RAPT CONSULTING

NGH Environmental

Air Assessment – Maritime Heritage Precinct – Marina, November 2018.

Contents

1. Introduction

1.1 Background

RAPT Consulting has been engaged to undertake a qualitative air assessment for NGH Environmental as part of a Review of Environmental Factors (REF) for the proposed Maritime Heritage Precinct (MHP) - Marina in Pyrmont Bay.

1.2 Proposal Description

Roads and Maritime Services (Roads and Maritime) proposes to construct a marina consisting of two new wharves, pontoons and a small vessel marina next to the Australian National Maritime Museum (ANMM) (the 'Proposal') in Pyrmont Bay. The marina would accommodate a variety of vessels, including the operational vessels of the Sydney Heritage Fleet, together with the SS South Steyne and other visiting vessels.

Key features of the proposal would include:

- Construction of two high capacity wharves including:
    - North Wharf – about 135 metres long by 10 metres wide with a 2,000 tonne capacity
    - South Wharf – about 149 metres long by 10 metres wide with a 6,000 tonne capacity
- Construction of a pontoon next to Wharf 7, referred to as the Wharf 7 Pontoon
- Construction of a Small Vessel Marina between the North Wharf and the South Wharf for smaller vessels
- Decommissioning and pile removal of the existing Pyrmont Bay Ferry Pontoon including demolition and removal of the existing ferry wharf concrete approach deck and gangway and removal of the ferry bumper guard and associated piles
- Construction of a new Pyrmont Bay Ferry Pontoon located at the end of the new North Wharf, this may include:
    - Temporary use of the Casino Wharf for existing ferry operations during construction; or
    - Staging the construction of the South Wharf and North Wharf.. This would include temporary use of the Casino Wharf while the existing Pyrmont ferry pontoon is relocated after the North Wharf has been completed.
- Partial demolition and reconstruction of sections of the southern boardwalk and removal of timber piles for the construction of the North Wharf and South Wharf
- Construction of steps down to the water near the boardwalk
- Installation of fenders

- Installation of wharf furniture including lighting, gates, seating, shade structure, bins and signage
- Construction of an electrical kiosk in Pyrmont Bay Park connecting to the Proposal
- Connection of other services from land to the Proposal including water, fire, communications, compressed air, security and sewer
- Provision for future installation of an oily water separator
- Transport for NSW would continue to operate the Pyrmont Bay Ferry Pontoon.
- Relocation and permanent berthing of the operational vessels of the Sydney Heritage Fleet (SHF) in accordance with the Bays Precinct Strategy
- Berthing of a variety of vessels including the SS South Steyne and other visiting vessels

Transport for NSW would continue to operate the Pyrmont Bay Ferry Pontoon.

The Proposal has been designed with collaboration between Roads and Maritime and the ANMM. It is intended that ANMM would lease the marina from Roads and Maritime for the establishment of a Maritime Heritage Precinct (MHP) including:

- Opening of the SHF and visiting vessels to the public, including associated public programs (including interpretation and guided tours) which by combination with the ANMM's national collection, would create the largest fleet of heritage vessels in the southern hemisphere
- Establishing ANMM operations (ticketed visitation to the vessels and other public programs, events and festivals)
- Operation of the SS South Steyne as a multi-use function centre including functions and events with live music, food and beverage and museum purposes (weddings, education, exhibitions, lectures and events)

Consent for ANMM to the operate the marina as a MHP, including museum operations by the ANMM and SHF, opening of the vessels to the public and the use of the SS South Steyne for functions would be subject to a separate approval process and is not the subject of this assessment.

The Proposal is located on the western side of Pyrmont Bay within the suburb of Pyrmont. Pyrmont is within the Sydney Local Government Area (LGA) on the southern side of Sydney Harbour with Sydney's central business district to the east.

