |
| | Links between pedestrian activity on the promenade and the proposed ferry hub, during peak periods such as festivals and public holidays.<br>Planning for potential pedestrian overflow from the proposed ferry hub onto the Barangaroo promenade. | Refer to Sections 4.2.2 and 6.2 for management of pedestrian activity during special events. |

| Category | Key issue/concern raised | Response |
|---|---|---|
| | Use of existing King Street Wharf following the commissioning of the proposed ferry hub. | The use of the King Street Ferry Wharf following the decommissioning of ferry services is currently being considered by TfNSW in consultation with relevant stakeholder. |
| | Wayfinding requirements and signage use at the proposed ferry hub. | Indicative wayfinding signage for the proposal is discussed at Section 4.2.2 and shown at Appendix D. |
| Community and stakeholder consultation | Period of exhibition of the EIS document. | The public exhibition period will be determined by the DP&E and would be for a minimum of 30 days. |

## 5.4 Stage 2 – EIS exhibition consultation

### 5.4.1 Public exhibition of the EIS

Notification of the exhibition of the EIS will be advertised and the document will be placed on public exhibition (both online as well as hardcopies) at various locations for a minimum period of 30 days as required under Part 5.1 of the EP&A Act

During the exhibition period, government agencies, interest groups and organisations, stakeholders and the community will be invited to make written submissions. A summary of the engagement activities and tools that will be used to encourage community and stakeholder participation during the public exhibition period is outlined below.

#### EIS display locations

During the exhibition period the EIS will be available for download from the DP&E website and hard copies will be available for viewing at the following locations:

- Department of Planning and Environment, Information Centre, 23-33 Bridge Street, Sydney
- City of Sydney Council, One Stop Shop, Town Hall House, Level 3, 456 Kent Street, Sydney
- Transport for NSW Transport Projects, Level 5, Tower A Zenith Centre, 821 Pacific Highway, Chatswood
- Transport Information Centre, Retail 5, 388 George Street, Sydney (cnr King and George Streets).

Information on the Barangaroo Ferry Hub will also be available through the Project Infoline on 1800 684 490, email address projects@transport.nsw.gov.au and website www.transport.nsw.gov.au/projects.

During the exhibition period, any person (including a public authority) may make a written submission to the Secretary of DP&E. All submissions received will be provided to TfNSW to be considered in the EP&A Act approval processes.

#### EIS public exhibition promotion

Advertisements will also be placed in key metropolitan newspapers to announce the EIS display. The advertisements will provide details of the exhibition including dates, locations, opening hours and will invite community members to write submissions in response to the EIS. The relevant contact details and closing date for lodging a submission will be included in the advertisements.

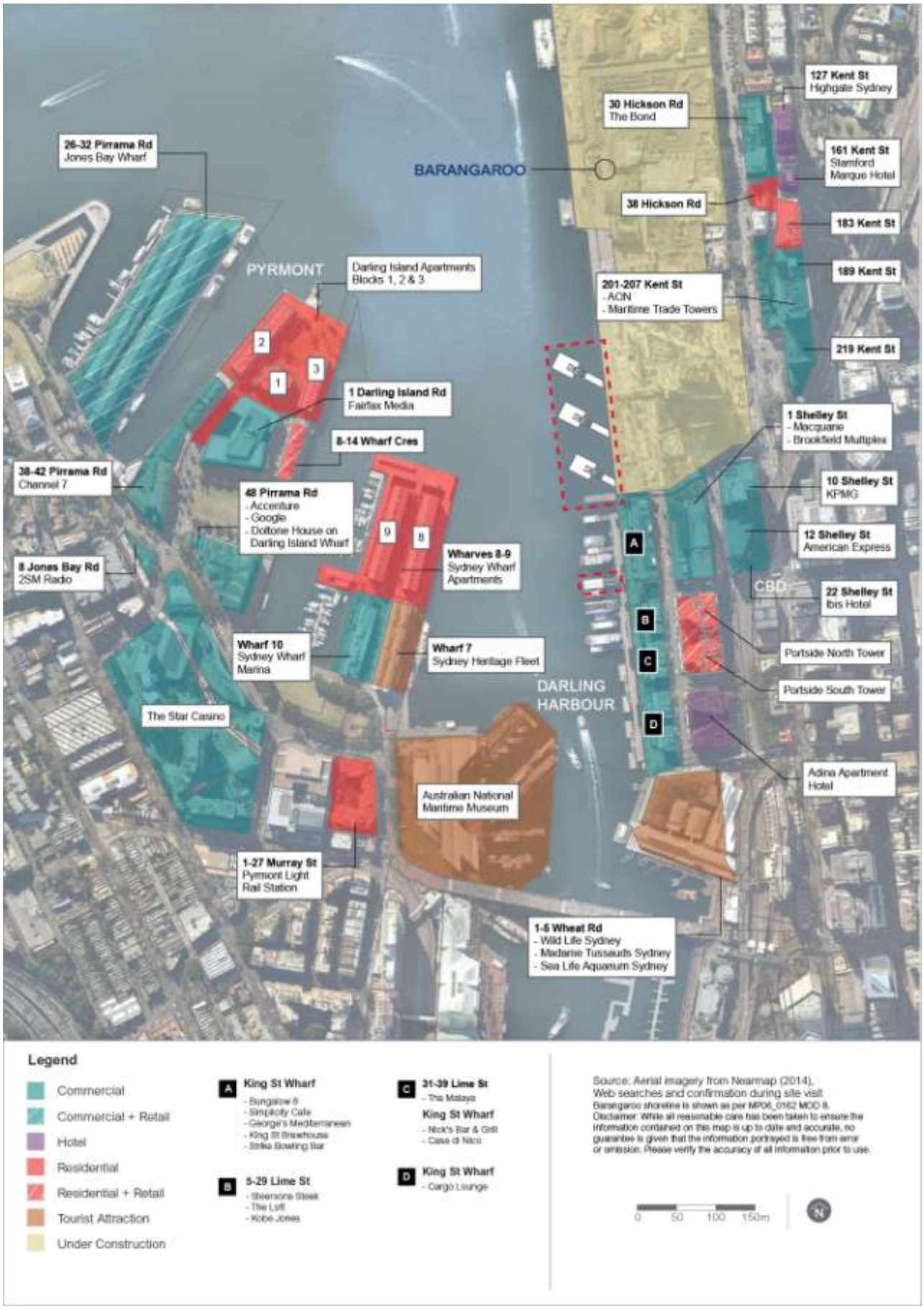
#### Letterbox drop

Residents and businesses directly affected by the proposed Barangaroo Ferry Hub (refer Figure 5-2) have been identified and will be targeted in a letterbox drop campaign to provide comprehensive information on the project.

The area targeted by the letterbox drop is as follows:

- Darling Harbour/Pyrmont: The area bounded by the foreshore, Pyrmont/Point Street to the west and Western Distributor to the south.
- Balmain East: The area bounded by the foreshore, Datchett Street to the west and Darling Street to the north.
- CBD: The area bounded by the foreshore to Kent Street to the east and King Street to the south.

## Figure 5-2 Proposed Notification area



## Community information

A community information session will be held during the public exhibition period to provide opportunities for members of the community and stakeholders to discuss the EIS with the project team and ask questions about the proposal. In addition to the information session the EIS will also be available to view at the Transport Information Centre, Retail 5, 388 George Street, Sydney.

The information session and information centre will provide the community with an opportunity to learn more about the submissions process. The Transport Information Centre at Retail 5, 388 George Street, Sydney (cnr King and George Streets) will provide the opportunity for members of the community and stakeholders to seek information about the proposal from TFNSW staff.

Information provided at the community information session and information centre will include a summary of what the Barangaroo Ferry Hub involves, the planning process, ferry hub design and the key aspects of the EIS. Localised letterbox drops will be used to invite the public to the information session and to visit the Transport Information Centre

A short EIS summary document will be produced to summarise the key facts and provide further information on the Barangaroo Ferry Hub proposal.

The Transport Information Centre is open between 9 am and 5 pm Monday to Friday (note that the Transport Information Centre will be closed from the 24 December 2014 to the 5 January 2014).

## Submissions report

Written submissions received by DP&E during the exhibition period will be forwarded to TfNSW for consideration. After reviewing the submissions, a Response to Submissions report will be prepared by TfNSW. The report will document all the submissions received and TfNSW's response to them. The submissions report will be publicly available on the TfNSW and the DP&E websites.

Stakeholders and the community will be notified about the completion and availability of the submissions report through advertisements in suburban and metropolitan press and the Barangaroo Ferry Hub website. Key stakeholders will also receive notification of the submissions report via a letter.

## Contact points

The Barangaroo Ferry Hub contact points (Infoline 1800 684 490) and email address (projects@transport.nsw.gov.au) will continue to operate throughout the EIS public exhibition period and beyond. Stakeholders and the community will be encouraged to contact the project team to discuss the EIS and submissions process. These details will continue to be included in all written communications distributed to the community or made available online.

## 5.5 Ongoing consultation

TfNSW is committed to community and stakeholder engagement beyond the planning stage through detailed design, construction and commissioning of the Barangaroo Ferry Hub. A construction communications plan would be prepared to ensure:

- Stakeholders and the community have a high level of awareness of all processes and activities associated with the project
- Accurate information is made available in an effective and timely manner
- A timely response is given to issues and concerns raised by stakeholders and the community.

TfNSW's Project Infoline and email address would continue to be available during the construction phase and targeted communication activities, such as letters, emails and website updates would continue as the proposal progresses.

Complaints during construction would be managed in accordance with TfNSW's Community Engagement Policy. A construction response line (1800 775 465) is available for all TfNSW projects and is a 24 hour contact point for complaints and urgent enquiries regarding construction works.

# 6 Environmental issues

This chapter provides a detailed description of the environmental issues associated with the construction and operation of the proposal. For each issue, the existing environment is characterised and then an assessment is undertaken as to how the proposal would impact on the existing environment. This chapter provides a summary of the findings of this assessment in relation to the proposal and responds to the SEARs as outlined in the table below.

## Secretary's environmental assessment requirements

| Key Issues | SEAR | Where Addressed |
|---|---|---|
| General requirements | Notwithstanding the key issues specified below, the EIS must include an environmental risk assessment to identify the potential environmental impacts associated with the development. | Chapter 6 and 7 |
| General requirements | Where relevant, the assessment of the key issues below, and any other significant issues identified in the assessment, must include:<br>• Adequate baseline data;<br>• Consideration of potential cumulative impacts due to other development in the vicinity; and<br>• Measures to avoid, minimise, and if necessary, offset the predicted impacts, including detailed contingency plans for managing any significant risks to the environment. | Chapter 6 |
| Construction Impacts | Identify measures to ameliorate potential construction impacts, including to vehicular, pedestrian and maritime access, noise and vibration, air quality, erosion and sediment control, water quality and waste management. | Chapter 6 |

## 6.1 Noise and vibration

This section assesses the potential impact of noise and vibration within the study area as a result of the proposal. The assessment presented in this section draws on information from the technical paper, Noise and Vibration Impact Assessment, prepared by SLR for the EIS (Appendix E) and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issues | SEAR | Where Addressed |
|---|---|---|
| Noise and Vibration | A Noise and Vibration Impact Assessment during construction, operation (loading, unloading and ferry layover) prepared in accordance with the relevant Environment Protection Authority guidelines shall be submitted. This assessment must consider any potential impacts on adjoining residential receivers. | Section 6.1.3 and Appendix E |
| Noise and Vibration | This assessment shall consider all noise sources including mechanical plant, public address and other amplified sound systems (including those installed on any vessels operating from the terminal) and vessel maintenance. The assessment should also be prepared in the context of existing construction activities at Barangaroo South. | Section 6.1.3 and Appendix E |

### 6.1.1 Assessment methodology

#### Construction

The NSW EPA *Interim Construction Noise Guideline* (ICNG) requires proposal specific Noise Management Levels (NMLs) to be established for noise affected receptors. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices are to be investigated to minimise noise emissions.

Having investigated all feasible and reasonable work practices, if construction noise levels are still predicted to exceed the NMLs then the potential noise impacts are to be managed via site specific construction noise management plans, to be prepared in the detailed design phase.

The ICNG provides an approach for determining LAeq(15minute) NMLs at residential receptors surrounding the project site with application of the measured LA90(15minute) background noise levels, as described in Table 6-1.

Table 6-1 Determination of noise management levels

| Time of Day | NML $LA_{eq(15minute)}$ | How to apply |
|---|---|---|
| Standard Hours<br>Monday to Friday<br>7 am to 6 pm<br>Saturday<br>8 am to 1:00 pm<br>No work on Sundays or public holidays | RBL + 10 dBA | The noise affected level represents the point above which there may be some community reaction to noise.<br>• Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level<br>• 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 | NML $LA_{eq(15minute)}$ | How to apply |
|---|---|---|
| | Highly noise affected<br>75 dBA | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account:<br>– 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<br>– If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| Outside recommended standard hours | RBL + 5 dBA | • A strong justification would typically be required for works outside the recommended standard hours<br>• The proponent should apply all feasible and reasonable work practices to meet the noise affected level<br>• Where all feasible and reasonable practice have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community |

*Source: Interim Construction Noise Guideline (DECC, 2009)*

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

*Note 2: The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy.*

The proposal specific LAeq(15minute) NMLs for other non-residential noise sensitive receptors from the ICNG are provided in Table 6-2.

Table 6-2 Noise management levels for other sensitive receptors

| Land Use | NML $L_{Aeq(15minute)}$ (Applied when the property is in use) |
|---|---|
| Active recreation areas<br>(characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion) | External noise level 65 dBA2 |
| Passive recreation areas<br>(characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. reading, meditation) | External noise level 60 dBA2 |
| Hotels | Internal noise level 35 dBA1 |
| Commercial and Offices | External noise level 70 dBA2 |

*Note 1: Based on recommended internal noise levels from AS2107:2000*

*Note 2: The external noise levels should be assessed at the most affected occupied point on the premises.*

Where construction would be undertaken during the night time period the potential for sleep disturbance should be assessed. The current approach to identifying potential sleep disturbance impacts is to set a screening criterion 15 dB above the RBL during the night time period (10:00 pm to 7:00 am).

The term 'screening criterion' indicates a noise level that is intended as a guide to identify the likelihood of sleep disturbance. It is not a firm criteria to be met, however where the screening level is met sleep disturbance is not likely. When the screening criterion is not met, a more detailed analysis is required.

The detailed analysis should assess the maximum noise level or LA1(1minute), the extent that the maximum noise level exceeds the background noise level and the number of times any exceedance occurs during the night time period.

The RNP which contains a section on sleep disturbance that includes a summary of current literature, concludes that:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions
- One or two events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly.

## Operation

Within NSW, predicted noise from industrial facilities and similar commercial operations is assessed against specific guidelines for fixed continuous noise sources. Additionally, guidelines exist for road traffic noise, rail noise and aircraft operations, to enable these types of developments to be designed for noise compliance. However, there are no specific guidelines for marine based transport operations.

In the absence of specific guidelines for ferry operations, the following NSW guidelines have been considered:

- NSW Industrial Noise Policy (INP)
- Road Noise Policy (RNP)
- Rail Infrastructure Noise Guideline (RING).

While none of these guidelines specifically address the nature of ferry operations, that is the short term duration of berthing and the variability of ferry travel routes, some aspects of each are relevant and possibly appropriate. Therefore, for the purpose of this EIS, two assessments of operational noise impacts have been undertaken. The first is an assessment of the proposal against the NSW INP requirements, and the second is an alternative assessment methodology that draws on relevant aspects of both the RNP and RING assessment approaches. Both assessments (INP and alternative approach) are presented below for consideration.

### *Assessment of proposal in relation to the NSW Industrial Noise Policy (INP)*

The NSW EPA's INP provides criteria for the assessment of noise impacts associated with industrial activities. It aims to balance the need for industrial activity with the desire for quiet within the community. The guidance levels are designed to protect at least 90 per cent of the population living in the vicinity of the industrial noise sources for at least 90 per cent of the time.

The INP's objectives are:

- To establish noise criteria that would protect the community from excessive noise
- To preserve the amenity for specific land uses
- To use the criteria for deriving project specific land uses
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.

Implementation is achieved by ensuring:

- That noise from any single source does not intrude greatly above the prevailing background noise level in the short term. This is known as the intrusive noise criterion; and that
- The background noise level does not exceed the level appropriate for the particular locality and land use. This is known as the amenity criterion[1].

It should be noted that the INP criteria relate specifically to industrial noise sources and do not apply to transport corridors (road, rail and air), community noise or construction noise. However, the INP is often referenced by Councils and local governments as a planning tool to address potential noise impacts from proposed noise generating facilities which are generally continuous in nature (e.g. mechanical plant located in commercial premises).

### Intrusiveness Criterion

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (LAeq) of the source should not be more than 5 dBA above the existing ambient (background) LA90 noise level (or RBL), measured during the different periods of the day (daytime, evening and night time) at the boundary of the nearest sensitive receivers.

It should be noted that the noise criterion for intrusiveness is based on the measurement of equivalent continuous noise over 15 minutes, (i.e. the LAeq(15minute)) during any time periods of the day.

### Amenity Criterion

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission).

The 'Amenity' noise goal is influenced by the extent to which existing industrial/commercial-related noise levels compare to the recommended noise levels for the type of land use involved (i.e. rural, suburban, urban and urban/industrial interface).The amenity noise level placed upon emissions of a new facility depends upon whether existing industrial/commercial-related LAeq(period) noise levels are lower or higher than the recommended amenity level.

If the existing noise level from industry approaches the amenity level, noise levels from new industrial noise sources need to be controlled so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion.

[1] *The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from sources (such as industrial) needs to be considered in assessing the impact against the amenity criterion.*

Conversely, where the existing noise level from industrial sources is close to the acceptable noise level, the noise level from any other sources must be controlled to preserve the amenity of an area.

The INP provides recommended acceptable noise levels for residents located in 'Rural', 'Suburban', 'Urban' and 'Urban/Industrial' areas. The recommended acceptable and maximum levels are reproduced in Table 6-3.

Table 6-3 Amenity Criteria – Recommended $L_{Aeq}$ noise levels from industrial noise sources

| Type of Receiver | Indicative Noise Amenity Area | Time of Day[1,2] | Recommended $L_{Aeq}$ Noise Level[3] | |
|---|---|---|---|---|
| | | | Acceptable | Recommended Maximum |
| Residence | Rural | Day | 50 dBA | 55 dBA |
| | | Evening | 45 dBA | 50 dBA |
| | | Night | 40 dBA | 45 dBA |
| | Suburban | Day | 55 dBA | 60 dBA |
| | | Evening | 45 dBA | 50 dBA |
| | | Night | 40 dBA | 45 dBA |
| | Urban | Day | 60 dBA | 65 dBA |
| | | Evening | 50 dBA | 55 dBA |
| | | Night | 45 dBA | 50 dBA |
| | Urban/Industrial Interface – for existing situations only | Day | 65 dBA | 70 dBA |
| | | Evening | 55 dBA | 60 dBA |
| | | Night | 50 dBA | 55 dBA |

*Note 1: For Monday to Saturday, Daytime 0700 hours – 1800 hours; Evening 1800 hours – 2200 hours; Night time 2200 hours – 0700 hours.*

*Note 2: On Sundays and Public Holidays, Daytime 0800 hours – 1800 hours; Evening 1800 hours – 2200 hours; Night time 2200 hours – 0800 hours.*

*Note 3: The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.*

Port activities (wharves and shipping infrastructure) have been the predominant land use at Barangaroo (previously known as Darling Harbour East) and the surrounding foreshore since the mid 1820s. The ongoing use of the wharf and foreshore for marine transport is not considered a new use, but rather another layer of port activity and therefore the urban/industrial indicative noise amenity criteria would apply.

However for Balmain East (NCA-05) the urban indicative noise amenity criteria would apply due to its different landuse characteristics.

### *Assessment of proposal in relation to RNP and RING*

As discussed above, some aspects of both the RNP and RING are relevant to the operation of the Barangaroo Ferry Hub. Both of these alternative assessment approaches are presented for consideration.

Road Noise Policy (RNP)

The characteristics of ferry terminal operations are considered to share some similarities with those of the 'local road – metropolitan category' described by the RNP as 'characteristically having low or intermittent traffic flows'.

The RNP assessment criteria for residences adjacent to such projects are summarised in Table 6-4.

Table 6-4 RNP criteria – residential

| Road Category | Type of Project/Land Use | Assessment Criteria (dBA) | |
|---|---|---|---|
| | | Daytime (7 am – 10 pm) | Night time (10 pm – 7 am) |
| Local Roads | 4. Existing residences affected by noise from new local road corridors | $L_{Aeq(1hour)}$ 55 (external) | $L_{Aeq(1hour)}$ 50 (external) |

It should be noted that the RNP noise criteria for local roads are based on assessment over a 1 hour period, LAeq(1hour) to take into account the nature of peak hour traffic.

Sleep disturbance (RNP)

RNP guidance for the assessment of sleep disturbance is reproduced as follows:

> *Triggers for, and effects of sleep disturbance from, exposure to intermittent noise such as noise from road traffic are still being studied. There appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise. The NSW Roads and Traffic Authority's Practice Note 3 (NSW Roads and Traffic Authority 2008) outlines a protocol for assessing and reporting on maximum noise levels and the potential for sleep disturbance.*

The procedure for assessing the potential for sleep disturbance, detailed within Practice Note III of the RMS Environmental Noise Management Manual (ENMM), is to perform an LAFmax – LAeq(1hr) calculation on individual vehicle passby noise measurements. A maximum noise level event is then defined as a passby for which the night time LAFmax – LAeq(1hr) difference is greater than 15 dB.

With regard to the reaction to potential sleep disturbance events, the RNP gives the following guidance:

> *From the research on sleep disturbance to date it can be concluded that:*
>
> - *maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
> - *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.*

It is generally accepted that internal noise levels in a dwelling with the windows open are 10 dB lower than external noise levels. Based on this conservative minimum attenuation of 10 dB, the first conclusion above suggests that short term external noises of 60 dBA to 65 dBA are unlikely to cause awakening reactions.

The second conclusion suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly.

Rail Infrastructure Noise Guideline (RING)

The RING is used to assess the noise and vibration impacts of new and upgraded rail infrastructure projects on sensitive receivers such as residential land uses. The noise trigger levels are separated into the following categories:

- Heavy rail development
- New rail line development
- Redevelopment of existing rail line
- Light rail development

Proposed ferry operations at Barangaroo Ferry Hub are considered to be more like light rail operations (on the basis of frequency, capacity and activity) than heavy rail which operates at higher speeds and has a much higher carrying capacity.

The relevant airborne light rail noise trigger levels for residential land uses are presented in Table 6-5.

Table 6-5 Airborne light rail noise triggers for residential land use

| Sensitive Land Use | Noise Trigger Level (dBA) | |
|---|---|---|
| | Daytime 7:00 am to 10:00 pm | Night time 10:00 pm to 7:00 am |
| Residential | 60 LAeq(15hour) and<br>80 LAmax | 50 LAeq(9hour) and<br>80 LAmax |

*Note: LAmax refers to the maximum noise level not exceeded for 95 per cent of rail pass-by events and is measured using the 'fast' response setting on a sound level meter.*

The RING requires noise to be assessed for the proposed year of opening as well as for a future design year, typically ten years after opening.

The RING noise triggers for non-residential sensitive receptors are applicable when the building or premise is in use. A summary of trigger levels for non-residential receivers is outlined in Table 6-6. All noise trigger levels are external levels except where otherwise stated. Sensitive receptors other than residential are listed in Table 6-6. Commercial receptors are not considered sensitive to operational airborne noise impacts.

Table 6-6 Airborne rail noise triggers for non-residential land use

| Sensitive Land Use | Noise Trigger Level (dBA), when in use | |
|---|---|---|
| | Daytime 7:00 am to 10:00 pm | Night time 10:00 pm to 7:00 am |
| Open space – passive use (e.g. parkland, bush reserves) | 60 $L_{Aeq(15hour)}$ external | 65 $L_{Aeq(9hour)}$ and<br>80 $L_{Amax}$ |

*Note: LAmax refers to the maximum noise level not exceeded for 95 per cent of rail pass-by events and is measured using the 'fast' response setting on a sound level meter.*

It should be noted that the noise trigger levels stipulated in the RING are assessed over 15 hour and 9 hour periods for daytime and night time respectively.

### 6.1.2 Existing environment

The primary influence on the existing ambient noise environment within the proposal area includes waterway and road traffic noise, as well as construction works.

To outline the existing noise environment for the proposal and surrounding areas and determine likely impacts, noise catchment areas (NCAs) were defined (refer to Figure 6-1). The five NCAs are considered representative of the changing land uses and ambient noise environments surrounding the proposal. Within each of the five NCAs (refer to Figure 6-1) noise and vibration sensitive receivers were identified and include residential, commercial and other (e.g. receivers, including the future hotel located at Barangaroo and outdoor recreational areas). A full description of each of the NCAs shown in Figure 6-1 is presented in Appendix E.

Table 6-7 presents results of unattended background monitoring at the three noise monitoring locations (NM1, NM2 and NM3 (refer to Figure 6-1)) for the assessment. Each of the monitoring locations was chosen as being representative of each of the NCAs as follows:

- NM1- representative of receivers within NCA-01 and NCA 02, including King Street Wharf and future receivers R8 and R9 at Barangaroo South
- NM2 – representative of receivers within NCA-03 and NCA-04
- NM3 – representative of adjacent receivers within NCA-05.

The rating background level (RBL) monitoring results are presented in the form of noise levels for the day time, evening and night-time periods as defined in the Interim Construction Noise Guideline (DECC, 2009) and are as follows:

- Day – 7 am to 6 pm (Monday to Saturday) and 8 am to 6 pm (Sunday)
- Evening – 6 pm to 10 pm (Monday to Sunday)
- Night – 10 pm to 7 am (Monday to Saturday) and 10 pm to 8 am (Sunday).

Noise levels recorded at each of the monitoring locations across the five NCAs display a diurnal trend, with noise levels lower during the night-time compared to the daytime period. However, the NCA-01 nearest to the proposal shows a less marked diurnal trend with evening noise levels increasing by 7 decibels (dB) over daytime noise levels before decreasing during the night-time period after 10 pm.

The results of attended monitoring confirmed that the logging results are considered representative of the noise catchment area surrounding the proposal.

## Figure 6-1 Noise catchment areas and monitoring locations

Table 6-7 Background noise monitoring results

| Location | Measured ambient noise level – dBA re 20 µPa | | | | | |
|---|---|---|---|---|---|---|
| | RBL, $L_{A90}$ | | | $L_{Aeq(period)}$ | | |
| | Daytime[2] 7 am to 6 pm | Evening[3] 6 pm to 10 pm | Night-time[3] 10 pm to 7 am | Daytime[3] 7 am to 6 pm | Evening[3] 6 pm to 10 pm | Night-time[2] 10 pm to 7 am |
| NM1 [1] | 52 | 59 | 46 | 61 | 66 | 70 (52) [3] |
| NM2 | 51 | 46 | 41 | 56 | 52 | 47 |
| NM3 [1] | 49 | 49 | 41 | 55 | 56 | 49 |

*Note 1: Noise monitoring data of NM1 and NM3 were taken from SLR's database (logger data from 2013)*

*Note 2: ICNG Governing Periods – Day: 7 am to 6 pm Monday to Saturday and 8 am to 6 pm Sunday; Evening: 6 pm to 10 pm (Monday to Sunday); Night: 10 pm to 7 am Monday to Saturday and 10 pm to 80 am Sunday*

*Note 3: Existing ambient noise levels excluding weekend bar operations on ground floor*

### 6.1.3 Potential impacts

#### Construction

In order to assess the potential noise and vibration impacts during construction, seven scenarios comprising typical construction works have been developed based on the proposal. These scenarios and the duration of works are considered to be representative of the noisiest construction activities and are as follows:

- Scenarios 1 to 3 – installation of piles. Expected duration of works to be about two months in total
- Scenario 4 – lifting works. Expected duration to be about one month in total
- Scenario 5 and 6 – potential demolition of King Street Wharf wave baffle, including pile extraction (scenario 6). Expected duration of works to be about two months in total
- Scenario 7 – construction of landside ancillary and ferry facilities. Expected duration of works to be about two months in total.

Consistent with the requirements of the *Interim Construction Noise Guidelines* (ICNG) (DECC, 2009), the construction noise impacts are based on a worst case assessment. For most activities the predicted results in this report are considered to be conservative and actual construction levels would likely be below these levels.

Construction noise and vibration emissions would be temporary impacts to nearby sensitive receivers. Potential impacts can vary greatly depending on factors such as the relative proximity of sensitive receivers, the overall duration of the construction work, the intensity of the noise and vibration levels, the time construction work is undertaken and the character of the noise or vibration emissions.

At this stage of the Barangaroo Ferry Hub proposal development, an indicative construction methodology is available, as detailed in Chapter 4. The construction noise and vibration assessment therefore focused on potential worst-case impacts based on assumptions regarding the likely construction techniques and staging (refer Section 8 of Appendix C for detail around assumptions).

Works would be carried out within both recommended standard hours (scenario 3, 5, 6 and 7) and outside of recommended standard hours (scenarios 1, 2 and 4). Determination of the noise management level (NML) for construction works is described in Table 6-2.

For assessment purposes, it has been assumed that all construction activities and scenarios may occur during any time period (i.e. day, evening or night-time) unless otherwise specified. In order to provide a conservative estimate of the LA1(60second) noise emission levels, 8 dBA is added to the predicted LAeq(15minute) noise levels.

The predicted noise levels for each work scenario are detailed in Table 6-8.

Due to the nature of the construction works and the close vicinity of sensitive receivers, some exceedances of the NML are predicted for both standard and out of standard construction hours. A classification of the potential noise exceedance has been adopted for use in defining the noise impacts and area s follows:

- Low Impact – 0 dBA to 9 dBA
- Moderate Impact – 10 dBA to 25 dBA
- High Impact – above 25 dBA.

Predicted noise levels at sensitive receivers during construction works indicate NML exceedances of between 1 dB and 26 dB for works carried out during standard construction hours and of between 1 dB and 37 dB for works carried out outside of standard construction hours.

Pile installation is highly sporadic and produces peaks of noise. Impact piling (hammering) is the noisiest of the proposed activities. This is expected to occur in one minute intervals (about 10 hits with the hammer within one minute), with five sessions spread over a period of one hour. Only one pile would be hammered in any one shift. Noise from intricate lifts and drilling of piles would be at lower levels and occur for longer duration. The approximate timeframes for pile installation activities are set out at Table 4-3.

Table 6-8 Predicted noise levels at nearest receivers

| NCA | Receiver Type | Noise Level – $LA_{eq(15minute)}$ (dBA) | | | | | | | | | Noise Level – $LA_{1(60second)}$ (dBA) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worst-case Predicted[5] | NML | | | | Exceedance | | | | Worst-case Predicted | Screening Crit. (RBL+15 dBA) | Exceedance |
| | | | Day | OOH Day | Evening | OOH Night | Day | OOH Day | OOH Eve | OOH Night | | | |
| **Scenario 1 – Pile Drilling[1]** | | | | | | | | | | | | | |
| NCA-01 | Residential[5] | 62-70 | 62 | 57 | 57 | 51 | **Up to 5** | **5-10** | **5-10** | **11-19** | 70-78 | 61 | **9-17** |
| | Commercial | 57-63 | 70 | 70 | 70 | 70 | - | - | - | - | 65-71 | N/A | N/A |
| | Other (Hotel)[7] | Up to 51 (26) | 35[6] | 35[6] | 35[6] | 35[6] | - | - | - | - | Up to 59 (34) | N/A | N/A |
| NCA-02 | Residential | Up to 32 | 62 | 57 | 57 | 51 | - | - | - | - | Up to 40 | 61 | - |
| | Commercial | 57-69 | 70 | 70 | 70 | 70 | - | - | - | - | 65-77 | N/A | N/A |
| | Other (Hotel) [7] | Up to 55 (30) | 35[6] | 35[6] | 35[6] | 35[6] | - | - | - | - | Up to 63 (38) | N/A | N/A |
| NCA-03 | Residential | 55-56 | 61 | 56 | 51 | 46 | - | - | **4-5** | **9-10** | 63-64 | 56 | **7-8** |
| | Commercial | 44-51 | 70 | 70 | 70 | 70 | - | - | - | - | 52-59 | N/A | N/A |
| NCA-04 | Residential | 48-52 | 61 | 56 | 51 | 46 | - | - | **Up to 1** | **2-6** | 56-60 | 56 | **Up to 4** |
| | Commercial | 31-49 | 70 | 70 | 70 | 70 | - | - | - | - | 39-57 | N/A | N/A |
| | Other (Outdoor Active) | 24-52 | 65 | 65 | 65 | 65 | - | - | - | - | 32-60 | N/A | N/A |
| NCA-05 | Residential | 41-42 | 59 | 54 | 54 | 46 | - | - | - | - | 49-50 | 56 | - |
| | Other (Outdoor Passive) | 38-43 | 60 | 60 | 60 | 60 | - | - | - | - | 46-51 | N/A | N/A |

| NCA | Receiver Type | Noise Level – $LA_{eq(15minute)}$ (dBA) | | | | | | | | | Noise Level – $LA_{1(60second)}$ (dBA) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worst-case Predicted[5] | NML | | | | Exceedance | | | | Worst-case Predicted | Screening Crit. (RBL+15 dBA) | Exceedance |
| | | | Day | OOH Day | Evening | OOH Night | Day | OOH Day | OOH Eve | OOH Night | | | |
| **Scenario 2 – Impact Piling[1]** | | | | | | | | | | | | | |
| NCA-01 | Residential[5] | 80-88[4] | 62 | 57 | 57 | 51 | **18-26** | **23-31** | **23-31** | **29-37** | 88-96 | 61 | **27-35** |
| | Commercial | 75-81 | 70 | 70 | 70 | 70 | **5-11** | **5-11** | **5-11** | **5-11** | 83-89 | N/A | N/A |
| | Other (Hotel) [7] | Up to 69 (44) | 35[6] | 35[6] | 35[6] | 35[6] | **Up to 9** | **Up to 9** | **Up to 9** | **Up to 9** | Up to 77 (52) | N/A | N/A |
| NCA-02 | Residential | Up to 50 | 62 | 57 | 57 | 51 | - | - | - | - | Up to 58 | 61 | - |
| | Commercial | 75-87 | 70 | 70 | 70 | 70 | **5-17** | **5-17** | **5-17** | **5-17** | 83-95 | N/A | N/A |
| | Other (Hotel) [7] | Up to 73 (48) | 35[6] | 35[6] | 35[6] | 35[6] | **Up to 13** | **Up to 13** | **Up to 13** | **Up to 13** | Up to 81 (56) | N/A | N/A |
| NCA-03 | Residential | 73-74 | 61 | 56 | 51 | 46 | **12-13** | **17-18** | **22-23** | **27-28** | 81-82 | 56 | **25-26** |
| | Commercial | 62-70 | 70 | 70 | 70 | 70 | - | - | - | - | 70-78 | N/A | N/A |
| NCA-04 | Residential | 67-70 | 61 | 56 | 51 | 46 | **6-9** | **11-14** | **16-19** | **21-24** | 75-78 | 56 | **19-22** |
| | Commercial | 49-67 | 70 | 70 | 70 | 70 | - | - | - | - | 57-75 | N/A | N/A |
| | Other (Outdoor Active) | 43-70 | 65 | 65 | 65 | 65 | **Up to 5** | **Up to 5** | **Up to 5** | **Up to 5** | 51-78 | N/A | N/A |
| NCA-05 | Residential | 59-60 | 59 | 54 | 54 | 46 | **Up to 1** | **5-6** | **5-6** | **13-14** | 67-68 | 56 | **11-12** |
| | Other (Outdoor Passive) | 57-61 | 60 | 60 | 60 | 60 | **Up to 1** | **Up to 1** | **Up to 1** | **Up to 1** | 65-69 | N/A | N/A |

| NCA | Receiver Type | Noise Level – $LA_{eq(15minute)}$ (dBA) | | | | | | | | | Noise Level – $LA_{1(60second)}$ (dBA) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worst-case Predicted[5] | NML | | | | Exceedance | | | | Worst-case Predicted | Screening Crit. (RBL+15 dBA) | Exceedance |
| | | | Day | OOH Day | Evening | OOH Night | Day | OOH Day | OOH Eve | OOH Night | | | |
| **Scenario 3 – Pile Finishing[3]** | | | | | | | | | | | | | |
| NCA-01 | Residential[5] | 66-68 | 62 | 57 | 57 | 51 | **4-6** | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 54-60 | 70 | 70 | 70 | 70 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 48 (23) | 35[6] | 35[6] | 35[6] | 35[6] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-02 | Residential | Up to 29 | 62 | 57 | 57 | 51 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 53-66 | 70 | 70 | 70 | 70 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 51 (26) | 35[6] | 35[6] | 35[6] | 35[6] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-03 | Residential | 51-53 | 61 | 56 | 51 | 46 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 41-48 | 70 | 70 | 70 | 70 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-04 | Residential | 45-48 | 61 | 56 | 51 | 46 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 28-45 | 70 | 70 | 70 | 70 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Active) | 21-48 | 65 | 65 | 65 | 65 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-05 | Residential | 37-38 | 59 | 54 | 54 | 46 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Passive) | 35-39 | 60 | 60 | 60 | 60 | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |

| NCA | Receiver Type | Noise Level – $LA_{eq(15minute)}$ (dBA) | | | | | | | | | Noise Level – $LA_{1(60second)}$ (dBA) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worst-case Predicted[5] | NML | | | | Exceedance | | | | Worst-case Predicted | Screening Crit. (RBL+15 dBA) | Exceedance |
| | | | Day | OOH Day | Evening | OOH Night | Day | OOH Day | OOH Eve | OOH Night | | | |
| **Scenario 4 – Intricate Lifts[1]** | | | | | | | | | | | | | |
| NCA-01 | Residential[5] | 59-67 | 62 | 57 | 57 | 51 | **Up to 5** | **2-10** | **2-10** | **8-16** | 67-75 | 61 | **6-14** |
| | Commercial | 54-63 | 70 | 70 | 70 | 70 | - | - | - | - | 62-71 | N/A | N/A |
| | Other (Hotel) [7] | Up to 48 (23) | 35[6] | 35[6] | 35[6] | 35[6] | - | - | - | - | Up to 56 (31) | N/A | N/A |
| NCA-02 | Residential | Up to 29 | 62 | 57 | 57 | 51 | - | - | - | - | Up to 37 | 61 | - |
| | Commercial | 54-66 | 70 | 70 | 70 | 70 | - | - | - | - | 62-74 | N/A | N/A |
| | Other (Hotel) [7] | Up to 52 (27) | 35[6] | 35[6] | 35[6] | 35[6] | - | - | - | - | Up to 60 (35) | N/A | N/A |
| NCA-03 | Residential | 51-53 | 61 | 56 | 51 | 46 | - | - | **Up to 2** | **5-7** | 59-61 | 56 | **3-5** |
| | Commercial | 41-48 | 70 | 70 | 70 | 70 | - | - | - | - | 49-56 | N/A | N/A |
| NCA-04 | Residential | 45-49 | 61 | 56 | 51 | 46 | - | - | - | **Up to 3** | 53-57 | 56 | Up to 1 |
| | Commercial | 28-46 | 70 | 70 | 70 | 70 | - | - | - | - | 36-54 | N/A | N/A |
| | Other (Outdoor Active) | 21-48 | 65 | 65 | 65 | 65 | - | - | - | - | 29-56 | N/A | N/A |
| NCA-05 | Residential | 38-39 | 59 | 54 | 54 | 46 | - | - | - | - | 46-47 | 56 | - |
| | Other (Outdoor Passive) | 35-40 | 60 | 60 | 60 | 60 | - | - | - | - | 43-48 | N/A | N/A |

| NCA | Receiver Type | Noise Level – $LA_{eq(15minute)}$ (dBA) | | | | | | | | | Noise Level – $LA_{1(60second)}$ (dBA) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worst-case Predicted[5] | NML | | | | Exceedance | | | | Worst-case Predicted | Screening Crit. (RBL+15 dBA) | Exceedance |
| | | | Day | OOH Day | Evening | OOH Night | Day | OOH Day | OOH Eve | OOH Night | | | |
| **Scenario 5 – Demolition of King Street Wharf wave baffle[3]** | | | | | | | | | | | | | |
| NCA-01 | Residential[5] | 63-71 | 62 | N/A[3] | N/A[3] | N/A[3] | **1-9** | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 58-64 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 52 (27) | 35[6] | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-02 | Residential | Up to 33 | 62 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 58-70 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 56 (31) | 35[6] | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-03 | Residential | 56-57 | 61 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 45-53 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-04 | Residential | 50-53 | 61 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 32-50 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Active) | 26-53 | 65 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-05 | Residential | 42-43 | 59 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Passive) | 40-44 | 60 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |

| NCA | Receiver Type | Noise Level – $LA_{eq(15minute)}$ (dBA) | | | | | | | | | Noise Level – $LA_{1(60second)}$ (dBA) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worst-case Predicted[5] | NML | | | | Exceedance | | | | Worst-case Predicted | Screening Crit. (RBL+15 dBA) | Exceedance |
| | | | Day | OOH Day | Evening | OOH Night | Day | OOH Day | OOH Eve | OOH Night | | | |
| **Scenario 6 – Pile Extraction[3]** | | | | | | | | | | | | | |
| NCA-01 | Residential[5] | 66-73 | 62 | N/A[3] | N/A[3] | N/A[3] | **4-9** | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 60-67 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 55 (30) | 35[6] | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-02 | Residential | Up to 35 | 62 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 60-72 | 70 | N/A[3] | N/A[3] | N/A[3] | **Up to 2** | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 58 (33) | 35[6] | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-03 | Residential | 58-59 | 61 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 47-55 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-04 | Residential | 52-55 | 61 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial | 34-52 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Active) | 28-55 | 65 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-05 | Residential | 44-45 | 59 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Passive) | 42-46 | 60 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |

| NCA | Receiver Type | Noise Level – $LA_{eq(15minute)}$ (dBA) | | | | | | | | | Noise Level – $LA_{1(60second)}$ (dBA) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Worst-case Predicted[5] | NML | | | | Exceedance | | | | Worst-case Predicted | Screening Crit. (RBL+15 dBA) | Exceedance |
| | | | Day | OOH Day | Evening | OOH Night | Day | OOH Day | OOH Eve | OOH Night | | | |
| **Scenario 7 – Landside Construction[3]** | | | | | | | | | | | | | |
| NCA-01 | Residential[5] | 70-73 | 62 | N/A[3] | N/A[3] | N/A[3] | **8-11** | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial[2] | 58-68 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 52 (27) | 35[6] | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-02 | Residential | Up to 32 | 62 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial[2] | 57-70 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Hotel) [7] | Up to 53 (28) | 35[6] | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-03 | Residential | 54-55 | 61 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial[2] | 45-52 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-04 | Residential | 48-51 | 61 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Commercial[2] | 31-48 | 70 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Active)[2] | 25-52 | 65 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| NCA-05 | Residential | 40-41 | 59 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |
| | Other (Outdoor Passive)[2] | 38-42 | 60 | N/A[3] | N/A[3] | N/A[3] | - | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] | N/A[3] |

*Note 1: Scenario would likely occur outside of standard construction hours*

*Note 2: Only assessed when in use*

*Note 3: Scenario would likely occur during standard construction hours*

*Note 4: Exceedance above 75 dB are predicted at residential receivers located at NCA-01*

*Note 5: Residential receivers at NCA-01 are currently under construction and expected to be complete late 2015*

*Note 6: Hotel NML is considered an internal noise level*

*Note 7: Hotel predicted internal noise levels are shown in brackets for comparison with the NML (see note 6). The predicted noise levels are based on 6.38 mm laminate glazing, and a window area of 2$m^2$ per Hotel suite*

*Source: Table 29 at Noise Impact Assessment, Appendix*

*Potential construction noise impacts during standard hours*

Potential 'high impact' exceedances of up to 26 dB are predicted for impact piling (scenario 2) at NCA-01 during standard hours.

Potential 'moderate impact' exceedances during standard hours are predicted at sensitive receivers including:

- NCA-01 – up to 11 dB exceedances during landside construction (scenario 7)
- NCA-03 – up to 13 dB exceedances during impact piling (scenario 2).

Potential 'low impact' exceedances during standard hours of between 1 dB and 9 dB are predicted at sensitive receivers including:

- NCA-01 – during pile drilling (scenario 1), pile finishing (scenario 3), intricate lifts (scenario 4), demolition of the wave baffle (scenario 5) and pile extraction (scenario 6)
- NCA-04 – during impact piling (scenario 2) during standard hours.

Other receptors (i.e. hotel) and commercial sensitive receivers would be subject to 'moderate impacts', with NML exceedances of up to 13 dB and 17dB respectively during impact piling works.

*Potential construction noise impacts outside standard construction hours*

Potential 'high impact' exceedances are predicted during impact piling (scenario 2) including:

- NCA-01 – up to 37 dB exceedances during night
- NCA-03 – up to 28 dB exceedances during night.