The surrounding area is predominately comprised of commercial uses to the west and south with residential apartments located above ground floor, and commercial uses on the south western corner of Pirrama Road and Murray Street. North and north-west of the site are Sydney Wharf Apartments, Maritime Heritage Centre and a recreational park. Darling Harbour, one of Sydney's major maritime, entertainment and tourist hubs is located to the east and south. Tourist accommodation is located further east and south on the fringe of Sydney's central business district.

1.3 Major Design Features

North Wharf and South Wharf

The North Wharf would be constructed to berth about four maritime heritage vessels. This may include vessels such as the Carpentaria, SS South Steyne, John Oxley and the Waratah.

The North Wharf would be a high capacity wharf with a deck constructed to 2.4 metres AHD. It would be about 135 metres long by 10 metres wide with a 2,000 tonne capacity. The North Wharf would include about 19 rows including two piles each (a total of about 38 piles), 18 reinforced concrete headstocks and a reinforced concrete deck (poured in-situ and pre-cast concrete). The relocated Pyrmont Bay Ferry Pontoon would also be located off the end of the North Wharf. The North Wharf would also include a floating pontoon and gangway for access to maritime heritage vessels such as the Waratah. The floating pontoon would be about 10 metres long by three metres wide and be attached to steel piles. The floating pontoon would not extend beyond the line of the North Wharf.

The South Wharf would be constructed to berth one maritime heritage vessel and a visiting vessel up to about 6,000 tonnes. This may include vessels such as the James Craig (maritime heritage vessel) and the RV Investigator (visiting vessel).

The South Wharf would be a high capacity wharf with a deck constructed to 2.4 metres AHD. It would be about 149 metres long by 10 metres wide. The South Wharf would include about 19 rows including two piles each (a total of about 42 piles), 18 reinforced concrete headstocks and a reinforced concrete deck (poured in-situ and pre-cast concrete).

Wharf 7 Pontoon

The Wharf 7 Pontoon would be constructed next to Wharf 7 and berth about two maritime heritage vessels that may include the Boomerang and Lady Hopetown. The Wharf 7 pontoon would be a floating pontoon measuring about 40 metres by four metres and attached to steel piles. A gangway would attach the Wharf 7 Pontoon to anew Wharf 7 landing.

Small Vessel Marina

The Small Vessel Marina would be constructed between the North Wharf and the South Wharf for about five smaller maritime heritage vessels that may include the Kookaburra II, Protex, Berrima, Harman and Currawong. The Small Vessel Marina would be a floating pontoon with four perpendicular pontoon fingers and a gangway. The Small Vessel Marina would be attached to about 11 steel piles.

Relocated Pyrmont Bay Ferry Pontoon

The Pyrmont Bay Ferry Pontoon would be relocated at the end of the new North Wharf. If practicable the existing floating Pyrmont Bay Ferry Pontoon would be reused. The Pyrmont Bay Ferry Pontoon measures about 20 metres by nine metres and may require up to eight steel piles. A gangway would attach the Pyrmont Bay Ferry Pontoon to the North Wharf. If practicable, the current gangway for the Pyrmont Bay Ferry Pontoon would be reused.

Southern Boardwalk

Works to the Southern Boardwalk would include partial demolition and reconstruction of sections of the southern boardwalk and Lot 20 boardwalk and removal of timber piles for the construction of the North Wharf and South Wharf. The height of the new Southern Boardwalk

would be raised to tie-in with the existing boardwalk. The boardwalk would be reconstructed with Fibre Reinforced Polymer (FRP) girders and FRP decking and concrete and/or stainless steel supports.

Steps down to the water would be constructed from the southern boardwalk from FRP and measure about 20 metres by five metres and attach to about four steel piles.

Figures 1 and 2 show the proposed MHP below.