Potential 'moderate impact' exceedances are predicted at sensitive receivers including:

- NCA-01 – up to 19 dB exceedances during pile drilling (scenario 1) and up to 16 dB during intricate lifts (scenario 4) at night
- NCA-03 – up to 10 dB exceedances during pile drilling (scenario 1) at night
- NCA-04 – up to 24 dB exceedances during impact piling (scenario 2) at night
- NCA-05 – up to 14 dB exceedances during impact piling (scenario 2) at night.

Potential 'low impact' exceedances outside of standard hours are predicted for activities such as intricate lifts and pile drilling (e.g. at NCA-03 and NCA-04).

Other receptors (i.e. hotel) and commercial sensitive receivers would be subject to 'moderate impacts', with NML exceedances of up to 13 dB and 17dB respectively during impact piling works.

*Sleep disturbance during construction*

It is predicted that sleep disturbance is likely to occur with the use of high noise activities such as impact piling (scenario 3) which would cause exceedances at residential receivers of up to 35 dB, 26 dB, 22 dB and 12 dB within NCA-01, NCA-03, NCA-04 and NCA-05 respectively.

Lower noise activities such as pile drilling (scenario 1) and intricate lifts (scenario 4) are predicted to cause exceedances at residential receivers of up to 17 dB, 8 dB and 4 dB at NCA-01, NCA-03 and NCA-04 respectively.

Table 6-9 provides a summary of the indicative out of hours works that are likely to be required during the construction period.

Table 6-9 Summary of indicative out-of-hours works (OOHWs)

| Activities | Time period |
|---|---|
| **Pile Drilling** | |
| Setup for drilling | 12:00 am to 1:00 am |
| Drilling of piles | 1:00 am to 6:00 am |
| Pack up | 6:00 am to 7:00 am |
| **Pile Hammering** | |
| Setup for hammering | 4:00 am to 5:00 am |
| Hammering of piles | 5:00 am to 7:00 am |
| **Intricate Lifting** | |
| Intricate Lifting and placement | 11:00 pm to 7:00 am |

The RNP suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly. The only activity predicted to involve external noise levels of more than 75 dBA at a residential receiver is impact piling. External noise levels of 80 to 88 dBA are anticipated at the residences within NCA-01 during impact piling. Impact piling activities are anticipated to be of a short duration (see Table 4-3 for further information).

It is noted that the ICNG would require the proposal to consider maximum noise levels where construction works are planned to extend over more than two consecutive nights. This would be addressed in the Construction Noise and Vibration Management Plan (CNVMP).

### Operation

Operational noise levels associated with the proposal have been predicted for three scenarios of Barangaroo Ferry Hub as follows:

- Scenario 1 – predicted maximum operations for year 2026:
  - 21 vessels per hour (entering and exiting)
  - Passengers across three wharves, engaged in conversation
  - Three PA systems (one per wharf).
- Scenario 2 – predicted off-peak operations for year 2026:
  - 10 vessels per hour (entering and exiting)
  - Passengers across three wharves, engaged in conversation
  - Three PA systems (one per wharf).
- Scenario 3 – predicted maintenance actives carried out at the Barangaroo Ferry Hub:
  - High pressure water cleaning on two wharves concurrently

- Sewage pump-out across two wharves assumed to be occurring concurrently.

The calculation of noise levels during operation of the proposal inevitably depends on the number of vessel movements, duration of operation at any one time and their location and orientation relative to sensitive receivers. In practice, the noise levels would vary due to the fact that vessels would move along their planned routes and would not all be operating concurrently.

### *Assessment using INP methodology*

Noise design levels for the proposal when applying the NSW Industrial Noise Policy (refer to Appendix E) are provided in Table 6-10.

Based on operational assessment methodology (refer to Appendix E), noise design levels are summarised below in Table 6-10.

Table 6-10 Operational and screening criteria for sensitive receivers

| Guidelines | Time period | Assessment Location | Descriptor | Levels, dBA |
|---|---|---|---|---|
| Industrial Noise Policy (Intrusive) | Daytime[2] 7 am to 6 pm | At receiver's boundary | $LA_{eq(15minute)}$ | Daytime RBL + 5 dB |
| | Evening 6 pm to 10 pm | At receiver's boundary | $LA_{eq(15minute)}$ | Evening RBL + 5 dB |
| | Night-time[2] 10 pm to 7 am | At receiver's boundary | $LA_{eq(15minute)}$ | Night-time RBL + 5 dB |
| Industrial Noise Policy (Amenity, Urban/Industrial Interface) | Daytime[2] 7 am to 6 pm | At receiver's boundary | $LA_{eq(period)}$ | 65 dBA to 70 dBA |
| | Evening 6 pm to 10 pm | At receiver's boundary | $LA_{eq(period)}$ | 55 dBA to 60 dBA |
| | Night-time[2] 10 pm to 7 am | At receiver's boundary | $LA_{eq(period)}$ | 50 dBA to 55 dBA |
| Industrial Noise Policy (Sleep disturbance) | Night-time[2] 10 pm to 7 am | Outside nearest affected bedroom | $LA_{max}$ or $LA_1$ | Night-time RBL + 15 dB |

*Note 1: Assessment time periods are 7 am to 10 pm for daytime and 10pm to 7 am for night-time.*

*Note 2: Time period shown are applicable to Monday to Saturday only. Sundays and public holidays daytime period is between 8 am to 6pm and night-time period is between 10pm to 8am.*

*Source: Table 15 at Noise Impact Assessment, Appendix E*

Based on the above requirements and the background noise levels established in Section 6.1.2, a summary of the noise criteria for the surrounding residential receivers of the proposal is provided below.

Table 6-11 Summary of project specific noise criteria (INP)

| NCA Receiver Type[1] | NM ID | Time Period | Measured RBL ($L_{A90}$) dBA | INP Assessment Criteria | |
|---|---|---|---|---|---|
| | | | | Intrusive Criteria | Amenity Criteria |
| | | | | LAeq (15 minute) | LAeq (period) |
| NCA01-RES | NM1 | Daytime | 52 | 57 | 65 |
| | | Evening | 59[2] | 57 | 55 |
| | | Night-time | 46 | 51 | 50 |
| NCA02-RES | NM1 | Daytime | 52 | 57 | 65 |
| | | Evening | 59[2] | 57 | 55 |
| | | Night-time | 46 | 51 | 50 |
| NCA03-RES | NM2 | Daytime | 51 | 56 | 65 |
| | | Evening | 46 | 51 | 55 |
| | | Night-time | 41 | 46 | 50 |
| NCA04-RES | NM2 | Daytime | 51 | 56 | 65 |
| | | Evening | 46 | 51 | 55 |
| | | Night-time | 41 | 46 | 50 |
| NCA05-RES | NM3 | Daytime | 49 | 54 | 60 |
| | | Evening | 49 | 54 | 50 |
| | | Night-time | 41 | 46 | 45 |

*Note 1: 'RES' refers to residential receivers only (i.e. apartments and single dwellings)*

*Note 2: Where the evening background noise level of evening period is higher than the measured daytime noise level, the lower measured level of daytime would be used. (INP Application notes of Section 0)*

Sound Power Levels (SWLs) derived from measurements taken during the various ferry activities (Appendix E) are shown in Table 6-12. The SWLs are the maximum noise emission levels of ferries that are expected to occur during each activity.

Table 6-12 Sound power level of ferry terminal activities

| Ferry Terminal Activities | SWL, dBA | Duty Factor (time operating per 15 minute period) |
|---|---|---|
| Accelerating | 98 | 2 minutes |
| Reverse Thrust | 93 | 1 minute |
| Idling | 92 | 5 minutes |
| Horn | 118 | 5 seconds |
| PA system | 73 | 5 minutes |
| Passenger noise – casual vocal effort | 60 | 10 minutes |
| Water pump (high pressure water) | 110 | 5 minutes |
| Sewage pump | 72 | 10 minutes |

The duty factor represents the likely amount of time that a particular activity would take during any 15 minute period. This takes account of the fact that in a 15 minute period one ferry operation may involve, for example, acceleration for 1 minute to the terminal, then berthing for 30 seconds using reverse thrust, idling for 5 minutes as the passengers embark the ferry, sounding the horn for 5 seconds before departing the terminal and accelerating to the next destination for 1 minute. (i.e. all the activities would not be operating simultaneously at the same wharf).

Operational noise levels have been predicted at the nearest noise sensitive receivers using the CONCAWE prediction methodology within SoundPLAN noise modelling software.

Note that in the absence of operating schedules, the peak period scenario has been derived based on the forecast operation of the terminal as a worst case (during peak hours with all three wharves in used within a one hour period).

The predicted noise levels for the operation in the peak period scenario are detailed in Table 6-13 and are compared to the assessment criteria as detailed in Section 2 of this report (and Appendix E).

Table 6-13 Predicted operational noise levels (INP)

| Scenario / NCA | Worst-case Predicted Noise Level (dBA) | | | INP Noise Criteria | | | | | | Exceedance | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Intrusive Criteria | | | Amenity Criteria | | | Intrusive Criteria | | | Amenity Criteria | | |
| | LAeq (15minute) | LAeq (Day and Evening) | LAeq (Night) | Daytime | Evening | Night-time | Daytime | Evening | Night-time | Daytime | Evening | Night-time | Daytime | Evening | Night-time |
| **Sc1 – Peak Period Ferry Movements 2026** | | | | | | | | | | | | | | | |
| NCA01-RES | 53 | 53 | 49-50 | 57 | 57 | 51 | 65 | 55 | 50 | - | - | Up to 2 | - | - | - |
| NCA02-RES | <30 | <30 | <30 | 57 | 57 | 51 | 65 | 55 | 50 | - | - | - | - | - | - |
| NCA03-RES | 50-53 | 50-53 | 47-49 | 56 | 51 | 46 | 65 | 55 | 50 | - | 1-2 | 4-7 | - | - | - |
| NCA04-RES | 46-49 | 46-49 | 42-46 | 56 | 51 | 46 | 65 | 55 | 50 | - | - | Up to 3 | - | - | - |
| NCA05-RES | 38-41 | 38-41 | 35-37 | 54 | 54 | 46 | 60 | 50 | 45 | - | - | - | - | - | - |
| **Sc2 – Off-Peak Period Ferry Movements 2026** | | | | | | | | | | | | | | | |
| NCA01-RES | Up to 50 | Up to 50 | 46-47 | 57 | 57 | 51 | 65 | 55 | 50 | - | - | - | - | - | - |
| NCA02-RES | <30 | <30 | <30 | 57 | 57 | 51 | 65 | 55 | 50 | - | - | - | - | - | - |
| NCA03-RES | 47-50 | 47-50 | 44-46 | 56 | 51 | 46 | 65 | 55 | 50 | - | - | 1-4 | - | - | - |
| NCA04-RES | 43-46 | 43-46 | 39-43 | 56 | 51 | 46 | 65 | 55 | 50 | - | - | - | - | - | - |
| NCA05-RES | 35-38 | 35-38 | 32-34 | 54 | 54 | 46 | 60 | 50 | 45 | - | - | - | - | - | - |

| Scenario / NCA | Worst-case Predicted Noise Level (dBA) | | | INP Noise Criteria | | | | | | Exceedance | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Intrusive Criteria | | | Amenity Criteria | | | Intrusive Criteria | | | Amenity Criteria | | |
| | LAeq (15minute) | LAeq (Day and Evening) | LAeq (Night) | Daytime | Evening | Night-time | Daytime | Evening | Night-time | Daytime | Evening | Night-time | Daytime | Evening | Night-time |
| **Sc3 – Maintenance Works** | | | | | | | | | | | | | | | |
| NCA01-RES | 64-66 | 64-66 | 61-62 | 57 | 57 | 51 | 65 | 55 | 50 | 7-9 | 7-9 | 13-15 | Up to 1 | 9-11 | 11-12 |
| NCA02-RES | <30 | <30 | <30 | 57 | 57 | 51 | 65 | 55 | 50 | - | - | - | - | - | - |
| NCA03-RES | Up to 50 | 50-52 | 47-49 | 56 | 51 | 46 | 65 | 55 | 50 | - | Up to 1 | 4-6 | - | - | - |
| NCA04-RES | 46-49 | 46-49 | 42-45 | 56 | 51 | 46 | 65 | 55 | 50 | - | - | Up to 3 | - | - | - |
| NCA05-RES | 38-40 | 38-40 | 35-36 | 54 | 54 | 46 | 60 | 50 | 45 | - | - | - | - | - | - |

*Note : INP assessment Periods –*

*Day: 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday;*

*Evening: 6.00 pm to 10.00 pm;*

*Night: 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday.*

Operational noise levels have been predicted at the nearest receiver locations to the proposed Barangaroo Ferry Hub. The resultant daytime, evening and night-time LAeq(15minute) and LAeq(period) noise level predictions are presented in Table 6-13 for the proposed operational scenarios and are compared with the relevant INP assessment criteria.

The predicted noise levels of scenario 1 and scenario 2 show compliance with the nominated daytime, evening and night-time amenity noise criteria.

Exceedances of up to 2 dB and 7 dB in relation to the evening and night-time intrusive criteria respectively have been predicted for scenario 1 activities.

Exceedances of up to 4 dB in relation to the night-time intrusive criteria have been predicted for scenario 2 activities.

Exceedances of up to 15 dB and 12 dB in relation to the nominated night-time intrusive and amenity criteria have been predicted for scenario 3 activities. The exceedances are likely due to the proposed use of high pressure water cleaning equipment

### *Assessment using alternative methodologies (RING and RNP)*

Noise design levels for the proposal using the alternative RNP and RING assessment methodologies are provided in Table 6-14 (refer to Appendix E).

Table 6-14 Operational and screening criteria for sensitive receivers – alternate

| Guidelines | Time period | Assessment Location | Descriptor | Levels, dBA |
|---|---|---|---|---|
| Rail Infrastructure Noise Guideline | Daytime[1] | 1 metre from nearest affected facade | $LA_{eq(15hour)}$ | 60 |
| | | | $LA_{max}$ | 80 |
| | Night-time[1] | 1 metre from nearest affected facade | $LA_{eq(9hour)}$ | 50 |
| | | | $LA_{max}$ | 80 |
| Road Noise Policy | Daytime[1] | 1 metre from nearest affected facade | $LA_{eq(1hour)}$ | 55 |
| | Night-time[1] | 1 metre from nearest affected facade | $LA_{eq(1hour)}$ | 50 |
| | | Outside nearest affected bedroom facade | $LA_{max}$ | 75 dBA to 80 dBA |

*Note 1: Assessment time periods are 7 am to 10 pm for daytime and 10pm to 7 am for night-time.*

*Note 2: Time period shown are applicable to Monday to Saturday only. Sundays and public holidays daytime period is between 8 am to 6pm and night-time period is between 10pm to 8am.*

*Source: Table 15 at Noise Impact Assessment, Appendix E*

The operational noise objectives which have been adopted are identified in Table 6-15. Predicted noise levels for operation during peak and off peak periods (scenario 1 and 2) and maintenance works (scenario 3) are detailed in Table 6-15 and compared to the screening levels.

Table 6-15 Operation predicted noise levels (alternate)

| NCA | Receiver Type | Worst-case predicted noise level (dBA) | | Operational noise objective | | | | | Exceedance | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Daytime | | Night-time | | | Daytime | Night-time | |
| | | $LA_{eq}$ (1hr) | $LA_{max}$ | $LA_{eq}$ (1hr) | $LA_{max}$ | $LA_{eq}$ (1hr) | $LA_{max}$ | Sleep Disturbance $LA_{max}$ | $LA_{eq(1hr)}$/ $LA_{max}$ | $LA_{eq(1hr)}$/$LA_{max}$ | Sleep Disturbance $LA_{max}$ |
| **Scenario 1 – Peak period ferry movements 2026** | | | | | | | | | | | |
| NCA-01 | Residential | Up to 53 | Up to 72 | 60 | 80 | 50 | 80 | 61 | -/- | **Up to 3**/- | **Up to 11** |
| | Commercial | 45-50 | 67-69 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Hotel)[3] | Up to 49 (24) | Up to 63 (38) | 35[2] | N/A | 35[2] | N/A | N/A | -/- | -/- | N/A |
| NCA-02 | Residential | <30 | 42-42 | 60 | 80 | 50 | 80 | 61 | -/- | -/- | - |
| | Commercial | 44-51 | 65-71 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Hotel)[3] | Up to 42 (17) | Up to 62 (37) | 35[2] | N/A | 35[2] | N/A | N/A | -/- | -/- | N/A |
| NCA-03 | Residential | 50-53 | 64-66 | 60 | 80 | 50 | 80 | 56 | -/- | **Up to 3**/- | **8-10** |
| | Commercial | 38-45 | 53-62 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| NCA-04 | Residential | 46-49 | 59-61 | 60 | 80 | 50 | 80 | 56 | -/- | -/- | **3-5** |
| | Commercial | 33-44 | 41-58 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Outdoor Active)[1] | 33-50 | 35-62 | 55 | N/A | N/A | N/A | N/A | -/N/A | -/N/A | N/A |
| NCA-05 | Residential | 38-41 | 50-52 | 60 | 80 | 50 | 80 | 56 | -/- | -/- | - |
| | Other (Outdoor Passive)[1] | 38-42 | 48-53 | 50 | N/A | N/A | N/A | N/A | -/N/A | -/N/A | N/A |

| NCA | Receiver Type | Worst-case predicted noise level (dBA) | | Operational noise objective | | | | | Exceedance | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Daytime | | Night-time | | | Daytime | Night-time | |
| | | $LA_{eq}$ (1hr) | $LA_{max}$ | $LA_{eq}$ (1hr) | $LA_{max}$ | $LA_{eq}$ (1hr) | $LA_{max}$ | Sleep Disturbance $LA_{max}$ | $LA_{eq(1hr)}$/ $LA_{max}$ | $LA_{eq(1hr)}$/$LA_{max}$ | Sleep Disturbance $LA_{max}$ |
| **Scenario 2 – Off-Peak Period Ferry Movements 2026** | | | | | | | | | | | |
| NCA-01 | Residential | Up to 50 | Up to 72 | 60 | 80 | 50 | 80 | 61 | -/- | -/- | **Up to 11** |
| | Commercial | 42-47 | 67-69 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Hotel)[3] | Up to 46 (21) | Up to 63 (38) | 352 | N/A | 352 | N/A | N/A | -/- | -/- | N/A |
| NCA-02 | Residential | <30 | 42-42 | 60 | 80 | 50 | 80 | 61 | -/- | -/- | - |
| | Commercial | 41-48 | 65-71 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Hotel)[3] | Up to 39 (14) | Up to 62 (37) | 352 | N/A | 352 | N/A | N/A | -/- | -/- | N/A |
| NCA-03 | Residential | 47-50 | 64-66 | 60 | 80 | 50 | 80 | 56 | -/- | -/- | **8-10** |
| | Commercial | 35-42 | 53-62 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| NCA-04 | Residential | 43-46 | 59-61 | 60 | 80 | 50 | 80 | 56 | -/- | -/- | **3-5** |
| | Commercial | 30-41 | 41-58 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Outdoor Active)[1] | 30-47 | 35-62 | 55 | N/A | N/A | N/A | N/A | -/N/A | -/N/A | N/A |
| NCA-05 | Residential | 35-38 | 50-52 | 60 | 80 | 50 | 80 | 56 | -/- | -/- | - |
| | Other (Outdoor Passive)[1] | 35-39 | 48-53 | 50 | N/A | N/A | N/A | N/A | -/N/A | -/N/A | N/A |

| NCA | Receiver Type | Worst-case predicted noise level (dBA) | | Operational noise objective | | | | | Exceedance | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Daytime | | Night-time | | | Daytime | Night-time | |
| | | $LA_{eq}$ (1hr) | $LA_{max}$ | $LA_{eq}$ (1hr) | $LA_{max}$ | $LA_{eq}$ (1hr) | $LA_{max}$ | Sleep Disturbance $LA_{max}$ | $LA_{eq(1hr)}$/ $LA_{max}$ | $LA_{eq(1hr)}$/$LA_{max}$ | Sleep Disturbance $LA_{max}$ |
| **Scenario – Maintenance Works** | | | | | | | | | | | |
| NCA-01 | Residential | 64-66 | 69-70 | 60 | 80 | 50 | 80 | 61 | **4-6**/- | **14-16**/- | **8-9** |
| | Commercial | 56-60 | 60-63 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Hotel)[3] | Up to 49 (24) | Up to 53 (28) | 352 | N/A | 352 | N/A | N/A | -/- | -/- | N/A |
| NCA-02 | Residential | <30 | <30 | 60 | 80 | 50 | 80 | 61 | -/- | -/- | - |
| | Commercial | 46-56 | 50-61 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Hotel)[3] | Up to 43 (18) | Up to 48 (23) | 352 | N/A | 352 | N/A | N/A | -/- | -/- | N/A |
| NCA-03 | Residential | 50-52 | 53-55 | 60 | 80 | 50 | 80 | 56 | -/- | **Up to 2**/- | - |
| | Commercial | 32-48 | 34-51 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| NCA-04 | Residential | 46-49 | 49-52 | 60 | 80 | 50 | 80 | 56 | -/- | -/- | - |
| | Commercial | <30-44 | 30-48 | 70 | N/A | 70 | N/A | N/A | -/N/A | -/N/A | N/A |
| | Other (Outdoor Active)[1] | <30-49 | <30-52 | 55 | N/A | N/A | N/A | N/A | -/N/A | -/N/A | N/A |
| NCA-05 | Residential | 38-40 | 41-42 | 60 | 80 | 50 | 80 | 56 | -/- | -/- | - |
| | Other (Outdoor Passive)[1] | 37-41 | 39-43 | 50 | N/A | N/A | N/A | N/A | -/N/A | -/N/A | N/A |

*Note 1: Only assessed when in use*

*Note 2: The Hotel NML is an internal noise level*

*Note 3: Hotel predicted internal noise levels are shown in brackets for comparison with the NML. The predicted noise levels are based on 6.38 mm laminate glazing, and a window area of 2$m^2$ per Hotel suite*

*-: No exceedance*

*N/A: Sensitive receiver not assessed against noise management levels.*

*Source: Table 19 at Noise Impact Assessment, Appendix E*

*Predicted peak and off peak noise impacts*

Predicted noise levels of vessel movements during peak (scenario 1) and off peak (scenario 2) periods comply with daytime noise levels (for both LAeq(1hour) and LAmax).

An exceedance of up to 11 dB above the sleep disturbance screening criterion has been predicted for the receivers located at NCA-01, up to 10 dB at NCA-03 and up to 5 dB at NCA-04 for both scenario 1 and 2. The peak noise events for peak and off-peak ferry movements are identical due to the use of warning horns, which are the likely cause of these predicted exceedances.

*Predicted maintenance noise impacts*

Predicted noise levels of maintenance works (scenario 3) would exceed noise levels by up to 6 dB and 16 dB at NCA-01 for maintenance works undertaken in daytime and night-time periods respectively. Predicted noise levels also indicate an exceedance of up to 2 dB at NCA-03 during maintenance works undertaken at night-time.

An exceedance of up to 9 dB above the sleep disturbance screening criterion has been predicted for the residential receivers in NCA-01.

The exceedances for Scenario 3 are due to the use of use of high pressure water cleaning equipment and the close proximity of receivers. The use of high pressure cleaning equipment is expected to only occur for short durations once per month at each wharf.

*Sleep disturbance*

Exceedances of the sleep disturbance screening criteria of up to 11 dB, 10 dB and 5 dB (predicted LAmax noise levels of 72 dB, 66 dB and 61 dB) are predicted in scenario 1 and scenario 2 for residential receivers at NCA-01, NCA-03 and NCA 04 respectively. This is likely due to the use of warning horns.

Exceedances of the sleep disturbance screening criteria of up to 9 dB (predicted LAmax noise level of 70 dB) are predicted in scenario 3 for residential receivers at NCA-01. This is likely due to the use of high pressure water cleaning equipment.

As discussed in Section 6.1.1, maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause sleep arousal. On this basis, the predicted short-term external noise levels of between 60 dBA to 65 dBA at residential receivers in NCA-02, NCA-04 and NCA-05 are unlikely to cause awakening reactions. A 1 dB variation in noise level would not be audible and thus the short-term external noise level predicted at for scenario 1 and scenario 2 at NCA-03 would be unlikely to cause sleep disturbance to the residential receivers in this noise catchment.

Maximum noise levels of up to 72 dBA for scenario 1 and scenario 2, and 70 dB for scenario 3 are predicted at the receivers in NCA-01. The RNP suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly. While the night-time vessel movements would likely decrease in the night-time periods (5:00 am to 7:00 am and 10:00 pm to 12:00 am midnight), the maximum noise level due to horn usage is unlikely to decrease. On this basis, the predicted noise levels show sleep disturbance at receivers in NCA-01.

### 6.1.4 Mitigation measures

The following mitigation measures are recommended to manage noise and vibration impacts:

- A Construction Noise and Vibration Management Plan (CNVMP) will be included in the CEMP to provide the framework and mechanisms for the management and mitigation of all potential noise and vibration impacts from the construction works.
- A CNVMP will be prepared and all work will be undertaken in accordance with the TfNSW *Construction Noise Strategy* (CNS) and Interim Construction Noise Guidelines where practicable. The CNVMP will as a minimum include:
  - Identification of nearby residences and sensitive land uses
  - Determination of Noise Management Levels (NMLs) and the prediction of noise levels
  - Details of construction activities and a schedule for construction works
  - Description of approved hours of work
  - An out of hours works protocol
  - Restrictions on the hours of construction for specific works
  - Details of work practices and measures that will be implemented to minimise noise impacts
  - Description of the complaints handling process.
- Details of monitoring that is required.
- Construction and demolition activities, including heavy vehicle movements will generally be restricted to the standard construction hours of:
  - Monday to Friday 7:00 am to 6:00 pm
  - Saturday 8:00 am to 1:00 pm
  - No work on Sundays or public holidays.
- The installation of piles and intricate lifting works will require specific weather conditions, such as calmer water. Therefore works may be required in the evening or night-time period, or during the night-time/daytime shoulder period (e.g. 5:00 am to 7:00 am), for safety of workers, businesses, residents and pedestrians.
- All works will be undertaken in accordance with the construction hours detailed above, except for the following works, as outlined in the TfNSW *Construction Noise Strategy* (CNS), which will be permitted outside of these hours:
  - Any works which do not cause noise emissions to be more than 5dBA higher than RBL (background) noise levels at any nearby residential property and/or other noise sensitive receiver
  - The delivery of plant, equipment and materials which is required outside these hours as requested by police or other authorities for safety reasons and with suitable notification to the community as agreed by the TfNSW Principal Manager Environmental Management
  - Emergency work to avoid the loss of lives, property and/or to prevent environmental harm
  - Any other work in accordance with TfNSW's Out-of-Hours Work (OOHW) Procedure and considered essential to the project.

- Where OOHW is proposed which has not been assessed in the EIS and CNVMP, activity and site specific Construction Noise Impact Statements (CNISs) will be developed to support an OOHW Application. The CNISs will provide a detailed assessment of potential noise levels and site specific measures to control potential noise impacts and minimise the potential for disturbance at affected receptors.
- Night works will be programmed to minimise the number of consecutive nights work impacting the same receptors, as per the TfNSW CNS.
- The proponent and construction contractor(s) will schedule work to provide respite periods from the noisiest activities, and communicate with the impacted residents by clearly explaining the duration and noise level of the works, as per the TfNSW CNS.
- Community notification and consultation, including notification regarding noisy works, will be undertaken in accordance with the TfNSW CNS.
- Specific notifications will be letterbox dropped or hand distributed to nearby stakeholders and other sensitive receivers no later than seven days ahead of new construction activities and construction activities that are to be undertaken out-of-hours or are considered high noise generating. This form of communication is used to support periodic notifications.
- Consultation will be undertaken with the Barangaroo Integrated Transport Plan Working Group to co-ordinate management measures for cumulative transport impact during construction.
- Broadband audible or non-tonal alarms will be used on all construction vehicles and mobile plant regularly used on site and for any out-of-hours work, as per the TfNSW CNS.
- The use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers will be avoided or limited where feasible and practicable.
- Equipment which is used intermittently will be shut down or throttled down to a minimum when not in use. Plant items such as barge(s), concrete trucks will be turned off when parked or otherwise not in use.
- Regular compliance checks on the noise emissions of all plant and machinery used for the proposal will be undertaken to indicate whether noise emissions from plant items are higher than predicted and whether any silencing equipment on items of plant is defective.
- Environmental awareness training must be provided, by the contractor, to all field personnel and subcontractors. Regular reinforcement (such as at toolbox talks) of the need to minimise noise will be undertaken.
- Noise monitoring at sensitive receivers will be used during construction to assist in managing high noise OOHW activities and in response to complaints. All noise monitoring will be carried out by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.2 Traffic and transport

This section assesses the potential impact on traffic and transport within the study area as a result of the proposal. The assessment presented in this section draws on information from the technical paper, Traffic and Transport Impact Assessment, prepared by Arup for the EIS (Appendix F) and responds to the relevant SEARs as outlined in the table below.

### Secretary's environmental assessment requirements

| Key Issues | SEAR | Where Addressed |
|---|---|---|
| Transportation and Operation | An assessment and modelling of the traffic and transport impacts of the development during construction and operation including consideration of:<br>• Estimated ferry arrivals and departures and impacts on the waterway (weekdays, weekends and public holidays);<br>• Access route identification;<br>• Estimated ferry passenger numbers (weekdays, weekends, public holiday and per year);<br>• Hours of operation;<br>• Estimated vehicle trips, type and frequency associated with ferry operations and maintenance;<br>• Vehicle access;<br>• Car parking and bicycle parking requirements.;<br>• Truck movements on the foreshore for the delivery of materials during construction; and<br>• Cumulative impacts of all projects at Barangaroo. | Sections 3.2, 6.2.2 and 6.17 and Appendix F |
| Transportation and Operation | Impacts on cyclist and pedestrian access and safety, including consideration of opportunities to integrate cycling and pedestrian elements with the public domain. | Section 6.2.2 and Appendix F |
| Navigation and Safety | A review of existing boating activities in the area and an assessment of the impacts of the development on water-based traffic and the existing users of Sydney Harbour and nearby ferry operations at King Street Wharf, Sydney Aquarium and Pyrmont Bay. | Section 6.2.2 and Appendix F |
| Public Access/Domain | Address queue management and adequacy of pedestrian circulation space and facilities (e.g. public toilets, awnings and/or landscaping for shade etc.) around the wharves. | Sections 4.2, 6.2.2 and 6.8 and Appendix F |
| Public Access/Domain | Address measures available to manage wharves and ferry capacity and congestion issues during major events. | Sections 6.2.2 and 6.8 and Appendix F |

### 6.2.1 Existing and adjacent development

#### Waterways

Darling Harbour is one of Sydney's busiest marine transport hubs. It is currently used by a variety of small leisure craft, ferries and commercial vessels, currently without restrictions on access. The waterway to the north and north-west of the proposal area is used by commercial vessels accessing White Bay and Johnston Bay, as well as ferries and leisure craft. The outer edge of the Darling Harbour waterway is largely occupied by commercial vessel berths. Access to these berths is through the entrance to Darling Harbour which is about 130 metres wide.

The nearest berth to the proposal area is the King Street Wharf 1. This wharf has two berthing faces (north and south). The northern berth is occupied by Captain Cook Cruises under a lease arrangement with Roads and Maritime. The King Street Wharf wave baffle is located on the northern side of the King Street Wharf 1.

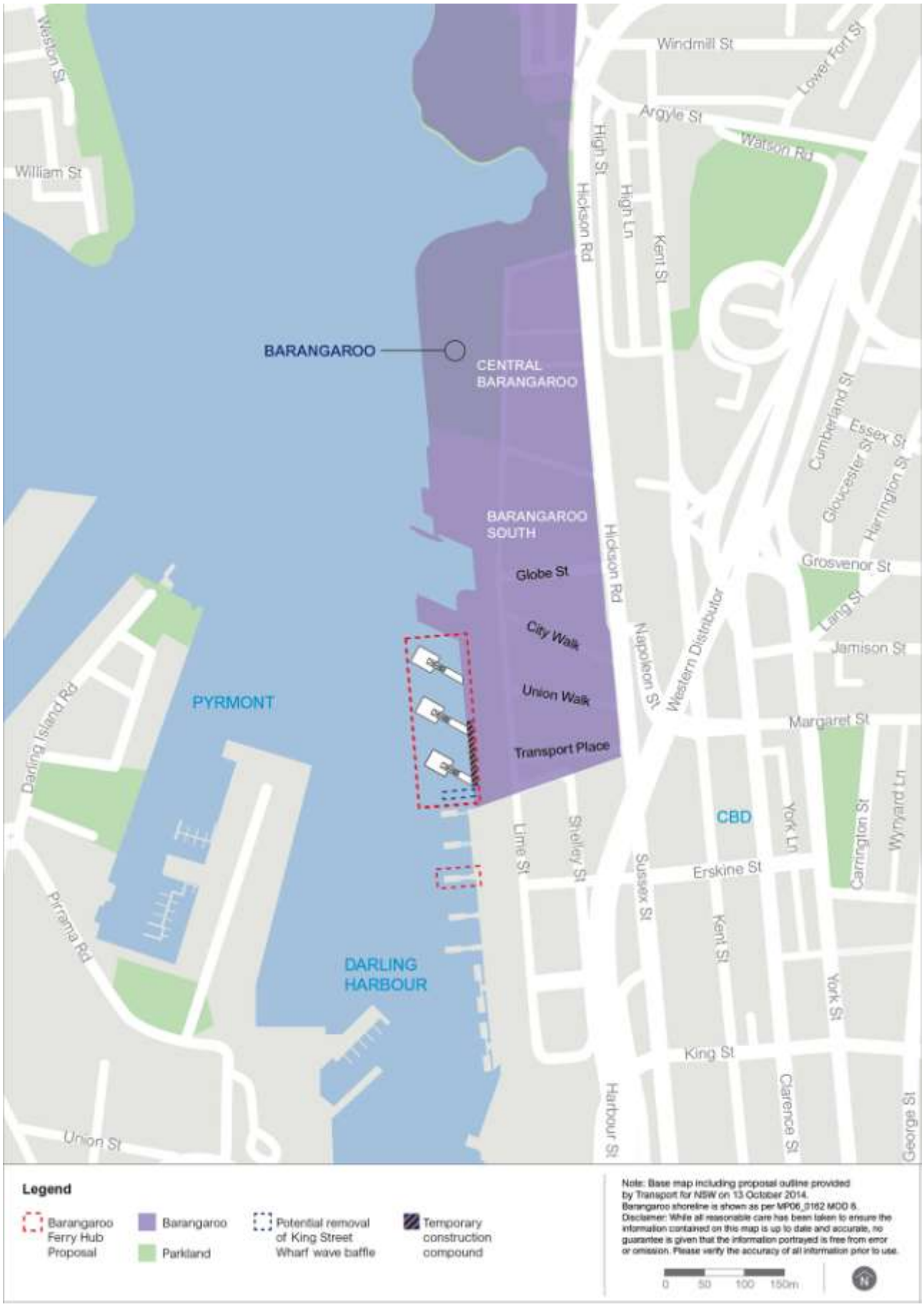
Sydney Ferries services, including Darling Harbour and Parramatta River services, currently operate from King Street Ferry Wharf on weekdays and weekends, with a total of 86 services per day during weekdays and 91 services per day on Saturdays and 94 services on Sundays. During the weekday morning peak and on the weekends there are up to eight ferry services per hour using King Street Ferry Wharf, with fewer services outside of peak periods. There are also many charter cruise companies operating from Darling Harbour providing scheduled and unscheduled cruises.

### Road network

The primary roads currently serving the Barangaroo precinct include Sussex Street, Hickson Road, Napoleon Street, Lime Street and Shelley Street, as shown in Figure 6-2. Lime Street is the closest vehicular traffic route to the proposal. Lime Street is a two lane local road that connects to King Street at the south and Shelley Street to the east. Lime Street is currently being extended further north to serve both Barangaroo South and Central Barangaroo.

Hickson Road (between Erskine Street and Lower Fort Street) and Napoleon Street (between Hickson Road and Kent Street) come under the control of BDA. City of Sydney Council manages all other roads in the precinct. The nearest State Roads under the control of Roads and Maritime Services are King Street and the Western Distributor.

## Figure 6-2 Existing road network



### Traffic volumes

The most recent traffic counts were undertaken in the Barangaroo precinct in July 2013 (which is considered sufficient for the purposes of this impact assessment). These counts indicate Sussex Street (in the vicinity of the proposal) carries more than 1100 vehicles in both the AM and PM commuter peak hours. During the morning peak hour (8 am to 9 am), more than 800 vehicles were recorded travelling north on Shelley Street south of Erskine Street.

Planned development in the vicinity of the proposal includes Barangaroo South, Central Barangaroo and Barangaroo Point. These developments have high targeted reliance on public transport with private vehicle movements restricted by the level of car parking provided. The additional vehicle trips expected to be generated by the Barangaroo precinct are shown in Table 6-16. These vehicle movements would be focused on Hickson Road and Napoleon Road for access to basement car parking areas. There would be minor traffic increases on local roads in the King Street Wharf precinct associated with local access and taxi circulation.

Table 6-16 Additional vehicle trips generated by the Barangaroo precinct

| Development | Vehicles per hour | |
|---|---|---|
| | AM peak hour | PM peak hour |
| Barangaroo South | 450 | 375 |
| Central Barangaroo | 150 | 200 |
| Barangaroo Point | 15 | 120 |
| Total | 615 | 675 |

*Source: Barangaroo Transport Management and Accessibility Plan (Arup, 2010)*

### Parking

On-street parking in the precinct is currently limited to time restricted parking, ranging from five minutes up to 10 hours. There are about 14 loading bays for vehicles on the western side of Lime Street between 7 am and 6 pm Monday to Friday and 7am to 10 am Saturday, with four hour parking restrictions in place outside these times. All day car parking is available in a number of off-street car parking areas in close proximity to the proposal. The closest public parking is available at 1 Shelley Street and 275 Kent Street. Limited additional public parking would be provided in Barangaroo South for visitors.

### Public transport

The current public transport services in and around the proposal area are shown on Figure 6-3 and detailed in the following sections.

#### *Ferries*

The closest public ferry wharf to the proposal is King Street Ferry Wharf. Based on the current ferry timetable, Parramatta River (F3) and Darling Harbour (F4) ferry services operate at King Street Ferry Wharf between 6.30 am and 11.30 pm on weekdays and 8.30 am to 11.30 pm on weekends and public holidays. Up to eight services per hour operate from this wharf in the peak direction, with fewer services in off-peak periods.

### *Rail*

Wynyard Station is the closest railway station to the proposal, located about 400 metres walking distance from the proposal. Wynyard is served by the T1 – North Shore Northern and Western line, T2 – Airport Inner West and South line and T3 – Bankstown line, making the station highly accessible for passengers from most parts of the Sydney metropolitan area.

### *Light Rail*

The existing light rail route extends from Central Station via Hay Street to Darling Harbour and then follows the freight rail corridor through Pyrmont, Glebe and Leichhardt to Dulwich Hill. The planned CSELR project would provide a new light rail line extending from Circular Quay through George Street to Central Station and to the University of NSW via Anzac Parade and Alison Road. A stop is proposed on George Street at Wynyard Station which would connect light rail and the Barangaroo Ferry Hub via Wynyard Walk and surface footpaths.

### *Bus*

Two bus routes currently directly service the Barangaroo precinct, those being routes 412 (King Street Wharf and Campsie via Lewisham) and 413 (King Street Wharf and Campsie via Dulwich Hill). These services operate at 15 minute frequencies during the morning and evening peak hours.

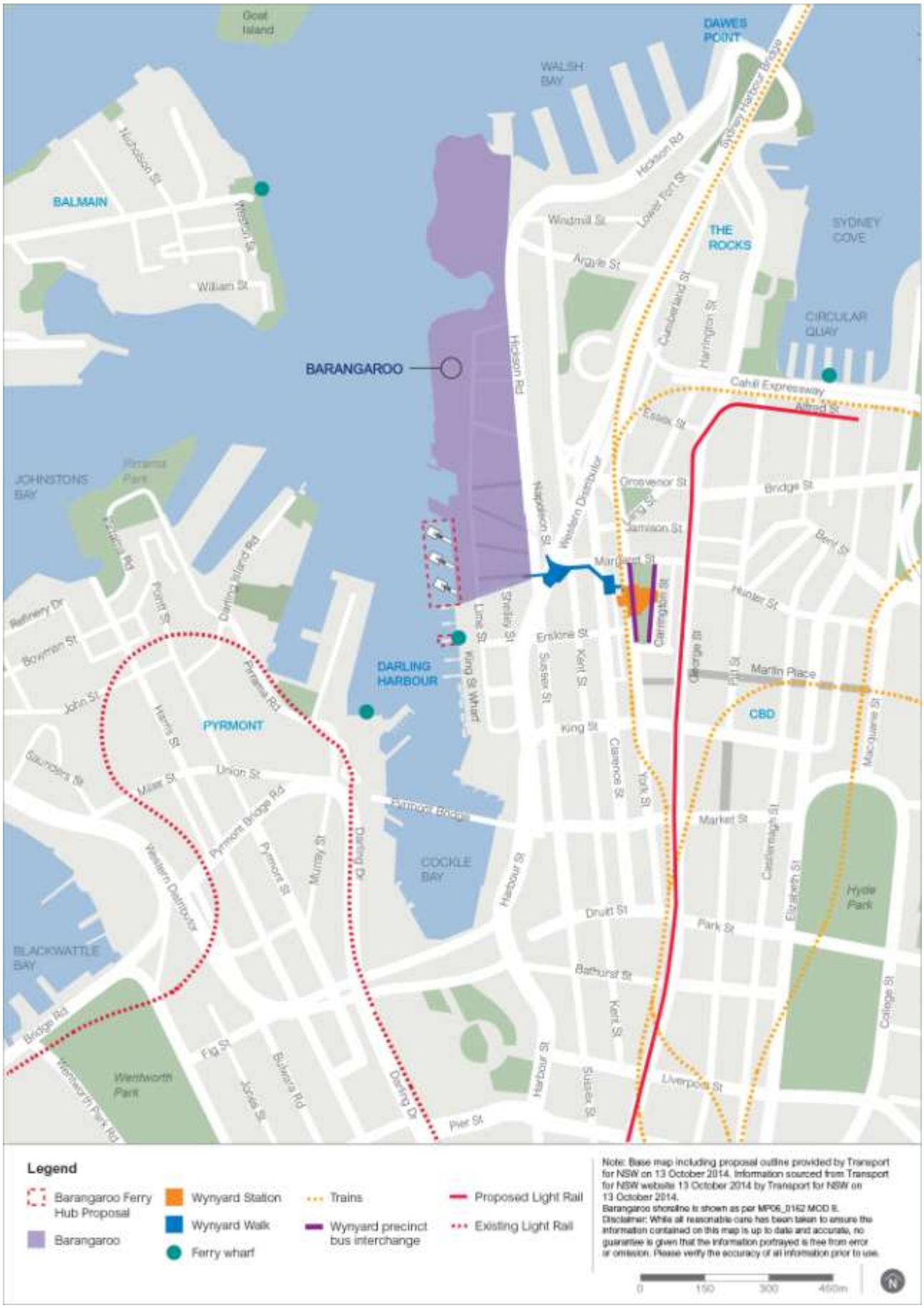
A number of bus routes operate along Clarence Street and York Street serving Wynyard Station. These bus routes largely service the North Shore, Northern Beaches and North-West Sydney.

The *Sydney City Centre Access Strategy* (TfNSW, 2013a) proposes new bus services along Hickson Road to service Barangaroo. Bus stop locations have not yet been determined.

## Taxis

A formal taxi rank is currently provided at the northern end of Shelley Street, with capacity for up to seven taxis queued at any one time. There is also a secure taxi rank at the northern end of Lime Street which operates between 10 pm and 4 am on Friday and Saturday nights. Barangaroo South would supplement these taxi ranks with new ranks proposed on Hickson Road and Globe Street.

## Figure 6-3 Public transport network



## Pedestrian network

The roads in the vicinity of the proposed Barangaroo Ferry Hub generally provide controlled pedestrian crossings on all legs of signalised intersections. Figure 6-4 shows the current pedestrian network in and around the proposal area. Footpaths are provided on both sides of all streets in the area. A number of physical barriers in the precinct may deter people from travelling west towards Barangaroo. These include:

- Busy traffic along York Street
- Severance caused by the Bradfield Highway between Argyle Street and Grosvenor Street
- Hickson Road cliff face
- Steep topography from Wynyard station to Barangaroo
- Western Distributor's elevated structures.

There is a difference in grade between Wynyard Station and the proposal site. Wynyard Walk (currently under construction) would improve connectivity for pedestrians by providing a grade separated link where pedestrians may bypass on-street delays, travelling between Wynyard and the Barangaroo waterfront in about six minutes.

Currently the foreshore adjacent to Barangaroo is closed to pedestrian movements for construction of the Barangaroo South buildings and public domain. The foreshore is planned to reopen in March 2015. The proposal area adjoins the northern edge of the King Street Wharf promenade. The King Street Wharf promenade is a busy pedestrian thoroughfare providing access to waterfront properties and the commercial and public ferry wharves at King Street Wharf. Access to the foreshore and the northern end of the King Street Wharf promenade is from Lime Street and connections from the south including Darling Harbour foreshore walk and Pyrmont Bridge.

Once constructed, Barangaroo South will comprise a series of pedestrian connections and roads. A pedestrian promenade is to be developed along the length of the Barangaroo foreshore edge – providing a continuous connection from Darling Harbour north to Barangaroo Point site. As shown in Figure 6-4, two new pedestrian bridges will cross Sussex Street connecting between Wynyard Walk and Barangaroo. Wynyard Walk Bridge provides a direct connection from Wynyard Walk to Transport Place. A second bridge known as City Walk Bridge (delivered as part of the Barangaroo development) would connect into the heart of Barangaroo South.

## Figure 6-4 Pedestrian network

### Bicycle network

The cycling network surrounding the proposal comprises a number of different routes, described below.

- Kent Street (bi-directional separated cycleway): Kent Street provides the predominant north-south cycling route through the CBD. It is largely used by cyclists travelling from the southern and eastern suburbs through the CBD, linking with the Harbour Bridge cycleway. Construction of stage two of the cycleway, connecting Druitt Street to Liverpool Street, is currently underway.
- Sydney Harbour Bridge (bi-directional separated cycleway): The Sydney Harbour Bridge cycleway provides access for cyclists arriving from the northern suburbs of Sydney. The cycleway connects with the Kent Street cycleway via a link through Observatory Hill Park.
- Pyrmont Bridge (shared pathway): The Pyrmont Bridge share pedestrian/cycle path provides a key link for cyclists arriving from the western suburbs and inner west. The path continues to the start of the King Street cycleway at the intersection of King Street and Sussex Street.
- Hickson Road (bicycle shoulder lane): The on-road cycleway along Hickson Road runs adjacent to the Barangaroo site and provides access to the Rocks and Circular Quay. The route is largely used by recreational cyclists, with users generally accessing the cycleway from other routes.
- Darling Harbour/Shelley Street (shared pathway/mixed traffic): A popular route for cyclists travelling to the north CBD area via the inner west, eastern and southern suburbs is via the Darling Harbour precinct and through to Shelley Street. This route is attractive for cyclists as it provides a direct route to the Barangaroo precinct with minimal interaction with vehicles along trafficable routes.

With an Opal card, cyclists may take their bikes onto the ferry at no additional cost (previously with paper tickets during peak hours, taking a bicycle on a ferry required an additional child ticket).

## 6.2.2 Potential impact

### Construction

Construction would normally be undertaken during the following recommended standard hours:

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

Some work outside of standard hours is likely to be required in order to carry out piling activities and intricate lifts from the barge mounted crane, due to the requirement for calm water conditions during these construction activities.

#### *Maritime transport*

The majority of construction plant, equipment, materials and personnel would access the construction site via Sydney Harbour, travelling by boat and/or barge from the construction contractor's off-site facility to the proposal area.

The 130 metre wide navigation channel would be maintained throughout the construction period wherever possible to minimise disturbance to vessel movements and safety of vessels travelling to and from Darling Harbour during construction. The proposal would generate minor increases in water traffic during the construction period.

Water-borne construction plant may also be operated and docked within the proposal area during the construction period. Some minor detours may be required during this time, however this is unlikely to have a significant impact to other users of the waterway and access to other ferry wharves would not be restricted.

Weekends and special event periods (i.e. New Years Eve, Vivid and Australia Day) are expected to attract the most recreational and unchartered commercial vessel movements.

Due to the proximity of the proposal to King Street Wharves, a management plan with appropriate measures would be prepared to manage vessel manoeuvring during construction work.

### *Vehicular traffic*

Construction of the proposal would require a small number of light and heavy vehicles to transport materials to and from the construction compound located on the foreshore. It is anticipated that the busiest period for land based vehicle access would be for concrete pours associated with the link structures after piling has been completed. Up to ten concrete trucks per day would access the site during concrete pours (about one vehicle per hour). The expected traffic impact is considered to be minimal in the context of existing and expected traffic volumes on Lime Street during the construction period.

During the construction period, some occupation at the Barangaroo South commercial space would have commenced. It is anticipated that traffic would be able to access the basement car park from Hickson Road with only minimal circulation traffic along Lime Street. Access to the construction compound may be from Lime Street via a gateway (if possible). The estimated construction vehicle movements could be easily accommodated by the surrounding road network with ample capacity, and therefore the proposal would result in negligible road network impacts.

### *Construction vehicle routes*

The anticipated traffic routes that construction vehicles would use are summarised below and shown in Figure 6-5 and Figure 6-6. These routes provide access primarily for concrete trucks from the batching plants. With the majority of activity being associated with the concrete pours, the impact is considered low and could be easily accommodated on the surrounding road network.

From the north and north-west:

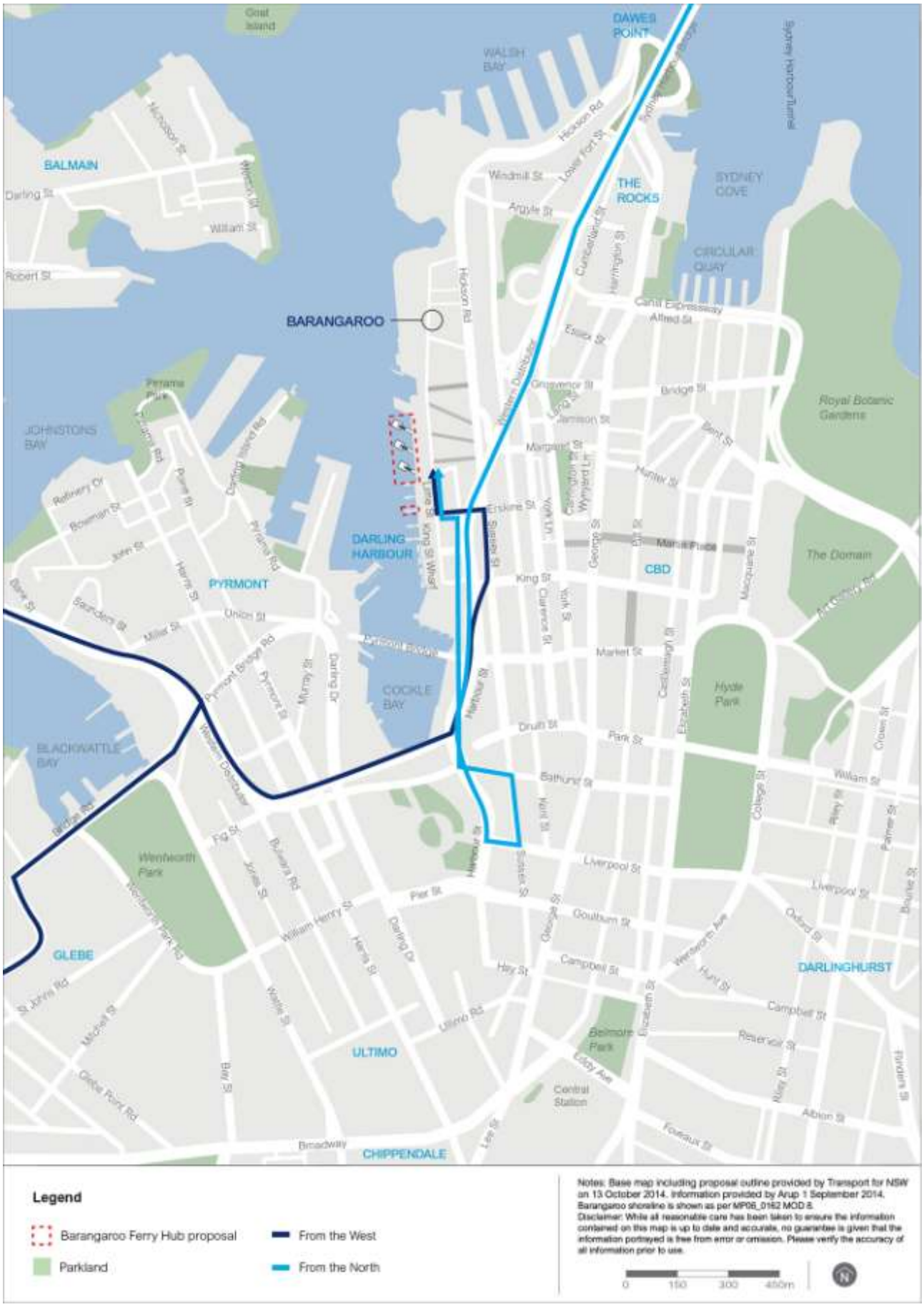
- Harbour Bridge – Western Distributor – Bathurst Street – Liverpool Street – Harbour Street – Shelley Street – Erskine Street – Lime Street(inbound).
- Lime Street – Erskine Street – Hickson Road – Napoleon Street – Kent Street – Western Distributor – Harbour Bridge (outbound).

This southbound vehicle activity would occur during peak hours as there is no access for general traffic from the Harbour Bridge to York Street between 6.30 am – 9.30 am (Monday – Friday).

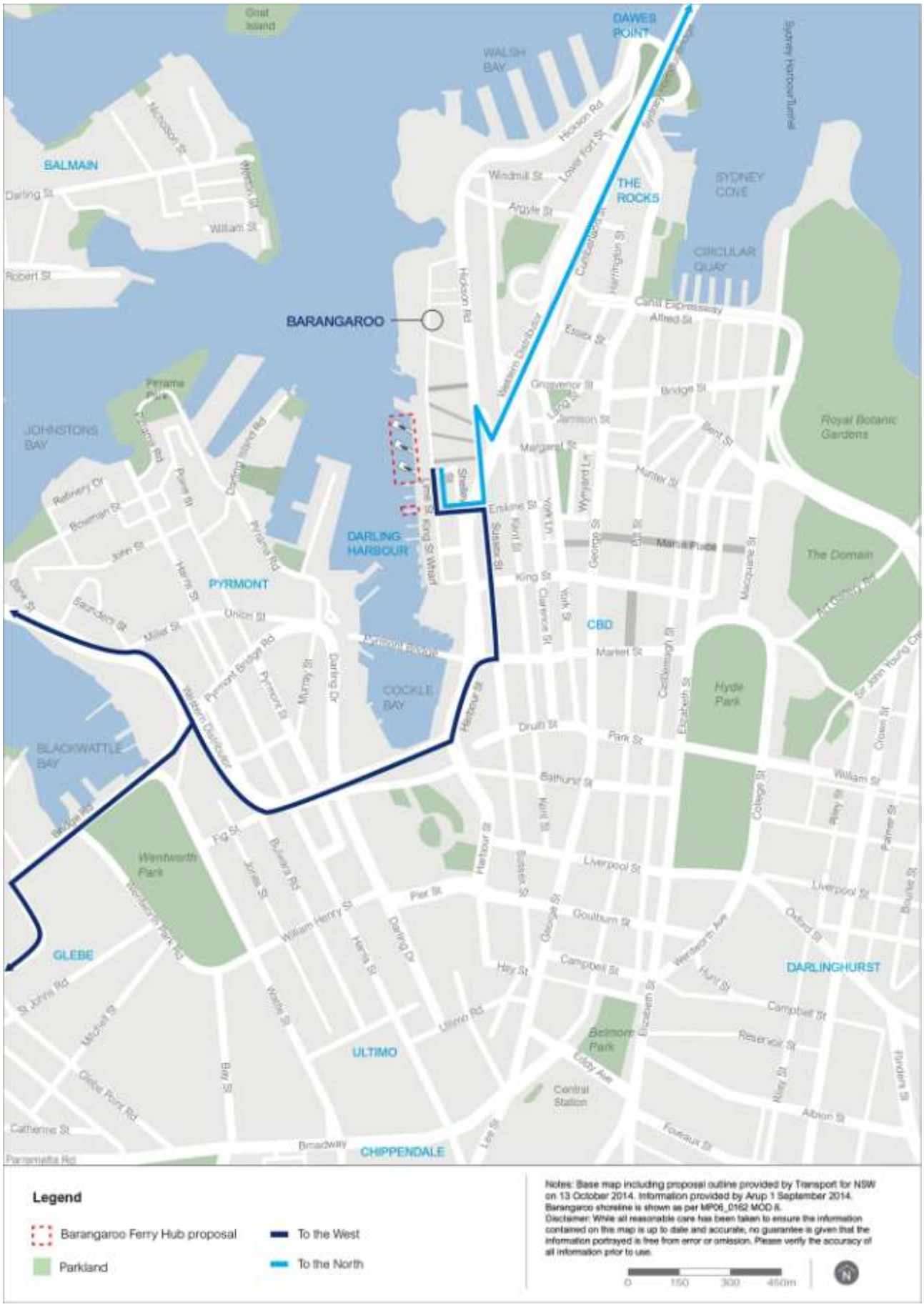
From the west:

- Pyrmont Bridge Road – Western Distributor – Sussex Street – Erskine Street – Lime Street (inbound).
- Lime Street – Erskine Street – Sussex Street – Western Distributor – Pyrmont Bridge Road (outbound).

Figure 6-5 Inbound traffic routes to the construction site



## Figure 6-6 Outbound traffic routes from the construction site



### *Parking*

The construction activity is specialised and would be undertaken by a relatively small team of workers. The construction workers would be encouraged to use public transport for daily access to the site. This is considered to typical practice for other CBD construction projects. The constrained parking environment surrounding the site, coupled with the relatively high cost of all day parking, would ensure that the majority of construction workers arrive to the site via public transport. A small number would arrive by boat accompanying equipment and supplies.

A small number of construction related vehicles may need to use existing parking spaces on Lime Street, where load and size restricts vehicles from using the construction compound. Potential impacts are expected to be minor, with no changes anticipated to the existing loading zones and time-restricted parking areas on Lime Street.

### *Pedestrian*

Currently the foreshore adjacent to Barangaroo is closed to allow for construction of the public domain works. When reopened in March 2015, it would again be used by pedestrians during day time hours for active and passive recreation. Part of this area would be occupied for construction activities associated with the proposal, potentially restricting pedestrian access on the foreshore between the proposal area and Barangaroo South. With the new foreshore public domain open, there would be more room for redirection of pedestrians using hoardings and directional signage.

## Operational

The proposed Barangaroo Ferry Hub would initially include two operating ferry wharves catering for most vessel classes. The wharves would operate to service public transport ferries primarily rather than commercial vessels which would continue to use King Street Wharf facilities.

This section presents details regarding the expected ferry movements, frequency and patronage of the Barangaroo Ferry Hub based on the construction of the initial two ferry wharves.

TfNSW is seeking planning approval for a third ferry wharf at Barangaroo to enable it to respond to growth or change in demand for ferry services to the CBD and in particular Barangaroo. This approval would also enable TfNSW flexibility to respond to changes in the network that might arise from upgrades to the Circular Quay Ferry Terminal.

## Ferry movements and frequency

At the year of opening (2016), the proposed Barangaroo Ferry Hub is expected to have service throughput of up to 11 vessels per hour during weekday peak periods and 14 vessels per hour all day Saturday and Sunday, as shown in Table 6-17. Patronage throughput is expected to increase, requiring an increase in ferry services of up to 15 vessels per hour during the weekday peak and 14 vessels per hour for weekend services by 2026. The full vessel throughput as outlined in Table 6-17 is expected to be accommodated within the two ferry wharves planned to be constructed initially.

Operating hours would be between 5 am and 12 am Monday to Friday and between 7 am and 12 am Saturday, Sunday and public holidays.

The 2016 AM peak ferry operation plan would increase the number of ferry services at Barangaroo in the peak one hour from seven to 11 services. However, by 2026 the

number of ferries visiting Darling Harbour in the morning peak one hour would further increase to 15 services per hour.

Predicted 2016 and 2026 services are based on modelling. Current modelling for peak one hour services at Barangaroo is shown below in Table 6-17. The exact numer of ferry services would be subject to an operational plan, which would be prepared prior to commencement of services at Barangaroo Ferry Hub and periodically updated as necessary.

Table 6-17 Peak hour ferry services to Barangaroo

| Services | AM Peak 1-hr | | | Weekend Peak 1-hr | | |
|---|---|---|---|---|---|---|
| | Existing | 2016 | 2026 | Existing | 2016 | 2026 |
| Parramatta River Services (F3) | 5 | 5 | 7 | 5 | 6 | 6 |
| Darling Harbour Services (F4) | 2 | 6 | 8 | 3 | 8 | 8 |
| **Totals** | **7** | **11** | **15** | **8** | **14** | **14** |

In addition to these regular services, there could also be occasions when special event ferry services or other commercial ferry services would be required to service Barangaroo. This would increase the number of services during the peak one hour period, particularly during weekends and public holidays.

It is expected that the two wharves planned to be constructed would cater for special event ferry services. Commercial ferry services would have the opportunity to use facilities at King Street Ferry Wharf and at Barangaroo (during periods where spare capacity exists) under the provisions of TfNSW's Wharf Access Policy.

In the opening year (2016), the Barangaroo Ferry Hub is expected to have service throughput of up to 11 vessels per hour during weekday peak periods and 14 vessels per hour all day Saturday and Sunday. Initially there would be four berths available, two at each wharf. The periods providing more frequent services are at risk of interruption and not having a berth immediately available. This includes Saturdays and Sundays and possibly during events. These are also the periods where recreational and unchartered commercial vessels are likely to have the most movements, increasing the risk of congestion in the waterway.

The proposal would transfer all public transport ferry trips from King Street Ferry Wharf to the proposed Barangaroo Ferry Hub, thereby releasing capacity at the King Street Ferry Wharf for private and commercial operations.

The proposal would assist in meeting future demand for public transport generated from the Barangaroo precinct and complement future planned infrastructure improvements in the vicinity of the site.

### Ferry patronage

Forecast ferry patronage at the Barangaroo Ferry Hub was calculated for the 2016 opening year and 2026 forecast year, based on the Sydney Ferries network outlined in *Sydney's Ferry Future* (TfNSW, 2013b). Ferry operation plans for the two forecasted years (2016 and 2026) have been specified by TfNSW and modelled by the Bureau of Transport Statistics using the Sydney travel model and the Sydney ferry demand model.

### *Weekday ferry patronage*

Around 3,000 users are expected in the weekday AM peak between 6:00 – 9.30 am in the opening year of the ferry hub in 2016. A substantial increase from existing ferry patronage at King Street Ferry Wharf between 2014 and 2016 is expected due to the completion and occupation of the Barangaroo precinct. The number of passengers alighting during the weekday AM peak period by 2026 is expected to increase to around 5,000 users.

Based on ferry patronage survey results for King Street Ferry Wharf (650) there is expected to be a substantial growth in demand by 2016 (year of opening) with a projected patronage level of around 3000 in the weekday morning (AM) peak period. Estimated increases in ferry patronage from the year of opening (2016) to 2026 show a predicted growth in patronage to about 5,000 trips during the morning (AM) peak period on weekdays. This growth is based on strong passenger demand along the Parramatta River and up to 26,000 jobs within the Barangaroo precinct by full occupation. It is noted that whilst the existing King Street Wharf is nearing capacity in terms of the number of vessels that are able to berth at the facility, there is some existing spare capacity on the ferries themselves. Once Barangaroo has opened, this spare capacity on the ferries is expected to be filled together with creating additional demand which would result in the need for increased services and bigger pontoons to accommodate the resulting loads. The facility has been designed to fully accommodate the AM peak estimated passenger demand through 2026.

### *Weekend, public holidays and special events ferry patronage*

The proposed Barangaroo Ferry Hub may be required to operate outside of the operating hours detailed above during special events such as New Years Eve, Vivid and Australia Day. The timetabling of services at the proposed Barangaroo Ferry Hub may also require adjustment to accommodate other events that take place in the Sydney metropolitan area.

Weekend, public holiday and special events patronage is likely to be greater than weekday commuter peak period patronage as a result of greater use of the Sydney Ferries network for recreation, leisure activities and events. Patronage is contingent on numerous variables including weather, type of events and ticketing arrangements (e.g. $2.50 Sundays with Opal), which are less easily defined than weekday commuter activities. As such the maximum passenger capacity per hour has been calculated as a representative for maximum weekend and public holiday patronage.

The maximum ferry passenger capacity passenger per hour that can be accommodated at the Barangaroo Ferry Hub is limited by the type of vessel and berth availability. The maximum ferry passenger capacity per hour which can be utilised on weekends and public holidays from the year of opening (2016) is described in Table 6-18. This does not apply for special events, which could see higher passenger movements for short periods subject to development of a special events overlay plan.

Table 6-18 Barangaroo Ferry Hub weekend forecast maximum passenger capacity (weekends)

| Services | Capacity | Vessels per hour | Maximum passenger capacity per hour |
|---|---|---|---|
| Parramatta River Services | 230 | 6 | 1,380 |
| Darling Harbour Services | 400 | 8 | 3,200 |
| **Total** | **630** | **14** | **4,580** |

### *Special event management*

The location and prominence of Barangaroo will mean it is a focal point for significant pedestrian movements for events within the precinct itself, as well as those around the wider Sydney CBD. Special events would generate demand greater than normal operating conditions.

The extent and arrival profile of event demand that uses the Barangaroo Ferry Hub would be dependent on:

- the mode share for ferries
- day and time of the week
- the type, location, and size of the event.

During special events such as New Years Eve, Vivid and Australia Day, temporary arrangements would be made to ensure efficiency and safety of larger than normal number of passengers (refer to Section 4.2.2).

### *Public domain and access*

The spatial requirements for boarding passengers has been determined using the London Underground's Station Planning Guidelines, which recommends a minimum area of 320 square metres be provided as a waiting and boarding area (Transport for London, 2012). This spatial provision has been incorporated into the concept design for the proposal (Aurecon, 2014b).

The overall wharf geometry, as detailed in the concept design (Aurecon, 2014b), responds to a number of site and navigational constraints. The design promotes easy pedestrian navigation through the use of roof and promenade structures as wayfinding devices, as well as segregation of alighting pedestrian flow and passengers waiting to board. The roof form and pontoon screening responds to prevailing weather conditions (shelter from the south and more open to the north east summer breeze) for pedestrian comfort while waiting for transport.

TfNSW has been working collaboratively with BDA and Lend Lease regarding landside ancillary facilities and impacts on public domain including those associated with special events and day to day operations. Queue management, and adequacy of pedestrian circulation space and facilities around the wharves would be the subject of ongoing consultation between TfNSW and relevant stakeholders.

### *Navigation and safety*

In June 2012, Roads and Maritime undertook a study to identify and review navigational issues associated with the potential for a ferry hub at Barangaroo. Other objectives of the study were to consider the development of the proposal from a navigational safety perspective and to agree a safe channel width in the harbour to inform early design of the proposal.

The study concluded the following:

- Darling Harbour is an extremely busy waterway with a high level of commercial and recreational vessel traffic and the second highest maritime incident rate on Sydney Harbour. A comprehensive vessel traffic management plan should be developed and implemented to facilitate the safe navigation of ferries and other vessels using the waterway.

- The orientation of the wharves would have the greatest impact on the navigable channel because of associated channel width and navigation issues and therefore should be given consideration during proposal design development. The design should maximise the available channel width and seek to maintain the current channel width of 130 metres.
- The lines of approach by ferries to and from the proposed wharves are critical to the safety of navigation in the Darling Harbour area, and these should be considered during proposal design development.
- For navigational safety, ferries should berth at the proposed Barangaroo Ferry Hub stern first to wharves angled in a north west direction to minimise the amount of deviation from the direction of flow of traffic in the north bound lane of the channel. Additionally this will enable ferries to depart the wharves head first and join the flow of traffic at as small an angle as possible, in accordance with international navigation best practice.
- Wharves should be slanted at a northwest angle (between 30º and 45º from perpendicular to the Barangaroo seawall) and the wharf configuration should minimise the projection of the structures into the Darling Harbour channel (analysis to date indicates the optimum projection is 65 metres).

Subsequent to this study, there is no longer a requirement that all berthing would be stern first, as such; vessel berthing is being revisited in workshops with TfNSW, the Harbour Master, Roads and Maritime and other relevant agencies and therefore is yet to be determined. A vessel traffic management plan, to be developed prior to construction, would outline the direction of berthing and the specifics of navigational procedures.

The proposed navigational procedures have been designed so that ferries accessing the wharves are able to manoeuvre and leave at least half of the navigational channel free for two–way vessel movements. This would minimise impact on other vessels accessing Darling Harbour.

Berth occupancy is dependent on the duration of the berth window. The berth window is a function of the ferry approach and departure time and the passenger boarding and alighting time for each service. The berth window varies for each service depending on the service patronage.

The duration of approach and departure at the proposed Barangaroo Ferry Hub is estimated as two minutes each. An average ferry dwell time at each berth of 15 minutes is estimated, which includes the unloading and loading of passengers. This provides an estimated average berth window of about 20 minutes, although as mentioned above this would be variable for each service.

The risk of congestion would also occur where services are not running to schedule. However, the historical on-time running of Sydney Ferries services means this risk is low.

A vessel traffic management plan, along the lines of that employed in Circular Quay, would be developed and implemented to minimise the impact of waiting vessels. This vessel traffic management plan would be supported by a risk assessment of the waterside operation of the proposal and its interface with marine traffic in Darling Harbour.

### *Maintenance*

Minor maintenance of ferries would be undertaken at the Barangaroo Ferry Hub, similar to the current maintenance activities that occur at Circular Quay. These would occur during

layover and include minor repairs, pump-out of sewage (generally once per day per layover vessel), cleaning of vessels, and updating passenger information displays. As these activities would generally only be completed once daily for each vessel while in layover, they are not expected to have any significant impact on operations.

At times of wharf maintenance, specific site management plans would be implemented to coordinate the timing and extent of interaction with normal ferry operations and passenger access and waiting. Works would be staged and timed to minimise impact on ferry operations.

### *Cyclist and pedestrian access and safety*

#### Pedestrian movements and access

Public transport nodes, such as train stations, bus stops and ferry wharves usually have a potential walking catchment of between 400 metres and 800 metres, which corresponds to five minutes and ten minutes walking time respectively. However, physical barriers such as topography, lack of crossing facilities and an impermeable road network can reduce the actual walkability of the area. Walking isochrones maps (lines of equal walking time) are used as an assessment and presentation tool for public transport catchment analysis.

A walking isochrones analysis was undertaken for the proposal to determine the potential catchment of the proposed Barangaroo Ferry Hub. The analysis considered the planned and proposed pedestrian improvement works around Barangaroo and Wynyard, including Wynyard Walk, City Walk pedestrian bridge and the Barangaroo footpath network. The resulting isochrones are illustrated in Figure 6-7 below.

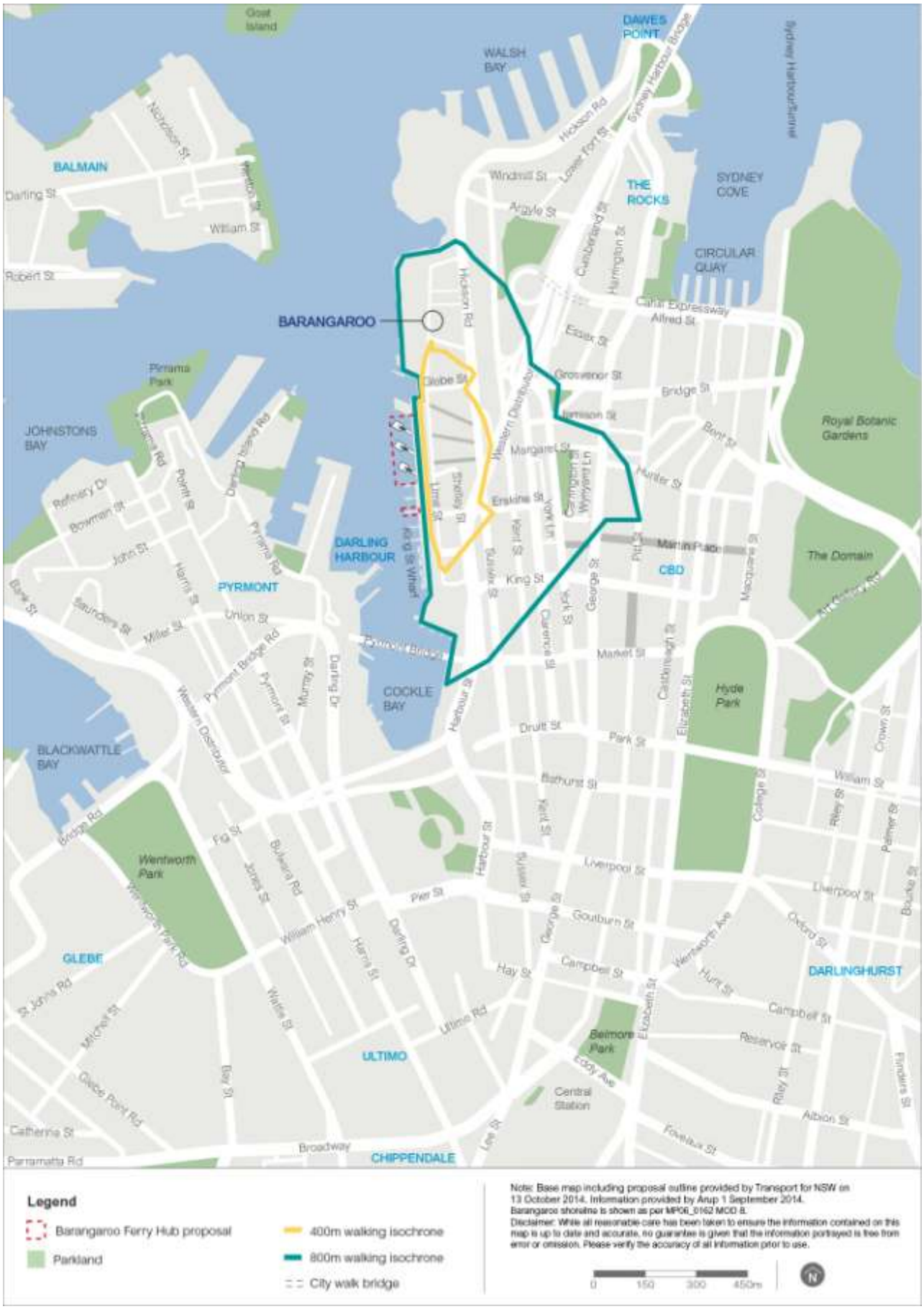
The analysis demonstrates the walking catchment for the Barangaroo Ferry Hub extends to George Street to the east, Darling Harbour to the south and Central Barangaroo to the north. Covering an area of about 20 hectares, the catchment would serve an employment population of about 53,000 people in 2016 (Bureau of Transport Statistics, 2014).

The proposal would be well served by a number of existing and future pedestrian connections. Following the introduction of Wynyard Walk, pedestrians travelling between George Street, Wynyard Station and the proposed Barangaroo Ferry Hub would be able to bypass on-street delays, travelling to the Barangaroo foreshore in about six to eight minutes. As Wynyard Walk has been designed to accommodate up to 20,000 pedestrians per hour (bi-directional), there would be sufficient capacity for passengers alighting from the ferry hub to be accommodated along with other pedestrian traffic accessing Wynyard Walk.

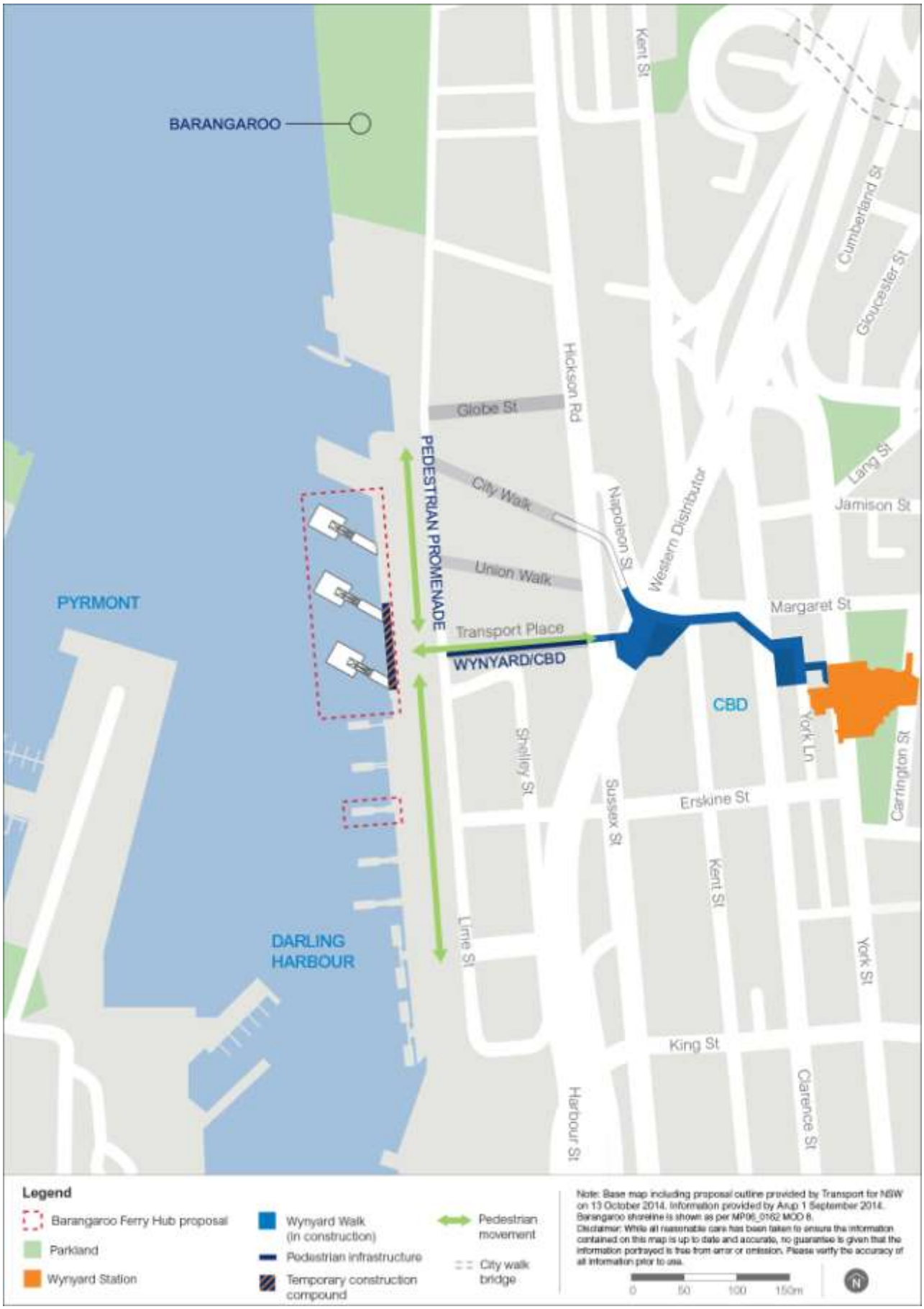
Transport Place, a new pedestrian plaza at the western end of Wynyard Walk, would provide a safe and accessible connection to the proposed Barangaroo Ferry Hub. The Barangaroo Pedestrian Precinct Demand Study (Arup, 2013) identified this linkage as the primary access route for pedestrians travelling to and from the proposed Barangaroo Ferry Hub.

Figure 6-8 illustrates the key pedestrian movements that are expected to occur in the vicinity of the proposal.

## Figure 6-7 Walking isochrones from Barangaroo Ferry Hub



## Figure 6-8 Pedestrian movements around Barangaroo Ferry Hub



The key destinations for customers alighting the ferry at Barangaroo are likely to be:

- Commercial office component of Barangaroo South
- Waterfront Promenade restaurants and street activities
- Wynyard Station/Sydney CBD via Transport Place
- King Street Wharf/Darling Harbour via the Foreshore.

A formal pedestrian crossing would be located on the Transport Place alignment for pedestrians to cross Lime Street between the proposed Barangaroo Ferry Hub and Transport Place. The expected low traffic volumes on Lime Street associated with local traffic circulation would create a pedestrian friendly environment.

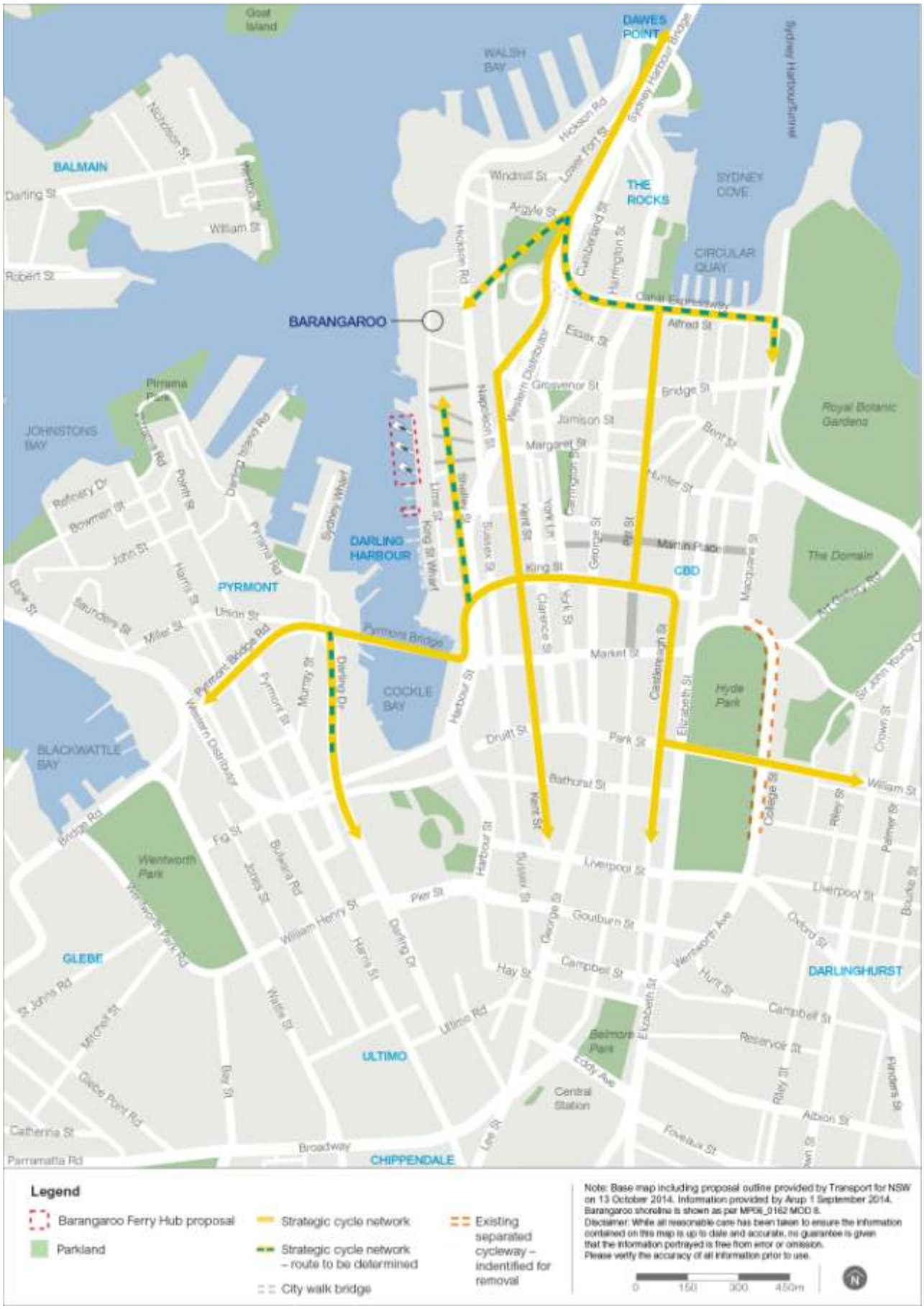
### Cyclists

The Kent Street bi-directional, segregated cycleway would provide the primary access route for cyclists travelling to/from the proposed Barangaroo Ferry Hub – serving arrivals from both the north (i.e. Harbour Bridge cycleway) and the south. New cycleways on Hickson Road and Napoleon Street are planned in the future to serve the commercial and residential populations of Barangaroo.

Cyclists accessing the proposed Barangaroo Ferry Hub from the Hickson Road and Napoleon Street cycleways would benefit from the new traffic signals being installed as part of Barangaroo South at the Hickson Road/Napoleon Street intersection.

Those arriving from the Pyrmont Bridge would either cycle down Sussex Street) or more likely walk their bike down the set of stairs at King Street and cycle along Lime Street. The *Sydney City Centre Access Strategy* identifies a future cycle connection from the Pyrmont Bridge linking directly with the Barangaroo precinct, as shown in Figure 6-9.

## Figure 6-9 Strategic cycleway network



The planned closure of the northern section of Shelley Street to form Transport Place will provide an off-road connection for cyclists between Sussex Street, Shelley Street and the waterfront. Shared access for cyclists and pedestrians along the waterfront continues from Darling Harbour around Millers Point connecting with the on-street network at Walsh Bay, providing access to the ferry hub from both the north and south.

A summary of the wider bicycle network serving the proposed Barangaroo Ferry Hub is shown in Appendix F. The future cycle network in the precinct would provide ample capacity to support bicycle movements to and from the proposed Barangaroo Ferry Hub. Access for cyclists to the proposed Barangaroo Ferry Hub would be improved with the public domain improvements occurring throughout the Barangaroo precinct and there is unlikely to be a potential impact from the proposal.

### *Integration with other* transport modes

#### Rail

Ferry patrons using the proposed Barangaroo Ferry Hub and changing to rail services would use Wynyard Station, located about 400 metres walking distance from the proposal. With the opening of Wynyard Walk, access between Wynyard Station and the proposed Barangaroo Ferry Hub would be enhanced with a direct link eliminating on-street delays. As discussed above, the expected pedestrian travel time between Wynyard Station and Barangaroo is about six minutes.

The proposed upgrade of Wynyard Station is planned to be supported by improved operational reliability through upgraded services and removal of redundant services. The additional impact, as a result of passenger interchange between the proposed Barangaroo Ferry Hub and Wynyard Station, on passenger flows around Wynyard Station would be negligible.

#### Buses

The *Sydney City Centre Access Strategy* (TfNSW, 2013a) planned city centre bus corridors, as shown in Figure 6-10 below, includes Hickson Road/Sussex Street, which would improve access for users travelling to and from the proposed Barangaroo Ferry Hub via bus. New bus stops are envisaged on Sussex Street which would provide convenient access for pedestrians interchanging modes, as well as relieving capacity from Wynyard bus station.

A shuttle service running between Circular Quay, Walsh Bay, Barangaroo and Darling Harbour was proposed in the *Barangaroo Integrated Transport Plan* (TfNSW, 2012a) to address short term connectivity issues with bus and light rail services. If this temporary service is provided, it would further improve access for bus passengers travelling to and from the proposed Barangaroo Ferry Hub.

Additional bus services along these identified routes are being considered by TfNSW to service bus passengers travelling to and from the proposed Barangaroo Ferry Hub.

## Figure 6-10 Planned bus corridors

### Vehicular traffic

Operation of the proposal is not expected to have an impact on vehicular traffic. A small number of passengers may be dropped off or picked up on roads in the vicinity of the proposed Barangaroo Ferry Hub, however the vast majority of users are expected to arrive using the enhanced pedestrian network as previously discussed. No additional road network enhancements or mitigation measures would be required to manage the impact of the proposal.

To minimise the impact on the local road network, no on-site parking is proposed to serve the proposed Barangaroo Ferry Hub. Off-street car parking is available at a number of nearby sites.

A small number of vehicles may need to access the site from time to time for routine maintenance activities. This would be easily accommodated by the surrounding road network. Emergency vehicles would use Lime Street to access the foreshore in the vicinity of the proposed Barangaroo Ferry Hub.

### Taxis

A formal taxi rank is currently provided at the northern end of Shelley Street, with capacity for up to seven taxis queued at any one time. Located within 100 metres of the proposal, this would provide convenient connections for passengers interchanging between ferry and taxi. New taxi ranks are planned for the precinct to service Barangaroo on Sussex Street and Globe Street North. Some informal taxi drop off and pick up activity may take place on Lime Street adjacent to the Barangaroo Ferry Hub. The potential impacts to the road network associated with these traffic movements are considered negligible.

#### *Emergency access*

Emergency access requirements would need to be accommodated at all times. It is likely that emergency vehicles would access the Barangaroo Ferry Hub using the pedestrian promenade via Lime Street at its intersection with Transport Place and/or Union Walk. Final arrangement of emergency access and congregation points would be subject to negotiation with BDA and Fire and Rescue NSW.

Various pieces of emergency equipment such as fire response equipment would be required to be kept at the Barangaroo Ferry Hub. Periodic testing and maintenance of emergency equipment would be required.

#### *Wayfinding*

The proposal would include high-quality integrated wayfinding and customer information system to help customers to better navigate the NSW public transport network by making it easier to understand and use, as outlined in Appendix D. This would assist non-regular customers (such as tourists) using the proposed Barangaroo Ferry Hub.

A Barangaroo precinct wayfinding strategy would be developed by the BDA, and Lend Lease, TfNSW and other stakeholders will provide input into this strategy to ensure wayfinding at Barangaroo Ferry Hub is consistent with other wayfinding across the precinct.