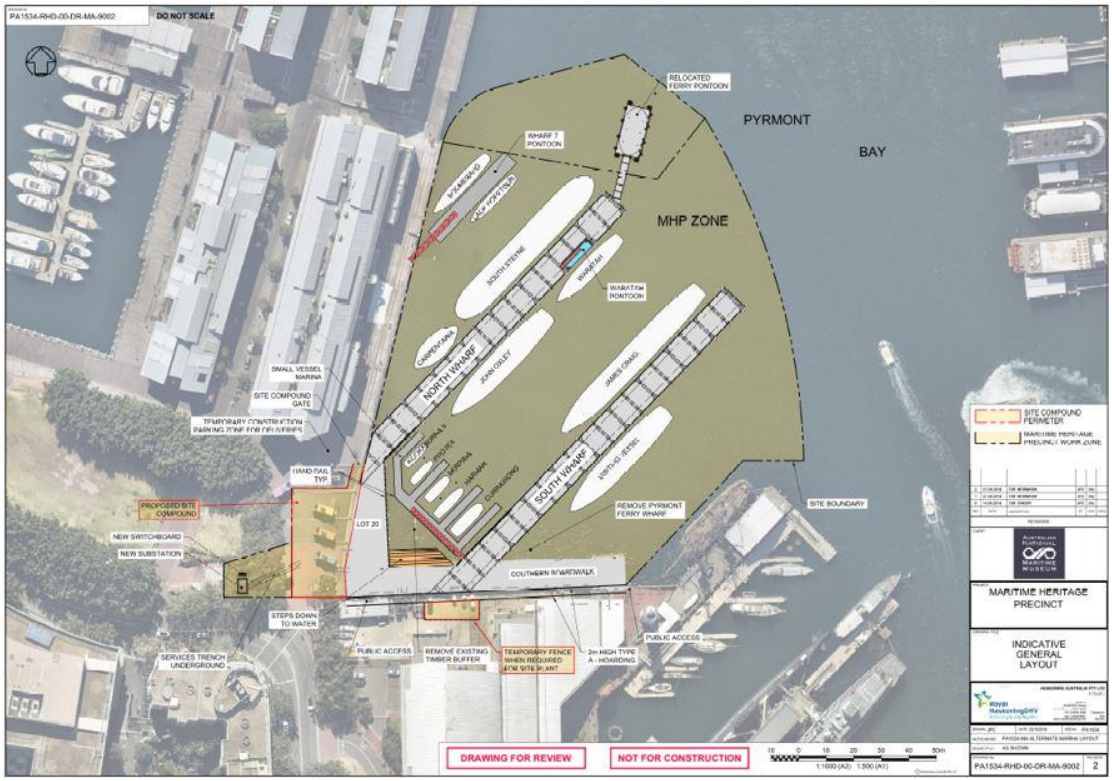

Figure 1 Proposed MHP in Brown

Figure 2 View of Proposed MHP from North-East

1.4 Limitations

The purpose of this report is to provide an independent air assessment for the proposed Maritime Heritage Precinct (MHP) in Darling Harbour.

It is not the intention of the assessment to cover every element of the ambient environment, but rather to conduct the assessment with consideration to the prescribed work scope.

The findings of the air assessment represent the findings apparent at the date and time of the assessment undertaken. It is the nature of environmental assessments that all variations in environmental conditions cannot be assessed and all uncertainty concerning the conditions of the ambient environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

In conducting this assessment and preparing the report, current guidelines for air were referred to. This work has been conducted in good faith with RAPT Consulting's understanding of the client's brief and the generally accepted consulting practice.

No other warranty, expressed or implied, is made as to the information and professional advice included in this report. It is not intended for other parties or other uses.

2. Construction

This section provides a summary of the likely methodology, staging, work hours, plant and equipment that would be used to complete the proposed work. For the purposes of the REF, indicative construction staging, and options are provided. Detailed methods and staging would be established by the construction contractor.

2.1 Work Stages

In order to minimise the impact on Pyrmont Bay Ferry customers, the proposal would be staged following one of the below options:

Option 1 – Construction of the North Wharf and South Wharf would be undertaken simultaneously with the temporary relocation of the Pyrmont Bay Ferry Pontoon.