### 6.2.3 Mitigation measures

The following mitigation measures are recommended to manage traffic and transport impacts:

#### Construction

- Consultation would be undertaken with the Barangaroo Integrated Transport Plan Working Group to co-ordinate management measures for cumulative transport impact during construction
- A Construction Traffic Management Plan would be prepared before the commencement of work. The plan will include:
  - A strategy for ongoing consultation with key stakeholders including Port Authority of NSW, Roads and Maritime Services and Harbour City Ferries
  - Specific mitigation measures to be developed prior to the commencement of work to minimise impact of the works on the road and maritime networks during construction
  - A Traffic Control Plan in accordance with the Roads and Maritime Traffic Control at Work Sites Manual and Australian Standard 1742.3
  - Event management during construction including avoiding events taking place in the harbour, such as the Sydney International Boat Show.
- Should the temporary closure of any pedestrian routes be required consultation would be undertaken with key stakeholders (including BDA and Lend Lease)
- Alternative pedestrian routes would be identified and communicated through the provision of appropriate information and signage at key locations
- The movement of construction barges in the harbour would follow the standard navigational procedures to limit impact on other vessels.

#### Operation

- A Vessel Traffic Management Plan would be prepared and implemented prior to commencement of operations at the Barangaroo Ferry Hub. This would be supported by a risk assessment for the Darling Harbour waterway which includes the Barangaroo Ferry Hub proposal.
- A tailored event management plan would be implemented during event periods or when a dramatic increase in pedestrians is expected, such as New Year's Eve.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.3 Ecology

This section assesses the potential impact on aquatic and terrestrial ecology within the study area as a result of the proposal. The assessment presented in this section draws on information from the technical paper, Aquatic Ecology Assessment, prepared by Marine Pollution Research Pty Ltd for the EIS (Appendix G) and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issues | SEAR | Where Addressed |
|---|---|---|
| Flora and fauna | Assessment of potential impacts on any flora and fauna, including threatened species, populations or communities (e.g. Psodonia seagrass) or their habitats. | Section 6.3.2 and Appendix G |
| Flora and Fauna | Recommendations of appropriate mitigation measures during construction and operation, including potential impacts of shading from fixed structures. | Section 6.3.3 and Appendix G |

### 6.3.1 Existing environment

#### Aquatic ecology

The existing marine environment within Darling Harbour and the surrounding area is typical of an inner city urban environment. The foreshore is generally retained by sandstone and concrete retaining walls (cassions). According to the Sydney Harbour Foreshores and Waterways Area DCP maps, the nearest aquatic habitat is an area of rock platform in Cameron's Cove about one kilometre north-west of the proposal. SREP Sydney Harbour maps dated 2005 identify wetlands at a rocky platform site at Balmain East about 600 metres to the north-west of the site. There are no mangroves or saltmarsh located within the vicinity of the proposal.

The seafloor adjacent to the Barangaroo foreshore slopes towards the centre of the waterway to a depth of about 11.3 to 13.4 metres below Indian Spring Low Water (ISLW).

Water depths range between about 9.5 to 11.5 metres above the sea floor depending on the tide.

An aquatic ecology dive survey at the location of the Barangaroo Ferry Hub was undertaken on 14 August 2014. The area surveyed included the seabed and the inshore concrete and sandstone retaining wall. No threatened or protected aquatic species as listed under the FM Act, TSC Act or EPBC Act were found at the site, and therefore none are expected (see Section 2.1 of Appendix G for additional consideration of possible threatened and protected species) within the vicinity of the proposal area.

An earlier dive on 22 May 2013 was commissioned by Brookfield for a separate project and included a survey of the seabed, all wetted surfaces associated with the King Street Wharf wave baffle, the inshore concrete and sandstone retaining wall (refer Figure 6-11).

Combined, the surveys identified three main aquatic habitats in the study area as follows:

- The sub-tidal and intertidal wetted surface of the concrete seawall, timber barge boards and King Street Wharf wave baffle
- The sandstone rock and rocky rubble reef which extends between 5 metres offshore from the land
- The seabed comprising soft silty-sand which comprises all other areas.

The study area for the proposal is identified in Figure 6-11.

Figure 6-11 Aquatic ecology study area

Based on the aquatic ecology survey, the specific species identified in the study area are shown in Table 6-19.

Table 6-19 Aquatic habitats and ecology identified during survey of study area

| Aquatic habitat zones | Species identified |
|---|---|
| The sub-tidal and intertidal wetted surface of the concrete seawall, timber barge boards and King Street Wharf wave baffle | Concrete seawall and timber barge boards<br>• Barnacles, Sydney rock oysters, limpets and green microalgae that are grazed by littorinid snails and periwinkles<br>• A mix of fringing plus frondose algae and tunicates growing on the lower shallow sub-tidal portions of the barge boards. These assemblages are scattered and less diverse on the shallow sub-tidal fringe of the concrete seawall due to being shaded by a floating silt-curtain associated with the development of Barangaroo<br>• Deeper surfaces of the concrete seawall support a matrix of bryozoa and accumulated silt with various sheet forming sponges, some branching sponges and colonial ascidians which are notably less than those at King Street Wharf wave baffle (see below).<br>King Street Wharf wave baffle<br>• Limited variety of intertidal animals; encrusting barnacles (*Elminius sp*.), green turfed algae and oysters<br>• Variety of gastropod molluscs; B. *nanum, Austrocochlea obtusa*, the Oyster borer, *Morula marginalba* and several limpet and false limpet species (*Cellana tramoserica* and *Montfortula sp*.)<br>• Patchy cover of encrusting red coralline algae plus a variety of short frondose brown algae species including *Dictyota dichotoma* plus Sargassum sp<br>• Shaded shallow sub-tidal habitats support an extended oyster band with black mussels<br>• Patchy band of algae including three brown *macroalgae* species (*Ecklonia radiata*, *Padina sp*., and *Sargassum* spp.), a number of *frondose al*gae, some *mussels* and a variety of sponge, *bryozoa* and tunicate species. Shaded areas do not support algae<br>• A kelp zone with very scattered cover was confined to the piles and part of one suspended wave baffle that are exposed to sunlight. The kelp zone was no more than four metres deep<br>• Diverse fauna of mainly encrusting species such as bryozoa, sponges, colonial ascidians and tufted bryozoans embedded in a silt matrix<br>• At around three metres above the seabed, the hard substratum habitats are covered in silt and support very few attached fauna. |
| Sandstone rock and rocky rubble reef | • The rock rubble toe and base of the seawall are covered in a thick veneer of fine silt that excludes most biota although a few isolated encrusting orange and yellow sponges were observed. Shell beds near the rock rubble were also smothered in silt<br>• A sea-star was observed in the rock rubble. |
| Seabed comprising soft silty-sand | • Soft substratum benthic fauna (animals that live in the sediments) comprising mainly ghost and snapping shrimp with sea-pens occurring further offshore<br>• No plants were encountered on the seabed<br>• Several sand anemones were found in inshore sediments. |

| Aquatic habitat zones | Species identified |
|---|---|
| Within water column | Several species of fish observed within the water column including senator wrasse, bat fish, bream, luderick, sea star, cardinal fish, eastern hula fish, fan belly leatherjackets, pygmy leatherjacket, flounder and sand gobies. |

The FM Act and the EPBC Act list a number of shark and other fish species as threatened species.

Of the listed threatened shark species, the Grey Nurse and Great White Shark could potentially visit the location of the proposal in pursuit of mobile prey, however, the location of the proposal does not provide habitat for these shark species. No threatened shark species were observed during the survey. It was considered that assessments of significance were not required for these species.

The listed Black Rock Cod (*Epinephelus daemelli*) has the potential to occur in rocky reef habitat areas of Johnstons Bay. A targeted search was made for the Black Rock Cod however none were observed. The Black Rock Cod could potentially occur in rocky reef habitats at Camerons Cove. However, Black Rock Cod is highly unlikely to occur at the site as the retaining wall and jetty surfaces do not provide suitable crevice habitat.

*Sygnathiformes* (seahorses, seadragons, pipefish, pipehorses and seamoths) are protected, under both the EPBC Act and the FM Act. Of the 31 *Sygnathiformes* species known from NSW waters, three (White's seahorse *Hippocampus whitei*, Coleman's Seahorse *Hippocampus colemani* and the Pygmy *Pipehorse Idiotropiscis sp*.) are endemic to NSW and White's seahorse is common in Sydney Harbour. Targeted searches were carried out for protected *Sygnathiformes* in the study area. Suitable habitat was not found to be present as:

- Shallow kelp and fringing algae habitat on the hard substratum surfaces is too sparse to provide sufficient feeding or shelter habitat.
- The lack of habitat topological complexity for the deeper encrusting assemblages does not afford any shelter from predatory fish, and the whole locality is isolated from suitable habitats at Camerons Cove and Balmain East.

No *Sygnathiformes* were observed during the dive surveys.

Other threatened aquatic species or populations that are known to occur in Sydney Harbour and may occur in the location of the proposal and its surrounds include various cetaceans (whales and dolphins), marine mammals (seals and sea lions), marine reptiles (turtles and sea snakes) and sea birds (ocean birds and waders). Of the species that may occur in the location of the proposal few would be using the resources to any great extent, rather they would generally be in the area as transients or opportunistic feeders. None were observed during the survey. Assessments of significance were not considered necessary for these species.

Individuals from the threatened population of Little Penguins (*Eudyptula minor*) at Manly are known to feed throughout Sydney Harbour and could be expected to visit the site from time to time. This population is listed as endangered under the TSC Act. The location of the proposal does not provide nesting or breeding habitat. An assessment of significance was not considered necessary for the Little Penguin population.

Commercial fishing was banned in Sydney Harbour in 2006 due to elevated levels of dioxins recorded in fish and crustaceans. There are no commercial fishing operations or aquaculture activities in the vicinity of the proposal.

### Terrestrial ecology

No native remnant vegetation or bushland is located within the vicinity of the proposal. Darling Harbour is a highly urbanised environment and the foreshore has been reclaimed. There are no trees located within the proposal area.

A search of the Atlas of NSW Wildlife (OEH, 2014a) on 19 August 2014 found records of 315 threatened fauna species, 162 threatened flora and fungi species, 22 ecological communities and two endangered populations listed under the TSC Act within a ten kilometre radius of the proposal area.

These results included microbats which are known to roost in man-made structures, including stormwater drains, culverts and under bridges in expansion joints or other crevices.

The proposal area, including the King Street Wharf wave baffle, is unlikely to provide suitable habitat, roosting or food resources for any other of the listed terrestrial species identified. An inspection of the underside of the King Street Wharf wave baffle for threatened microbats was undertaken on 1 May 2013 and nocturnal Anabat surveys were conducted on 22 and 23 April 2013 (RPS, 2013). During the inspection it was noted that there was no suitable roosting habitat at the site as potential locations were exposed to the weather. The Anabat surveys did not detect any microbats within the area of the wave baffle. No assessments of significance under the TSC Act were considered necessary.

An EPBC Protected Matters Report (Department of Environment (DoE), 2014) was sourced on 19 August 2014 for a 10 kilometre radius from the site. The search identified the potential for the following species to occur within that area:

- three threatened ecological communities
- 72 threatened species
- 69 migratory species
- 95 listed marine species
- 13 whales and other cetaceans.

The location of the proposal is unlikely to provide suitable habitat, roosting or food resources for any of the listed terrestrial species identified. Some of the listed migratory, marine species, including whales and other cetaceans could potentially visit the location of the proposal. However, the location of the proposal does not provide habitat for these species. As a result no further assessment was considered to be required for these species.

## 6.3.2 Potential impact

### Construction

#### *Aquatic ecology*

The potential impacts of the proposal on aquatic ecology are summarised in Table 6-20.

Table 6-20 Potential impact on aquatic habitats and ecology during construction

| Construction activity | Potential impact |
|---|---|
| Potential removal of piles associated with the King Street Wharf wave baffle | Disturbed sediments would be highly localised in the bottom waters around the pile removal and any mobilisation of sediments would rapidly re-settle. A floating silt curtain would be installed between the inner piles and the shore to protect remaining seawall and rock toe hard substratum habitats from potential smothering or excessive turbidity.<br>There would be a low risk of contaminated sediments being mobilised into the water column. Rather, it is more likely contaminated sediments would stay firmly bonded to the fine particulate and organic materials making up the sediments and rapidly re-settle. Potential impacts from mobilisation of contaminated sediments are considered further at Section 6.12.<br>The loss of aquatic biota on wetted surfaces is discussed in operational impact below. |
| Installation of piles into bare seabed sediments | While there would be a loss of benthic fauna in the direct location of the piles, there would be a net gain in overall aquatic habitat in the project area as a result of wetted surfaces on the new piles that are available for colonisation by attached and encrusting biota including marine algae.<br>Disturbed sediments during the installation of piles would be highly localised in the bottom waters around the pile location and sediments would rapidly re-settle. It is not expected that this work would impact on any rock toe hard substratum habitats and any potential impact would be mitigated with the installation of a floating silt curtain between the inner piles and the seawall.<br>Impact on sediment benthic communities arising from this work would be reasonable given the large expanses of this sediment habitat within and surrounding the proposal.<br>Similar to the removal of piles, it is not expected that the installation of piles would mobilise contaminated sediments (see construction impacts in Table 6-21). |
| Manoeuvring of construction vessels | Given the water depths which range between about 9.5 to 11.5 metres above the sea floor depending on the tide, there is low risk of bottom sediment disturbance from construction related vessel wash and propeller thrust when manoeuvring at the site, however contractors would be instructed to not use excessive thrust as not to disturb the seabed.<br>As there are no marine vegetated habitats within the area of the proposed new wharves and the only rock habitat is smothered by silt, there would be no risk of impact to rocky reef area from the use of anchors, mooring blocks and other apparatus for undertaking the construction work. |
| General construction | The risks of spillages of liquids and solids from the construction work and use of vessels can be managed by a combination of normal best-practice measures to be specified in the project CEMP that would include information about the threat posed to marine biota (fishing birds, marine mammals and fish) of ingestion and throttling from discarded garbage and in particular from plastic wrapping materials and plastic offcuts (such as hosing, jetty fenders, electrical wiring). |

### *Terrestrial ecology*

It is not anticipated that the proposal would impact on any terrestrial flora or fauna during construction.

## Operational

### *Aquatic ecology*

The potential impacts of the proposal on aquatic ecology are summarised in Table 6-21.

Table 6-21 Potential impact on aquatic habitats and ecology during operation

| Operation activity | Potential impact |
|---|---|
| Removal of King Street Wharf wave baffle | The removal of the King Street Wharf wave baffle would eliminate shading impact on the adjacent seawall, which would be recolonised by algae in the shallow sub-tidal zone.<br>Removal of the King Street wharf wave baffle piles would remove hard substratum habitat. This impact would be balanced by the installation of the new wharves as detailed below. |
| Interaction with Harbour Heat Rejection System | There are not likely to be any impacts of the thermal water discharge on mapped protected areas, areas of aquatic vegetation, nor benthic habitats. Some minor changes in the diversity and abundances of marine fauna may occur around the discharge. However, any impacts would be highly localised and not expected to be significant on a larger scale (JBA Planning, 2012). |
| Installation of new wharves | The three proposed fixed gangways would shade portions of the caisson seawall which could limit or prevent growth of macroalgae on these portions of wall. However, as the offshore floating silt curtain currently shades most of the seawall there is a low risk of actual loss of existing macroalgae habitat.<br>The piles required for the new wharves and ferry crash barrier structures would provide new hard substratum habitat. Further, there would be a large net increase in the available wetted surface areas suitable for colonisation by macroalgae and other encrusting and attached biota arising from the increase in floating pontoon wetted surfaces.<br>The net increase in available hard substratum algae and attached biota habitat would provide increased shelter and feeding habitat for small reef fish and for the larger pelagic fish that prey on these reef fish.<br>Overall, the size of the floating pontoons would provide a long term net gain in available hard-substratum marine vegetation (algae) habitat. |
| Manoeuvring of vessels | The overall depths within the proposal area (about 9.5 to 11.5 metres above the sea floor depending on the tide) means that there is low risk of bottom sediment disturbance from ferry manoeuvring in and out of the berths or transiting the proposed Barangaroo Ferry Hub.<br>The ferries would create wash when manoeuvring to the wharves, which may contact the piles, arrestor systems, pontoon and seawall. For less direct was there would be a low risk of dislodging attached biota from the walls or dislodging cryptic fauna. In fact, the residual wash currents would more likely provide a beneficial impact in dislodging loose silts that can accumulate on these habitats in still waters.<br>For vessels using the layover berths, the wash is directed at the arrester systems which would reduce wash reaching the seawalls. Biota colonisation of surfaces would be adapted to the conditions. For example, biota on the arrester baffles would be exposed to higher wash action and this may result in an overall more wash resilient biota colonising these surfaces which is also known to occur at Pyrmont Bay Wharf. |

| Operation activity | Potential impact |
|---|---|
| General operation | The risk of spillages of liquids and solids from fuelling, pump-out and maintenance work can be managed by a combination of normal best-practice measures, to be detailed in operational policies and procedures, and that would also include information about the threat posed to marine biota (fishing birds, marine mammals and fish) of ingestion and throttling from discarded garbage and in particular from plastic wrapping materials and plastic offcuts (such as hosing, jetty fenders, electrical wiring). |

*Terrestrial ecology*

There would be no impact to terrestrial flora or fauna as a result of the proposal.

### 6.3.3 Mitigation measures

The following mitigation measures are recommended to manage aquatic ecology impact. Mitigation measures to address potential water quality impacts at Section 6.9.3 are also relevant to aquatic ecology.

- The project CEMP will include mitigation measures to avoid impacts to marine ecology. This will include information about the risk of spills and leaks, as well as the threat posed to marine biota (fishing birds, marine mammals and fish) of ingestion and throttling from discarded garbage and in particular from plastic wrapping materials and plastic off cuts (such as hosing, jetty fenders, electrical wiring)
- Environmental awareness training will be provided, by the contractor, to all field personnel and subcontractors. Regular reinforcement (such as at toolbox talks) covering ecology impacts will be undertaken

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.4 Visual amenity and urban character

This section assesses the potential impact on visual amenity and landscape character within the study area as a result of the proposal. The assessment presented in this section draws on information from the technical paper, Landscape and Visual Impact Assessment, prepared by Iris Visual Planning and Design for the EIS (Appendix H) and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issues | SEAR | Where Addressed |
|---|---|---|
| Visual Impacts | Including an assessment of the visual impacts of the proposal, particularly on the scenic quality of Sydney Harbour. | Section 6.4.2 and Appendix H |
| Visual Impacts | The visual impact assessment should consider (but not be limited to) the potential impacts on future residential and retail development currently under construction at Barangaroo South, as well as impacts of ferry layover, pump out and maintenance facilities on Sydney Harbour and the public domain. | Section 6.4.2 and Appendix H |
| Lighting and signage | The EIS shall include consideration of lighting impacts. | Section 6.4.2 and Appendix H |

### 6.4.1 Assessment methodology

The assessment of visual impact is based on the identification of the level of visual modification created by the proposal, and the sensitivity of the viewer. Combined, these characteristics of the view are then considered to assign a level of likely visual impact. This approach is summarised below and detailed at Appendix H.

The visual impact assessment was undertaken in accordance with the Sydney Harbour Foreshores and Waterways Area DCP, which offers guidance on methodology for developments within the Sydney Harbour and its tributaries. The assessment is also consistent with the Roads and Maritime Guidance note *EIA-N04 Guidelines for Landscape Character and Visual Impact Assessment* (2013). The visual impact assessment has been undertaken on all aspects of the proposal, including the three wharves, ferry layover and associated landside facilities. It has also been undertaken in the context of the rapid urban expansion of the Barangaroo precinct.

When assessing impacts on viewpoints and landscape character, the term 'visual sensitivity' refers to the nature and duration of views. Locations from which a view would potentially be seen for a longer duration, where there are higher numbers of potential viewers and where visual amenity is important to viewers can be regarded as having a higher visual sensitivity. The range of visual sensitivities is comprised of 'national' (highest sensitivity) down to 'neighbourhood' (lowest sensitivity), or when considering night time visual impacts these are E1: Intrinsically dark landscapes (highest sensitivity) to E4: High district brightness areas – town/city centres with high levels of night time activity (lowest sensitivity).

Visual modification describes the extent of change resulting from the proposal and the compatibility of these new elements with the surrounding landscape. There are three levels of visual modification:

- Considerable reduction or improvement in visual amenity
- Noticeable reduction or improvement in visual amenity

- No perceived reduction or improvement in visual amenity.

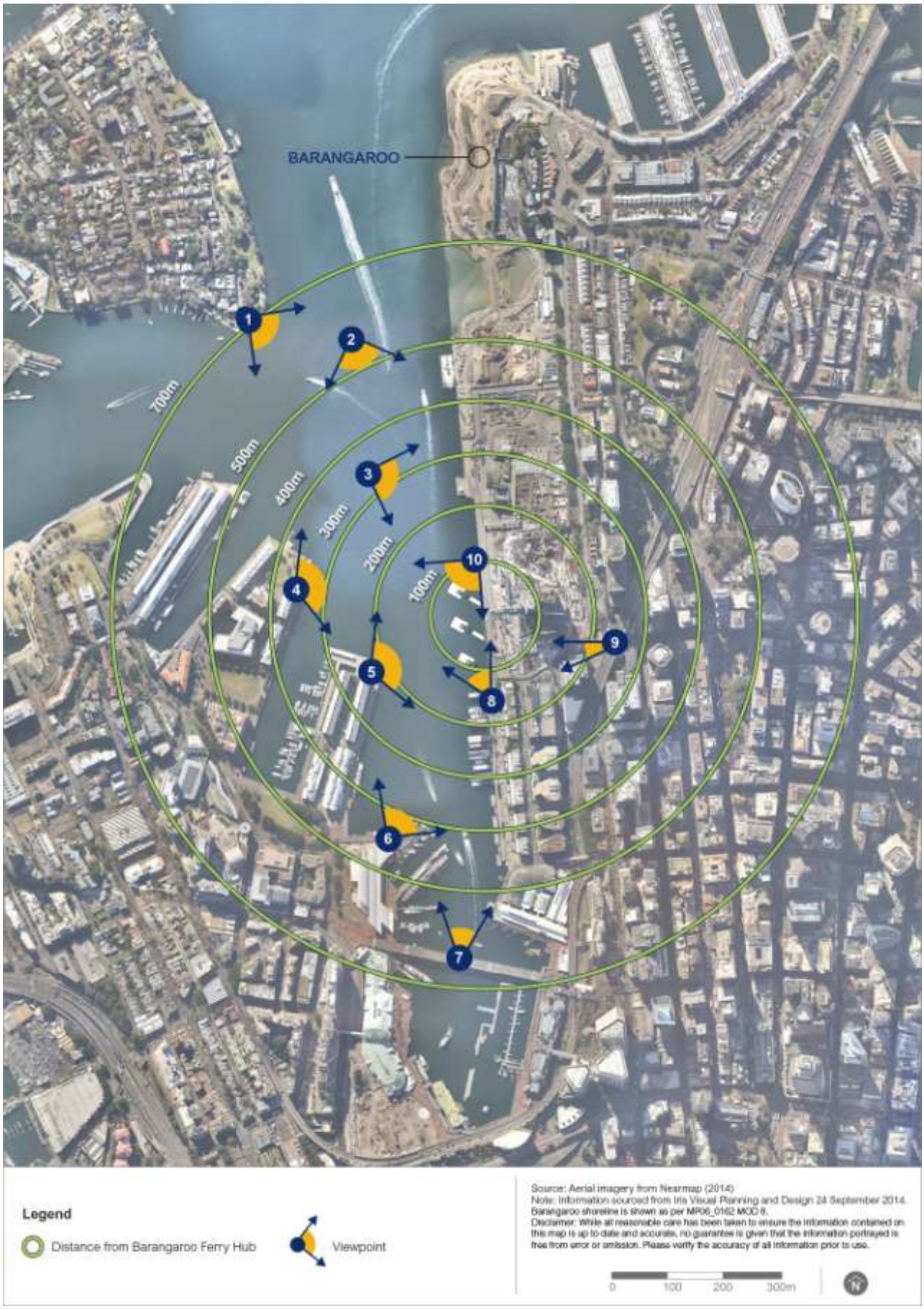
To determine the level of impact on viewpoints or landscape character the sensitivity of the viewpoint or the area is considered against the level of visual modification and assigned an impact level between having a very high beneficial impact to having a very high adverse impact.

A site inspection of the project area and its surrounds was undertaken during August 2014. The following viewpoints were selected as representative of the range of views to the project area and proposal (See Appendix H):

- Viewpoint 1 – View from Illoura Reserve, Balmain East
- Viewpoint 2 – View from a ferry travelling between Balmain East and King Street Ferry Wharf
- Viewpoint 3 – View from a ferry approaching the proposal (and Barangaroo South)
- Viewpoint 4 – View from Ballarat Park, Pyrmont
- Viewpoint 5 – View from Pier 10, next to the heritage fleet, Pyrmont
- Viewpoint 6 – View from Pyrmont Bay Ferry Wharf, Pyrmont
- Viewpoint 7 – View from Pyrmont Bridge, Cockle Bay
- Viewpoint 8 – View from restaurants at the King Street Wharf, Darling Harbour.
- Viewpoint 9 – View from footpath adjacent to The Sussex Hotel to Sussex Street
- Viewpoint 10 – View south along the harbour edge, Barangaroo South.

Figure 6-12 shows the key viewpoints surrounding the proposal area and Table 6-23 summarises the construction impact identified in the viewpoint assessment. The view points are also shown within the Landscape and Visual Impact Assessment (Appendix H).

## Figure 6-12 Key viewpoints



### 6.4.2 Existing environment

The immediate surrounds of the proposal area is currently in a period of intense change. The Barangaroo precinct is a major construction zone with Barangaroo Point and Barangaroo South currently under construction. Central Barangaroo to the north east of the proposal area will also be developed in the future. The Barangaroo precinct will eventually become a landmark high-end commercial, residential and recreational precinct upon completion. The ultimate development form within Barangaroo has been considered as a baseline for this landscape and visual impact assessment.

The visual catchment of the proposal area is constrained on the landside by large scale urban development, a tight street pattern, and limited open space. The proposal area is, however, much more widely seen from the harbour and across the harbour from areas to the north, west and south.

Key landscape and visual features of this visual catchment include a number of landmarks, such as:

- The former port control tower at the northern end of Barangaroo, Observatory Hill and the Sydney Harbour Bridge to the north (potentially to be removed as part of Barangaroo)
- The National Maritime Museum and Heritage Fleet, the Pyrmont Bridge, and Sydney Aquarium to the south
- Views to the Sydney Tower nestled in the skyline to the east of Cockle Bay.

The CBD skyline creates a strong visual edge to the east of most views within the area. The verticality of the CBD skyline creates visual enclosure to easterly views and reduces the depth of views. At harbour level, a range of edge treatments characterise the harbour edge in the vicinity of the proposal area, with open water in the north, and becoming more densely developed in the south.

There are a range of landscape character types around the proposal area, including three different harbour character areas to the west of the proposal area, and three urban development areas to the east. The six landscape character areas are described in Table 6-22.

Table 6-22: Landscape character areas in the vicinity of the project area

| Landscape character area | Description |
|---|---|
| Balmain East to Millers Point | The character of the harbour stretching from Balmain East to Millers Point is both urban and open. Views typically include a large expanse of open water with a residential or open space harbour edge. This openness sits in contrast to the CBD skyline which creates a strong vertical element in views and a western boundary to most views. The Sydney Harbour Bridge is a visual feature, seen in some views. Sydney's north shore and glimpses into distant inlets and bays can also be seen in many north and east facing views. The harbour in this area is relatively wide and numerous ferries and other vessels, including large cruise ships, frequently use this stretch of water. East Balmain and Millers Point both have a rocky parkland character, and a fabric of historic architecture. Views from Balmain have a sense of tranquillity, created by the contrast of the quiet viewing location and busy city in the view. |

| Landscape character area | Description |
|---|---|
| Barangaroo to White Bay | Between Barangaroo in the east, and Johnstons and White Bays in the west, there is a large expanse of open water and a lower profile built form, with predominantly three to five storey finger wharves and buildings stepping back from the harbour. Visual features of this precinct include finger wharves, a cruise ship terminal, open space and waterfront promenades and residential and commercial uses. There is a less touristy feel to this precinct, and a sense of calm, with small harbours and bays providing an undulation to the harbour edge that creates visually enclosed pockets. |
| Darling Harbour to Cockle Bay | The landscape character in the vicinity of Darling Harbour and Cockle Bay is of a highly urban, visually cluttered harbour. A range of historic and modern vessels are moored in this part of the harbour. Visual features include the iconic Australian National Maritime Museum building, lighthouse and moored replica 'Endeavour' tall-ship. The neck of the harbour is narrow, and can appear visually cluttered as boats pass in close proximity between moored ships and ferries. At wharf level, numerous floating restaurants, moored ships and ferries create a built edge to the harbour, restricting views to the open water of the harbour. To the south the historic Pyrmont Bridge crosses Cockle Bay, providing elevated views across the harbour, and to the vertical mass of the CBD skyline. |
| King Street Wharf | The King Street Wharf area of east Darling Harbour includes a dense urban form, stepping up from harbour-side restaurants and foreshore plazas, to the high-rise towers of the CBD skyline beyond. The CBD buildings are predominantly glass-clad multi-storey commercial office towers. The Sydney Tower is a visible feature of this portion of the skyline in some views. Restaurants line the east of the bay, and broad timber promenades line the harbour edge. |
| Barangaroo South | Upon completion, Barangaroo South will appear as a stepped massing of urban built form from harbour foreshore plazas, to a medium scale, to high rise towers and to a backdrop of the existing CBD skyline. Lower residential, retail and commercial buildings will be seen adjacent to the proposal area. In the centre of the Barangaroo South site, three glass-clad multi-storey commercial office towers will rise above the surrounding built form. These large scale high rise structures include curved glass walls, which softens the overall massing of these buildings. There is a consistency between the materials and character of these high rise towers with the existing CBD buildings in both scale and mass. These buildings will appear larger, and be more visually prominent, due to the development's proximity to the harbour foreshore and grander scale. |
| Central Barangaroo and Barangaroo Point | The northern portion of the Barangaroo precinct will comprise two precincts.<br>Barangaroo Point, in the north, has been designed as a parkland mimicking the original character of the bushland and rocky headlands of the harbour. An irregular, stepped sandstone wall will create an edge to the site, which will rise steeply and be densely planted with native vegetation. Harbour areas next to this park will be undeveloped and feature an open water edge.<br>Central Barangaroo will include public and cultural buildings, with commercial facilities, recreational areas and, urban plazas. This precinct will include some high-rise and medium scale development of similar character to the Barangaroo South development and CBD skyline adjacent.<br>There will be a mix of open water and developed harbour edge in this area. |

### 6.4.3 Potential impact

#### Construction

During construction there would be barge mounted cranes and equipment visible on the water within the construction site boundary. The on-water construction area would replace the view of open water.

From the land there would be a construction work area and a temporary construction compound visible along the Harbour edge about 420 square metres in area.

Table 6-23 Summary of viewpoint assessment during construction phase

| Viewpoint number and location | Visual sensitivity | Visual modification (Day) | Visual impact (Day) |
|---|---|---|---|
| Viewpoint 1 – View from Illoura Reserve, Balmain East | Regional | Due to the distance and urban context, there would be no reduction or improvement in visual amenity as a result of the proposal. | Negligible |
| Viewpoint 2 – View from a ferry travelling between Balmain East and King Street Ferry Wharf | Regional | The development envelope would extend towards the viewer at this location. Due to the overall character of the construction activity, including barges and associated cranes, there would be a noticeable reduction in visual amenity. | Moderate adverse |
| Viewpoint 3 – View from a ferry approaching the proposal (and Barangaroo South) | Regional | The development envelope would extend towards the viewer at this location, comprising a large portion of the middle ground of this view. Due to the proximity of the view and the character of construction activity including barge mounted cranes, there would be a noticeable reduction in visual amenity. | Moderate adverse |
| Viewpoint 4 – View from Ballarat Park, Pyrmont | Regional | The development envelope would extend towards the viewer at this location, comprising a large portion of the middle ground of this view. Due to the proximity of the view and the character of construction activity including barge mounted cranes, there would be a noticeable reduction in visual amenity. | Negligible |
| Viewpoint 5 – View from Pier 10, next to the heritage fleet, Pyrmont | Regional | The development envelope would extend towards the viewer at this location, replacing the view of open water and a uniform uncluttered harbour edge. Due to the proximity of the view, there would be a noticeable reduction in visual amenity. | Moderate adverse |

| Viewpoint number and location | Visual sensitivity | Visual modification (Day) | Visual impact (Day) |
|---|---|---|---|
| Viewpoint 6 – View from Pyrmont Bay Wharf, Pyrmont | State | The development envelope would extend towards the viewer at this location, and would be aligned with existing wharf facilities at King Street Wharf. Due to the increased visual clutter, obstruction of views to open water and close proximity of the view, there would be a noticeable reduction in visual amenity. | High adverse |
| Viewpoint 7 – View from Pyrmont Bridge, Cockle Bay | State | The development envelope would extend towards the viewer at this location, seen within a context of a visually cluttered harbour. This change would not result in a noticeable reduction or improvement in visual amenity of this view. | Negligible |
| Viewpoint 8 – View from restaurants at the King Street Wharf, Darling Harbour | Regional | The proposal would extend across much of the middle ground of this view. This work would obscure views to open water of the harbour, and to the Sydney Harbour National Park beyond. There is a precedent for construction activity seen in the vicinity of the site with a range of construction projects occurring next to the site and continuing along the Barangaroo peninsula. This change would result in a noticeable reduction in visual amenity. | Moderate adverse |
| Viewpoint 9 – View from footpath adjacent to The Sussex Hotel to Sussex Street | Regional | During construction there would be a construction worksite along the harbour edge and associated construction equipment located in the water beyond.<br>Due to the location of the site at the end of this view, and obstruction of the harbour, this change would result in a noticeable reduction in visual amenity. | Moderate adverse |
| Viewpoint 10 – View south along the harbour edge, Barangaroo South. | Regional | There is a precedent for construction activity seen in the vicinity of the site with a range of construction projects occurring next to the site.<br>However, this change would result in a considerable reduction in visual amenity. | High adverse |

In views at a distance, such as from ferries within the harbour, the Illoura Reserve at Balmain East and Ballarat Park in Pyrmont, there would be no noticeable reduction or improvement in visual amenity as a result of the proposal. As a result, there would be a negligible visual impact from much of the study area during construction.

In views at a closer proximity, such as from ferries within the harbour and Pier 10, there would be a noticeable reduction in amenity during construction, resulting in a moderate adverse visual impact.

In views from the Pyrmont Bay Wharf, a higher sensitivity viewpoint with the proposal area located in the middle ground of the view, the proposal would create a noticeable reduction in visual amenity during construction, and an overall high adverse visual impact.

Views from Pyrmont Bridge, also a location of higher visual sensitivity, would experience views to the proposal area, resulting in no noticeable reduction or improvement in visual amenity.

Directly to the south of the proposal, views from the promenade and restaurants at King Street Wharf are of regional visual sensitivity. Due to the proximity of the proposal to this viewing location and the obstruction of views to the open water of the harbour, islands and north shore, there would be a noticeable reduction in the visual amenity of the proposal during construction, resulting in a moderate adverse visual impact.

Views from Barangaroo South, including the future waterfront promenade, retail and residential areas, would be of regional visual sensitivity. Due to the obstruction of views to the open water of the harbour, and iconic harbour buildings beyond, a change that would comprise a large extent of the views, there would be a considerable reduction in the visual amenity of the proposal during construction, resulting in a high adverse visual impact.

In views from the future Wynyard Walk and adjacent footpaths to the east of the proposal site, views of regional visual sensitivity, there would be a noticeable reduction in the amenity of the view. This is mainly due to the location of the site at the terminus of views along Transport Place, which will link Wynyard Walk and the Barangaroo Ferry Hub. There would be a moderate adverse visual impact on these views during construction.

Although there is a precedent for construction activity seen in the vicinity of the site with a range of construction projects occurring next to the site and continuing along the Barangaroo peninsula, the overall construction impact ranges from negligible to high adverse. These impacts are temporary in nature and would be seen in the context of a continuum of construction on the Barangaroo peninsula.

### *Landscape character impact*

An assessment of the landscape character impact has been undertaken for each landscape character area during construction, and is summarised in Table 6-24.

Table 6-24 Summary of landscape character assessment during construction phase

| Landscape character area | Landscape sensitivity | Landscape modification (Day) | Landscape impact (Day) |
|---|---|---|---|
| Balmain East to Millers Point | Regional | No reduction or improvement | Negligible |
| Barangaroo to White Bay | Regional | Noticeable reduction | Moderate adverse |
| Darling Harbour to Cockle Bay | State | No reduction or improvement | Negligible |
| King Street Wharf | Regional | Noticeable reduction | Moderate adverse |
| Barangaroo South | Regional | Noticeable reduction | Moderate adverse |
| Central Barangaroo and Barangaroo Point | Regional | No reduction or improvement | Negligible |

The landscape character of the Barangaroo to White Bay and Barangaroo South areas of the harbour would be directly impacted by construction of the proposal, with a change to the Barangaroo foreshore and reduction in the area of open water. As a result it is expected that there would be a noticeable reduction in the quality of the landscape character of these areas, resulting in a moderate adverse landscape impact.

At Barangaroo South, the landscape character would be directly impacted by the creation of the Barangaroo Ferry Hub, with a change to the Barangaroo harbour edge to a more densely developed treatment, and reduction in the area of visible open water from adjacent promenade and plazas, ground and lower level retail and residential areas. The character of these water views would be a considerable feature of the character of this precinct. This proposal has a character that is compatible with the future development form of this precinct. There would be views over and through the proposal area, however, some views would be interrupted by the angled alignment of the proposed wharves. This would locate the proposal on the terminus of views along Transport Place and Union Walk, increasing the legibility and visual connectivity of the public transport network, and is therefore considered to be an appropriate character for this densely developed area of the City.

The landscape character of the King Street Wharf precinct would not be directly impacted by the proposal. However, where the character is influenced, in a small part, by views to the harbour in the vicinity of Barangaroo South there would be some impacts experienced. There would be a temporary reduction in landscape amenity during construction, resulting in a moderate adverse visual impact. At night the brightly lit environment would limit visibility to the harbour through the proposed Barangaroo Ferry Hub and is likely to result in a noticeable reduction in landscape character, resulting in a moderate adverse visual impact. During the day, impact would be negligible. This is because changes are generally compatible with the landscape character of the Barangaroo precinct.

During construction the character of the proposal area is compatible with the urban character of the remaining landscape character areas, with the proposal area becoming an extension to the densely developed waters and character of these precincts. Therefore the proposal would not result in a perceived reduction in the quality of the landscape character of these surrounding areas.

## Operation

The proposed Barangaroo Ferry Hub architecture would have a similar character to recently constructed wharves at Milsons Point, Balmain and Rose Bay. These wharves are based on a design which has been adapted from the Roads and Maritime Ferry Wharf Upgrade Program, which aims to create a distinctive theme for public ferry wharves within Sydney Harbour. These wharves are characterised by a low profile, steel framed structure with a curved roof, grey panels and glass as show in Figure 6-13.

In addition to the wharf structures, there would be ferries arriving and departing, laying over, and manoeuvring in the waters in and around the proposed Barangaroo Ferry Hub.

The proposal would be operational during both day and night time hours. At night the proposal would be brightly lit to accommodate safe public use of the facility. Ferries approaching the facility and manoeuvring within the harbour would also include lighting.

Figure 6-13 Character images of the proposed Barangaroo Ferry Hub

*Visual impact*

Table 6-25 summarises the operational impact identified in the viewpoint assessment.

There would be a negligible visual impact on views from the north-west, west and south during the day, due to the highly urban visual backdrop and the compatibility of the character of the proposal with existing wharves.

During the day, views from the promenade and restaurants at King Street Wharf, Barangaroo South, and the future Wynyard Walk and adjacent footpaths would be considerably reduced due to the proposal. This impact is largely due to the reduced visibility or obstruction of the open water views of the harbour, and in the instance of the King Street Wharf, the close proximity of the view. This would result in a moderate adverse visual impact.

At night, from locations to the north-west, west and south-west, the proposal would be viewed against a brightly lit urban environment. In these views there would be no perceived reduction or improvement in the amenity of these views, resulting in a negligible visual impact.

In west facing views, with the harbour beyond, such as from the King Street Wharf area, the obstruction of views to the open water would be less noticeable at night when the brightly lit foreground limits the depth of view. Therefore, from this location there would be negligible visual impact at night.

In views from Barangaroo South, the obstruction of open water views is more prominent at ground level and the lower levels of future development due to the close proximity of these views and extent of the view that would be altered. This would result in a noticeable reduction in the amenity of these views during the day and night, resulting in a moderate adverse visual impact. Views from above the lower levels of future residences at Barangaroo South are anticipated to include the roof plane of the Barangaroo Ferry Hub, associated vessels and open water beyond however it is expected that majority of the views from these residents would be largely unaffected by the proposal. Views from the lower levels of development at Barangaroo South, including residences, are also expected to be affected by trees that are likely to be planted between the residences and the water at the Barangaroo foreshore.

Table 6-25 Summary of viewpoint assessment during operation phase

| Viewpoint number and location | Visual sensitivity | Day | | Night | |
|---|---|---|---|---|---|
| | | Visual modification | Visual impact | Visual modification | Visual impact |
| Viewpoint 1 – View from Illoura Reserve, Balmain East | Regional | Three covered wharves would extend towards the viewer, with the short end of each wharf seen from this angle, reducing the visual scale of the structures and creating a more varied edge to the harbour in the view. Due to the highly urban visual context and the amount of open water visible in the foreground of this view, the proposal would be absorbed into the character of this view, resulting in no perceived reduction or improvement in visual amenity. | Negligible | The Barangaroo Ferry Hub would be brightly lit and operational at night. As the proposal would be viewed against the existing brightly lit urban environment, and there are already a considerable number of ferries and other vessels using this stretch of the Harbour. This change would not result in a noticeable reduction or improvement in visual amenity as a result of the proposal.. | Negligible |
| Viewpoint 2 – View from a ferry travelling between Balmain East and King Street Ferry Wharf | Regional | Three covered wharves would extend towards the viewer, with the short end of each wharf seen from this angle, reducing the visual scale of the structures. Due to the highly urban visual context, and the amount of open water visible in the foreground of this view, there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible | The Barangaroo Ferry Hub would be brightly lit and operational at night. As the proposal would be viewed against a brightly lit urban environment and there are already a considerable number of ferries using this stretch of the harbour. This change would not result in a noticeable reduction or improvement in visual amenity as a result of the proposal. | Negligible |

| Viewpoint number and location | Visual sensitivity | Day | | Night | |
|---|---|---|---|---|---|
| | | Visual modification | Visual impact | Visual modification | Visual impact |
| Viewpoint 3 – View from a ferry approaching the proposal | Regional | Three covered wharves would extend towards the viewer, with the short end of each wharf seen from this angle, reducing the visual scale of the structures and creating a more varied edge to the harbour in this view. Due to the highly urban visual context, and the nearby built harbour edge with the wharves to the south of the proposal area, and visual compatibility of the proposal with this area, there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible | The Barangaroo Ferry Hub would be brightly lit and operational at night. As the proposal would be viewed against a brightly lit urban environment and there are already a considerable number of ferries using this stretch of the harbour. This change would not result in a noticeable reduction or improvement in visual amenity as a result of the proposal. | Negligible |
| Viewpoint 4 – View from Ballarat Park, Pyrmont | Regional | Three covered wharves would extend towards the viewer. The wharves and ferries would obstruct potential views towards Transport Place and to the Wynyard Walk, and would extend the irregular edge to the harbour see at King Street Wharf. Due to the highly urban visual context, and the amount of open water visible in the foreground of this view, there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible | The Barangaroo Ferry Hub would be brightly lit and operational at night. As the proposal would be viewed against a brightly lit urban environment and there are already a considerable number of ferries using this stretch of the harbour. This change would not result in a noticeable reduction or improvement in visual amenity as a result of the proposal. | Negligible |

| Viewpoint number and location | Visual sensitivity | Day | | Night | |
|---|---|---|---|---|---|
| | | Visual modification | Visual impact | Visual modification | Visual impact |
| Viewpoint 5 – View from Pier 10, next to the heritage fleet, Pyrmont | Regional | Three covered wharves would extend towards the viewer, The wharves and ferries would obstruct potential views towards Transport Place and to the Wynyard Walk, and would extend the irregular edge to the harbour at King Street Wharf. Due to the highly urban visual context, and the amount of open water visible in the foreground of this view, there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible | The Barangaroo Ferry Hub would be brightly lit and operational at night. As the proposal would be in character with the existing harbour edge, as seen from this location, therefore there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible |
| Viewpoint 6 – View from Pyrmont Bay Ferry Wharf, Pyrmont | State | Three covered wharves would extend towards the viewer. The full length of the wharves and the ferries would be seen in this view, extending into the harbour, further than extending wharves at King Street Wharf. Due to the highly urban visual context, and visual compatibility of the character of the ferry hub with the existing wharves at King Street, there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible | The Barangaroo Ferry Hub would be brightly lit and operational at night. As the proposal would be in character with the existing harbour edge, as seen from this location, therefore there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible |

| Viewpoint number and location | Visual sensitivity | Day | | Night | |
|---|---|---|---|---|---|
| | | Visual modification | Visual impact | Visual modification | Visual impact |
| Viewpoint 7 – View from Pyrmont Bridge, Cockle Bay | State | Three covered wharves would extend towards the viewer. The full length of he wharves and the ferries would be seen in this view, extending into the harbour further than existing wharves at King Street Wharf. Due to the highly urban visual context, and visual compatibility of the character of the Barangaroo Ferry Hub with the existing wharves at King Street, there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible | The Barangaroo Ferry Hub would be brightly lit and operational at night. As the proposal would be viewed against a brightly lit urban environment, and there are already a considerable number of ferries using this stretch of the harbour, there would be no perceived reduction or improvement in visual amenity as a result of the proposal. | Negligible |
| Viewpoint 8 – View from restaurants at the King Street Wharf, Darling Harbour | Regional | Three covered wharves would extend towards the viewer, extending the character of the existing King Street Wharf area, north along the harbour edge. As a result, views to the open water of the harbour, islands, Balmain peninsula and north shore beyond would be obscured when seen from this location. Despite, the highly urban visual context, and visual compatibility of the character of the Barangaroo Ferry Hub with the existing wharves at King Street, there would be a noticeable reduction in visual amenity as a result of the proposal due to the loss of water views and visual connection to the wider harbour background. | Moderate adverse | The Barangaroo Ferry Hub would be brightly lit and operational at night and in character with the surrounding brightly lit urban land uses. There would be an obstruction of visible open water from this location, however, this would be less noticeable at night when the brightly lit foreground limits the depth of view. For this reason, there would not be a noticeable reduction in visual amenity as a result of the proposal at night. | Negligible |

| Viewpoint number and location | Visual sensitivity | Day | | Night | |
|---|---|---|---|---|---|
| | | Visual modification | Visual impact | Visual modification | Visual impact |
| Viewpoint 9 – View from footpath adjacent to The Sussex Hotel to Sussex Street | Regional | A covered wharf would be seen extending across the background of this view. The Barangaroo Ferry Hub would be a visual feature at the end of this view. Due to the obstruction of the harbour there would be a noticeable reduction in visual amenity. | Moderate adverse | The Barangaroo Ferry Wharf would be brightly lit and operational at night. The proposal would be viewed against the water in this view, the context is a brightly lit urban environment and the ferry hub would be in character with these surrounding uses. Views to open water would be obstructed from this location, however, this would be less noticeable at night when the brightly lit foreground limits the depth of view. | Negligible |
| Viewpoint 10 – View south along the harbour edge, Barangaroo South. | Regional | Three covered wharves would extend across the view, obstructing views to the open water of the harbour and iconic harbour buildings beyond. Despite, the highly urban visual context, and visual compatibility of the character of the Barangaroo Ferry Hub with the existing wharves at King Street, there would be a noticeable reduction in visual amenity as a result of the proposal. | Moderate adverse | The Barangaroo Ferry Hub would be brightly lit and operational at night. The context is a brightly lit urban environment and the proposal would be in character with the surrounding land uses. However, a large area of open water would be obstructed in views from this location. This would result in a noticeable reduction in visual amenity as a result of the proposal at night. | Moderate adverse |

*Landscape character impact*

An assessment of the landscape character impact has been undertaken for each landscape character area during operation, and is summarised in Table 6-26.