- Temporary relocation of the Pyrmont Bay Ferry Pontoon to the Casino Ferry Wharf for operation of ferry services during construction period
- Demolition and removal of existing Pyrmont Bay Ferry Pontoon
- Construction of the Proposal and installation of the Pyrmont Bay Ferry Pontoon at the end of the North Wharf
- Recommence Pyrmont Bay Ferry Pontoon services from the relocated Pyrmont Bay Ferry Pontoon

Option 2 – Construction of the North Wharf and South Wharf to minimise the closure of the Pyrmont Bay Ferry service

- Continue use of the existing Pyrmont Bay Ferry Pontoon from its current location during construction of the North Wharf
- Following completion of the North Wharf:
    - Temporarily use the Casino Ferry Wharf during relocation of the Pyrmont Bay Ferry Pontoon from its current location to the North Wharf
    - Relocate the Pyrmont Bay Ferry Pontoon to the end of the North Wharf and recommence Pyrmont Bay Ferry Pontoon services
- Following relocation of the Pyrmont Bay Ferry Pontoon, demolish the existing Pyrmont Bay Ferry Pontoon and construct the South Wharf.

2.2 Work Methodology

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

Establishment of Site Compound

Ancillary facilities would be established for use during construction of the Proposal.

Traffic control measures (including for vehicles, watercraft, pedestrians and cyclists) would be established in accordance with the traffic management plan (TMP). Appropriate way finding signage would be installed advising of alternative routes.

Environmental controls would be established in accordance with the construction environmental management plan (CEMP) for the Proposal.

Construction site entry and exit points from the water and land would be established.

Establishment of a waterside construction work area would be undertaken using floating booms and buoys to delineate the area. This would be a physical boundary which marine vessels would not be permitted to cross for safety reasons. The anticipated dimensions of the work barge(s) are about 10 metres (beam) by 20 metres (length).

Temporary construction zone, potential materials staging area and potential works zone

Two locations for temporary construction areas on land have been identified. These locations are the Wharf 7 forecourt and a small area next to the southern boardwalk and would include:

- A construction zone for utilities augmentation including a site compound
- A works zone for loading and unloading materials
- A small materials storage area
- The parking of plant and vehicles

The construction zone for utilities augmentation including a site compound would be used for two, two-week periods during utilities augmentation.

The works zone would be used for loading and unloading materials and equipment required for the construction of the landside works. The duration of occupation of the works zone would be from twelve to eighteen months.

The materials staging area would be used for the delivery and storage of materials for construction and during utilities augmentation and may be used for a period of up to twelve months during standard construction hours.

Equipment used within the works zone and materials staging area would include a crane and trucks delivering material.

Removal of existing structures

The concrete structure connecting the boardwalk with the Pyrmont Bay Ferry Pontoon would be demolished and all associated piles would be removed. All piles would be removed completely from the seabed unless it is demonstrated that by applying a vertical upwards load of 50 tonnes per pile, that the pile cannot be removed. In this situation consideration would be given to leaving such a pile in place and cutting the pile 500 millimetres below the seabed level. This would be undertaken by a diver and include hand removal of sediment and using underwater cutting tools.

All existing services associated with the ferry terminal would be terminated at the boardwalk and made safe. Ferry users would be redirected to the new temporary location of the ferry service (either Casino Wharf or the end of the new North Wharf). The ferry bumper guard and all associated piles would be removed.

Sections of the timber boardwalk on the northern and western faces would be demolished, so that the wharf deck, capable of supporting trucks and mobile cranes, can move from the Museum forecourt onto the South Wharf. The work includes reconstruction of the boardwalk and connecting it to the new concrete wharf deck.

Connection of services of the Proposal to the services on land

Power, water, firefighting (water), sewage, telecommunications and compressed air services would be required for the Proposal. These services would require connection to the services on the landside.