Table 6-26 Summary of landscape character assessment during operational phase

| Landscape character area | Landscape sensitivity | Day | | Night | |
|---|---|---|---|---|---|
| | | Landscape modification | Landscape impact | Landscape modification | Landscape impact |
| Balmain East to Millers Point | Regional | No reduction or improvement | Negligible | No reduction or improvement | Negligible |
| Barangaroo to White Bay | Regional | Noticeable reduction | Moderate adverse | No reduction or improvement | Negligible |
| Darling Harbour to Cockle Bay | State | No reduction or improvement | Negligible | No reduction or improvement | Negligible |
| King Street Wharf | Regional | Noticeable reduction | Moderate adverse | No reduction or improvement | Negligible |
| Barangaroo South | Regional | No reduction or improvement | Negligible | No reduction or improvement | Negligible |
| Barangaroo Central and Barangaroo Point | Regional | No reduction or improvement | Negligible | No reduction or improvement | Negligible |

The landscape character of the Barangaroo to White Bay area of the harbour would be directly impacted by operation of the proposal, with a change to the Barangaroo foreshore and reduction in the area of open water. There would also be an increase in ferry movements, and ferry manoeuvring within the narrow stretch of the harbour. As a result it is expected that there would be a noticeable reduction in the quality of the landscape character of this area, resulting in a moderate adverse landscape impact.

The landscape character of Barangaroo South would be directly impacted by the proposal, with a change to the Barangaroo foreshore to a more densely developed treatment, and reduction in the area of visible open water. This proposal has a character that is compatible with the future development form of this precinct, however some views would be interrupted by the angled alignment of the proposed wharves. As a result it is expected that there would be a noticeable change in landscape character during operations. This results in a moderate adverse landscape impact.

During operation the character of the proposal is compatible with the urban character of the remaining landscape character areas, with the proposal becoming an extension to the densely developed waters and character of these precincts. Therefore the proposal would not result in a perceived reduction in the quality of the landscape character of these areas.

Overall it is considered that there would be no cumulative impacts in views seen across the harbour waters, as the Barangaroo Ferry Hub would be largely visually absorbed into the highly urban background of Barangaroo South and the CBD.

### 6.4.4 Mitigation measures

Mitigation measures for visual amenity and urban character would ultimately form part of the CEMP and OEMP for the proposal.

*Construction*

- Lighting in line with *AS/NZ 1158 Set:2010: Lighting for roads and public spaces* will be used to ensure glare and light spill are minimised while meeting safety and amenity requirements
- Regular maintenance of site hoarding and perimeter site areas will be undertaken, including the prompt removal of graffiti.

*Operation*

The following visual amenity design considerations will be investigated during detailed design:

- The use of glass or similar material to create transparency and reduce the obstruction of views to the water
- Integrate and minimise the scale of elements such as the pump-out facility, gateline 'kiosk', and any pontoon facilities as much as possible to reduce visual obstruction to water views
- Minimise the use of railings and structures that obstruct views to the water and create visual clutter
- Integrate elements of the structure to create a unified and coherent character to the architecture of the Barangaroo Ferry Hub
- Given the visually congested context of the future Barangaroo precinct, the design of Barangaroo Ferry Hub should create a simple, low scaled ferry hub that maximises views to the water and which relates to the architectural language of the existing Ferry Wharf Upgrade Program
- Selection of finishes to be visually compatible with the adjacent Barangaroo South development.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.5 Built and non-Indigenous Heritage

This section assesses the potential impact on built and non-Indigenous heritage within the study area as a result of the proposal. The assessment presented in this section draws on information from the Statement of Heritage Impact (SOHI), prepared by RPS for the EIS (Appendix I) and responds to the relevant SEARs as outlined in the table below.

### Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Heritage | The EIS is to include a Heritage Impact Statement (HIS) which must assess the likely impacts of the proposal on significance of heritage items in the vicinity of the site. | Section 6.5.2 and Appendix I and Appendix J |
| Heritage | The EIS should include an assessment of any potential maritime heritage including shipwrecks, previous maritime infrastructure, archaeological items and/or relics (both above and below water and under historical reclamation areas) that may be impacted by the proposal, including strategies and procedures to be followed in the case of an unexpected discovery of heritage items and/or relics. The maritime heritage component of the EIS should be undertaken by a suitably qualified maritime archaeologist. | Section 6.5.2 and Appendix I and Appendix J |

The proposal area and marine archaeology study area considered in the SOHI at Appendix I is identified in Figure 6-14.

The SOHI was prepared in accordance with *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Burra Charter) (Australia ICOMOS, 2013) and associated Guidelines as well as best practice standards set by the NSW Heritage Division of OEH. Best practice guidance followed in the SOHI include *Assessing Heritage Significance* (Heritage Office, 2002) and *Statements of Heritage Impact* (Heritage Office and Department of Urban Affairs and Planning, 2002).

Figure 6-14 Marine archaeology study area and proposal area

### 6.5.1 Existing environment

#### Historical setting

A literature review of historical sources indicates that the land in the vicinity of the project area was occupied by Indigenous Australians prior to 1788. After 1788, Europeans colonised Sydney and development was undertaken, in particular, shipbuilding and transport wharves were constructed in the area from the early 1800s. The Australian Gas Light Company constructed their coal gas plant in 1841 in the vicinity of the Barangaroo precinct (to the north east of the project area).

In 1900 the spread of bubonic plague from the wharves to the city changed the face of the eastern Darling Harbour waterfront. The land along the eastern waterfront was resumed and redeveloped, with larger wharves enabling the berthing of larger steamships (Sydney Harbour Foreshore Authority, 2010).

Part of the development of the eastern Darling Harbour waterfront involved land reclamation. Reclamation destroyed the natural shore line and buried many of the timber wharves constructed prior to 1900. Archaeological investigations carried out by Casey & Lowe in 2012 uncovered a number of the timber pilings of these wharves, as well as a large stone sea wall still surviving beneath the fill introduced as part of the land reclamation (Casey & Lowe, 2012).

Later in the twentieth century, further land reclamation was carried out and newer wharves constructed.

In 1998 the area was the scene of the Australian waterfront dispute, in which Patrick Corporation sought to restructure their stevedoring operations, resulting in the lockout of workers. In 2006 Patrick Corporation moved their stevedoring operations from Barangaroo to Port Botany, thereby ending cargo operations at the wharves at Barangaroo. Since this time Barangaroo has been used as the World Youth Day site in 2008, where Pope Benedict XVI conducted a mass, and a temporary overseas passenger terminal during the construction of the White Bay cruise terminal, which was completed in 2013.

#### NSW heritage register review

A search of the Australian Heritage Database on 25 June 2014 indicated that there are no World Heritage Sites or items on the National heritage list or the Commonwealth Heritage List located within or near the project area.

A search of the State heritage register, NSW Heritage Inventory (s170 Heritage Registers) and Schedule 5 of the Sydney LEP was completed on 25 June 2014. There were no items with State or local heritage significance within the project area. Eleven items with State or local heritage significance were identified in the vicinity of the proposal area. The details of these items are provided in Table 6-27.

Table 6-27 Items of State or local heritage significance in the vicinity of the project area

| Item | Address | Register listed | Approximate distance from project area |
|---|---|---|---|
| Sewage Pumping Station No 13 (SP0013)<br>Former MWS&B Pumping Station | Sussex Street, Sydney | s170 heritage registers<br>Sydney LEP | 170 metres east |
| Grafton Bond Store and Sandstone Wall<br>Former Grafton Bond Store, including interiors | Hickson Road, Millers Point | State heritage register<br>s170 heritage registers<br>Sydney LEP | 200 metres east |
| MSB stores complex<br>Former MSB Stores, including interior | 2-4 Jenkins Street, Millers Point | State heritage register<br>s170 heritage registers<br>Sydney LEP | 200 metres east |
| Sussex Hotel/Big House Hotel<br>Former 'New Hunter River Hotel', including interiors | 20 Sussex Street, Sydney | State heritage register<br>Sydney LEP | 200 metres east |
| Trees and sandstone retaining walls (adjacent Napoleon Street) | Sussex Street, Sydney | Sydney LEP | 200 metres east |
| Lane off Gas Lane including sandstone walls and wrought iron street light | Jenkins Street, Sydney | Sydney LEP | 230 metres east |
| Warehouses (former Dalgety's Bond Stores) | Munn Street, Millers Point | s170 heritage registers | 490 metres north |
| Iloura Reserve | Weston Street, Balmain East | State heritage register | 510 metres north-west |
| Pyrmont Bridge | Darling Harbour | State heritage register | 590 metres south-west |
| South Steyne (S.S.) | Port Jackson | State heritage register | 600 metres south-west |
| Goat Island | Sydney Harbour | State heritage register | 1.1 kilometres north-west |

Historic shipwrecks more than 75 years old in enclosed waters within NSW are protected by Part 3C of the *Heritage Act 1977* (Heritage Act).

A search of the NSW maritime heritage online database indicated that there are no known shipwrecks located within the proposal area. Two items are listed on the opposite shore of Darling Harbour:

- Australian National Maritime Museum – located approximately 350 metres south-west of the proposal area
- Sydney Heritage Fleet – various locations on the western shore between 260 metres to 460 metres south-west of the proposal area.

Given the separation of these items from the proposal area, neither of these items would be impacted by the proposal.

Historic shipwrecks that are known to have occurred in Darling Harbour as listed in the *Heritage Act 1977* are identified in Table 6-28. It should also be noted that several other historic shipwrecks are known to be located in Sydney Harbour however their exact locations are currently unknown.

Table 6-28 Shipwrecks known to be within Darling Harbour

| Ship | Where lost | When |
|---|---|---|
| Omeo | Darling Harbour near Bathurst Street | 1899 |
| Orphan Girl | Darling Harbour | 1880 |
| Sterling | Darling Harbour near Federal Wharf | 1919 |
| William Woolley | Darling Harbour | 1854 |

## Visual inspection

### *Land based*

A visual inspection of the project area was made on 8 August 2014 by a qualified cultural heritage consultant.

The proposal area comprises a long wharf running the length of the eastern Darling Harbour shore line north from the King Street Wharf precinct. It is located on reclaimed land and retains features from its former use as a cargo wharf. There are no heritage items adjoining the project area.

There are a number of State heritage items near the project area, none of which are close enough to be impacted, either tangibly or intangibly, by the proposal. One of the items is on Sussex Street, with the Barangaroo construction between it and the proposed Barangaroo Ferry Hub. The remaining items are located at Millers Point or across the harbour and are of a sufficient distance to not be impacted, either directly or indirectly, by the proposal.

### *Water based*

To investigate if the proposal would impact on any unknown historic shipwrecks or other maritime heritage multi-beam sonar data and side-scan data for the proposal area were reviewed by suitably qualified maritime archaeologist to identify anomalies on the seabed with potential for heritage significance (ArchaeoMar, 2014).

On 11 September 2014 dives were carried out by ArchaeoMar to confirm the presence of the anomalies on the seabed, identify whether the targets were potential heritage items, and, if heritage items, assess their significance.

The dives confirmed that the anomalies were modern debris, including a discarded silt curtain, anchor chain, timber piles, chairs, and plastic containers. The remaining anomalies were either components of modern construction infrastructure such as a used navigational aid or natural geological features.

No items of historic heritage significance were identified during the visual dive inspection.

### Heritage significance

Although the Barangaroo area has been an important waterfront location since the early nineteenth century and the general location has long been engaged in water transport and stevedoring operations, the proposal area is not considered to contain any heritage significance.

The proposal area displays no evidence of heritage significance, and while its setting within Sydney Harbour is of high scenic value it is not considered to be of aesthetic heritage significance.

The proposal area is therefore assessed as not having heritage significance.

## 6.5.2 Potential impact

### Construction phase

There are no identified built or non-Indigenous heritage items in the proposal area.

The construction of the proposal would not physically impact upon any identified heritage items near the proposal area. Therefore it is not considered to impact upon the heritage significance of any of these heritage items.

### Operational phase

Similarly, there will be no operational impacts on heritage.

The new pontoon structure would be lightweight and open in appearance, and the materials are considered appropriate within the waterside context.

## 6.5.3 Mitigation measures

- All relevant staff and contractors are to be trained regarding their statutory obligations and responsibilities under the *Heritage Act 1977* and best practice outlined in *The Burra Charter 2013*, through the site induction and toolbox talks in the event suspected historical cultural material is uncovered
- The CEMP for the proposal will include that provisions for unexpected finds. If, during the course of construction of the proposal, suspected historic cultural heritage material is uncovered:
  - Work will cease in that area immediately and the area will be cordoned off
  - TfNSW environment staff and a suitably qualified archaeologist will be contacted.

  Should the finds constitute non-Indigenous heritage then the Heritage Division, Office of Environment & Heritage will be notified.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.6 Climate change

This section assesses the potential impact of climate change within the study area as a result of the proposal. The assessment presented in this section draws on information from the technical paper, Climate Change Risk Assessment, prepared by Arup for the EIS (Appendix K) and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Sea Level Rise | The EIS must assess the risks associated with sea level rise on the proposal. | Section 6.6.2<br>Appendix K |

### 6.6.1 Assessment methodology

This climate change risk assessment has been conducted in accordance with the following policies, guidelines and reports:

- *Australian Standard/New Zealand Standard 5334-2013: Climate Change Adaptation for Settlements and Infrastructure – A Risk Based Approach*.
- The latest Intergovernmental Panel on Climate Change (IPCC) report, the *Fifth Assessment Report*, known as AR5 (IPCC, 2013). This report provides a view of the current state of global scientific knowledge relevant to climate change.
- *A Guide to Climate Change Risk Assessment for NSW Local Government* (OEH, 2011). As well as providing guidance on conducting risk assessment for a range of local government assets, this document also provides regional climate change projections for NSW which are based on the same models used for the IPCC Fourth Assessment Report (AR4) and the CSIRO Australian Bureau of Meteorology (BoM) in their 2007 report, Climate Change in Australia.
- The *NSW Climate Impact Profile* (OEH, 2010). The Profile assess the likely impact of future climate change to 2050 on five biophysical parameters – biodiversity, soils, streamflow and run-off, the coastal zone and flooding risk in each region of NSW (as defined by NSW 2021 (NSW Government, 2011)).
- The *Climate Change in Australia-Technical Report* produced by the CSIRO in 2007 provides regional projections for Sydney city, using high emissions climate scenarios A1Fl and B1 for 2070 based on the IPCC AR4.
- The Stage One Coastal Management Reforms announced on 8 September 2012. As part of these reforms, the NSW Government no longer recommends statewide sea level rise benchmarks for use by local councils. Previously the NSW sea level rise planning benchmarks were an increase above 1990 mean sea levels of 0.4 metres by 2050 and 0.9 metres by 2100 (no benchmark is provided for 2070, the planning horizon closest to the project design life). The reforms allow councils to have the flexibility to consider local conditions when determining local future hazards.

The most recent data released as part of AR5 provides updated global projections for a range of climate change models and shows that emissions are currently tracking above the high emission scenarios from AR4 at a global scale. This data has not yet been applied at a regional scale (i.e. NSW or Sydney) or incorporated into the two sources detailed above. It is understood that the CSIRO is about to commence a study on the application of AR5 to Australia and its regions. Until this has occurred, it is considered

appropriate to continue to use regional projections based on AR4, but choosing the higher emission scenarios where available e.g. A1F1.

The proposal is anticipated to commence operation in 2016. The design life of the various components of the proposed Barangaroo Ferry Hub is estimated as 50 years. Projections are generally produced for the years 2050, 2070 or 2100 only. Therefore, projections centred around 2070 have been used where available.

The proposal would accommodate ferries over a planning horizon to 2066 (assuming a minimum 50 year design life). Given the coastal location of the proposal, it is expected to be vulnerable to sea level rise and storm surge events in particular. Therefore projected changes in climate need to be taken into consideration for the design, construction, operation and maintenance of the proposal.

This section addresses the potential climate change impact related to proposed infrastructure and vessel operations only. For further assessment on sustainability and greenhouse gases for the proposal, refer to Section 6.13.

### 6.6.2 Existing environment

Sydney's climate can generally be described as a temperate climate which is characterised by warm summers and cool winters. The annual maximum mean temperature is 21.7 degrees Celsius, and the minimum mean temperature is 13.8 degrees Celsius. Sydney receives an average annual rainfall of 1211.9 millimetres.

The existing sea wall at Barangaroo varies from 2.1 metres to 2.2 metres Australian Height Datum (AHD) with the site rising to 2.06 to 3.5 metres AHD at Hickson Road about 200 metres landwards of the seawall.

A sea wall has been approved as part the Barangaroo South Public Domain (Stage 1A) works. The minimum sea wall crest level adopted for Barangaroo South is 2.5 metres AHD representing the current DCP requirement with the graduated increase within the precinct to 3.4 metres AHD to incorporate additional 0.9 metres adopted from the repealed NSW Sea Level Rise Policy Statement 2009 and the *NSW Coastal Planning Guideline: Adapting to Sea Level Rise 2010* (DECCW, 2009) for up to 2100.

The NSW coastal zone experiences semi-diurnal tides, which consist of two high and two low tides daily. The larger or 'spring' tidal range (around two metres) occurs during full or new moon when the gravitational pull of the moon and sun are combined. The tidal plane levels for Sydney Harbour are presented in Appendix K.

A summary of sea level rise policy benchmarks and projections relevant to the proposal have been provided in Table 6-29.

Table 6-29 Projections of mean sea level rise

| Sea Level Rise Benchmarks | Sea level rise | Period |
|---|---|---|
| OzCoasts Sea Level Rise Mapping, produced by the Australian Government (IPCC AR4 high range scenario, allowing for likely AR5 increases) | 0.7 m (relative to 1990 levels) | 2070 |
| Abandoned NSW Sea Level Rise Policy Statement | 0.4 m | 2050 |
| AS4997-2005 Guidelines for the Design of Maritime Structures | 0.2 m (relative to 1990 levels) | 2030 |
| IPCC AR5 Upper Limit RCP8.5 projections | 0.30 (0.22 – 0.38 m) | 2046-2065 |

For the purposes of this assessment, the IPCC projections for global mean sea level rise have been utilised as the benchmark for the design life (2066), as outlined in Table 6-29.The resulting impact on current sea levels at Barangaroo by 2065 is presented in Table 6-30

Table 6-30 Projections of mean sea level rise to 2065

| Extreme water level | m ADH | |
|---|---|---|
| | Current level (No Sea Level Rise) | +0.30 m Sea Level Rise |
| Highest astronomical tide (HAT) | 1.175 | 1.475 |

*Note: Levels would be considered during detailed design*

### 6.6.3 Potential impact

Potential impacts as a result of climate change to the proposed infrastructure or operations include:

- More rapid deterioration of infrastructure and utilities over time, including a requirement for more frequent maintenance due to more frequent storms and increase in annual mean temperature
- Temporary delays or obstruction of ferry berthing due to sea level rise and storm surges
- Misalignment with ferry berthing and landside infrastructure i.e. the ramp steepness and connection to the wharf due to leave level rise and storm surges
- Temporary or permanent inundation of ferry wharf fixed infrastructure due to sea level rise and storm surges. Currently the design allows for 50 centimetres in sea level rise over 50 year design life of the proposal. This is considered reasonable and prudent given the uncertainty associated with projects beyond 2070. This would be further evaluated at detailed design of the proposal, and necessary design measures would be implemented
- More frequent power cuts due to larger city power consumption during extreme heatwaves
- More extreme weather conditions reducing patronage on Sydney Harbour Ferries
- Loss or degradation of marine ecological values due to leaks/breakages to utilities (such as sewerage connection) in extreme weather events.

The climate change risk assessment for the construction and operation of the proposal is shown in Table 6-31. The initial assessment includes key risks associated with the proposal and assigns an overall risk rating.

This assessment concludes that risks associated with future climate scenarios are manageable, by utilising industry standard and proven design and construction techniques and mitigation measures as outlined below.

Table 6-31 Climate change risk assessment

| Asset/service | Climate variable | Potential climate change impact | Consequence | Likelihood | Overall risk |
|---|---|---|---|---|---|
| Construction | Various – including sea level rise, increase in temperatures, increased rainfall intensity. | As construction is scheduled to occur in 2015/2016, the impact of climate change is unlikely to be sufficient to cause disruption to construction. | Insignificant | Very unlikely | Low |
| Ferry wharf structure including floating pontoons and gangways | Storm surge | More rapid deterioration of infrastructure and utilities over time and requirement for frequent maintenance. | Minor | Likely | Moderate |
| | More frequent storms | | | | |
| | Increase in annual mean temperature and days over 35ºC | | | | |
| | Increase in annual mean temperature and days over 35ºC | Movement of joints and structures, fatigue of structural material. Damage to structure. Perceived safety risk due to increased movement. | Minor | Likely | Moderate |
| | Increase in annual average wind speed | | | | |
| | Sea level rise | Temporary or permanent inundation of ferry wharf fixed infrastructure. Disruption of utilities (electricity, telecoms, water etc.). | Major | Very unlikely | Moderate |
| Ferry berthing | More frequent storms, increased rainfall intensity, storm surge | Temporary delays or obstruction of ferry berthing. | Minor | Moderate | Low |
| | Sea level rise | Temporary or permanent inundation of ferry fixed berthing infrastructure. | Major | Very unlikely | Moderate |
| | | Misalignment with ferry berthing and landside infrastructure – i.e. the ramp steepness and connection to the wharf. | Moderate | Moderate | Moderate |
| Ancillary infrastructure | Increase in annual mean temperature and annual number of hot days over 35ºC | More frequent power cuts due to larger city power consumption. Passengers seeking shade. | Minor | Moderate | Low |
| Disruption to ferry services | More frequent storm events, increased rainfall intensity | Temporary decreased access to the wharf may disrupt ferry berthing and | Minor | Moderate | Low |

| Asset/service | Climate variable | Potential climate change impact | Consequence | Likelihood | Overall risk |
|---|---|---|---|---|---|
| | Various – temperature increase, increased storm events, increased rainfall intensity | ability for passengers to embark/disembark. | | | |
| Passenger numbers | Various – temperature increase, increased storm events, increased rainfall intensity | More extreme weather conditions reduces patronage on Sydney Harbour Ferries. | Minor | Very unlikely | Low |
| Marine ecological values | Various – temperature increase, increased storm events, increased rainfall intensity | Loss or degradation of marine ecological values due to leaks/breakages to utilities (such as sewerage connection) in extreme weather events. | Moderate | Unlikely | Moderate |

### 6.6.4 Mitigation measures

A risk assessment analysis identified potential high and medium risks to the physical and natural assets within the proposal area.

Generally there are four possible approaches in responding to climate change:

- Avoid – avoid locating assets in vulnerable areas
- Adapt – design and/or design standards to operate in predicted climate conditions
- Defend – install defences at or around critical infrastructure
- Retreat – develop and implement plans to relocate from the vulnerable area.

In order to address potential impact and inform further design and operational considerations, the following mitigation measures would be implemented:

- The design of the fixed link structure, in particular the allowance for sea level rise. The potential for adaptation or upgrading of the deck at a future date (when there is greater certainty regarding sea level rises and projections) to cater for potential sea level rise beyond the design life will be considered.
- Materials selection to minimise accelerated degradation of infrastructure.
- Shading for user comfort in extreme heat.
- Regular inspections of the infrastructure would be undertaken. Should excessive deterioration be identified, more regular or more substantial maintenance activities may be required within the design life of the project.
- Inspection of infrastructure after storm events would be undertaken to determine damage and appropriate maintenance requirements.

The preliminary concept (Aurecon, 2014b) sufficiently addresses the potential impacts of climate change presented in the previous sections of this report through the provision of a fixed deck that allows for sea level rise and the provision of shade for passenger comfort.

Following implementation of the identified mitigation measures in response to the potential impact identified, risks for the proposal were reassessed and the majority of risks were reduced from moderate to low, as summarised in Appendix K.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.7 Air quality

This section assesses the potential impact on air quality within the study area as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Air Quality and Odour | An Air Quality Impact Assessment during construction and operation prepared in accordance with relevant Environment Protection Authority guidelines shall be submitted. | Section 6.7.3 |

### 6.7.1 Assessment methodology

A qualitative assessment of potential impact on air quality during construction and operation was carried out. It involved:

- Identifying the location of the nearest sensitive receivers
- Characterising the existing air quality environment
- Identifying the location, type and intensity of major construction activities
- Describing the potential local and regional air quality impact during construction and operation
- Outlining how potential impacts would be managed and mitigated.

### 6.7.2 Existing environment

The air quality within the proposal area is expected to be typical of the adjoining CBD. There are likely to be existing airborne particulates associated with the major construction works being undertaken at the Barangaroo precinct as well as from vehicle use within the CBD road network and existing ferry and commercial vessel operations.

OEH undertakes air quality monitoring for five key air pollutants: ozone ($O_3$), nitrogen dioxide ($NO_2$), carbon monoxide (CO), sulphur dioxide ($SO_2$) and particulates less than 10 micrometres in diameter (PM10), as well as providing an hourly and daily regional air quality index. The broader Sydney Central-East monitoring region provides the closest air quality monitoring results to the Sydney CBD, with air quality currently monitored from sites at Chullora, Rozelle, Lindfield, Randwick and Earlwood.

A search of the daily regional air quality index for the Sydney Central-East region for last year (August 2013 to August 2014) (OEH, 2014) showed that the region experienced:

- Very good air quality on 11.2 per cent of days
- Good air quality on 70.8 per cent of days
- Fair air quality on 10.2 per cent of days
- Poor air quality on 4.2 per cent of days
- Very poor air quality on 1.0 per cent of days
- Hazardous air quality on 2.6 per cent of days.

Within the last year, at the nearest OEH air quality monitoring station at Rozelle Hospital about five kilometres west of the proposal, there were no exceedances of the air quality goals for $NO_2$, CO or $O_3$. No background monitoring data relating to $SO_2$ is available, however it is expected that given the absence of significant nearby sources of $SO_2$, background concentrations would be negligible. There were three exceedances of the annual PM10 air quality goal (which is below the five maximum allowable exceedances per year).

The closest BoM monitoring station is the Observatory Hill monitoring station located about 700 metres north east of the proposal site. Data from the BoM reports that the average annual rainfall recorded at Observatory Hill is 1212 millimetres (BoM, 2014).

According to the BoM the average annual wind speed ranges between about 10.6 kilometres per hour (at 9 am) to 16.6 kilometres per hour (at 3 pm). Wind direction and speed varies throughout the day, usually being calmer in the morning. Wind speed and direction also varies throughout the year (BoM, 2014).

Currently up to seven vessels per hour berth at the King Street Ferry Wharf during weekday peak periods and eight vessels per hour on weekends.

### Sensitive receivers

Sensitive receivers in the vicinity of the proposal area include:

- Residents and workers in the Barangaroo precinct (new residents are due to begin occupying the new Barangaroo residential apartments during construction of the proposal)
- Pedestrians and visitors to Barangaroo and King Street Wharf
- Residential and commercial premises along King Street Wharf
- Pyrmont Bay residences.

## 6.7.3 Potential impact

### Construction

Air quality impact during construction of the works would include temporary impact associated with dust particles. Anticipated sources of dust and dust-generating activities include:

- Dust generated from the loading and transfer of material from trucks or barges
- Demolition of King Street Wharf wave baffle (potential).

Dust and particulates pose a potential health risk, particularly for children, the elderly or people with respiratory issues. Dust and particulates can also affect local amenity and cause a nuisance for nearby receivers. Minimal landside excavation and no soil stockpiling is expected as a result of the proposal. As such the dust load generated over a typical construction day is likely to be small and is not expected to result in reduced local air quality, provided that adequate management measures are implemented during works (refer to Section 6.7.4).

Other potential air quality impact include emissions of CO, $NO_2$, $SO_2$, $PM_{10}$, volatile organic compounds and polycyclic aromatic hydrocarbons (PAH) compounds associated with the combustion of diesel fuel and petrol from construction vehicles, vessels, plant and equipment. Based on the duration of works, the number of emission sources and the

scheduling of machinery (i.e. not all machinery would be operating simultaneously) potential emissions affecting air quality are expected to be minor and manageable through the effective implementation of appropriate mitigation measures (refer to Section 6.7.4).

### Operational

Air quality impacts during operation would include emissions of CO, $NO_2$, $SO_2$, $PM_{10}$, VOCs and PAH compounds associated with the combustion of diesel fuel due to the addition of ferry vessels. As a result of the proposal, existing ferry services, which are diesel fuelled, would be moved about 100 metres north from King Street Ferry Wharf to the new location at Barangaroo with additional ferry services to be added. Moving the ferry services is not considered to cause an impact to local air quality due to the already large number of public and commercial vessels operating in the Darling Harbour area.

Additional ferry services are expected to be added to existing services overtime due to the demand generated by the Barangaroo precinct (as detailed in Section 6.2.2). As outlined in Sydney's Ferry Future (TfNSW, 2013), from 2016 a program of replacing the existing ferry fleet is anticipated to modernize and grow Sydney Ferries fleet to increase fuel efficiency and reduce noise levels which would result in increased air quality benefits across the network.

Increasing ferry services overtime due to increase patronage is expected to have a minor air quality impact when considered together with the upgrade of the existing ferry fleet as outlined in Sydney' Ferry Future (TfNSW, 2013a). The increase in ferry services is unlikely to have an adverse impact on nearby sensitive receivers (including new Barangaroo apartments) and regional air quality. Additionally, the provision of increased ferry services to the new Barangaroo precinct, for commuters and weekend users, would encourage greater use of public transport.

Odour impact as a result of the pump-out facilities to be used during ferry layovers has been addressed by providing direct pump-out facilities to the recycled water plant within the Barangaroo precinct. This pump-out facility is an enclosed system (with no ventilation outlets) which therefore means the operation of this system would have no odour emissions. Maintenance of this system may cause minor odour impacts however impacts would be periodic and would be managed as outlined in Section 6.7.4.

## 6.7.4 Mitigation measures

The following mitigation measures are recommended to manage air quality impact during construction:

- Methods for management of emissions will be incorporated into the CEMP and included in project inductions, training and pre-start talks
- Dust will be visually monitored and where necessary the following measures implemented:
  - Loads on vessels and trucks transporting material to and from the construction work area will be appropriately covered
  - Tailgates of road transport trucks will be securely fixed prior to loading and after unloading.

- Plant and machinery would be regularly checked and maintained in a proper and efficient condition
- All site vehicles and machinery would be switched off or throttled down to a minimum when not in use.

The following mitigation measures are recommended to manage air quality impact during operation:

- Vessel engines will be switched off during overnight layover. The operator will develop procedures to manage vessel idling at the wharves.
- The detailed design of pump-out facilities would consider air quality impacts, in particular the need to avoid odour release from the pump out system.
- The operator would develop procedures to manage pump-out facilities at the wharves. These procedures are to consider the operation and maintenance of the facilities to ensure no odour impacts.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.8 Property and land use

This section assesses the potential impact on property and land use within the study area as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issues | SEAR | Where Addressed |
|---|---|---|
| Public Access/Domain | Consideration of landside ancillary facilities and impacts on the public domain including those associated with day-to-day operations. | Section 6.8.2 |
| Public Access/Domain | Details on the interface between the proposed wharfs, public domain, and the relationship to and impact upon the existing public domain. | Sections 4.3 and 6.8.1 |

### 6.8.1 Existing environment

The proposal would be located on the Barangaroo foreshore, within the Darling Harbour waterway and within the King Street Wharf precinct. Figure 2-2 shows the relevant land zones which affect the proposal. The proposal is located within the City of Sydney LGA. The waterside proposal area falls under the provision of the SREP SHC and the majority of the landside proposal areas fall under the provisions of the MD SEPP, as detailed in Sections 2.2.3 and 2.2.4.

The majority of the landside proposal features would be located within the Barangaroo precinct, currently owned by the BDA and being developed by Lend Lease. The Barangaroo precinct currently under construction will be a mixed use precinct including commercial, retail, residential, and recreational uses. The Barangaroo Foreshore Walk is a key pedestrian link which, when it opens (expected March 2015), would complete a generally uninterrupted 14 kilometre foreshore walk from Woolloomooloo to the Anzac Bridge. Submissions are currently being assessed from the display of an EIS seeking consent to subdivide the Barangaroo precinct (Lots 3, 5 and 6 in DP 876514) into two Torrens title lots, namely Lot 100 comprising Barangaroo South (Stages 1A and 1B) and Lot 101 comprising Central Barangaroo and Barangaroo Point (JBA Planning, 2014). Further planned development at the Barangaroo precinct is detailed in Section 2.13.

Some landside proposal features such as wayfinding signage would be located within the King Street Wharf promenade (as detailed in Appendix D) which is owned by SHFA under the *Sydney Harbour Foreshore Authority Act 1998*. Development within King Street Wharf includes a mix of tourism, commercial, residential and maritime land uses. Buildings surrounding the King Street Wharf promenade are managed by Brookfield.

Some proposal features are located within the King Street Wharf (harbourside) which is owned by Roads and Maritime. The King Street Wharf wave baffle situated at the northern end of King Street Wharf is a Roads and Maritime asset which is currently used for maintenance. Commercial vessels operate out of the majority of the King Street Wharf berths, with the exception of King Street Ferry Wharf which is currently used for Sydney Ferries services.

### 6.8.2 Potential impact

#### Construction

As the proposal would be situated within the Darling Harbour waterway and on land forming part of the Barangaroo precinct, there would be no property impact to private land owners.

The location of a temporary construction compound about six metres by 70 metres (420 square metres) for the proposal would be negotiated between TfNSW and BDA and Lend Lease to be established on the foreshore of the Barangaroo South, along the Barangaroo Foreshore Walk (see indicative location at Figure 4-1). TfNSW would negotiate all construction and access arrangements with Lend Lease and the BDA.

Pedestrian access along the Barangaroo foreshore would be reduced to about 12 metres in width due to the location of the temporary construction compound. This would provide ample space for pedestrians as well as wheelchair users to pass through the area, therefore, pedestrian detours are unlikely to be required during the construction of the proposal.

TfNSW is negotiating with Roads and Maritime regarding the potential demolition of the wave baffle. If demolished, additional space would be made available to enable the navigation of ferries at the proposed wharf.

Wayfinding signage, ticketing and Opal facilities would be located on land owned by BDA (and some wayfinding signage on land owned by SHFA) as such the location of these elements would be subject to agreements with these agencies. Connections to services to the proposal site has been agreed to be provided by BDA and Lend Lease as part of works for Barangaroo South (refer to Section 4.2.1).

Approvals would be sought prior to construction for construction works from Roads and Maritime and for works within the harbour from Port Authority of NSW.

During construction, emergency access would be provided at all times. Access arrangements would be agreed with emergency services to ensure emergency access routes are available throughout the construction period.

#### Operational

Once operational, the proposal would be owned and maintained by Roads and Maritime.

There would be a change in land use as a result of the proposal from currently unoccupied waterway to public ferry wharves.

The proposal would include three operating ferry wharves. Two wharves would operate initially with the third wharf to be constructed in the future when the demand for ferry services necessitates. The Barangaroo Ferry Hub would cater for most vessel classes (with exception of the larger Manly Freshwater Ferries). The increase in number of ferry services would have a minor impact on the navigational capacity within Darling Harbour and would gradually increase over time.

The operation of the proposed ferry wharves may impact the surrounding areas during special events, such as New Years Eve, Australia Day and Vivid. Some encroachment into surrounding pedestrian areas may occur as a result of queuing to board services during special event times causing a minor impact. Special events arrangements would be negotiated with BDA, Lend Lease, Roads and Maritime and SHFA to ensure adequate arrangements are made during operation of the proposal.

Once the public transport elements at King Street Wharf are removed, additional space allocation would be returned for use by commercial vessels which would have a positive impact to commercial operators.

### Public access and domain

The design of the ferry hub has been undertaken having regard to the Barangaroo South public domain (Stage 1A) development and TfNSW has been working closely with BDA and Lend Lease to optimise the interface between the two developments. The majority of works for the ferry hub are to be undertaken over the water, and therefore there would be limited impacts on the existing public domain (except during construction as identified in Sections 4.2.1 and 6.2). With regards to the future public domain, the following facilities as part of either the Barangaroo South development or the Barangaroo Ferry Hub would be available to commuters and other users of the area:

- Shade would be provided by:
  - Waterfront promenade tree planting proposed as part of Barangaroo South
  - Roof structures over the pontoon and gangway of the ferry wharves
  - Roof structures over landside ticketing machines to provide shade and rain cover while purchasing tickets.
- Seating would be provided:
  - At various locations throughout the Barangaroo South public domain including along the waterfront promenade
  - In commuter waiting areas located on each pontoon (indicative wharf seating locations are indicated in concept design drawings at Appendix B).
- Toilet facilities would not be provided at Barangaroo Ferry Hub, however, commuters would have access to facilities within the ferry vessels and facilities to be provided as part of Barangaroo South
- Linkages between the proposed Barangaroo Ferry Hub and Transport Place, King Street Wharf, Globe Square, Barangaroo Point and other public domain areas as discussed in Section 6.2

TfNSW convenes the Landside Working Group and Barangaroo Business Liaison Group which would continue to meet regularly through detailed design and delivery of the proposal to discuss interface issues with BDA and Lend Lease. The public domain interface is a standing agenda item at the working group meetings, and issues of queue management and wind conditions among others would be subject to ongoing discussion between TfNSW, BDA and Lend Lease.

Additionally TfNSW has provided formal submissions in relation to the Barangaroo South public domain modification (SSD 6303). Certain key issues raised in those submissions include:

- The landscape design of the waterfront and its relationship with the proposed Barangaroo Ferry Hub, particularly in relation to sight lines
- Wind impacts of the Barangaroo development on pedestrians within the public domain space, particularly waiting ferry passengers.

### 6.8.3 Mitigation measures

The following mitigation measures are recommended to manage property and land use impact:

- Landside works and access during construction and operation would be negotiated with the BDA, Lend Lease, Roads and Maritime and SHFA.
- Where necessary, easements would be created to protect services and allow Roads and Maritime Services to maintain them into the future.
- Approvals would be sought prior to construction for construction works from:
  - Roads and Maritime
  - Port Authority of NSW.
- Emergency access arrangements would be provided throughout construction and operation, with specific arrangements to be considered in consultation with emergency services, BDA and Lend Lease.
- Should demolition of the King Street Wharf wave baffle be recommended, the removal would be subject to negotiation with Roads and Maritime Services.
- A special event management system would be prepared by the operator of the Barangaroo Ferry Hub prior to operation of the wharves. It would consider queue management and service provision to be implemented during special events. BDA, Lend Lease, Roads and Maritime and SHFA would be consulted during preparation of this management system.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.9 Water quality and hydrology

This section assesses the potential impact on water quality and hydrology within the study area as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

### Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Water Quality and Contamination | Undertake an assessment of the potential impacts on water quality of Darling Harbour. Relevant consideration should be given to the *National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ), the ANZECC Guideline and Water Quality Objectives in NSW (OEH)* and *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (OEH).* | Section 6.9.2 |
| Water Quality and Contamination | Assess the potential impact of the wharves and ferry operations including the approved district cooling system at Barangaroo South, potential impacts on heat dissipation outflows from the harbour heat rejection plant and the potential for short-circuiting of outfall discharges back to the intake. | Section 6.9.2 |
| Water Quality and Contamination | Assess the impacts of the proposal in surface and groundwater quality and hydrology. | Section 6.9.2 |
| Water Quality and Contamination | The assessment must include details of proposed erosion and sediment controls (during construction) and management and mitigation measures for the containment of pollutant (e.g. fuel and sewage) and prevention of potential water quality impacts during construction and operation. | Section 6.9.2 |
| Water Quality and Contamination | Assess the potential impact of the development in groundwater flow paths and discharge flows and water discharge from the harbour heat rejection plant. | Section 6.9.2 |
| Water Quality and Contamination | Include a suitable water quality monitoring program. | Section 6.9.3 |

### 6.9.1 Existing environment

#### Darling Harbour catchment

The Barangaroo Ferry Hub proposal is located within the Darling Harbour catchment which ultimately drains to Sydney Harbour. In general, the catchment area is highly urbanised, with large areas of hardstand created by roads, footpaths and buildings, combined with areas of parkland and construction sites. Underground water systems ultimately discharge into the downstream receiving environment.

Development in the catchment area has resulted in poor water quality at times of low flushing rate.

## Groundwater

Groundwater at the proposal flows in an east to west direction and ranges from about 1.5 to three metres below ground level. The water table at the proposal area is directly influenced by tidal fluctuations (ERM 2007, AECOM 2010), with short-term variations in groundwater levels previously reported close to the sea wall. Salinity levels are consistent with levels within Sydney Harbour (Davis 2011).

Groundwater is characterised by three subsurface layers (Davis 2011):

- Fill material (variable material type, density, pore-space and grain size; highly permeable)
- Estuarine sediments (less permeable; forms a confining layer below the fill material)
- Hawkesbury Sandstone (effectively impermeable with the exception of fissures and fractures).

A search of NSW Department of Natural Resources records identified 32 groundwater bores within a four kilometre radius of the proposal area (ERM, 2007). No registered groundwater bores were identified at the proposal or within Barangaroo.

Geotechnical investigations undertaken by Aurecon in October 2014 confirmed the presence of Hawkesbury Sandstone from depths as shallow as 0.6 metres below the seabed to depths of 16.2 metres below the seabed. The sediment thickness above the sandstone bedrock generally increases seawards from the wharfline and northwards from the southeast corner of the proposal (Aurecon, 2014a). The borehole logs characterise the sandstone bedrock at each sample location as having some degree of fracturing. It is expected that water would fill these fractures, however this water is anticipated to be highly saline. It is not likely that water within the sandstone bedrock at the proposal area is connected to local freshwater groundwater resources.

## Water quality

Water quality in Darling Harbour is largely influenced by point source water pollution such as stormwater drainage outlets and diffuse water pollution such as urban runoff that does not enter stormwater drains. Darling Harbour is open to Sydney Harbour and in close proximity to the Tasman Sea and is therefore relatively well flushed.

Gross pollutant traps are used within the City Area sub-catchment however the use of these traps within the Darling Harbour sub-catchment has not been identified within the *City of Sydney Decentralised Water Master Plan WSUD & Stormwater Infrastructure Report* (GHD, 2012).