Installation of steel piles within the Waterway

The North Wharf, South Wharf, Pyrmont Bay Ferry Pontoon, Small Vessel Marina and Wharf 7 Pontoon would require about 110 steel tube piles. The piles would be transported by barge to the site from an off-site facility. Each pile would be lifted from the barge and put into place using a barge-mounted crane. A drill rig mounted onto a barge would attach to the pile using a helmet fitting. It is anticipated that installation of steel piles would be preferably undertaken at night and early morning to benefit from still water conditions that would enable safer working conditions and improved accuracy of piling from the floating barge that can remain still. Pyrmont Bay is usually calmer in the early morning with wind and wind chop increasing throughout the day.

Constructing piles founded in bedrock consists of three phases:

Phase 1: Piles would be screwed 500mm into stable rock during night time. This method has been proven at numerous locations around Sydney Harbour, and is expected to generate minimal noise and can be carried out during night time conditions of calm water (for safety reasons) with minimal impact.

Phase 2: The piles would be hammered (using a 30 tonne weight) to final set level, at least one day after screwing to depth and during conditions of calm water generally between 5am to 7am. It is anticipated that each pile would be hammered for one minute (approximately 10 hits with the hammer within one minute). For each pile this activity is likely to occur about five times over a period of around one hour. There are about 110 piles to be hammered.

Phase 3: The steel piles would be cut and a protective high density polyethylene sleeve (hdpe) would be slid over the pile and into the seabed for pile protection.

The duration of installing steel piles is expected to be about five months.

Construction of North Wharf and South Wharf

Following installation of steel piles, it is likely that concrete headstocks would preferably be lifted into place at night, again for reasons of site safety and to benefit from still water conditions. Precast concrete panels would also be lifted into place using a barge mounted crane during night works. In situ topping slabs would be formed and poured using a concrete pump from concrete agitators on land or barges. This would be undertaken during extended standard construction hours

Pre-cast non-mountable vehicle kerbs would be constructed with 30 tonne bollards every 15 to 20 metres, as well as pneumatic fenders on all berth faces.

Construction of the deck and steps to the water

Following the installation of support piles, the deck and steps would be constructed with concrete or stainless steel frames with FRP girders and FRP decking. A barge or land-based crane would be used for any heavy lifts. This work would be undertaken during extended standard construction hours.

Construction of pontoons and ramp

The Small Vessel Marina and Wharf 7 pontoons would be built off site then towed to site in calm conditions. The piles would have been already installed and the pontoons would be attached to the piles using pile guides. On completion of the pontoons the power and water services would be installed and the attachments (services bollards, mooring cleats, hose reels, ladders and fendering) installed. This would be undertaken during extended standard construction hours.

Site clean-up

- The site would be cleaned up and restored to its previous state
- Controls and temporary structures would be removed
- A safety assessment of the structure would be carried out to identify any risks and rectify any safety hazards resulting from construction before opening these areas to the public
- All construction fencing/hoarding and signage would be removed.

2.3 Construction Hours and Duration

The proposal would be constructed over a period of twelve to eighteen months (weather permitting), subject to the REF approval and other planning approvals.

The standard work times would include:

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

However, Roads and Maritime propose to have extended standard construction hours as follows to reduce the overall construction duration and to provide contingency should the duration of piling be affected by weather and difficult ground conditions:

- 7am to 7pm Monday to Friday
- 7am to 5pm Saturday

Extended construction hours would apply for the duration of construction.

Out Of Hours Work (OOHW) would be required to carry out piling activities and intricate lifts from the barge mounted crane for reasons of site safety and to benefit from still water

conditions. If OOHW is required, an OOHW Procedure would be developed by the construction contractor and would include notification and ongoing consultation to nearby impacted residents.

Piling

Screwing of steel piles is expected to be undertaken at night (OOHW) when water is calm and still. Screw piling is expected to commence around 11pm and continue to about 7am. Hammering of piles following screwing would be undertaken at least one day after screwing to depth and during conditions of calm water generally between 5am to 7am.

Piling would take about five months and be carried out five nights per week, from Sunday to Thursday.

Intricate lifting activities

Intricate lifting activities are expected to be undertaken at night to benefit from calm and still water conditions. Intricate lifting activities would take about six months and be carried out five nights per week, concurrently with the screw piling.

The number of these lifts depends on the construction techniques adopted by the contractor. Intricate lifts would be for the installation of headstocks on piles and the installation of precast concrete planks.

Intricate lifting and placement of components would be carried out using a barge mounted crane. Intricate lifting and placement would be carried out during the night (OOHW) and is expected to commence around 11pm and continue to about 7am.

2.4 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:

- Generators
- Lighting towers
- Power hand tools
- Light vehicles
- Boats
- Barges
- Drill rigs (barge mounted)
- Cranes (barge mounted)
- Water pumps
- Chainsaws
- Concrete trucks
- Hammer drills
- Concrete boom pump
- Hand tools

- Excavator
- Crane
- Delivery trucks

Plant and equipment for OOHW includes:

- Generators
- Welder/s
- Lighting towers
- Boats
- Barges
- Drill rigs (barge mounted)
- Cranes (barge mounted)
- Hand tools

2.5 Potential Air Emission Sources

Potential pollutants during construction would include dust and combustion products including:

- Total suspended particulates (TSP).
- Particulate matter equal to or less than 10 microns in diameter (PM_{10}).
- Particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$).
- Oxides of Nitrogen (NOx).
- Carbon Monoxide (CO).
- Sulphur Dioxide (SO_2).

Air emissions during construction including:

- Dust emissions from any potential excavation activities; and
- Combustion emissions from mobile equipment, construction vehicles, plant, equipment and vessels.

3. Operation

Berthing of vessels

A variety of vessels would be berthed, permanently or temporarily, at the marina. It is intended that the operational vessels of the Sydney Heritage Fleet together with the State heritage listed SS South Steyne would be permanently berthed at the marina. Other vessels may visit from time to time, for maritime festivals and would be berthed on a short term basis.

Vessels berthed at the marina may include coal and steam powered vessels.

ANMM purposes

Roads and Maritime is aware that the ANMM and the SHF would propose to use the marina for museum purposes. This use would identify the Maritime Heritage Precinct as a community facility. A community facility is defined by the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (SREP) as:

'a building or place that provides for the physical, social, cultural, religious or intellectual development or welfare of the community'.

The museum would operate ticketed visitation to the SHF vessels and the SS South Steyne for public programs, events and festivals.

To use the marina for museum purposes, the ANMM would be required to seek separate planning consent as the Proponent for 'a community facility' in accordance with the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (SREP).

Other purposes

The SS South Steyne may be used as a function centre, in addition to museum purposes as described above. A function centre is defined by the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (SREP) as:

'a building or place used for the holding of events, functions, conferences and the like, and includes convention centres, exhibition centres and reception centres, but does not include an entertainment facility'.

Functions and events on the SS South Steyne may include activities such as live music, food and beverage, weddings, education, exhibitions, lectures and events.

To operate vessels as a function centre at the Maritime Heritage Precinct, the vessel owner would be required to seek separate planning consent as the Proponent for 'a function centre' in accordance with the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (SREP).

Table 3 shows the vessels and their operating profiles.