OEH measures the recreational water quality of Sydney Harbour and surrounding beaches through the Harbourwatch and Beachwatch programs. Rainfall data is used to predict the likelihood of bacterial contamination at sample sites. Samples have been taken at various locations in the harbour, however none in Darling Harbour. The closest monitoring site to Darling Harbour is Greenwich Baths about three kilometres to the north-west of the site. According to the *Central Sydney State of the Beaches 2012-2013* report (Beachwatch, 2013), the water quality at Greenwich Baths over this 12 month period was considered to be good. The water in Darling Harbour is likely to be of a lower quality than that measured at Greenwich Baths given its location within a more protected bay, its use as a busy working harbour, and its collection of runoff from higher densities of development.

The waters of Darling Harbour are used by a variety of vessels for pick up and drop off of passengers, berthing and maintenance causing ongoing issues for existing water quality in Darling Harbour. These activities create turbidity from propeller wash and anchoring on the harbour bed, and have the potential to cause accidental spills.

Lend Lease has been undertaking daily water quality monitoring at Barangaroo South since April 2012 in accordance with BDA's Environmental Protection Licence (EPL).The monitoring location EPL Point 2 is located to the immediate north of the proposal, while a 'background' monitoring location (EPL Point 4) is located to the north-west, in Jones Bay. Table 6-32 provides a summary of ambient conductivity, pH, temperature and turbidity at these locations over the period from April 2012 to June 2014.

Table 6-32 Darling Harbour water quality monitoring summary (April 2012 – June 2014)

| | | Turbidity (NTU) | Conductivity (mS/cm) | pH | Temperature (°C) |
|---|---|---|---|---|---|
| Trigger value[1] | | 0.5-10 | - | 8.0-8.4 | - |
| EPL Point 2 | Min | 0.0 | 26.1 | 7.0 | 13.6 |
| | Max | 35.4 | 58.6 | 8.6 | 25.4 |
| | Mean | 2.9 | 52.5 | 8.0 | 19.9 |
| EPL Point 4 (Background) | Min | 0.0 | 25.8 | 7.4 | 13.9 |
| | Max | 136.2 | 58.2 | 8.6 | 25.3 |
| | Mean | 3.3 | 52.5 | 8.0 | 20.0 |

*Note 1: Trigger values are for marine ecosystems in South-east Australia (ANZECC Guidelines, 2000).*

### Existing drainage and flooding

The drainage systems at the proposal area are located in the City of Sydney Council LGA, while existing stormwater truck mains are Sydney Water assets. Stormwater flows are discharged into Darling Harbour and Sydney Harbour via an underground pipe system after being collected from roadside kerb and guttering, the roofs of buildings, and other hardstand areas. Stormwater also reaches Darling Harbour directly from the surrounding hardstand areas and structures over the water, such as pontoons and jetties.

Upgrade works are currently proposed to the north of the King Street Wharf wave baffle in order to upgrade the land-water interface stormwater drainage network and do not form part of the EIS.

In rainfall events where flows exceed the pipe system capacity, surface water runoff is generally conveyed within the road system as uncontrolled flow. During such rainfall events, there is the potential for flood conditions resulting from combined flow velocities and depths.

Due to the topography of the site, flooding would be limited to storm surges or stormwater inundation associated with a flood event. There are no open channels within the proposal area to assist with drainage and no flooding issues have been previously identified for the area of the proposal (GHD, 2012).

### Water levels

Water levels at the site are determined by astronomical tides and storm surges. Hydrographic surveys indicate the seafloor along the Barangaroo foreshore slopes towards the centre of the waterway (refer to Section 6.3).

### Tides

The NSW coastal zone experiences semi-diurnal tides, which consist of two high and two low tides daily. The larger or 'spring' tidal range (around 2 metres) occurs during full or new moon when the gravitational pull of the moon and sun are combined. The tidal plane levels for Sydney Harbour are presented in Table 6-33.

Table 6-33 Tidal plane levels for Sydney Harbour (Australian National Tide Tables, 2014)

| Tidal Levels | (m CD1) | (m AHD) |
|---|---|---|
| Highest Astronomical Tide (HAT) | 2.10 | 1.17 |
| Mean High Water Springs (MHWS) | 1.60 | 0.67 |
| Mean High Water Neaps (MHWN) | 1.40 | 0.47 |
| Mean Water Level (MWL) | 1.00 | 0.07 |
| Mean Low Water Neaps (MLWN) | 0.60 | -0.33 |
| Mean Low Water Springs (MLWS) | 0.40 | -0.53 |
| Lowest Astronomical Tide (LAT) | 0.00 | -0.93 |

*Note 1: Chart Datum (CD) approximates to LAT and is 0.925 metres below Australia Height Datum (AHD).*

### Currents

Currents within Darling Harbour are most commonly driven by astronomical tides. Due to the deep and open nature of Port Jackson, tidal currents in Darling Harbour are minor. The mean spring and neap tides stated above translate to a maximum current of 0.5 knots or less (0.25 metres per second). Wind shear on the water surface generates the strongest currents in the location of the proposal.

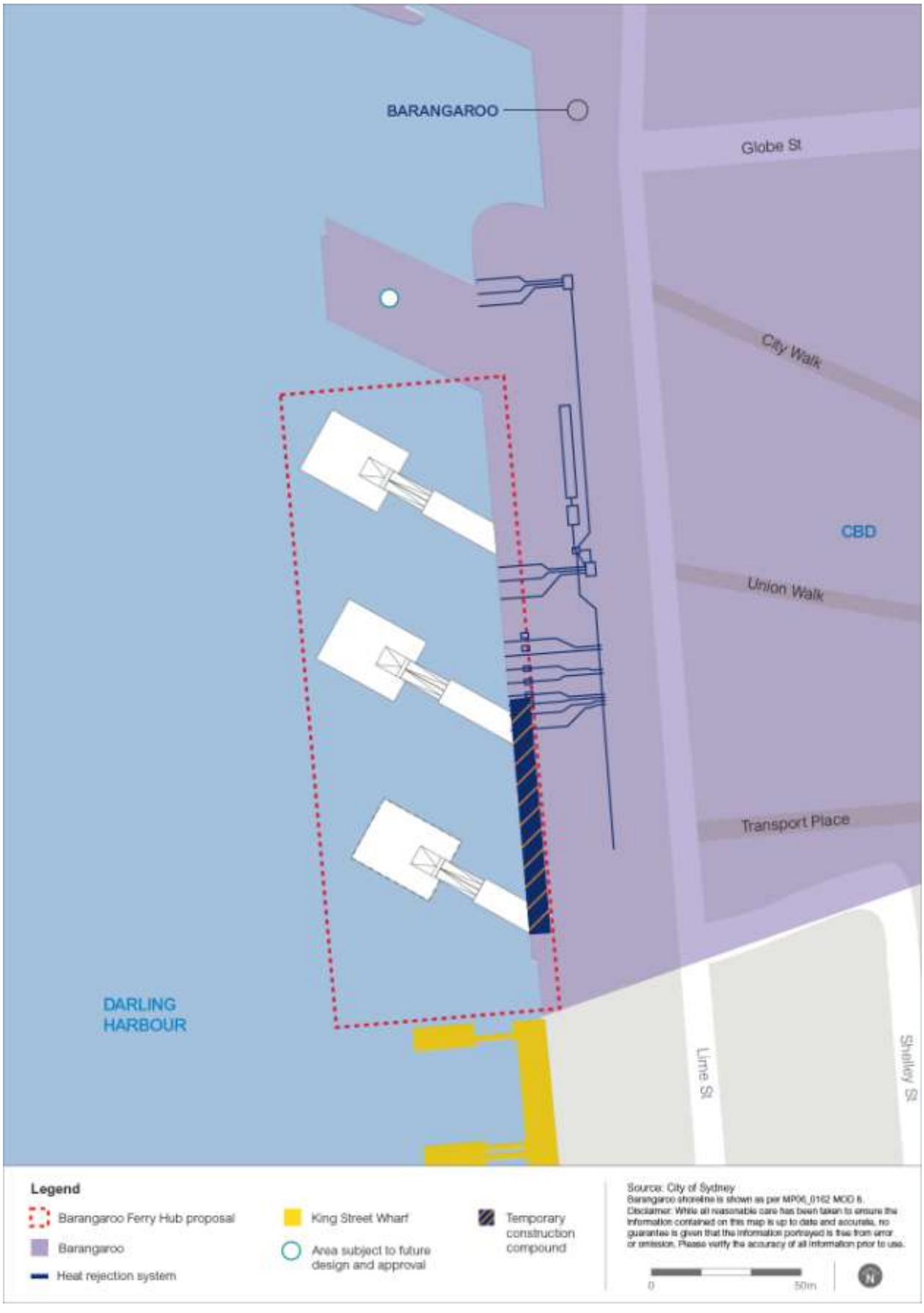
### Waves

The location of the proposal is generally sheltered from the majority of the wind directions, however the proposal area is exposed to long fetches to the north (about 2.7 kilometres to major landform at McMahons Point) and north-west (about 950 metres to major landform at Balmain East). However, it is located within a busy working harbour with a high volume of traffic. Vessel wash is modified by speed and wash restrictions, although many vessels such as ferries and government agency vessels are exempt from these. As a consequence the proposal area is exposed to regular wave action generated from wind chop and wash from passing vessels. The proposal area is not affected by oceanic swells.

### Barangaroo South water cooling system

The centralised cooling system at Barangaroo South (modification to the Concept Plan (MP 10_0023 MOD 5)) will support the cooling systems of all of the buildings proposed in the Barangaroo precinct (Lend Lease, 2012).The cooling plant will use harbour water to support the cooling systems. Once the water has passed through the cooling system it would be returned back into the harbour through seven outfall pipes (heat rejection system) located about two metres below the water surface along the waterfront within the area of the proposed Barangaroo Ferry Hub as indicated in Figure 6-15.

Figure 6-15 Barangaroo Ferry Hub and its interaction with the Barangaroo South water cooling system



The heat rejection system includes an intake zone (north of Barangaroo Ferry Hub), a pumping and cooling system (within the Barangaroo precinct) and a discharge zone (within the area of the Barangaroo Ferry Hub proposal area). The Section 75W Modification MP 10_0023 report (JBA Planning, 2012) (MOD 5 report) indicates the inlet is to be constructed within the proposed Southern Cove. The system discharge is designed for a constant peak annual flow rate of about 2,410 litres per second (total). Once the harbour water has passed through the cooling system the heat exchange function would return water at a slightly higher temperature than the ambient harbour water temperature (about seven degrees celcius above the ambient harbour water temperature). This water temperature differential would be quickly dissipated (through a number of adjacent pipes discharging below the water surface into the harbour) within a number of metres of the discharge point and is in accordance with Australian Standards and ANZECC Guidelines.

When MOD 5 was prepared it was known that there was an intention to build wharves within the area of the current Barangaroo Ferry Hub proposal. The Barangaroo Integrated Transport Plan released in August 2012 had identified the need for a ferry interchange at Barangaroo, and the BDA and Lend Lease participated in its preparation. Roads and Maritime Services made a submission on MOD 5 raising the issue of safe navigation of vessels using the wharves.

The Response to Submissions for MOD 5, dated 26 March 2013, is cited in the Director General's Environmental Assessment Report for MOD 5. In relation to the RMS submission the proponent Lend Lease identified:

*"This issue of vessels berthing near the heat exchange outlet has been assessed in the Thermal Water Marine Ecological Impact Assessment Report prepared by Worley Parsons and submitted within the application. High jet discharge velocities have been found to be restricted to within two metres of the discharge pipes and to quickly dissipate within six to seven metres from the point of discharge."* That report had assumed a 30 metre separation between the discharge point and berthed vessels, which is not accurate for the current Barangaroo Ferry Hub proposal. However, it is a requirement of the detailed design of the Barangaroo Ferry Hub that no layover of vessels would take place within 8 metres of the sea wall (and therefore the heat rejection discharge points). Section 4.3 of the Worley Parsons report indicated 'a temperature reduction to 1°C above ambient was achieved within 8 metres'.

Some piles may be located within two metres of the sea wall. These piles are not anticipated to cause any substantial impediment to water movements. Appendix G to the MOD 5 report, Barangaroo South – District Cooling Plant (DCP), Harbour Heat Rejection System Thermal Water Marine Ecological Impact Assessment (Worley Parsons, 2012), considers temperature impacts of the Barangaroo South heat rejection system. That report concludes at Section 4.5 that:

*"The modelling undertaken represents a conservative scenario that would not occur under natural operating conditions as flow rates would generally be lower due to diurnal, weekly and annual variations and the design peak is unlikely to be attained. As such, key findings under the most severe operating conditions have been characterised as:*

- *temperature increases of about two degrees celsius localised to within four metres of the outfalls for all seasons;*
- *typical temperature increases of up to 0.6 degrees celsius are predicted under summer operating conditions in the surrounding environment (within a few hundred metres of the outfall), with an average of 0.2 degrees celsius;*

- *there is no evidence of significant short-circuiting of the outfall discharges to the intakes; and*
- *there is no evidence of sustained build-up of temperature in Darling Harbour*."

The proposal's interface with the heat rejection system would be considered during the detail design phase and in collaboration with BDA and Lend Lease. Of consideration would be the proposal's effects on the velocity and turbidity of water proximate to the heat rejection system's seawater intake and discharge areas and how this would interact with the safety of the system and the expected heat dissipation.

TfNSW would also work with Roads and Maritime and Lend Lease to understand the maintenance requirements of the heat rejection system and how this would interface with the operation of the proposal and maintenance of the ferry hub infrastructure.

## 6.9.2 Potential impact

### Construction

#### *Groundwater impact*

Construction of ancillary landside facilities included as part of the proposal would not involve disturbance of sub surface materials and therefore would not intercept groundwater along the foreshore area (estimated to between 1.5 metres and three metres below ground level).

#### *Water quality impact*

During construction, the key impacts on water quality would include marine sediment disturbance and potential for accidental spills of chemicals and other hazardous construction materials such as hydraulic fluid or fuel used in the construction plant or equipment and during the transporting of waste from the proposal area during construction of the wharves.

Mitigation measures would be installed at the construction work area to ensure runoff from the work site and/or the temporary site compound would not result in discharge of contaminants to Pyrmont Bay and Darling Harbour, further contributing to poor water quality in the catchment. Visual inspections would be carried out at the proposal area and included within the CEMP. Any water quality issues observed in or outside of the proposal area would be reported to TfNSW and appropriate action would be taken.

#### *Drainage and flooding impact*

With appropriate management, construction phase stormwater flows should not result in additional flow velocities or volumes. Consequently, no impact on the drainage network is expected.

Given that no stormwater issues or flooding issues have been identified at the site, it is not expected that there would be any flood hazards associated with the location of the temporary construction compound.

#### *Tide level, tidal flows currents and water levels*

The proposal does not involve any construction work that would affect tide levels, tidal flows, or currents. The use of floating barges may result in a minor localised reduction in wave energy in the inshore area. This impact would be temporary and contained in the area where the barges are anchored.

### *Water temperature*

The ongoing operation of the Barangaroo Ferry Hub is not expected to substantially alter the temperature of the harbour water in the vicinity of the proposal.

The proposal's interface with the heat rejection system, and in particular how it would interact with the expected heat dissipation during operation, would be considered during the detail design phase in consultation with BDA and Lend Lease.

## Operational

### *Water quality impact*

During operation there is potential for marine sediment disturbance from manoeuvring of vessels. However given the current use of the harbour for ferry and commercial vessels, the proposal is not anticipated to significantly alter the current level of sediment disturbance in the harbour. There is also potential for accidental spills of chemicals and other hazardous materials into Pyrmont Bay and Darling Harbour, such as hydraulic fluid and fuel used in ferries or sewage during pump out operations. Appropriate mitigation would be implemented to address the risk of accidental spills as identified in Section 6.9.3.

Cleaning of wharves is typically carried out by use of high pressure spray without use of chemicals and therefore it is not expected that this would contribute to run-off of chemicals into the harbour.

No groundwater would be impacted during operation of the proposal.

### *Drainage and flooding impact*

The addition of structures within the waterway would marginally increase stormwater run-off within the harbour. However, given the stormwater would enter the waterway directly from the wharf the proposal should not result in any change to existing flow velocities or volumes. Consequently, no impact on the drainage network is expected.

### *Tide level, tidal flows, currents and water levels*

The pontoons would float on top of the water while being held in place by piles. The floating pontoon would largely move up and down with the water level so would not inhibit existing water movement patterns. The gangway would be supported by the link structure and floating pontoon above the water level allowing existing water movement patterns to continue.

It is expected that there would be a minor reduction in wave energy in the inshore area during operation of the wharves. The impact would be relative to the size of the pontoon and the location of the berthing area further away from the shoreline.

Consideration of sea level rise is discussed in Section 6.6.

### *Water temperature*

The ongoing operation of the Barangaroo Ferry Hub is not expected to alter the temperature of the harbour water in the vicinity of the proposal. This is due to there being no on-going discharge of water during operation of the proposal to the harbour.

The approved design of the heat rejection system has considered the Barangaroo Ferry Hub. Refer to MP10_0023 MOD 5.

### 6.9.3 Mitigation measures

The majority of the mitigation measures identified in Section 6.3.3 to manage aquatic ecology impacts during construction and operation would also manage impacts on water quality. The following additional measure would also be implemented to reduce potential impact on water quality:

- Weather forecasts will be checked regularly during construction and where flooding is forecast, all equipment and materials would be removed from the construction compound or appropriately secured where flood levels are expected to rise above existing surface levels for the area.
- Prior to construction an erosion and sediment control management plan for all land construction activities will be developed in accordance with *Managing Urban Storm Stormwater: Soils and Construction* (The Blue Book) and included in the CEMP. The plan will require all erosion and sediment controls to be installed prior to any land works commencing, maintained throughout construction and removed only once all disturbed areas have been reinstated.
- The establishment of the temporary construction compound will be done in accordance with The Blue Book and outlined in the CEMP.
- A water monitoring program would be outlined within the CEMP to monitor key water quality parameters established in consultation with OEH and DP&E
- During construction, there will be no stockpiling of demolition or construction materials on the seabed.
- If the King Street Wharf wave baffle is agreed to be removed, prior to commencement of the demolition, the CEMP will include protections for water quality, including:
  - Scaffolding or similar protection to prevent solid materials, paint or fragments entering the water during demolition.
  - Silt curtains will be installed between the inner piles and the shore to protect remaining seawall and rock toe hard substratum habitats from potential smothering or excessive turbidity. The silt curtains will remain in place for the duration of the demolition activities.
- Prior to commencement of piling activities of each individual wharf, silt curtains will be installed between the inner piles and the shore to protect the remaining seawall and rock toe hard substratum habitats from potential smothering or excessive turbidity. The silt curtains will remain in place for the duration of the piling activities for that wharf.
- Visual inspections will be carried out at the proposal area and included within the CEMP. Any water quality issues observed in or outside of the proposal area will be reported to TfNSW. In the event of a spill the TfNSW Incident Management Procedure will be followed and appropriate action will be taken.
- Emergency spill kits will be kept on-site and maintained throughout construction work. The spill kits will be appropriately sized for the volume of substances at the work site and be specific to the marine environment. A spill kit will be kept on each barge and at the temporary construction compound site.
- During construction, all staff will be made aware of the location of the spill kits and trained in their use.

- If a spill occurs during construction, the TfNSW Contract Manager and TfNSW environment staff will be notified as soon as practicable, as outlined in the Incident Management Procedure.
- Equipment barges (carrying plant, machinery, fuels or chemicals) will be bunded to contain any accidental chemical spills or leaks.
- Any chemicals or fuels stored at the temporary construction compound will be within double bunded areas.
- All equipment, materials and wastes transported between an offsite facility, and the construction work area will be secured to avoid spills during transportation.
- Vehicles, vessels and plant will be properly maintained and regularly inspected for fluid leaks during construction.
- No vehicle or vessel wash down will occur on-site during construction.
- In an event of a spill during operation, the incident emergency plan will be implemented in accordance with the Port Corporations response to shipping incidents and emergencies outlined in the *NSW State Waters Marine Oil and Chemical Spill Contingency Plan* (TfNSW, 2012b).
- Specific management measures are to be included in an Operation Environmental Management Plan (OEMP) prepared by the operator of the Barangaroo Ferry Hub, to minimise the risks of spillages of liquids and solids from pump-out and maintenance works.
- TfNSW will continue to work closely with stakeholders, in particular BDA and Lend Lease regarding the interface between the operation of the proposed ferry hub and approved heat rejection system to be included within the Barangaroo South development.
- Detailed design of the pump-out system will address the risk of accidental spills, and an alarm system to identify any accidental spill will be considered.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.10 Indigenous heritage

This section assesses the potential impact on Indigenous heritage within the study area as a result of the proposal.

The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (Department of Environment, Climate Change and Water (DECCW), 2010) provides a framework to assist individuals and organisations to exercise due diligence when carrying out activities that may harm Aboriginal objects and to determine whether an Aboriginal Heritage Impact Permit (AHIP) is required.

A due diligence cultural heritage investigation for the proposal was carried out in accordance with DECCW (2010). This investigation included a desktop review of the environmental and archaeological contexts of the proposal area and surrounds, a search of the Aboriginal Heritage Information Management Systems (AHIMS) database maintained by OEH, and a visual inspection of the landside section of the proposal area on 8 August 2014.

A cultural heritage assessment was also prepared by ArchaeoMar in September 2014 to investigate Indigenous and non-Indigenous heritage potential in the waterside section of the proposal area. The report included a desktop review of the environmental and archaeological contexts of the proposal area and surrounds, and a visual inspection of the harbour floor. This assessment is provided in Appendix I.

The findings from the due diligence cultural heritage investigation and ArchaeoMar's cultural heritage assessment are summarised below.

### 6.10.1 Background

Prior to the European colonisation of Sydney, the landscape was characterised by sandstone ridges and plateaus cut by streams and rivers forming bays and estuaries that provided a wide range of resources for the local indigenous people.

The Sydney region was the traditional country of the Cadigal (Gadigal) people of the Darug language group. Their country extended across the southern shore of Port Jackson (Sydney Harbour) from South Head to Darling Harbour and to Petersham in the south. With a subsistence economy based on hunting, fishing and gathering the area would have had abundant food resources in the sea, wetlands, forests and woodlands which supported a large Aboriginal population.

Along the east coast of Australia, including the Sydney Basin region, the majority of Aboriginal sites are found within close proximity to water sources, such as deflation basins and swamps or close to shore. Women caught fish either from canoes or from the shore using fishing line made from bark and shellfish hooks, and men fished from the shore using spears. Shell middens are common around coasts and estuaries.

Indigenous people were observed to use the waters around Sydney Harbour. Captain John Hunter arrived in 1788 and noted in his journal 'Canoes 67 – men 94 – women 34 – children 9' (Attenbrow, 2010).

Engravings and axe grooves may be present if large flat sandstone slabs occur in the areas and rock art or cultural deposits may be present where there are rock overhangs in low cliffs. Bora grounds and stone arrangements are fragile sites, unlikely to have survived colonisation.

The Aboriginal history of Port Jackson is still apparent, with Aboriginal names for many headlands and other features around the harbour. Since the 1970s there has been a considerable amount of archaeological research and site recording. Despite extreme levels of landscape modification, the Port Jackson area still contains numerous archaeological sites, including middens, artefact scatters, burials, scarred trees, rock shelters with art and/or cultural deposit, axe grinding grooves and rock engravings.

### 6.10.2 Existing environment

Plans from 1802 identify that the eastern shore of Darling Harbour, now Barangaroo, had rocky cliffs with steep gradients and a protected intertidal zone. Together with the number of creeks meandering through the head of Darling Harbour and the type of vegetation depicted, it is assumed that this area is predominantly swampland or marsh. This land type would have been considered fertile hunting ground for the Indigenous populations.

The natural terrain and landform has been highly modified and development has been extensive within the proposal area throughout European colonisation. Over time the harbour in this area has been progressively reclaimed and developed for maritime uses. Such development over the past 190 years has reduced the likelihood of any Aboriginal sites being present within the proposal area. A search of the AHIMS database was conducted on 3 July 2014 within a one kilometre radius (plus 50 metre buffer) of the proposal area.

Twenty-six Aboriginal sites have been recorded within the search area. There are no Aboriginal objects or places present within the proposal area. The closest site to the proposal area is a potential archaeological deposit excavated at the Kent, Erskine, Napoleon and Sussex Streets site (about 500 metres east of the proposal area).

Other sites in the vicinity include:

- A rock engraving located about 650 metres to the north
- A midden located about 700 metres to the north east
- An artefact scatter about 750 metres to the north
- A rock engraving at Dawes Point about 1.1 kilometres to the north east

These, and Aboriginal sites further afield, are shown on Figure 6-16 below.

Shell middens are common around coasts and estuaries such as Port Jackson. Burials may be present in middens. Engravings and axe grooves may be present if large flat sandstone slabs occur in the areas and rock art or cultural deposits may be present where there are rock overhangs in low cliffs. Bora grounds and stone arrangements are fragile sites, unlikely to have survived colonisation. The water/land interface at the proposal area has been severely modified. Middens and artefact scatters may still be present in less disturbed areas back from the water's edge but not within the proposal area given its previous disturbance. There are no large flat sandstone slabs or rock overhangs within the proposal area.

The majority of the proposal (including all waterside works) is over submerged harbour bed about 70 metres from the natural harbour waterline Landside aspects of the proposal are located in an area of the harbour which has been progressively reclaimed and developed for maritime uses. No landside or waterside Aboriginal objects were identified during visual inspections of the proposal area. As a result, there is no potential for Aboriginal objects to be identified, and no risk of harm to Aboriginal objects.

A search of the Native Title database on 20 August 2014 shows no Native Title claimants or holders for this area.

Figure 6-16 Indigenous heritage sites in vicinity of the proposal area

### 6.10.3 Potential impact

The purpose of the due diligence assessment was to identify whether Aboriginal objects are present, or likely to be present, in the proposal area in order to determine whether the proposal is likely to harm Aboriginal objects (if present) and to determine whether an AHIP is required.

#### Construction

Due to the nature of the works no natural terrain (other than the sea bed) is anticipated to be disturbed during the works.

There were no identified Aboriginal objects in the proposal area, as such, there would be no identified risk of harm to Aboriginal objects during construction of the proposal and an AHIP is not required.

#### Operational

As there are no identified Aboriginal objects in the proposal area, there is no identified risk of harm to Aboriginal objects during operation of the proposal and an AHIP is not required.

### 6.10.4 Mitigation measures

The following measures would be implemented to reduce potential impact on Indigenous heritage:

- Project staff and contractors would be made aware of their statutory obligations for heritage under the *National Parks and Wildlife Act 1974* through the site induction and toolbox talks
- The CEMP for the proposal will include provisions for unexpected finds. If, during the course of construction of the proposal, suspected Indigenous heritage material is uncovered:
  - Work will cease in that area immediately and the area will be cordoned off
  - TfNSW environment staff and a suitably qualified archaeologist will be contacted.

  Should the finds constitute Indigenous heritage material then the Office of Environment & Heritage will be notified.
- In the event that skeletal remains are uncovered, works in the immediate area will cease, the area would be cordoned off and the NSW Police Coroner and TfNSW environment team would be contacted to determine if the material is of Aboriginal origin. If determined to be Aboriginal, the OEH Enviroline 131 555 and relevant Aboriginal stakeholders would be contacted to determine an action plan for the management of the skeletal remains prior to works re-commencing.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.11 Socio-economic

This section assesses the potential impact on socio-economics within the study area as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issues | SEAR | Where Addressed |
|---|---|---|
| General requirements | An estimate of the jobs that will be created by the development during the construction and operational phases of the development; | Section 6.11.2 |

### 6.11.1 Existing environment

The proposal is located within the City of Sydney LGA. Key surrounding land uses include commercial and public transport facilities, commercial waterfront properties, waterfront residential properties, office buildings, hotels, residential apartments, public access areas (such as boardwalks along the foreshore), general open spaces and tourism (refer to Figure 5-2).

According to the Australian Bureau of Statistics (2011), 56 per cent of the 14,308 dwellers within the Sydney CBD (Postcode 2000) do not own a vehicle and are therefore often reliant on public transport. Of the Sydney CBD residents 45.6 per cent walk to work, 27.7 per cent travel to work by public transport and 12.6 per cent drive to work. By comparison, for Greater Sydney, 58.4 per cent of the population travel to work by car (either as a driver or passenger) and 20 per cent of people travel by some form of public transport.

Barangaroo is currently being redeveloped as a mixed use precinct including commercial, retail, residential, and recreational uses as described in Section 1.3. The Barangaroo precinct development is expected to substantially increase the volume of people utilising the Barangaroo precinct when complete. Overall, this will include about 2,500 residents, and up to 23,000 office workers and 33,000 visitors per day.

Nearby waterfront properties at King Street Wharf include offices located within the Brookfield, American Express and KPMG buildings on Shelley Street, the King Street Wharf apartments and Medina Grand apartments on Lime Street, the Ibis hotel on Shelley Street, and the Sydney Wharf apartments at Pyrmont Bay.

Commercial vessels operate out of the majority of the wharves located at King Street , Wharf, and alongside ferry services operated by Harbour City Ferries.

Commercial businesses along King Street Wharf attract locals and tourists and include a number of restaurants and bars, a bowling alley and tourism information desks.

### 6.11.2 Potential impact

#### Construction

Socio-economic impacts expected during construction include:

- Reduction in local amenity due to increased noise and vibration, and reduced visual amenity (detailed below)
- Temporary loss of open space along the Barangaroo foreshore promenade
- Temporary loss of parking on Lime Street or nearby parking facilities

- Temporary impact to water vehicle traffic, including minor detours
- Potential temporary impact to commercial vessel operators at King Street Wharf during the demolition of the existing King Street Wharf wave baffle
- Construction would have positive impact on the local economy by providing employment for the local workforce, and likely increased trade for commercial outlets (such as food and beverage retailers) throughout construction.

### *Construction workforce*

It is anticipated that the construction workforce would comprise a maximum of approximately 15 people on site at any one time. It is expected that there would be about 60 people over the duration of the construction period for the first two wharves.

The following sections detail specific socio-economic impact relating to noise, visual amenity and traffic, access and parking.

### *Noise*

The primary influence on the existing ambient noise environment within the proposal area is waterway and road traffic noise. Construction works currently being carried out at the Barangaroo precinct also intermittently contributes to the existing noise environment. There would be a continuation of the existing ambient noise environment during the construction of the Barangaroo Ferry Hub proposal; however effects may result in a greater extent, scale or duration of noise impacts to near-by sensitive receivers.

Noise and vibration impacts are further discussed in Section 6.1.

### *Visual amenity*

There would be some adverse impact to the visual amenity of nearby viewpoints due to the Barangaroo Ferry Hub proposal. The visual impact during construction works would have a moderately negative impact as on-water construction works would replace the view of open water and from the land there would be a construction work area and a temporary construction compound visible along the foreshore about 420 square metres in area. The visual intrusion of construction works at the site is likely to have a moderate adverse impact on some nearby landscape character areas as discussed in Section 6.4.

There are certain particularly sensitive viewpoints from the harbour, as this is the ‘gateway to Pyrmont Bay and Darling Harbour’ for tourists and visitors. In views at close proximity, such as from ferries within the harbour and Pier 10 next to the heritage fleet at Pyrmont, there would be a noticeable reduction in amenity during construction, resulting in a moderate adverse visual impact.

Visual impacts are further discussed in Section 6.4.

### *Traffic, access and parking*

There would be some reduction in pedestrian access and connectivity to the foreshore during the construction of the proposal, predominantly due to the construction compound located on the foreshore. There is also likely to be an increase in traffic movements within connecting streets due to a small number of light and heavy vehicle trips (e.g. concrete deliveries) to and from the construction compound.

Additional impacts are discussed in Section 6.2.

## Operation

The proposal would provide an improved quality of service and additional service capacity for customers travelling by ferry to the Sydney CBD.

There would be no property acquisition required or businesses or residents relocated as result of the proposal.

The proposal would support the Sydney ferry network by providing additional weekday peak hour and weekend services catering for the additional demand expected to be generated by an increase in visitors to the Barangaroo precinct, as well as accommodating future growth in ferries transport in accordance with *Sydney Ferries Future* (TfNSW, 2013b).

Wayfinding signage would identify and direct people to various Darling Harbour attractions, as well as connections with other public transport services.

Ferry services to the Barangaroo Ferry Hub may have a positive economic impact for nearby commercial outlets located in the Barangaroo precinct, however there could be a minor impact on King Street Wharf businesses who could expect some reduction in passing trade due to the change in location of the ferry wharves.

The removal of public transport elements from the existing King Street Ferry Wharf would make available additional wharf infrastructure which may potentially be used for commercial opportunities. This may provide some offset for the loss of passing trade for businesses at King Street Wharf.

The following sections detail specific socio-economic impact relating to noise, visual amenity and traffic, access and parking.

### *Operational staffing requirements*

Each wharf would typically require two staff on an ordinary shift – one at the gateline, and one wharf hand.

There is likely to be two shifts per day to cover operational hours, plus an overnight maintenance shift.

Additional staff would be required during special events as discussed further below.

### *Noise*

Due to the change in location and increase in capacity of the ferry wharves there would be a change in the noise profile within the harbour associated with operation of the proposal. This would have an impact on surrounding sensitive receivers as detailed in Section 6.1.

### *Visual amenity*

There would be some adverse impact to the visual amenity of nearby viewpoints due to the Barangaroo Ferry Hub. There would be a permanent visual change with the installation of permanent structures as a result of the proposal. This would have a minor impact to the local community and public (including tourists) as a portion of the existing open views to Daring Harbour would be obstructed by the proposed ferry hub structures.

Views during the daytime at close proximity to the proposal, such as King Street Wharf and from the Barangaroo precinct, would have a noticeable reduction in visual amenity, resulting in moderate adverse visual impacts as detailed in Section 6.4. There would be no noticeable reduction in visual amenity as a result of the proposal at night.

*Traffic, access and parking*

The introduction of ancillary facilities, such as ticketing and Opal card facilities, along the Barangaroo foreshore promenade has the potential to change pedestrian movements. Some minor impacts may be experienced by pedestrians as a result of ferry customers queuing, particularly during special events, as detailed in Section 6.2.

### 6.11.3 Mitigation measures

Mitigation measures as listed in Table 8-1 would be applied throughout construction to minimise the impacts considered above, which would assist in managing socio-economic impact. In addition the following mitigation measures are proposed:

- A community liaison plan will be prepared to support the Stakeholder and Community Engagement Strategy throughout project delivery.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.12 Soils, geology and contamination

This section assesses the potential impact on geology, soils and contamination within the study area as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Water Quality and Contamination | Assess the geotechnical and contamination issues (including Acid Sulfate Soils) associated with the construction of the development including the contamination status of the sediments to be disturbed, the impacts associated with disturbance of sediment, and the management and mitigation measures to be employed during marine works. | Section 6.12.2. |

### 6.12.1 Existing environment

The proposal area is underlain by a number of geological and soil landscape units. The general topography and anticipated geological and soil landscape units, and the potential occurrence of acid sulfate soils (ASS) at the site are discussed further in the following sections.

#### Geology

*Waterside*

Water levels at the site are determined by astronomical tides and storm surges. Hydrographic surveys indicate the seafloor along the Barangaroo foreshore slopes towards the centre of the waterway (refer to Section 6.3).

The *1:100,000 Geological Survey of NSW (Sydney) Sheet 9130* identifies that geology within the proposal area comprises Hawkesbury Sandstone formation (Coffey, 2009a) of the Middle Triassic. This formation is described as fine to medium grained quartzose sandstone deposited in 1-3 m thick beds. The formation represents the fluvial process of deposition in a large braided river system (Coffey, 2009a).

*Landside*

Landside topography is relatively flat, having been cut and filled for its previous use as a stevedoring facility and ranges between two and three metres above AHD.

According to the *1:100000 Geological Survey of NSW (Sydney) Sheet 9130 (ed 1) 1983* the site is generally underlain by man-made fill and Hawkesbury Sandstone. The *1:100000 Geological Survey of NSW (Sydney) Sheet 9130 (ed 1) 1983* states that man-made fill may consist of *'dredged estuarine sand and mud, demolition rubble, industrial and household waste'*. Hawkesbury Sandstone is characterised as 'medium to course-grained quartz sandstone with very minor shale and laminate lenses'.

#### Soil landscape

*Waterside*

Marine sediments within the Darling Harbour (including the proposal area) typically comprise:

- Silt (0 – 0.2 metres below harbour floor)

- Silty sand or sandy silt (0.5 – 1.2 metres below harbour floor)
- Silty clay (0.6 – 1.2 metres below harbour floor).

Shelly fragment and evidence of roots and decaying plant material have been identified within shallow marine floor sediments. Additionally, anthropogenic debris including rocks, chains, bricks, steel and fencing have been encountered (Worley Parsons, 2010).

Seven borehole sample locations were drilled below ground level (Aurecon, 2014a). The boreholes revealed sediment encountered at the proposal area consists of grey to dark grey silty clay, medium to high plasticity, with gravel or fine medium grained sand (0 – 1 metre below ground level), through to grey and orange brown, fine to medium grained sandstone, extremely weathered and fractured. (>6.3 metres below ground level). Sediments in between these depths are described as grey to grey brown sandy clay, clayey sand or sand with fine to medium grained sand (1.0 – 2.3 below ground level) and grey to dark brown silty clay with fine grained sand (2.3 – 6.3 below ground level) (Aurecon, 2014a).

#### *Landside*

The landside area is generally covered in concrete and bitumen hardstand. The subsurface condition typically comprises:

- Asphalt overlaying medium to coarse grained sandy gravel fill (0 – 0.08 metres below ground level).
- Fill characterised by clayey sand, sand, clay and ripped sandstone (0.08 – 12.5 metres below ground level). The fill material is highly variable and consists predominantly of granular material including crushed rock, sand and gravel. The deeper fill material consists of sandstone blocks while the shallow fill consists of concrete blocks, linker, brick, ash steel, timber and other materials.
- Alluvial sediments characterised by clayey sand, sandy clay, clayey silt and clay (12.5 – 19.5 metres below ground level).
- Residual soils weathered from sandstone bedrock (19.5 – 27 metres below ground level)
- Hawkesbury sandstone (>27 metres below ground level) (Aurecon, 2014a).

### Hydrology

Subsurface service trenches (i.e. for stormwater and sewer drains) and associated high permeability granular fill material exist within Barangaroo and are potential preferential pathways for transport of contaminants in groundwater (ERM, 2007). A description of the existing hydrology within the proposal area is discussed in Section 6.9.

### Acid sulfate soils

An acid sulfate soils risk map for the site is provided in Figure 6-17. The map provides an indication of the presence of acid sulfate soils at specified depths below ground level (e.g. any works undertaken in a ‘class 1’ area would have the potential to expose acid sulfate soils).

Potential acid sulfate soils have been identified underlying fill at Barangaroo at depths ranging from 10.5 and 15.5 metres below ground level (JBA, 2010a), therefore any landside works within the proposal area would have the potential to expose acid sulfate soils.

There is a high probability that estuarine sediments across the proposal area contain acid sulfate soils (JBA 2010). However samples collected by Aurecon (October, 2014a)

showed no waterside sample before oxidation ($pH_{KCl}$) measured a laboratory result of less than 4, indicating that it is unlikely that acid sulfate soils are present in marine sediments.

One sample after oxidation (pHox) however did exhibited a significant drop in pH units (>1 pH unit) from the measured $pH_{KCl}$, indicating the presence of potential acid sulfate soils within the proposal area, including the King Street Wharf wave baffle.

## Figure 6-17 Acid sulphate soils risk map

## Existing contamination

A number of historical studies and environmental site investigations have been undertaken to assess the extent and nature of contaminants within the Barangaroo precinct as a whole.

Potential sources of contamination as a result of previous land uses within and adjacent to the proposal area include:

- Ship berthing and associated commercial activities
- Former gasworks (adjacent to the proposal area), former garages and workshops, and their subsequent demolition
- Imported fill.

Previous contamination investigations undertaken within and adjacent to Barangaroo and the proposal area have identified a number of likely contamination issues within the general area. The findings of these are outlined below:

- Preliminary sediment screening works at East Darling Harbour, Adjacent to Barangaroo (as outlined in the Barangaroo Concept Plan Amendment (MP06_0162 MOD4) – Marine Ecology, Water Quality and Contaminated Sediment Impact Assessment (Worley Parsons, 2010).
  - A majority of samples exceeded the ANZECC/ARMCANZ (2000) interim sediment quality guidelines (low) for Polycyclic aromatic hydrocarbons (PAH) and heavy metals (including arsenic, copper, lead, mercury and zinc)
  - Elevated concentrations of total petroleum hydrocarbons (TPH) $C_{10}$ – $C_{36}$ and organochlorine (OC) pesticides were also reported
  - One sample had elevated concentration of Tributyltin (Aurecon, 2014a).

The Overarching Remedial Action Plan (RAP) for Barangaroo summarises soil contaminants with concentrations exceeding the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (1999) Health Investigation Levels (D), (E), (F) or NSW EPA (1994) assessment criteria throughout Barangaroo from investigations between 2006 and 2010 (Aurecon, 2014a).

Aurecon conducted Stage 2 Limited Detailed Site Investigation (LDSI) in October, 2014 at the proposal area to determine the nature and extent of potential contamination resulting from the site's historic use. The investigation identified the following:

- Human health risk – concentrations were below the human health assessment criteria for commercial and industrial land use for all contaminants. Subsequently, all potential pollutant linkages associated with human receptors are not considered further and no further investigation was recommended.
- Environmental risk – Benzo(a)pyrene was identified at concentrations exceeding the environmental risk assessment criteria for commercial/industrial land uses. However, given the existing condition of the Darling Harbour, potential pollutant linkages associated with identified contamination were assessed as presenting a low risk to environmental receptors and no further investigation was recommended.

## 6.12.2 Potential impact

### Construction

#### *Land based*

Land based activities would include the erection of a temporary construction compound adjacent to the wharf. The indicative location of the compound is on a paved surface to the east of the proposal and would not require any excavation or land disturbance (see Figure 4-1).

Installation of wayfinding signage and ticketing (Opal card facilities) would be required to support the ongoing operation of the Barangaroo Ferry Hub. Utilities connections are expected to be installed as part of the Barangaroo precinct and installation of these facilities are not anticipated to require any excavation. Should minor excavation works be required the impact on soil and contamination and/or groundwater is expected to be negligible given the depth and small scale of works, therefore the probability of encountering acid sulfate soils and/or groundwater as a result of landside works is low.

#### *Water based*

Most of the proposed construction activity is located within the waterway area below the mean high water mark. However, the proposal does not involve any dredging, filling or excavation works above or below the mean high water mark.

Sediment contamination, including the potential presence of acid sulfate soils identified within the proposal area presents a potential contaminant source to surface water and aquatic ecology within the proposal area, upon disturbance of the sediments construction works (e.g. piling activities).

While construction activities would have the potential to disturb sand and sediments causing an increase in turbidity and/or exposing acid sulfate soils on the harbour bed during activities, as installation and removal of piles and manoeuvring and anchoring of barges, these impacts would be localised and of a temporary nature. Proposed mitigation measures outlined below and in Section 6.3.3 would assist in mitigating potential risks.

### Operational

There is some potential for silt and sediment mobilisation as ferries enter and exit the facility, particularly on structures higher in the water column more so than the seabed. However, water depths are considered sufficient in this area to avoid any significant propeller or jet wash mobilisation of seabed sediments during operation of the Barangaroo Ferry Hub.

## 6.12.3 Mitigation measures

The mitigation measures proposed to manage impact on aquatic ecology (Section 6.3.3) and water quality (refer to Section 6.9.3) would also manage impact on soils, geology and contamination. The following additional measures would also be implemented to reduce potential impact on soils, geology and contamination:

- The CEMP will include a contamination plan outlining the methodology (in accordance with Waste Management Guidelines) to manage any potential contamination should small amounts of material be recovered (e.g. during pile removal). This plan would also include an unexpected finds protocol

- All construction areas (including area used for the temporary construction compound) will be reinstated to their intended state once construction is complete.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.13 Ecologically sustainable development

This section assesses the potential ecologically sustainable development opportunities as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

### Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Ecologically Sustainable Development | Identify how the development will incorporate ESD principles in the design, construction and ongoing operation phases of the development. | Section 6.13 |
| Ecologically Sustainable Development | Identify opportunities to minimise water and energy use. | Section 6.13<br>Appendix L |

TfNSW is committed to ensuring that its projects are implemented in a manner that is consistent with the principles of ESD.

Table 6-34 summarises how the four principles of ESD have been addressed through the proposal design and assessment processes. Further discussion on sustainability initiatives that have been considered during the development of the proposal is provided in Section 6.13.1 below.

### Table 6-34 Adherence with principles of ESD

| ESD Principle | Adherence |
|---|---|
| The precautionary principle | A precautionary approach has been applied throughout the proposal's development.<br>An environmental risk analysis has been completed, with initial analysis during the proposal's development and review of risks identified as part of this EIS, including assessment of key issues by technical specialists in these areas.<br>The options development and assessment, the design development and the EIS process (and resulting mitigation measures) reduce the environmental impact of the proposal. Although some residual environmental impacts were identified these are not anticipated to result in any threats of serious or irreversible environmental damage. In areas where there is some uncertainty in relation to potential impact, detailed mitigation measures and/or strategies have been proposed. |
| Intergenerational equity | Issues that have potential long-term implications, such as consumption of non-renewable resources, waste disposal, greenhouse gas emissions, removal of vegetation, land use changes and impact on visual amenity, have been considered in this EIS and the impact reduced through design considerations and identification of various mitigation and management measures.<br>When the proposal begins operation, it would deliver inter-generational equity by:<br>• Improving access to Barangaroo and the CBD and supporting continued population and employment growth in the area<br>• Delivering improved journeys for public transport users including a reduction in congestion at Circular Quay. |

| ESD Principle | Adherence |
|---|---|
| Conservation of biological diversity and ecological integrity | A specialist ecology assessment was completed as part of this EIS, as described in Section 6.3. No threatened aquatic species were anticipated to be impacted as a result of the proposal, and a net increase in available habitat for aquatic vegetation would result from the proposal.<br>There is no terrestrial vegetation within the study area, and no impact on terrestrial biodiversity is anticipated.<br>A range of mitigation measures are proposed to minimise impact on biological diversity and ecological integrity and ensure ecosystems, species and genetic diversity are maintained with development of the proposal. |
| Improved valuation, pricing and incentive mechanisms | Through the implementation of TfNSW Sustainable Design Guidelines for the project (as discussed in Section 6.13.1) the cost of implementing sustainability initiatives has been incentivised. |

### 6.13.1 Sustainability in design

#### Sustainability targets

TfNSW Transport Projects Division (TPD) has developed a framework of sustainability objectives (and indicators and targets which sit within these objectives) to enable the benefits achieved on TfNSW projects to be measured and reported. The TfNSW Sustainable Design Guidelines v3 is the main avenue for implementing sustainability into project design. The Guidelines are divided into the following key themes:

- Energy and greenhouse gas
- Climate resilience
- Materials and waste
- Biodiversity and heritage
- Water
- Pollution control
- Community benefit.

The Guidelines currently do not cover maritime assets, therefore the Sydney Ports Green Port Guidelines have also been included in this sustainability assessment for the proposal.

Applicable initiatives within the Sustainable Design Guidelines v3 and the Sydney Ports Green Port Guidelines would be further assessed for inclusion in detailed design. Appendix L provides a list of all sustainability initiatives applicable to the proposal. The following section outlines some of these initiatives. As per the requirements of the guidelines all applicable initiatives would be considered further during the detailed design, construction and operational phases of the proposal.

#### Energy and Greenhouse gas

The proposal aims to reduce the operational and embodied energy associated with the construction and operation of the Barangaroo Ferry Hub. Key initiatives include:

- Undertaking a qualitative greenhouse gas (GHG) assessment to identify the Scope 1, Scope 2 and Scope 3 GHG emissions for the construction phase of the proposal

(refer to Section 6.13.2). A quantitative carbon footprint would be undertaken during detailed design

- Purchasing at least 25 per cent of site based electricity needs from Green Power or other renewable sources during construction
- Investigating incorporating energy efficient LED lighting throughout the proposal
- Developing a green travel plan for employees to get to site during construction.

### Climate resilience

A climate change risk assessment has determined specific issues for the proposal as outlined in Section 6.6 and Appendix K. As construction is scheduled to occur in 2015/2016, the impacts of climate change (such as sea level rise, increase in temperatures and increased rainfall intensity) are unlikely to be sufficient to cause disruption to construction. However some impacts may potentially occur during operation. The main impacts are summarised here:

- Heatwaves and increased temperatures causing accelerated degradation of materials due to increased solar radiation as well as more frequent and prolonged blackouts during more frequent and severe heat waves
- Storm surges causing damage to infrastructure, particularly due to the movement of joints and structures and subsequent fatigue of structural material
- Storm surges coupled with sea level rise may cause disruption to ferry services or potentially temporary or permanent inundation of fixed wharf infrastructure.

The projections for changes in climate and the potential risks identified in this technical paper would be considered by TfNSW and appropriate design responses developed to mitigate risk.

### Materials and Waste

Throughout the design of the proposal recycled materials would be considered to reduce the use of virgin materials and reduce waste (as discussed in Section 6.15). Key initiatives requiring further investigation during detailed design include:

- Reducing virgin materials and use of recycled materials through sustainable procurement
- Using whole of life costing methodology to inform decision making during detailed design and construction for significant proposal options (such as material selection)
- Diverting at least 95 per cent of construction and demolition waste from landfill
- Optimising the design to minimise material consumption and mass/volume/space use
- Using prefabricated infrastructure components to reduce construction waste material usage, pollution risks and travel
- Designing for disassembly of new structures to maximise opportunities for recycling materials. Develop a deconstruction plan supported by disassembly principles.

### Biodiversity and heritage

An aquatic ecology impact assessment has been undertaken to identify impact within the proposal area, as detailed in Section 6.3.

Both non-Indigenous and Indigenous heritage items nearby to the proposal have been identified and an impact assessment has been undertaken as part of this EIS, as detailed in Sections 6.5 and 6.10 respectively.

### Water

The proposal aims to reduce potable water use associated with the construction and operation of the Barangaroo Ferry Hub. Key initiatives include:

- Managing and recording water usage during construction
- Installing waterless or water efficient fixtures as part of the proposal design
- Implementing waste management processes to protect the water quality of the harbour and other water bodies during construction and operation.

### Pollution Control

The proposal aims to reduce pollution associated with the construction and operation of the Barangaroo Ferry Hub. Key initiatives include:

- Ensuring the safe handling and storage of hazardous waste onsite during construction
- Noise and vibration impacts associated with construction and operation of the project have been assessed as part of this EIS, as detailed in Section 6.1
- Minimising light spill and glare towards neighbouring properties in accordance with *AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.

### Community Benefit

The proposal aims to benefit stakeholders and the community through implementing key initiatives including:

- Engaging with stakeholders and the community during planning of the proposal
- Optimising links between the proposal, community facilities, existing pedestrian routes and other transport modes
- Implementing a wayfinding strategy around the proposal
- Providing real-time displays of timetabling information
- Reducing graffiti risks by treating surfaces with anti-graffiti coatings.

## 6.13.2 Greenhouse gas assessment

The sources of greenhouse gas emissions related to the proposal can be categorised as part of emissions of three scope types, depending on the sources of these emissions. Section 6.13.2 describes these categories and the probable sources of emissions.

Table 6-35 Emission types and probable sources

| Emission Scope | Type of emission | Probable proposal source |
|---|---|---|
| Scope 1 | Direct emissions within the boundary of the proposal operations, such as fuel combustion and manufacturing processes, or provision of supplementary energy such as generating electricity for onsite usage. | Construction phase:<br>• Fuel combustion emissions from construction plant and equipment.<br>Operations phase:<br>• Maintenance activities. |
| Scope 2 | Indirect emissions from consumption of purchased electricity, steam or heat purchased for the proposal but produced by another organisation. | Construction phase:<br>• Electricity used to operate site office.<br>Operations phase:<br>• Electricity use on ferry wharf, such as for lighting and timetable displays. |
| Scope 3 | Indirect emissions from all other emissions that are a consequence of activities of the project but are not from sources owned/controlled by the proposal. | Construction phase:<br>• Embodied energy of construction materials<br>• Emissions from transporting such materials to and from site<br>• Emissions from the extraction, production, transmission and distribution of fuel and electricity used onsite.<br>Operations phase:<br>• Embodied energy in maintenance materials. |

### 6.13.3 Potential impact

#### Construction

Construction of the proposal would result in increased greenhouse gas emissions associated with the materials required to construct the wharves, the transport of materials to site, and the fuel consumption of construction plant and equipment.

The volume of greenhouse gas emissions that would be generated during construction would depend on the quantity of construction materials consumed and the types of construction plant and equipment used. Due to the scale and temporary nature of the construction works, greenhouse gas emissions are not expected to be significant.

Sustainability initiatives identified for the proposal would provide opportunities to reduce greenhouse gas emissions during detailed design and construction including:

- Undertake detailed carbon footprinting (during detailed design)
- Purchase at least 25 per cent of site-based electricity energy needs from Green Power or renewable sources during construction of the asset
- Ensure that at least 95 per cent of construction and demolition waste generated is either recycled or reused
- Use prefabricated components to reduce construction waste material usage, pollution risks and travel (through reduction in waste transport).

### Operational

During detailed design, further opportunities to identify sustainability opportunities and reduce operational risks (such as climate change risks) would be investigated through the use of the *TfNSW Sustainable Design Guidelines v3* and *Sydney Ports Green Port Guidelines* (refer to Appendix L).

Operation of the proposal would result in minor additional greenhouse gas emissions associated with the ongoing electricity requirements for the new ferry wharves. Additional ferry services being added to the Sydney Ferries network over time to meet the demands of the Barangaroo precinct would also result in minor increases in operational greenhouse gas emissions. However, given the nature and scale of the proposal, operational greenhouse gas emissions would be relatively minor and would not represent a substantial increase in energy usage. As outlined in Sydney's Ferry Future (TfNSW, 2013), from 2016 a program of replacing the existing ferry fleet is anticipated to modernise and grow Sydney Ferries fleet to increase fuel efficiency which would result in increased sustainability benefits across the network.

The delivery of the proposed Barangaroo Ferry Hub with additional ferry services would also encourage public transport use.

## 6.13.4 Mitigation measures

The following mitigation measures are recommended to manage greenhouse gas impact:

- The applicable initiatives within the *TfNSW Sustainable Design Guidelines and Sydney Ports Green Port Guidelines* (refer to Appendix L) will be further considered during detailed design to identify sustainability opportunities through the design and construction of the proposal
- An environmental management induction developed for the project would include measures to promote sustainable work practices by construction personnel.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.14 Utilities and services

This section assesses the potential impact on utilities and services within the study area as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

### Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Infrastructure Servicing | Detail the existing infrastructure on site and identify possible impacts on any such infrastructure from the proposal including the harbour heat rejection plant outfalls. | Sections 4.3, 6.9, 6.14.1 and 6.14.2 |
| Infrastructure Servicing | Detail measures to mitigate the impacts of the proposal on any infrastructure items, including proposed relocation. | Sections 6.9, 6.14.2 and 6.14.3 |
| Infrastructure Servicing | Detail of water supply, consideration of water sensitive urban design and water conservation measures. | Sections 6.9, 6.13 and 6.14.2 |

### 6.14.1 Existing environment

Subsurface utilities located at the King Street Ferry Wharf include connections to power, water and telecommunications (refer to Section 4.2).

The King Street Wharf wave baffle is not connected to any utilities or services.

Underground utilities at the Barangaroo precinct have a substantial footprint and interface with existing utilities in the Sydney area. The proposal does not include any works that would affect these utilities.

There are no known existing utilities within the waterside area of the works (e.g. the wharf construction area).

#### Interaction with existing and proposed services and utilities

The Barangaroo South Public Domain Stage 1A development application submitted to DP&E in May 2014 proposed a network of subsurface utilities including power and water servicing public infrastructure. Approval is also being sought for the provision of all services required for the Barangaroo Ferry Hub which would extend to the harbour edge to provide for future connections to the Barangaroo Ferry Hub (JBA Planning, 2014).

Therefore, if approved, the Barangaroo South Public Domain development would include installation of all sub-surface utilities within the proposal area (Cardno, 2014). The proposal design has been developed to integrate with these future utilities (including power, water, sewerage, data and telecommunications) which would be installed to the harbour edge by Lend Lease for connection to the proposal during construction.

It is not expected that there would be any further impact on utilities infrastructure as a result of the proposal. However, consultation with utility providers is continuing to inform the design development (refer consultation process in Chapter 5).

### 6.14.2 Potential impact

#### Construction

Public utilities would be delivered to the edge of the Barangaroo foreshore under the public domain works for Barangaroo South (Concept Design Modification 4) (refer to Section 4.2). Existing and future proposed) services and utilities may be impacted during

construction, as a result of scheduled stoppages during connection works or accidental damage during construction activities.

Construction activities (such as operation of the compound site or use of machinery) are not expected to place a large demand on existing utility use within the proposal area. Therefore any impacts to utility operation within the area during construction are expected to be minor.

### Operational

The operation of the proposal, including maintenance work carried out at the Barangaroo Ferry Hub would require the ongoing provision of all services (e.g. power and water supply to the wharves). The proposal would be designed to operate in an energy efficient manner with minimum drawdown on local power.

Other operational utilities connections for the proposal include sewerage pipes for pump-out of sewage from ferries and water supply for cleaning and maintenance of ferries and the wharves. This is expected to have a minimal impact on available water supply to the area.

Data and telecommunications connections would also be provided, with no anticipated impact on those networks.

## 6.14.3 Mitigation measures

The following measures would be implemented to reduce potential impact on utilities and services:

- Investigations will be carried out during the detailed design phase to ensure that all appropriate measures are in place to minimise the potential risks to existing utilities and services prior to commencement of construction works. These measures would be outlined in the CEMP.
- Relevant service utility providers or owners will be consulted to verify locations, potential impact and any protection, relocation or decommissioning work required
- In addition to current investigations into the location of sub-surface utilities in the vicinity of the proposal area, the construction contractor(s) will be required to confirm the locations of existing underground utilities and services. This will include a revised and detailed Dial Before You Dig (DBYD) search
- A services search within land not covered by the DBYD search will be carried out to identify the location of utility services.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.15 Waste and resource use

This section assesses the potential impact of waste and resource use within the study area as a result of the proposal. The assessment presented in this section draws on desktop information and responds to the relevant SEARs as outlined in the table below.

### Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| Waste Management | Identify all potential sources of liquid waste and non-liquid wastes as defined in the EPA's *Waste Classification Guidelines 2008*. The EIS should identify any waste that will be stored, separated or processed on the site and identify the procedures to be adopted to minimise, manage, dispose of this waste in accordance with the relevant standards and guidelines. | Sections 6.15.1 and 6.15.2 |

### 6.15.1 Potential impact

#### Construction

*Waste*

The construction of the Barangaroo Ferry Hub is not expected to generate large volumes of construction waste. This is due to there being limited demolition works as part of the proposal area. The extent of expected waste generation is considered to be manageable. Construction waste streams that could be generated during construction of the new ferry wharves include:

- Excess building materials (e.g. concrete, steel, timber) and packaging materials
- Waste generated from the maintenance of construction plant and equipment
- Soil, sand and sediment, including the potential for contaminated soil, sand and/or sediment
- General waste, including food, paper and other waste generated by construction workers and the construction compound.

These waste streams could have potential impact in terms of:

- Storage and management of waste generated on site
- Disposal of waste generated on-site
- Volumes of waste sent to landfill, including from the inadequate collection, classification and disposal of waste
- Contamination of soil, surface water and groundwater from inadequate waste handling.

The proposal also includes the potential demolition of the existing King Street Wharf wave baffle and the decommissioning and removal of the public transport elements of the existing King Street Ferry Wharf. Both these activities would generate waste that would require reuse, recycling or disposal.

The proposed King Street Wharf wave baffle would be demolished and taken to the off-site facility by barge. Waste generated from this demolition would include the removal of:

- timber decking
- supporting timber girders
- underlying wash barrier steel substructure
- piles.

The decommissioning and removal of the public transport elements of the existing King Street Ferry Wharf would include the removal of ticket machines, ticket barriers and any signage no longer required.

#### *Resources*

Resources required for the construction of the proposal are outlined in Section 4.2.1 of this report. The volume of resources required is not expected to be significant and all the resources are commonly available. Therefore the proposal is unlikely to affect supply and demand.

Energy and water resources would also be required throughout the construction of the proposal. This would include:

- Electricity supply for the compound site, lighting and use of machinery
- Fuel for construction machinery, plant and equipment and vehicles
- Water for use by the compound site, staff facilities and wash down and clean up of machinery.

The utilities available in the proposal area are discussed in Section 6.14. The energy and water resources required for the proposal are not expected to be significant and would be readily available in the local area. Therefore the proposal is unlikely to effect local supply and demand.

### Operational

#### *Waste*

Waste generating activities during the operation of the proposal would include cleaning and maintenance of the Barangaroo Ferry Hub, including waste products from the cleaning of the wharf facilities and rubbish from public waste bins.

Public toilet facilities on board the Sydney Ferries fleet operating at the Barangaroo Ferry Hub proposal would need to be emptied at regular intervals (refer to Section 4.2). A pump-out facility would be provided at each of the new wharves to service the Sydney Ferries fleet. The pump-out facilities would provide a connection from the ferries pump-out user point to the sewerage system connection at the edge of the Barangaroo promenade. The proposed pump-out-system would be a direct pumping system as described in Section 4.2.

Management of this waste removal process is not a scheduled activity under Schedule 1 of the POEO Act 1997 (refer to Section 2.4) and therefore does not require an EPL. Ongoing operational waste management for the proposal would be governed by operational policies and procedures.

*Resources*

Water resources would be required for the ongoing cleaning and maintenance of the ferry wharves.

The Barangaroo Ferry Hub would require the use of electricity resources as part of ongoing routine operations (e.g. lighting and ticketing).

These impacts are expected to require an increase in the use of these resources in the local area. However this demand is expected to be minor and is unlikely to affect the local supply and demand of these resources.

No fuelling of ferries would occur during operation of the Barangaroo Ferry Hub ferries.

### 6.15.2 Mitigation measures

The following mitigation measures are recommended to manage potential waste and resource impact:

- A waste management plan will be prepared as part of the CEMP. Construction waste would be managed through the waste hierarchy established under the *Waste Avoidance and Recovery Act 2001*, which comprises the following principles:
  - Avoidance of waste: Minimising the amount of waste generated during construction by avoiding unnecessary resource consumption (e.g. avoiding the use of inefficient plant and construction equipment, and avoiding materials with excess embodied energy and excessive packaging)
  - Resource recovery: Reusing, reprocessing and recycling waste products generated during construction to minimise the amount of waste requiring disposal
  - Disposal: Where resources cannot be recovered, disposing of them appropriately to minimise the potential adverse environmental impact.
- The materials removed as part of the demolition of the King Street Wharf wave baffle and the decommissioning of public transport elements of the King Street Ferry Wharf will be reused and/or recycled where possible. Ways to reuse or recycle these materials will be investigated as part of detailed design
- All waste requiring off-site disposal will be classified in accordance with OEH's (2009) Waste Classification Guidelines prior to disposal
- Environmental management measures to reduce energy usage (and any associated greenhouse gas emissions) are discussed in Section 6.13.2
- Operational policies and procedures would be prepared by the operator of the Barangaroo Ferry Hub, which will outline how waste, energy and demand on resources will be managed during operation.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.16 Hazards and risks

This section assesses the potential impact of hazards and risks within the study area as a result of the proposal.

### 6.16.1 Existing environment

The proposal area is predominantly within the foreshore and water environment of Darling Harbour and therefore the main risk presented by the proposal is the risk of accidental spills which could enter the water during construction and operation.

### 6.16.2 Potential impact

#### Construction

Hazards and risks associated with the construction phase of the proposal can be generally categorised into the following:

- Environmental hazards and risks – including discharge of potentially hazardous materials to the environment
- Occupational health and safety hazards and risks – including any activity or outcome that may affect the health and/or safety of construction personnel or the community
- Construction hazards and risks – including operation and maintenance of plant and machinery, and use of materials required for construction.

Further discussion on the above hazards and risks is provided in the following sections.

#### Environmental hazards and risks

Environmental hazards and risks associated with construction of the proposal include the transportation, use and storage of hazardous materials on-site, as well as the potential discovery of acid sulfate soils and/or contaminated soils/groundwater and their subsequent disposal. It is not anticipated that landside works would require any excavation, therefore the probability of encountering acid sulfate soils and/or contaminated soils/groundwater as a result of landside works is low.

During construction, potentially hazardous materials would be stored and used on-site at the proposed construction compound as shown in Figure 4-4 (refer to Chapter 4), and potentially on barges and ancillary work areas. The types of potentially hazardous materials that may be required to be stored on-site during construction of the proposal would include hydraulic fluid and fuel.

Potentially hazardous materials would be transported to and from the site via barges on Sydney Harbour. Spills and leaks during transportation could potentially result in the contamination of waterways outside of the Barangaroo Ferry Hub proposal area.

#### Occupational health and safety hazards and risks

Occupational health and safety hazards would potentially arise throughout construction, when inadequate hazard/risk identification, reporting and monitoring systems are not implemented and/or maintained. Hazards and risks that could occur during the construction of the Barangaroo Ferry Hub proposal include:

- Construction workers falling from the promenade or vessels in Darling Harbour potentially resulting in physical injury or drowning
- Undertaking construction works close to publically accessible/highly trafficked areas

- Undertaking construction works in the vicinity of existing services and utilities
- The use and storage of hazardous materials
- The use of heavy machinery
- Working on and over water and being exposed to wave and wind impacts.

### Construction hazards and risks

The maintenance and refuelling of barges and construction plant would be undertaken at an appropriately approved and licensed depot prior to accessing the site. However, there is low potential that the barge may leak hydraulic oil or fuel into the water and cause localised contamination. Hydrocarbons may condense and become suspended in the water column or degrade and be released into the atmosphere.

Fuels and chemicals would likely be stored at the temporary construction compound (located on the Barangaroo foreshore (e.g. petrol for refuelling of generators or oils for minor maintenance of machinery) during construction. There is potential for leaks and spills of chemicals, oils and lubricants within this facility.

### Operational

Hazards and risks associated with the operation of the Barangaroo Ferry Hub proposal would primarily include:

- Passengers or staff falling from the promenade or vessels in Darling Harbour potentially resulting in physical injury or drowning
- Objects falling from the ferries or the wharves into Pyrmont Bay or Darling Harbour, causing water pollution
- A spill (e.g. hydraulic fluid and/or fuel) from a ferry or pump-out waste entering the waters of Darling Harbour
- Damage to Barangaroo Ferry Hub infrastructure caused by impact from a ferry
- Natural events (including extreme weather events) and impact of climate change (changed frequency of natural events).

The above hazards and risks are considered to be manageable during operations through design (e.g. incorporating adequate safety provisions into the design of wharf infrastructure), the application of community education programs (e.g. signage identifying potential safety risks – such as the risk of injury due to falling from the wharf), and standard Sydney Ferries operational plans and policies consistent with other wharves.

## 6.16.3 Mitigation measures

The following mitigation measures would be implemented to manage potential hazard and risks associated with the proposal:

- Site safety protocols, tool box talks, risk assessments and incident management and emergency procedures would be prepared prior to the commencement of construction works and implemented as required throughout construction
- Chemicals and potentially hazardous substances would be used and stored according to regulatory requirements including the *Work Health and Safety Act 2011*

- Chemical, fuel and oil containers would be stored, transported and managed according to the Material Safety Data Sheet (MSDS) and manufacturers' directions
- Activities with the potential to cause environmental, occupational and construction hazards and risks would be identified in the CEMP. Work practices which minimise such hazards and risks during work activities would be investigated and applied where reasonable and feasible to address the following issues:
  - chemical spills and leaks
  - surface water quality
  - disposal of materials.
- Methods for management of hazards and risks would be incorporated into project inductions, training and pre-start talks
- Sydney Ferries standard operational policies and procedures would be applied to the ongoing operation of the Barangaroo Ferry Hub, as well as operational policies and procedures, in order to manage potential hazards and risks associated with spills (e.g. hydraulic fluid and/or fuel) from a ferry or pump-out waste entering the waters of Darling Harbour.

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

## 6.17 Cumulative impacts

This chapter provides an assessment of potential cumulative impacts and benefits associated with operation and construction of the proposed Barangaroo Ferry Hub and other major future or current developments within the vicinity of the proposal (refer Figure 1-2). The assessment also responds to the relevant SEARs as outlined in the table below.

General requirements and key issues

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| General requirements | Consideration of potential cumulative impacts due to other development in the vicinity; | Section 6.17 |
| Water Quality and Contamination | As assessment of potential cumulative impacts on water sources and mitigation measures to manage the cumulative impacts. | Section 6.17. |

The following subsections provide an overview of the types of cumulative impacts that may occur during the construction and operation of the proposed Barangaroo Ferry Hub and other major developments. Proposal specific impacts are discussed in Chapter 6.

### 6.17.1 Purpose and approach

When considered in isolation, the environmental impact and benefits of an individual project may not be substantial. However, when combined with the effects of other developments, the resultant cumulative effects may result in a greater extent, scale or duration of impact. Identifying potential cumulative impact assists in developing appropriate environmental management measures and provides a basis for coordinated planning and environmental monitoring.

Proposed developments when considered in combination with the Barangaroo Ferry Hub proposal may result in cumulative impacts, were identified through:

- Consultation with the Barangaroo Ferry Hub project team
- A search of the Department of Planning's major projects register on 16 October 2014
- A search of the NSW Planning Assessment Commission's project register for Sydney City and Leichardt LGAs on 16 October 2014
- A review of background documents including planning strategies and major facility master plans

The assessment focused on proposed developments that are:

- In proximity to the Barangaroo Ferry Hub proposal
- Likely to be under construction and/or operation concurrent with the Barangaroo Ferry Hub proposal
- Large scale and of the type that may have cumulative impacts, when considered in combination with the Barangaroo Ferry Hub proposal
- Likely to be developed considering their approval status and/or support from relevant government planning strategies and local environmental plans.

This cumulative assessment does not focus on potential projects that are not subject to an application for planning approval and/or have no current government commitment or existing developments.

### 6.17.2 Potential impact

Table 6-36 below outlines the proposed projects, which when considered in combination with the proposed Barangaroo Ferry Hub may result in cumulative impacts. Cumulative impacts are considered for all project phases including design, construction and operation.

Table 6-36 Nearby projects with the potential of cumulative impact

| Project (proponent) and Description | Status and indicative timing | Potential cumulative impacts |
|---|---|---|
| **Barangaroo precinct (BDA and Lend Lease)** | | |
| The Barangaroo precinct is divided into three sections:<br>• Barangaroo South – a major new business, tourism, residential and retail precinct opening onto a public waterfront promenade. This is the area in which the proposed Barangaroo Ferry Hub would be located<br>• Central Barangaroo – a cultural and civic focal point for recreation, relaxation, events, festivals, entertainment and leisure activities as well as recreational, residential, retail and commercial facilities<br>• Barangaroo Point – a six hectare open space precinct designed to complement the neighbouring headlands of Sydney Harbour.<br>(Refer Sections 1.3 and 2.1.3 of this EIS for further details) | Currently under construction. Early occupancy of Barangaroo South is expected mid/late 2015 | Design<br>• The design of the Barangaroo precinct, particularly Barangaroo South has taken the proposal into account to ensure design interface issues between the two projects are identified and discussed. This has been facilitated by regular meetings between TfNSW, BDA and Lend Lease. This has resulted in positive cumulative impacts particularly with regard to visual impacts and integration of landside ancillary facilities.<br>Construction<br>• Construction at Barangaroo South would be largely completed (with potential for some internal fit outs remaining) by mid 2015. Other parts of the Barangaroo precinct may be in construction when construction of the proposed Barangaroo Ferry Hub is expected to commence. There is the potential for overlap between the two construction programs, therefore resulting in cumulative construction impacts, such as noise, pedestrian access disruptions, visual impacts and dust. This is considered in Section 6.17 of this EIS. The cumulative impacts of an extended construction duration over multiple projects being constructed simultaneously and/or in sequence within the broader precinct may lead to a sense of 'construction fatigue' within the community.<br>• The overall construction related disruption at the Barangaroo precinct would be extended particularly impacting pedestrians accessing the Barangaroo foreshore area. This area is currently closed to pedestrians until March 2015 for works associated with Barangaroo South. A limited area may remain closed to accommodate early works for the proposal when the remainder of the foreshore reopens.<br>• As occupation of Barangaroo South is likely to commence while construction of the proposed Barangaroo Ferry Hub is in progress the new occupants of Barangaroo South may be affected by construction impacts (noise, traffic and transport, dust and amenity impacts) from the proposal. This is considered in Chapter 6 of this EIS. |

| Project (proponent) and Description | Status and indicative timing | Potential cumulative impacts |
|---|---|---|
| | | Operation<br>• Once work is complete at the Barangaroo precinct and the proposed Barangaroo Ferry Hub, there would be a positive cumulative impact in relation to the provision of ferry services to cater for commuters arriving and departing from Barangaroo precinct. |
| **Wynyard Walk (TfNSW)** | | |
| New pedestrian link from Wynyard Station to the intersection of Kent and Napoleon Streets, including:<br>• a new plaza (Napoleon Plaza) over the entrance<br>• a new Sussex Street pedestrian bridge at the western end<br>• an underground component at the eastern end<br>Wynyard Walk is designed to have capacity for 20,000 pedestrians per hour. | Currently under construction. Due to be completed in 2016. | Design<br>• The design of the proposal has taken into account of the Wynyard Walk project, and in particular in the location of the proposed Barangaroo Ferry Hub.<br>Construction<br>• Construction of Wynyard Walk will be complete in 2016.<br>• There may be cumulative impacts associated with the overlap of the two construction programs. Key cumulative impacts would include traffic disruptions, noise, dust, visual and amenity impacts and socio-economic impacts particularly for local businesses at Wynyard Walk and King Street Wharf.<br>Operation<br>• In the long term the cumulative impacts of both the Barangaroo Ferry Hub and Wynyard Walk would be positive. Connectivity between the proposal, the CBD, Wynyard train station and other transport modes (including buses and the future light rail) would be improved. A cumulative benefit is anticipated in terms of visual quality and amenity of the precinct, and socio-economic outcomes, a cumulative benefit is anticipated. |

| Project (proponent) and Description | Status and indicative timing | Potential cumulative impacts |
|---|---|---|
| **CBD South East Light Rail (CSELR) (TfNSW)** | | |
| TfNSW will be constructing a new light rail line extending from Circular Quay through George Street to Central Station and to the University of NSW.<br>The CSELR project would include a stop at Wynyard on George Street (refer Figure 1-2). | Construction on the project will take place in stages, with city streets closed in sections to minimise disruption to residents, businesses and commuters.<br>Construction is likely to take between five<br>and six years to complete. Early works are planned to commence shortly on George Street. | Design<br>• The strategic planning for the proposed Barangaroo Ferry Hub (refer Chapter 3 for further discussion) took into account the potential cumulative benefit of integration between a ferry hub at Barangaroo and other public transport modes within the northern CBD area including the CSELR.<br>Construction<br>• Major construction is expected to commence after Anzac Day 2015 with the system open and operational in 2019/2020.<br>Operation<br>• The cumulative impact of the Barangaroo Ferry Hub and CSELR would be positive, with improved public transport connections and socio-economic factors. |
| **Wynyard Station Upgrade** | | |
| An upgrade of the station is planned to transform an ageing station into a new gateway for Sydney's financial district and western CBD.<br>Premium fixtures and finishes, a wider concourse and ticket gates, and less clutter on the concourse and platforms will improve customer experience and make it easier for customers to move in and around the station. Passenger services will be maintained throughout construction and Wynyard Station will remain open for business during the upgrade. | Proposed upgrade is being assessed under Part 5 of the EP&A Act. | Design<br>• These projects are being planned and developed in a co-ordinated manner.<br>• Cumulative benefits for customers of improved services and integration between transport modes around the northern part of the CBD has been considered as part of the strategic planning framework for these proposals.<br>Construction<br>• Wynyard Station Upgrade is expected to start construction in early 2015 and finish in 2016, subject to planning approval. Due to the distance from the proposal negligible cumulative construction impacts are anticipated (e.g. construction traffic movements).<br>Operation<br>• In the long term the cumulative impacts of both the Barangaroo Ferry Hub and the upgrade of Wynyard Station would be positive, with improved public transport connections and socio-economic factors. |

| Project (proponent) and Description | Status and indicative timing | Potential cumulative impacts |
|---|---|---|
| **Ferry Wharf Upgrade Program** | | |
| The NSW Government is progressively upgrading ferry wharves across Sydney Harbour to improve Sydney's ferry service for passengers. The new wharves are part of the NSW Government's Transport Access Program.<br>Current projects include:<br>• Balmain East Wharf<br>• Cremorne Wharf<br>• McMahons Point Wharf<br>• Pyrmont Bay Wharf<br>• Sydney Olympic Wharf | Construction of these projects is due to commence in late 2014 and early 2015.<br><br>The Pyrmont Bay Wharf Upgrade, the closest of the wharf upgrades to the proposal, is anticipated to start in late 2014 and take up to about four months to complete, weather permitting. | Design<br>• The 12 wharves to be upgraded as part of the Ferry Wharf Upgrade Program have been designed to create a distinctive theme for Sydney Harbour. The design aims to unify and identify the harbour wharves and the ferry commuter transport system. The design of the proposed Barangaroo Ferry Hub is consistent with these design principles to ensure the same standard and quality of appearance, amenity and customer comfort is provided.<br>Construction<br>• There is likely to be overlapping construction timetables for the proposal and some ferry wharf upgrades. Potential disruption to ferry services is being managed as part of the Sydney Commuter Wharf Upgrade Program. During the construction of the proposal King Street Ferry Wharf would remain operational for public ferry services therefore it is not anticipated the construction at Barangaroo would add any cumulative impacts on ferry services.<br>• Works at Pyrmont Bay Wharf would be complete prior to commencement of construction of the proposal however it is expected that there would be some cumulative impacts as there is some overlap of receivers.<br>Operation<br>• In the long term the Sydney Commuter Wharf Upgrade Program in combination with the proposed Barangaroo Ferry Hub would provide an improved customer experience for ferry commuters around Sydney Harbour. |
| **Darling Harbour Live** | | |
| The international convention centre will be capable of collectively hosting more than 12,000 delegates and holding multiple large conferences and exhibitions concurrently in what will be Australia's largest exhibition space. | Opening in December 2016 | Given the distance to the proposal this project is unlikely to result in a cumulative impact and therefore has not been considered further. |

### 6.17.3 Mitigation measures

The potential cumulative impacts associated with the Barangaroo Ferry Hub proposal and other major transport and other developments would be further considered as the detailed design and detailed construction planning are developed. Transport for NSW would coordinate activities with the proponents of these other major proposals to minimise any potential cumulative impact.

As a minimum, the following construction management plans would incorporate measures to manage cumulative construction impact:

- Construction Environmental Management Plan (including measures relevant to management of the construction compound).
- Construction Traffic Management Plan
- Construction Noise and Vibration Management Plan

Refer to Table 7-1 for a complete list of proposed mitigation measures for the proposal.

# 7 Environmental management

This chapter of the EIS identifies how the environmental impact of the proposal would be managed through environmental management plans and mitigation measures. Section 7.2 lists the proposed mitigation measures for the proposal to minimise the impact of the proposal identified in Chapter 4 and 6.

This chapter also provides a summary of an environmental risk analysis that was undertaken for the proposal at Section 7.3.

## 7.1 Environmental management plans

A CEMP including any relevant environmental management sub-plans for the construction phase of the proposal would be prepared in accordance with the requirements of the TfNSW Environmental Management System (EMS). The CEMP would provide a centralised mechanism through which all potential environmental impact relevant to the proposal would be managed, and outline a framework of procedures and controls for managing environmental impact during construction.

The CEMP would incorporate as a minimum all environmental mitigation measures identified below in Section 7.2, any conditions from licences or approvals required by legislation, and a process for demonstrating compliance with such mitigation measures and conditions.

## 7.2 Mitigation measures

Mitigation measures for the proposal are listed below in Table 7-1. These proposed measures would minimise the potential adverse impact of the proposal identified in Chapter 4, should the proposal proceed.

Table 7-1 Proposed mitigation measures

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **General environmental management** | | | | |
| General environmental management | G1 | A Construction Environmental Management Plan (CEMP) will be prepared and implemented to ensure appropriate environmental management measures are followed during project delivery. The CEMP will provide a framework for environmental management during construction and will:<br>• Outline all environmental management practices and procedures to be followed during construction and demolition works associated with the project<br>• Describe all activities to be undertaken on the site during construction of the project<br>• Detail how the environmental performance of the construction works will be monitored<br>• Detail what corrective actions will be taken to address identified adverse environmental impacts<br>• Describe the roles and responsibilities for all relevant employees involved in the project<br>• Include relevant sub-plans:<br>– Construction Noise and Vibration Management Plan<br>– Construction Traffic Management Plan<br>– Erosion and Sediment Control Management Plan<br>– Waste Management Plan<br>The CEMP will be developed in accordance with *Guideline for the Preparation of Environmental Management Plans* (Department of Infrastructure, Planning and Natural Resources, 2004). | TfNSW<br>Construction contractor | Pre-construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Environmental awareness training | G2 | Environmental awareness training will be provided, by the contractor, to all field personnel and subcontractors. The environmental induction will include:<br>• Construction noise and vibration management<br>• Traffic (road and maritime) management<br>• Marine ecology<br>• Non-Indigenous heritage<br>• Air quality<br>• Indigenous heritage<br>• Ecologically Sustainable Development<br>• Hazards and risks | Construction contractor | Pre-construction and during construction as required |
| **Noise and vibration** | | | | |
| Construction Noise and Vibration Management Plan | N1 | A Construction Noise and Vibration Management Plan (CNVMP) will be included in the CEMP to provide the framework and mechanisms for the management and mitigation of all potential noise and vibration impacts from the construction works.<br>A CNVMP will be prepared and all work will be undertaken in accordance with the TfNSW Construction Noise Strategy (CNS) and Interim Construction Noise Guidelines where practicable.<br>The CNVMP will as a minimum include:<br>• Identification of nearby residences and sensitive land uses.<br>• Determination of Noise Management Levels (NMLs) and the prediction of noise levels.<br>• Details of construction activities and a schedule for construction works.<br>• Description of approved hours of work.<br>• An out of hours works protocol<br>• Restrictions on the hours of construction for specific works.<br>• Details of work practices and measures that will be implemented to minimise noise impacts.<br>• Description of the complaints handling process.<br>• Details of monitoring that is required. | TfNSW<br>Construction contractor | Pre-construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Construction hours | N2 | Construction and demolition activities, including heavy vehicle movements will generally be restricted to the standard construction hours of:<br>• Monday to Friday 7:00 am to 6:00 pm.<br>• Saturday 8:00 am to 1:00 pm.<br>• No work on Sundays or public holidays.<br>The installation of piles and intricate lifting works will require specific weather conditions, such as calmer water. Therefore works may be required in the evening or night-time period, or during the night-time/daytime shoulder period (e.g. 5:00 am to 7:00 am), for safety of workers, businesses, residents and pedestrians. | Construction contractor | Construction |
| Out of hours work | N3 | All works will be undertaken in accordance with the construction hours detailed above, except for the following works, as outlined in the *TfNSW Construction Noise Strategy* (CNS), which will be permitted outside of these hours:<br>• Any works which do not cause noise emissions to be more than 5dBA higher than RBL (background) noise levels at any nearby residential property and/or other noise sensitive receiver.<br>• The delivery of plant, equipment and materials which is required outside these hours as requested by police or other authorities for safety reasons and with suitable notification to the community as agreed by the TfNSW Principal Manager Environmental Management.<br>• Emergency work to avoid the loss of lives, property and/or to prevent environmental harm.<br>• Any other work in accordance with TfNSW's Out-of-Hours Work (OOHW) Procedure and considered essential to the project.<br>Where OOHW is proposed which has not been assessed in the EIS and CNVMP, activity and site specific Construction Noise Impact Statements (CNISs) will be developed to support an OOHW Application. The CNISs will provide a detailed assessment of potential noise levels and site specific measures to control potential noise impacts and minimise the potential for disturbance at affected receptors.<br>Night works will be programmed to minimise the number of consecutive nights work impacting the same receptors, as per the TfNSW CNS. | Construction contractor | Construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Respite periods | N4 | The proponent and construction contractor(s) will schedule work to provide respite periods from the noisiest activities, and communicate with the impacted residents by clearly explaining the duration and noise level of the works, as per the TfNSW CNS. | Construction contractor | Construction |
| Community consultation | N5 | Community notification and consultation, including notification regarding noisy works, will be undertaken in accordance with the TfNSW CNS. | TfNSW | Construction |
| Avoid noisy works | N6 | • Broadband audible or non-tonal alarms will be used on all construction vehicles and mobile plant regularly used on site and for any out-of-hours work, as per the TfNSW CNS.<br>• The use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers will be avoided or limited where feasible and practicable. | Construction contractor | Construction |
| Switch off noisy equipment | N7 | Equipment which is used intermittently will be shut down or throttled down to a minimum when not in use. Plant items such as barge(s), concrete trucks will be turned off when parked or otherwise not in use. | Construction contractor | Construction |
| Compliance checks on equipment | N8 | Regular compliance checks on the noise emissions of all plant and machinery used for the proposal will be undertaken to indicate whether noise emissions from plant items are higher than predicted and whether any silencing equipment on items of plant is defective. | Construction contractor | Construction |
| Environmental awareness | N9 | • Environmental awareness training will be provided, by the contractor, to all field personnel and subcontractors.<br>• Regular reinforcement (such as at toolbox talks) of the need to minimise noise will be undertaken. | Construction contractor | Pre-construction and during construction as required |
| Specific Notifications | N10 | Specific notifications will be letterbox dropped or hand distributed to nearby stakeholders and other sensitive receivers no later than seven days ahead of new construction activities and construction activities that are to be undertaken out-of-hours or are considered high noise generating. This form of communication is used to support periodic notifications. | Construction contractor<br>TfNSW | Construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Monitoring | N11 | Noise monitoring at sensitive receivers will be used during construction to assist in managing high noise OOHW activities and in response to complaints. All noise monitoring will be carried out by an appropriately trained person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures. | Construction contractor | Construction |
| **Traffic and transport** | | | | |
| Consultation | T1 | Consultation will be undertaken with the Barangaroo Integrated Transport Plan Working Group to co-ordinate management measures for cumulative transport impact during construction. | TfNSW | Detailed design |
| Traffic management plan | T2 | A Construction Traffic Management Plan will be prepared before the commencement of work. The plan will include:<br>• Ongoing consultation with key stakeholders including Port Authority of NSW, Roads and Maritime Services and Harbour City Ferries.<br>• Specific mitigation measures to minimise impact of the works on the road and maritime networks during construction.<br>• A Traffic Control Plan in accordance with the *Roads and Maritime Traffic Control at Work Sites Manual* and *Australian Standard 1742.3.*<br>• Event management during construction including avoiding events taking place in the harbour, such as the Sydney International Boat Show. | TfNSW<br>Construction contractor | Pre-construction |
| Pedestrian routes | T3 | • Should the temporary closure of any pedestrian routes be required consultation will be undertaken with key stakeholders (including BDA and Lend Lease).<br>• Alternative pedestrian routes will be identified and communicated through the provision of appropriate information and signage at key locations. | TfNSW<br>Construction contractor | Pre-construction<br>Construction |
| Navigation | T4 | The movement of construction barges in the harbour will follow the standard navigational procedures to limit impact on other vessels. | Construction contractor | Construction |
| Operational vessel management | T5 | A Vessel Traffic Management Plan will be prepared and implemented prior to commencement of operations at the Barangaroo Ferry Hub. This will be supported by a risk assessment for the Darling Harbour waterway which includes the Barangaroo Ferry Hub proposal. | Ferry operator | Operation |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Event management during operation | T6 | A tailored event management plan will be implemented during event periods or when a dramatic increase in pedestrians is expected, such as New Year's Eve. | Ferry operator | Operation |
| **Ecology** | | | | |
| Marine ecology | E1 | The project CEMP will include mitigation measures to avoid impacts to marine ecology. This will include information about the risk of spills and leaks, as well as the threat posed to marine biota (fishing birds, marine mammals and fish) of ingestion and throttling from discarded garbage and in particular from plastic wrapping materials and plastic off cuts (such as hosing, jetty fenders, electrical wiring). | Construction contractor | Pre-construction |
| Environmental awareness | E2 | Environmental awareness training will be provided, by the contractor, to all field personnel and subcontractors. Regular reinforcement (such as at toolbox talks) covering ecology impacts will be undertaken. | Construction contractor | Pre-construction and during construction as required |
| Spills during operations | E3 | Operational procedures and policies will include mitigation measures to avoid the risk of spillages of liquids and solids from pump-out and maintenance. This will be managed by a combination of normal best-practice, and policies and procedures. Information about the threat posed to marine biota (fishing birds, marine mammals and fish) of ingestion and throttling from discarded garbage and in particular from plastic wrapping materials and plastic offcuts (such as hosing, jetty fenders, electrical wiring) will also be included. | Ferry operator | Operation |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **Visual amenity and urban design** | | | | |
| Visual amenity | V1 | The following visual amenity design considerations will be investigated during detailed design:<br>• The use of glass or similar material to create transparency and reduce the obstruction of views to the water.<br>• Integrate and minimise the scale of elements such as the pump-out facility, gateline 'kiosk', and any pontoon facilities as much as possible to reduce visual obstruction to water views.<br>• Minimise the use of railings and structures that obstruct views to the water and create visual clutter.<br>• Integrate elements of the structure to create a unified and coherent character to the architecture of the Barangaroo Ferry Hub.<br>• Given the visually congested context of the future Barangaroo precinct, the design of Barangaroo Ferry Hub should create a simple, low scaled ferry hub that maximises views to the water and which relates to the architectural language of the existing Ferry Wharf Upgrade Program.<br>• Selection of finishes to be visually compatible with the adjacent Barangaroo South development. | TfNSW | Detailed design |
| Visual amenity | V2 | Where feasible, the elements within the construction sites will be located to minimise visual impact, where feasible and reasonable. | Construction contractor | Construction |
| Lighting | V3 | Lighting in line with *AS/NZ 1158 Set:2010: Lighting for roads and public spaces* will be used to ensure glare and light spill are minimised while meeting safety and amenity requirements. | Construction contractor | Construction |
| Construction hoardings | V4 | Hoarding treatments will be designed to support wayfinding, display key messages, improve the look and feel of the construction site and document project progress. Regular maintenance of site hoarding and perimeter site areas will be undertaken, including the prompt removal of graffiti. | Construction contractor | Construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **Built and non-Indigenous heritage** | | | | |
| Heritage awareness | H1 | All relevant staff and contractors will be trained regarding their statutory obligations and responsibilities under the *Heritage Act 1977* and best practice outlined in *The Burra Charter 2013*, through the site induction and toolbox talks. | Construction contractor | Pre-construction and during construction as required |
| Heritage items uncovered | H2 | The CEMP for the proposal will include that provisions for unexpected finds. If, during the course of construction of the proposal, suspected historic cultural heritage material is uncovered:<br>• Work will cease in that area immediately and the area will be cordoned off.<br>• TfNSW environment staff and a suitably qualified archaeologist will be contacted.<br>Should the finds constitute non-Indigenous heritage then the Heritage Division, Office of Environment & Heritage will be notified. | Construction contractor | Construction |
| **Climate change** | | | | |
| Design for climate change | CC1 | The following climate change design considerations will be investigated during detailed design:<br>• The design of the fixed link structure, in particular the allowance for sea level rise. The potential for adaptation or upgrading of the deck at a future date (when there is greater certainty regarding sea level rises and projections) to cater for potential sea level rise beyond the design life will be considered.<br>• Materials selection to minimise accelerated degradation of infrastructure.<br>• Shading for user comfort in extreme heat. | TfNSW | Detailed design |
| Inspection of infrastructure | CC2 | • Regular inspections of the infrastructure will be undertaken. Should excessive deterioration be identified, more regular or more substantial maintenance activities may be required within the design life of the project.<br>• Inspection of infrastructure after storm events will be undertaken to determine damage and appropriate maintenance requirements. | Ferry operator | Operation |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **Air quality** | | | | |
| Air quality awareness | AQ1 | Methods for management of emissions will be incorporated into the CEMP and included in project inductions, training and pre-start talks. | Construction contractor | Construction |
| Dust management | AQ2 | Dust will be visually monitored and where necessary the following measures implemented:<br>• Loads on vessels and trucks transporting material to and from the construction work area will be appropriately covered.<br>• Tailgates of road transport trucks will be securely fixed prior to loading and after unloading. | Construction contractor | Construction |
| Vehicle emissions | AQ3 | • Plant and machinery will be regularly checked and maintained in a proper and efficient condition.<br>• All site vehicles and machinery will be switched off or throttled down to a minimum when not in use. | Construction contractor | Construction |
| Vessel emissions | AQ4 | During operation, vessel engines will be switched off during overnight layover. The operator will develop procedures to manage vessel idling at the wharves. | Ferry operator | Operation |
| Pump-out facility | AQ5 | The detailed design of pump-out facilities will consider air quality impacts, in particular the need to avoid odour release from the pump out system. | TfNSW | Detailed design |
| Pump-out facility | AQ6 | The operator will develop procedures to manage pump-out facilities at the wharves. These procedures are to consider the operation and maintenance of the facilities to ensure no odour impacts. | Ferry operator | Operation |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **Property and land use** | | | | |
| Consultation regarding property and access | P1 | • Landside works and access during construction and operation will be negotiated with BDA, Lend Lease, Roads and Maritime and SHFA.<br>• Where necessary, easements will be created to protect services and allow Roads and Maritime Services to maintain them into the future.<br>• Approvals will be sought prior to construction for construction works from:<br>– Roads and Maritime<br>– Port Authority of NSW.<br>• Emergency access arrangements will be provided throughout construction and operation, with specific arrangements to be considered in consultation with emergency services, BDA and Lend Lease.<br>• Should demolition of the King Street Wharf wave baffle be recommended, the removal will be subject to negotiation with Roads and Maritime Services. | TfNSW | Pre-construction<br>Construction |
| Special event management | P2 | A special event management system will be prepared by the operator of the Barangaroo Ferry Hub prior to operation of the wharves. It will consider queue management and service provision to be implemented during special events. BDA, Lend Lease, Roads and Maritime and SHFA would be consulted during preparation of this management system. | Ferry operator | Operation |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **Water quality and hydrology** | | | | |
| Drainage and flooding | WQ1 | • Weather forecasts will be checked regularly during construction and where flooding is forecast, all equipment and materials would be removed from the construction compound or appropriately secured where flood levels are expected to rise above existing surface levels for the area. | Construction contractor | Construction |
| Erosion and sedimentation | WQ2 | • Prior to construction an erosion and sediment control management plan for all land construction activities will be developed in accordance with *Managing Urban Storm Stormwater: Soils and Construction* (The Blue Book) and included in the CEMP. The plan will require all erosion and sediment controls to be installed prior to any land works commencing, maintained throughout construction and removed only once all disturbed areas have been reinstated.<br>• The establishment of the temporary construction compound will be done in accordance with The Blue Book and outlined in the CEMP. | Construction contractor | Pre-construction<br>Construction |
| Water quality during construction | WQ3 | • A water monitoring program would be outlined within the CEMP to monitor key water quality parameters established in consultation with OEH and DP&E | Construction contractor | Pre-construction<br>Construction |
| Stockpiling | WQ4 | During construction, there will be no stockpiling of demolition or construction materials on the seabed. | Construction contractor | Construction |
| Wave baffle removal | WQ5 | If the King Street Wharf wave baffle is agreed to be removed, prior to commencement of the demolition, the CEMP will include protections for water quality, including:<br>• Scaffolding or similar protection to prevent solid materials, paint or fragments entering the water during demolition.<br>• Silt curtains will be installed between the inner piles and the shore to protect remaining seawall and rock toe hard substratum habitats from potential smothering or excessive turbidity. The silt curtains will remain in place for the duration of the demolition activities. | Construction contractor | Construction |
| Water quality during piling | WQ6 | Prior to commencement of piling activities of each individual wharf, silt curtains will be installed between the inner piles and the shore to protect the remaining seawall and rock toe hard substratum habitats from potential smothering or excessive turbidity. The silt curtains will remain in place for the duration of the piling activities for that wharf. | Construction contractor | Construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Spills during construction | WQ7 | • Visual inspections will be carried out at the proposal area and included within the CEMP. Any water quality issues observed in or outside of the proposal area will be reported to TfNSW. In the event of a spill the TfNSW Incident Management Procedure will be followed and appropriate action will be taken.<br>• Emergency spill kits will be kept on-site and maintained throughout construction work. The spill kits will be appropriately sized for the volume of substances at the work site and be specific to the marine environment. A spill kit will be kept on each barge and at the temporary construction compound site.<br>• During construction, all staff will be made aware of the location of the spill kits and trained in their use.<br>• If a spill occurs during construction, the TfNSW Contract Manager and TfNSW environment staff will be notified as soon as practicable, as outlined in the Incident Management Procedure. | Construction contractor | Construction |
| Bunding | WQ8 | • Equipment barges (carrying plant, machinery, fuels or chemicals) will be bunded to contain any accidental chemical spills or leaks.<br>• Any chemicals or fuels stored at the temporary construction compound will be within double bunded areas. | Construction contractor | Construction |
| Construction vehicles/vessels | WQ9 | • All equipment, materials and wastes transported between an offsite facility, and the construction work area will be secured to avoid spills during transportation.<br>• Vehicles, vessels and plant will be properly maintained and regularly inspected for fluid leaks during construction.<br>• No vehicle or vessel wash down will occur on-site during construction. | Construction contractor | Construction |
| Spills during operations | WQ10 | • In an event of a spill during operation, the incident emergency plan will be implemented in accordance with the Port Corporations response to shipping incidents and emergencies outlined in the *NSW State Waters Marine Oil and Chemical Spill Contingency Plan* (TfNSW, 2012b).<br>• Specific management measures are to be included in an Operation Environmental Management Plan (OEMP) prepared by the operator of the Barangaroo Ferry Hub, to minimise the risks of spillages of liquids and solids from pump-out and maintenance works. | Operator | Operation |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Heat rejection system | WQ9 | TfNSW will continue to work closely with stakeholders, in particular BDA and Lend Lease regarding the interface between the operation of the proposed ferry hub and approved heat rejection system to be included within the Barangaroo South development. | TfNSW | Detailed Design |
| Pump-out system | WQ10 | Detailed design of the pump-out system will address the risk of accidental spills, and an alarm system to identify any accidental spill will be considered. | TfNSW | Detailed Design |
| **Indigenous heritage** | | | | |
| Indigenous heritage awareness | IH1 | Project staff and contractors will be trained regarding their statutory obligations and responsibilities under the *National Parks and Wildlife Act 1974* through the site induction and toolbox talks. | Construction contractor | Pre-construction and during construction as required |
| Unexpected finds | IH2 | The CEMP for the proposal will include provisions for unexpected finds. If, during the course of construction of the proposal, suspected Indigenous heritage material is uncovered:<br>• Work will cease in that area immediately and the area will be cordoned off.<br>• TfNSW environment staff and a suitably qualified archaeologist will be contacted.<br>Should the finds constitute Indigenous heritage material then the Office of Environment & Heritage will be notified. | Construction contractor | Construction |
| Unexpected finds | IH3 | In the event that skeletal remains are uncovered, then works in the area will cease immediately, the area will be cordoned off and the TfNSW environment team and NSW Police Coroner will be contacted to determine if the material is of Aboriginal origin. If determined to be Aboriginal, the OEH Enviroline 131 555 and relevant Aboriginal stakeholders will be contacted to determine an action plan for the management of the skeletal remains prior to works re-commencing. | Construction contractor | Construction |
| **Socio-economic** | | | | |
| Community engagement during construction | SE1 | A community liaison plan will be prepared to support the Stakeholder and Community Engagement Strategy throughout project delivery. | TfNSW<br>Construction contractor | Pre-construction<br>Construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **Soils, geology and contamination** | | | | |
| Contamination management | SC1 | The CEMP will include a contamination plan outlining the methodology (in accordance with Waste Management Guidelines) to manage any potential contamination should small amounts of material be recovered (e.g. during pile removal). This plan would also include an unexpected finds protocol. | TfNSW<br>Construction contractor | Pre-construction<br>Construction |
| Reinstate construction area | SC3 | All construction areas (including the temporary compound site) will be reinstated to their intended state once construction is complete. | Construction contractor | Construction |
| **Ecologically sustainable development** | | | | |
| Sustainability initiatives | SD1 | The applicable initiatives within the *TfNSW Sustainable Design Guidelines* and *Sydney Ports Green Port Guidelines* (refer to Appendix L) will be further considered during detailed design to identify sustainability opportunities through the design and construction of the proposal. | TfNSW<br>Construction contractor | Detailed design<br>Construction |
| Environmental awareness | SD2 | The environmental induction developed for the project will include measures to promote sustainable work practices by construction personnel. | Construction contractor | Pre-construction and during construction as required |
| **Utilities and services** | | | | |
| Utilities and service investigations | U1 | Investigations will be carried out during the detailed design phase to ensure that all appropriate measures are in place to minimise the potential risks to existing utilities and services prior to commencement of construction works. These measures will be outlined in the CEMP. | TfNSW | Detailed design |
| Consult utility and service providers | U2 | Relevant service utility providers or owners will be consulted to verify locations, potential impact and any protection, relocation or decommissioning work required. | TfNSW | Detailed design |
| Dial before you dig | U3 | In addition to current investigations into the location of sub-surface utilities in the vicinity of the proposal area, the construction contractor(s) will be required to confirm the locations of existing underground utilities and services prior to commencing construction work. This will include a revised and detailed Dial Before You Dig (DBYD) search. | Construction contractor | Pre-construction |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| Search for utilities and services | U4 | A services search within land not covered by the DBYD search will be carried out to identify the location of utility services. | Construction contractor | Pre-construction |
| **Waste and resource use** | | | | |
| Waste management plan | W1 | A waste management plan will be prepared as part of the CEMP. Construction waste will be managed through the waste hierarchy established under the *Waste Avoidance and Recovery Act 2001,* which comprises the following principles:<br>• Avoidance of waste: Minimising the amount of waste generated during construction by avoiding unnecessary resource consumption (e.g. avoiding the use of inefficient plant and construction equipment and avoiding materials with excess embodied energy, waste and excessive packaging)<br>• Resource recovery: Reusing, reprocessing and recycling waste products generated during construction to minimise the amount of waste requiring disposal<br>• Disposal: Where resources cannot be recovered, disposing of them appropriately to minimise the potential adverse environmental impact | Construction contractor | Pre-construction |
| Reuse/recycle materials | W2 | The materials removed as part of the demolition of the King Street Wharf wave baffle and the decommissioning of public transport elements of the King Street Ferry Wharf will be reused and/or recycled where feasible. Ways to reuse or recycle these materials will be investigated as part of detailed design. | TfNSW<br>Construction contractor | Detailed design<br>Construction |
| Off-site disposal | W3 | All waste requiring off-site disposal will be classified in accordance with *OEH's (2009) Waste Classification Guidelines* prior to disposal. | Construction contractor | Construction |
| Reducing energy use | W4 | Environmental management measures to reduce energy usage (and any associated greenhouse gas emissions) are discussed in Section 6.13.2. | Construction contractor | Construction |
| Operational Environmental Management Plan | W5 | Operational policies and procedures will be prepared by the operator of the Barangaroo Ferry Hub, which will outline how waste, energy and demand on resources will be managed during operation. | Ferry operator | Operation |

| Environmental Issue | ID | Environmental management measure | Responsibility | Timing |
|---|---|---|---|---|
| **Hazards and risks** | | | | |
| Site safety management | R1 | Site safety protocols, incident management and emergency procedures will be prepared prior to the commencement of construction works and implemented as required throughout construction. | Construction contractor | Pre-construction<br>Construction |
| Minimising hazards and risks | R2 | Activities with the potential to cause environmental, occupational and construction hazards and risks will be identified in the CEMP. Work practices which minimise such hazards and risks during work activities will be investigated and applied where reasonable and feasible to address the following issues:<br>• chemical spills and leaks<br>• surface water quality<br>• disposal of materials. | Construction contractor | Pre-construction<br>Construction |
| Hazards and risks awareness | R3 | Methods for management of hazards and risks will be incorporated into project inductions, training and pre-start talks | Construction contractor | Pre-construction and during construction as required |
| Storage of hazardous goods | R4 | • Chemicals and potentially hazardous substances will be used and stored according to regulatory requirements including the *Work Health and Safety Act 2011*<br>• Chemical, fuel and oil containers will be stored, transported and managed according to the Material Safety Data Sheet (MSDS) and manufacturers' directions. | Construction contractor | Construction |
| Operational safety policies | R5 | Sydney Ferries standard operational policies and procedures will be applied to the ongoing operation of the Barangaroo Ferry Hub in order to manage potential hazards and risks associated with spills (e.g. hydraulic fluid and/or fuel) from a ferry or pump-out waste entering the waters of Darling Harbour. | Ferry operator | Operations |

## 7.3 Environmental risk analysis

An environmental risk analysis was undertaken for the Barangaroo Ferry Hub proposal during the preparation of the EIS. The purpose of the environmental risk analysis was to:

- Identify potential environmental risks that are likely to be associated with the construction and operational phases of the Barangaroo Ferry Hub
- Evaluate the likelihood and consequence of each environmental risk without the implementation of any mitigation measures
- Identify appropriate mitigation measures that could reduce the likelihood and/or consequence of the identified environmental risk to an acceptable level
- Evaluate the likely effectiveness of the proposed mitigation measures (as documented in Section 7.2) to adequately manage the identified environmental risks of the proposal
- Identify the magnitude of environmental risks that would remain following the implementation of proposed mitigation measures (i.e. the residual environmental risks).

Secretary's environmental assessment requirements

| Key Issue | SEAR | Where Addressed |
|---|---|---|
| General requirements | Notwithstanding the key issues specified below, the EIS must include an environmental risk assessment to identify the potential environmental impacts associated with the development. | Section 7.3. |

### 7.3.1 Environmental risk analysis methodology

#### Risk identification

A comprehensive list of environmental risks was developed for the proposal, based on the following:

- A review of the design of the Barangaroo Ferry Hub
- Specialist studies prepared for the proposal as part of this EIS
- The sensitivity of the receiving environment in which the proposal is located
- The location of known environmental constraints (e.g. sensitive receivers).

The environmental risks that were identified for the proposal are provided in Table 7-6

#### Risk analysis and evaluation

The 'likelihood' and 'consequence' of each environmental risk was assessed and ranked using the criteria described in Table 7-2 and Table 7-3. These rankings were then used to rate each environmental risk (as either low, moderate, high or major) using the matrix presented in Table 7-4.

Likelihood is defined as the 'chance of something happening' (*AS/NZ ISO 31000:2009. Risk management – Principle and guidelines*). The selected rankings for likelihood (e.g. possible, likely to happen etc.) were determined by professional judgement, previous experience and evidence available from similar projects.

Consequence is defined as 'the outcome of an event affecting objectives ((*AS/NZ ISO 31000:2009. Risk management – Principle and guidelines*). Selection of the 'consequence' rankings for this assessment were based on the nature of the impact (e.g. duration, magnitude) and the likely outcomes on the receiving environment and/or sensitive receptor.

Table 7-2 Summary of likelihood criteria used in the environmental risk analysis

| Likelihood | Description of rating |
|---|---|
| Almost certain (AC) | is expected to almost always occur in similar construction or operation circumstances |
| Likely (L) | is likely to occur in similar construction or operation circumstances |
| Possible (P) | does not usually occur but could occur |
| Unlikely (U) | rarely occurs in the course of *normal* construction or operation circumstances |
| Remote (R) | Is very unlikely to occur, however could occur in *exceptional* construction or operation circumstances |

Table 7-3 Summary of consequence criteria used in the environmental risk analysis

| Consequence | Description of rating |
|---|---|
| Critical (C) | An event would have very significant long-term impacts on the environment, people, and/or infrastructure. The event is likely to involve a major breach of laws or regulations and require long-term remedial action. Media attention and regulatory intervention/action is likely to be triggered |
| Major (Maj) | An event would result in major but not long-term impacts on the environment, people, and/or infrastructure. Considerable remedial work is likely to be required and the event could involve a serious breach of laws or regulations. Media attention and regulatory intervention/action could result. |
| Moderate (Mod) | An event would result in short lived impacts to the environment, people, and/or infrastructure. It may involve a minor breach of laws or regulations and minor remedial action may be required. Media attention or regulatory action is unlikely but could result. |
| Minor (Min) | An event would result in a change from existing conditions within the proposal area, however this would be minor and within regulatory limits.<br>Incident reporting would be implemented according to industry standard policies and procedures |
| Insignificant (Insg) | An event would result in no considerable impact on the environment, people or infrastructure.<br>Incident reporting may not be required but could be implemented according to industry standard policies and procedures |

Table 7-4 Environmental risk rating matrix

| Likelihood \ Consequence | Insignificant | Minor | Moderate | Major | Critical |
|---|---|---|---|---|---|
| Almost certain | Moderate | Moderate | High | Major | Major |
| Likely | Low | Moderate | High | High | Major |
| Possible | Low | Moderate | Moderate | High | High |
| Unlikely | Low | Low | Moderate | Moderate | High |
| Remote | Low | Low | Low | Moderate | High |

An initial environmental risk rating (i.e. low, moderate, high or major) was assigned to each environmental risk, based on the 'likelihood' and 'consequence' of that risk occurring (refer to Table 7-4). The initial risk rating was used to reflect the severity of the impact that is likely to occur without the implementation of mitigation measures to reduce the impact. The environmental risk categories assigned to each issue are described in Table 7-5.

Table 7-5 Summary environmental risk categories used in the environmental risk analysis

| Risk category | Description of rating |
|---|---|
| Major (Maj) | Potential impacts would result in irreversible impacts on the environment, people, and/or infrastructure and would present a significant risk to the proposal.<br>Potential impacts would need to be specifically addressed during the detailed design and construction phases of the proposal. Specific mitigation measures and safeguards would need to be developed to address the risk, in consultation with relevant stakeholders |
| High | Potential impacts would result in long-term impacts on the environment, people and/or infrastructure outside of the proposal area and long-term remediation may be required.<br>Specific mitigation measures and safeguards would need to be developed to address the risk. Impacts would present a significant risk to the proposal. |
| Moderate (Mod) | Potential impacts would result in temporary and reversible impacts on the environment, people and/or infrastructure, and remediation may need to be undertaken. General mitigation measures would be required to be implemented to reduce the risk of the impact occurring. Impacts would not present a significant risk to the proposal. |

| Risk category | Description of rating |
|---|---|
| Low | Potential impacts would be minor in nature and could be adequately controlled through the design process and/or application of standard mitigation measures During the construction and/or operational phases of the project. Impacts would not present a significant risk to the proposal. |

An analysis was then undertaken for all environmental risks to consider what the potential residual impacts would be for each risk following the application of mitigation measures. This process included a qualitative analysis of potential mitigation measures, and their potential effectiveness, to determine the extent to which the proposed measures would reduce the risk of the potential impact. The conclusions from the environmental risk analysis process are summarised in Table 7-6.

### Environment risk analysis

Table 7-6 provides a comprehensive list of the environmental risks that were identified for the proposal during the environmental risk analysis. It also documents the initial risk rating (and associated likelihood and consequence rankings) that was assigned to each risk (i.e. the severity of the risk without mitigation measures), mitigation measures that would be implemented to reduce that risk, as well as the rating of the likely residual impact, following the implementation of adequate mitigation measures.

Table 7-6 Results of risk assessment

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| **Noise and Vibration** | | | | | | | | |
| 1.1 | Construction noise impacts during standard working hours exceeding noise level criteria for residential properties (Rating Background Level + 10dBA). | L | Mod | High | N1, N2 | L | Min | Mod |
| 1.2 | Construction noise impacts outside standard daytime working hours (Saturday 1pm to 6pm, Sunday and Public Holidays) exceeding noise level criteria for residential properties (Rating Background Level + 5dBA). | L | Mod | High | N1, N3, | L | Min | Mod |
| 1.3 | Construction noise impacts during evening and night-time exceeding noise level criteria for residential properties (Rating Background Level + 5dBA). | L | Mod | High | N1, N3, | L | Min | Mod |
| 1.4 | Sleep disturbance – maximum noise levels exceeding noise criteria where construction works are planning for more than two consecutive nights. | L | Mod | High | N1, N3, N4 | L | Min | Mod |
| 1.5 | Construction vibration activities causing ‘cosmetic damage’ (two to 20 metres) or ‘human discomfort’ (greater than 20 metres). | P | Mod | Mod | N1 | U | Min | Low |
| 1.6 | Construction vibration activities causing ‘minor structural damage’. | U | Mod | Mod | N1 | U | Min | Low |
| 1.7 | Operational noise impacts<br>• Scenario 1 – Year 2026 maximum peak ferry operations<br>• Scenario 2 – Year 2026 maximum off peak ferry operations<br>• Scenario 3 – Night time cleaning and maintenance operations | L | Mod | High | N13 | L | Min | Mod |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| **Traffic and Transport** | | | | | | | | |
| 2.1 | Increase in vehicle movements to and from construction site, including staff accessing the site and light and heavy vehicles transporting materials. | L | Min | Mod | T2 | L | Min | Mod |
| 2.2 | Increase water vessel movements to and from the construction site. | L | Min | Mod | T2, T4 | L | Min | Mod |
| 2.3 | Detours required for water vessels around water-borne construction machinery and equipment within the harbour. | L | Min | Mod | T2, T4 | P | Min | Mod |
| 2.4 | Impacts on water vessel access and movements during weekends and special/major events during construction (e.g. New Years Eve, Vivid and Australia Day). | L | Mod | High | T2, T4 | P | Min | Mod |
| 2.5 | Impacts on vessel access and movements to and from King Street Ferry Wharf during construction. | L | Mod | High | T2, T4 | P | Min | Mod |
| 2.6 | Impacts on available parking within and surrounding (e.g. Lime Street) the construction site as a result of vehicles and staff accessing the site. | L | Min | Mod | T1, T2 | U | Min | Low |
| 2.7 | Public access to the foreshore would be restricted during construction activities. | L | Min | Mod | T1, T2 | L | Insg | Low |
| 2.8 | Increased operation of vessel movements to and from the new wharf may impact on vessels accessing Darling Harbour. | L | Min | Mod | T5 | P | Min | Mod |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| 2.9 | Potential for congestion at the wharves, and in the adjacent waterways, as a result of extended ferry berthing times at the wharves during peak events, when ferries are out of schedule or as a result of impacts from commercial vessels. | P | Mod | Mod | T5, T6 | P | Insg | Low |
| 2.10 | Insufficient passenger waiting facilities/room and pedestrian access to the wharves and through the adjacent areas during major events. | P | Mod | Mod | T6 | P | Min | Mod |
| 2.11 | Impacts to traffic (road and water) and pedestrian movements throughout and around the proposal area as a result of cumulative construction works with the Barangaroo development. | P | Mod | Mod | T1, T2, T3, T4 | P | Min | Mod |
| **Ecology** | | | | | | | | |
| 3.1 | Sediments disturbed during removal and installation of piles may impact on aquatic and/or benthic habitats. | P | Mod | Mod | E1 | P | Insg | Low |
| 3.2 | Impacts on aquatic fauna on the seabeds during pile removal and installation. | P | Min | Mod | E1 | U | Min | Low |
| 3.3 | Spillages of liquids or solids during construction may impact marine biota. | P | Mod | Mod | E1, WQ4 | U | Mod | Mod |
| 3.4 | The removal of the King Street wharf baffle would remove hard substratum habitat (however new wharf structures would be installed). | AC | Min | Mod | E1 | AC | Insg | Mod |
| 3.5 | The proposed fixed gangways would shade portions of the caisson seawall which could limit or prevent growth of macroalgae. | L | Min | Mod | E1 | L | Insg | Low |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| 3.6 | Sediment disturbance as a result of ferry manoeuvring in and out of the berths. | P | Min | Mod | E1 | U | Min | Low |
| 3.7 | Spillages of liquids or solids during operation from ferries, the pump-out system and during maintenance may impact marine biota. | P | Min | Mod | E1, WQ7, R6 | U | Mod | Mod |
| **Visual amenity and urban character** | | | | | | | | |
| 4.1 | During construction there would be barge mounted cranes and equipment visible on the water within the construction site boundary. The on-water construction area would replace the view of open water. | L | Mod | High | V2 | L | Min | Mod |
| 4.2 | During construction there would be a construction work area and a temporary construction compound visible along the Harbour edge approximately 420 square metres in area. | L | Mod | High | V2, V3, V4 | L | Min | Mod |
| 4.3 | A new ferry wharf structure would be permanently erected and would be visible both from land and water viewpoints. In particular views from the promenade and restaurants at Kings Street Wharf and Barangaroo South would be considerably reduced due to the proposal. This impact is largely due to the reduced visibility or obstruction of the open water views of the harbour, and in the instance of the King Street Wharf, the close proximity of the view. | AC | Mod | High | V1 | AC | Min | Mod |
| 4.4 | Ferries arriving and departing, laying over and manoeuvring in the waters in and around the proposal would be visible from all viewpoints. | L | Min | Mod | V1 | L | Insg | Low |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| 4.5 | At night the Wharf facilities would be brightly lit to accommodate safe public use of the facility and ferries using the facilities would be lit. This would potentially impact the visual amenity of the proposal area. | L | Min | Mod | V3 | L | Insg | Low |
| 4.6 | Graffiti of structures would be visually unappealing during both construction and operation. | L | Min | Mod | V4 | P | Insg | Low |
| **Built and non-Indigenous Heritage** | | | | | | | | |
| 5.1 | Discovery of un-expected finds of heritage significance during construction activities. | P | Mod | Mod | H1, H2 | U | Min | Low |
| **Climate Change** | | | | | | | | |
| 6.1 | Deterioration of infrastructure and utilities over time as a result of increased storm surges, more frequent storms, wind speeds and/or increase in temperatures and extreme heat days. | L | Mod | High | CC1, CC2 | L | Min | Mod |
| 6.2 | Sea Level Rise causing temporary or permanent inundation of ferry wharf fixed infrastructure. | P | Maj | High | CC1 | P | Min | Mod |
| 6.3 | Disruption to ferry services and impacts on patronage as a result of extreme weather conditions | P | Mod | Mod | CC1 | P | Mod | Mod |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| **Air quality** | | | | | | | | |
| 7.1 | Dust generation during construction activities (e.g. movement of material and demolition of King Street Wharf wave baffle). | L | Min | Mod | AQ1, AQ2 | L | Insg | Low |
| 7.2 | Emissions of CO, NO2, SO2, PM10, volatile organic compounds and polycyclic aromatic hydrocarbons (PAH) compounds associated with the combustion of diesel fuel and petrol from construction vehicles, vessels, plant and equipment. | L | Min | Mod | AQ3 | L | Insg | Low |
| 7.3 | Increase ferry services (over time) would increase emissions of CO, NO2, SO2, PM10, volatile organic compounds and polycyclic aromatic hydrocarbons (PAH) compounds associated with the combustion of diesel fuel from the operation of ferry's. | L | Min | Mod | AQ4 | L | Insg | Low |
| 7.4 | Odour impact as a result of the pump-out facilities to be used during ferry layovers has been addressed by providing direct pump-out facilities to the recycled water plant within the Barangaroo precinct. | P | Min | Mod | AQ5 | U | Insg | Low |
| **Property and land use** | | | | | | | | |
| 8.1 | Pedestrian access along the Barangaroo foreshore would be reduced due to the location of the temporary construction compound. | L | Min | Mod | P1 | L | Insg | Low |
| 8.2 | The operation of the ferry services may impact public capacity during major events, such as queuing to board services. | P | Min | Mod | P1, P2 | P | Insg | Low |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| **Water quality and hydrology** | | | | | | | | |
| 9.1 | Disturbance of sediments (aquatic) during construction activities (such as piling) and via movement of vessels on the water. | L | Mod | High | WQ2 | P | Min | Mod |
| 9.2 | Spills of chemicals and other hazardous construction materials (such as hydraulic fluid or fuels) from the construction site or during transportation via water. | P | Mod | Mod | WQ3, WQ7 | U | Mod | Mod |
| 9.3 | Storm surges or flooding impacting the construction site. | P | Mod | Mod | WQ1, WQ2 | U | Min | Low |
| 9.4 | Marine sediment disturbance as a result of the manoeuvring of vessels during operation. | P | Min | Mod | T5 | U | Min | Low |
| 9.5 | Spills of chemicals and other hazardous materials during operation of the ferry's or sewage pump-out. | P | Mod | Mod | WQ10, WQ12, R6 | U | Min | Low |
| 9.6 | Water used in cleaning of the ferries and wharves running off into the Harbour. | P | Min | Mod | WQ10 | U | Min | Low |
| **Indigenous Heritage** | | | | | | | | |
| 10.1 | Discovery of previously unidentified objects/sites during construction activities. | U | Mod | Mod | IH1, IH2, IH3 | U | Min | Low |
| **Socio-economic** | | | | | | | | |
| 11.1 | Reduction in local amenity due to general construction activities. | L | Min | Mod | N1, T2, V2, SE1 | L | Insg | Low |
| 11.2 | Loss of open space along the Barangaroo foreshore promenade during construction. | L | Min | Mod | SE1, T3 | L | Insg | Low |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| 11.3 | Potential business impacts to commercial vessel operators at King Street Wharf during demolition of the existing King Street Wharf wave baffle. | P | Min | Mod | SE1, T2 | P | Min | Mod |
| **Soils, geology and contamination** | | | | | | | | |
| 12.1 | Disturbance of contaminated soils during excavations for utilities on land. | U | Min | Low | SC1, SC2 | U | Insg | Low |
| 12.2 | Disturbance of marine sediments during construction activities. | L | Min | Mod | SC1, SC2 | L | Insg | Low |
| 12.3 | Disturbance of marine sediments during operation as a result of ferries utilising the wharves. | P | Min | Mod | SC1, T5 | U | Min | Low |
| **Ecologically Sustainable Development** | | | | | | | | |
| 13.1 | Increased greenhouse gas emissions associated with the materials required to construct the wharves, the transport of materials to the site, and the fuel consumption of construction plant and equipment. | L | Min | Mod | SD1 | L | Insg | Low |
| 13.2 | Increase in greenhouse gas emissions associated with the ongoing electricity requirements for the new ferry wharves and additional ferry services operating. | L | Min | Mod | SD1 | L | Insg | Low |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| **Utilities and services** | | | | | | | | |
| 14.1 | Services and utilities may be impacted during construction as a result of scheduled stoppages during connections works or accidental damage during construction activities. | P | Mod | Mod | U1, U2, Q3, U4 | P | Insg | Low |
| 14.2 | Some construction machinery and the compound site will require the use of some utilities and services (such as water and electricity). | L | Min | Mod | SE1, U2 | L | Insg | Low |
| 14.3 | The operation of the Barangaroo Ferry Hub would require ongoing power supply to electrical equipment at the wharves. | L | Min | Mod | W5 | L | Insg | Low |
| 14.4 | Maintenance of the wharves and the ferries would require the use of some utilities and services (e.g. water and electricity). | L | Min | Mod | W5 | L | Insg | Low |
| 14.5 | The use of the pump-out for sewage would require the use/access to the local sewage system. | L | Min | Mod | W5 | L | Insg | Low |
| **Waste and resource use** | | | | | | | | |
| 15.1 | Generation of waste as a result of construction activities (e.g. building materials from demolition, excess building and packaging materials, waste from maintenance of machinery etc). | L | Min | Mod | W1, W2, W3 | L | Insg | Low |
| 15.2 | Generation of waste from construction staff and compound site activities (such as food, paper, food and beverage packaging etc). | L | Min | Mod | W1, W2, W3 | L | Insg | Low |
| 15.3 | Shortage of resources required for construction. | U | Min | Low | W1 | U | Min | Low |
| 15.4 | Generation of waste from cleaning and maintenance of ferries and the Barangaroo Ferry Hub. | L | Min | Mod | W1, W2, W3 | L | Insg | Low |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| 15.5 | Waste produced from the toilet facilities provided. The pump-out facilities provided at each wharf would require connection to the sewage system. | L | Min | Mod | W1, SE1, U2 | L | Insg | Low |
| 15.6 | Resources such as water, electricity and fuel would be required for the ongoing operation of the ferry service and the wharves. | L | Min | Mod | SE1, W5 | L | Insg | Low |
| **Hazards and risks** | | | | | | | | |
| 16.1 | Transportation (including via barges on the harbour), use and storage of hazardous materials on site. | L | Mod | High | R1, R2, R3, R5, R6 | P | Min | Mod |
| 16.2 | Maintenance and refuelling of barges and construction plant. | L | Mod | High | R1, R2, R3, | P | Min | Mod |
| 16.3 | Discovery of previously unidentified contaminated soils. | P | Min | Mod | SC1,SC2, R1 | U | Min | Low |
| 16.4 | Hazards to construction workers through general construction activities. | P | Maj | High | R1, R2, R3, R4 | U | Maj | Mod |
| 16.5 | Safety risks to passengers or staff through the operations of the ferry wharves. | P | Maj | High | R6 | U | Maj | Mod |
| 16.6 | Spills from a ferry or the pump-out facilities into Darling Harbour during operation. | P | Mod | Mod | WQ12, R6 | U | Min | Low |
| 16.7 | Damage caused to the ferry wharves infrastructure caused from ferry impact. | P | Mod | Mod | R6 | P | Insg | Low |

| Risk # | Description of Environmental Risk | Initial Risk Rankings | | | Mitigation Measure | Residual Risk Rankings | | |
|---|---|---|---|---|---|---|---|---|
| | | Likelihood | Consequence | Overall risk | | Likelihood | Consequence | Overall risk |
| **Cumulative Impacts** | | | | | | | | |
| 17.1 | Concurrent construction activities with the adjacent Barangaroo Development and Wynyard Walk impacting on local activities, including traffic management, pedestrian and local access and socio-economic impacts. | L | Mod | High | SE1 | L | Min | Mod |
| 17.2 | Overlapping of construction timetables for the proposal and ferry wharf upgrades. | P | Min | Mod | SE1 | U | Min | Low |

# 8 Strategic justification and conclusion

Chapter 8 provides overall justification of the proposal in relation to its performance relative to the proposal objectives; its anticipated key impacts, benefits and costs; the objectives of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act); the principles of ESD; and the public interest.

## 8.1 Proposal justification

### 8.1.1 Alignment between the proposal need, objectives and benefits

The need for the Barangaroo Ferry Hub is described in Chapter 3 of this EIS. In summary, the Barangaroo Ferry Hub would to a significant extent address the public transport challenges of the Barangaroo precinct as well as provide an overall improvement in Sydney's ferry transport capability and capacity. In particular, implementation of the proposal would provide:

- Improved quality of service to customers travelling by ferry to the Sydney CBD
- Reduced capacity constraints on nearby ferry terminals, including Circular Quay and King Street Ferry Wharf
- Improved transport access to the western and central parts of the CBD, through linkages with Wynyard rail and bus services (via Wynyard Walk), and facilitation of access to other modes such as light rail, walking and cycling
- Direct access to the Barangaroo precinct from ferry routes across Sydney
- Improved resilience of ferry services for special events or maintenance activities.

These outcomes are directly related to the objectives of the proposal, as described in Section 5.1. In turn, the objectives of the proposal are directly linked to its anticipated social, economic and environmental benefits, which consist of:

- Customer benefits – improved and more reliable journeys for public transport users
- Operating benefits – improvements in transport capacity and the resilience of ferry services for special events or maintenance activities
- Broader community benefits – through a reduction in environmental and public health externalities such as air pollution and noise
- Wider economic benefits – through opportunities for urban renewal projects along existing ferry routes.

### 8.1.2 Key biophysical, economic and social impacts of the proposal

There would be a number of impacts associated with the construction and operation of the Barangaroo Ferry Hub. These have been described in detail in the preceding chapters and include:

- Noise and vibration impacts associated with the construction and operation of the proposal

- Traffic and transport impacts, including disruptions to public space and pedestrian access on the foreshore between the proposal area and Barangaroo South during construction
- Potential aquatic habitat impacts including a loss of benthic fauna in direct location of piles for the proposal however overall there would be a net gain in aquatic habitat due to additional surfaces available for colonisation by attached and encrusting biota
- Some visual amenity and urban character impacts including reduced views of the harbour at the site and the reduction of open space along the Barangaroo promenade during construction of the proposal
- Temporary air quality impacts during construction of the proposal
- Minor impacts on navigation within Darling Harbour due to the increase in the number of ferry services during operation of the proposal
- Potential water quality impacts as a result of accidental spills of chemicals, fuels and/or other hazardous materials during construction of the proposal
- Socio-economic impacts, including noise, visual amenity and traffic and parking impacts during both construction and operation of the proposal
- Soil, geology and contamination impacts, including the disturbance of soil and sediment during both land and water based construction works
- Greenhouse gas emissions as a result of the construction of the proposal, however the increase of emissions would depend on the quantity of construction materials consumed and the types of construction plant and equipment used. Operation of the proposal would result in minor additional greenhouse gas emissions associated with the ongoing electricity requirements for the new ferry wharves however the provision of increased ferry services for commuters and weekend users would encourage greater use of public transport which may reduce private vehicle use which may result in a slight reduction overall in greenhouse gas emissions.

Details of the mitigation and management measures proposed to address the identified impacts are provided in Section 8.

### 8.1.3 Objectives of the EP&A Act

Table 8-1 identifies the objectives of the EP&A Act and summarises how the Barangaroo Ferry Hub proposal has responded to and/or meets the relevant objectives.

Table 8-1 The proposal's adherence with and/or response to EP&A Act objectives

| Objective | Barangaroo Ferry Hub adherence/response |
|---|---|
| To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns, villages for the purpose of promoting the social and economic welfare of the community and a better environment | The Barangaroo Ferry Hub proposal would to a significant extent address the public transport needs of the Barangaroo precinct as well as provide an overall improvement in Sydney's ferry transport capability and capacity, as discussed in Section 8.1.1. No significant impacts on natural resources are anticipated, as the proposal is located in an urban waterway. Social, environmental and economic impacts of the proposal have been assessed in detail in this EIS, and detailed mitigation and management measures are proposed to reduce potential impacts to negligible or acceptable levels. |
| To encourage the promotion and coordination of the orderly and economic use and development of land | The proposal assists in meeting the aims of a number of NSW Government strategic planning and transport policies and plans, and is expected to have several benefits as described above and in Chapter 3 of this EIS. The proposal is also located on government-owned land which would require agreements and easements to be established for services, access arrangement and maintenance. There is no need for the acquisition of private property. |
| To encourage the protection, provision and co-ordination of communication and utility services | The proposal does not require the protection and relocation of existing utilities, as described in Section 6.14 of this EIS. Consultation with utility providers and BDA/Lend Lease will be undertaken as required. Further investigations would be carried out during the detailed design phase to ensure that all appropriate measures are in place to minimise the potential risks to existing utilities and services prior to commencement of construction works. |
| To encourage the provision of land for public purposes | The Barangaroo Ferry Hub is proposed for a public purpose, and would significantly enhance the capacity and quality of Sydney's ferry transport capability and capacity, including routes from the Lower North Shore, Parramatta and inner harbour. |
| To encourage the provision and co-ordination of community services and facilities | Impacts of the proposal on community services and facilities are discussed in Chapter 6 of this EIS. The proposal is also expected to respond directly to customer needs linking with accessible connections to existing bus and rail transport modes, including Wynyard Walk. |
| To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats | The proposal would not result in the loss of habitat for threaten species (refer to Section 6.3). |

| Objective | Barangaroo Ferry Hub adherence/response |
|---|---|
| To encourage ecologically sustainable development (ESD) | Section 6.13 of this EIS provides an outline of the manner in which sustainability considerations have been taken into account through the design development of the proposal and actions to be taken forward into detailed design and construction phases. Furthermore, the principles of ESD have been considered and implemented as part of the proposal, as described in Section 6.13. |
| To encourage the provision and maintenance of affordable housing | Chapter 8 of this EIS identifies that the Barangaroo Ferry Hub may indirectly contribute to encouraging the provision and maintenance of affordable housing by providing improved access to/from areas identified for housing development as part of the NSW Government's Draft Metropolitan Strategy for Sydney (e.g. residential growth expected along the Parramatta River through urban renewal projects). |
| To promote the sharing of responsibility for environmental planning between different levels of government in the State | The Barangaroo Ferry Hub proposal development and assessment has included consultation with key government stakeholders. Key stakeholders includes both NSW Government and local government stakeholders, as described in Chapter 5 of this EIS |
| To provide increased opportunity for public involvement and participation in environmental planning and assessment | The EIS has incorporated feedback from the community and other key stakeholders on issues of concern relating to the proposal. Details are described in Chapter 5 of this EIS.<br>The community will also be encouraged to respond during exhibition of the EIS, and (subject to planning approval) would continue to be engaged in the proposal throughout the detailed design and construction phases |

### 8.1.4 Principles of ESD

ESD is development that promotes ecologically sustainable development through the conservation and ecologically sustainable use of natural resources. As described in Section 6.13, the principles of ESD have been an integral consideration for the Barangaroo Ferry Hub proposal throughout its development. This includes the integration of the four principles of ESD throughout the proposal design and assessment processes.

Details of how the principles of ESD have been incorporated into the proposal are provided in Table 6-34.

### 8.1.5 The public interest

The 'public interest' is generally defined as 'community wellbeing' or 'general welfare of the public'. The Barangaroo Ferry Hub proposal is considered to be in the public interest in relation to the following aspects:

- The anticipated transport, social and economic benefits for users of the Barangaroo Ferry Hub, the broader community and the wider economy – as described in Section 6.11

- The adverse implications of not proceeding with the proposal – as described in Section 3.3
- The fact that the proposal would assist in meeting the aims of a number of NSW Government strategic planning and transport policies and plans – as described above and in Chapter 3.

Although the Barangaroo Ferry Hub proposal has the potential for environmental impacts associated with the construction and operation of the proposal (as described in Chapter 6 of this EIS), overall, the benefits of the proposal are considered to outweigh these impacts. Furthermore, detailed management and mitigation measures are proposed to ensure the impacts are acceptable or able to be controlled to acceptable levels by appropriate management.

## 8.2 Conclusion

This EIS has been prepared in accordance with Part 5.1 of the EP&A Act and other relevant legislation. In particular, it addresses the Secretary of the Department of Planning and Environment's environmental assessment requirements. The EIS also includes consideration of issues raised by the community and stakeholders during development of the proposal and preparation of the EIS.

There is strong justification for the Barangaroo proposal, as summarised in Section 8.1 and supported by the objectives of the EP&A Act.

The approach for mitigation and management of the potential adverse impacts of the proposal is outlined in Chapter 7 of the EIS. These measures would be incorporated into the CEMP and any relevant environmental management sub-plans to be developed prior to the construction of the proposal and subsequently (as required), into the future operator's environmental management system.

Provided the measures and commitments specified in this EIS are applied and effectively implemented during the design, construction and operational phases of the proposal, the identified potential environmental impacts are considered to be acceptable or able to be controlled to acceptable levels by appropriate management of construction works and ferry operations.

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