Name	Operating Profile	Fuel Type
James Craig	Sails once a fortnight departing in at 1000, returning at 1600. Also, periodic cruises on the harbour or at sea. (Subject to a separate approval), open to the	Diesel

Name	Operating Profile	Fuel Type
	public during museum opening hours when berthed at the MHP.	
Waratah	In steam every second weekend Friday to Sunday cruises from the precinct. Also available for public bookings for tours, cruises and periodic charters. (Subject to a separate approval), open to public during museum opening hours as a museum display for escorted small group tours.	Steam / Coal
John Oxley	On display alongside (at present). (Subject to a separate approval), open to the public during museum opening hours as a museum display.	Steam / Diesel
SS South Steyne	Static display and (subject to a separate approval) operating as a multi-use facility including food and beverage and museum purposes (education, exhibitions, lectures, events)	Steam / Static non-operational
Lady Hopetoun	In steam every second weekend Friday to Sunday cruises from the precinct. Also available for public bookings for tours, cruises and periodic charters. (Subject to a separate approval), open to public during museum opening hours as a museum display for escorted small group tours.	Steam / Coal
Boomerang	Periodic SHF member/sponsor cruises. Also available for public bookings for tours, cruises and periodic charters. (Subject to a separate approval), open to public during museum opening hours as a museum display for escorted small group tours.	Diesel
Visiting vessels	Except for major events, about four vessels a year come and go. (Subject to a separate approval), open to the public during museum opening hours when berthed at the MHP.	Diesel
Small craft	One or two vessels operating daily on harbour cruises.	Diesel
Harbour City Ferries (HCF)	About 40 HCF movements would leave from the relocated Pyrmont Bay Ferry Pontoon per day.	Diesel
Manly Fast Ferry (MFF)	About 12 MFF movements would leave from the relocated Pyrmont Bay Ferry Pontoon per day.	Diesel

Table 1 MHP Vessels and Operating Profiles

3.1 Potential Air Emission Sources

Potential pollutants during operation of the marina would include dust and combustion products including:

- Total suspended particulates (TSP).
- Particulate matter equal to or less than 10 microns in diameter (PM_{10}).
- Particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$).
- Oxides of Nitrogen (NOx).
- Carbon Monoxide (CO).
- Sulphur Dioxide (SO_2).

Air emissions during operational activities include combustion from vessel operations including steam and coal combustion from heritage vessels. No odours are expected from the vessels moored at the proposed MHP and any potential odour sources from installation of sewerage system pipes are expected to be negligible as it would be a fully enclosed system.

4. Air Assessment Criteria

4.1 Air Quality Criteria

Table 4 summarises the NSW EPA's environmental impact assessment criteria for the pollutants included in this assessment.

Pollutant	Averaging Period	Criteria
Total Suspended Particulates (TSP)	Annual Average	90 ug/m^3
Particulate Matter (PM_{10})	Maximum 24-hour average	50 ug/m^3
	Annual Average	25 ug/m^3
Particulate Matter ($PM_{2.5}$)	Maximum 24-hour	25 ug/m^3
	Annual Average	8 ug/m^3
Carbon Monoxide (CO)	Maximum 1-hour average	30 mg/m^3
	Maximum 8-hour average	10 mg/m^3
Sulphur Dioxide (SO_2)	Maximum 1-hour average	570 ug/m^3
	Maximum 24-hour average	228 ug/m^3
	Annual Average	60 ug/m^3
Nitrogen Dioxide (NO_2)	Maximum 1-hour average	246 ug/m^3
	Annual Average	62 ug/m^3

Table 2 NSW EPA Air Quality Criteria (EPA 2017)

4.2 Potential Environmental and Health Issues

Particulate Matter (PM_{10} and $PM_{2.5}$)

The relationship between particle mass (as PM_{10} and $PM_{2.5}$) and health outcomes such as decreased lung function, increased respiratory symptoms, increased chronic obstructive pulmonary disease, increased cardiovascular and cardiopulmonary disease, and increased mortality is well established. However, health effects are difficult to quantify given the wide range of metrics associated with particulate matter. Particles can span 4 orders of magnitude in size between 1 nm to 10s of mm. Particles can be present in vast numbers; surface areas; be different shapes (such as spherical, angular); be wholly liquid based or feature some crystalline elements; and span a wide range of chemical complexity, according to source regions and transport.

Amenity impacts from dust are usually associated with coarse particles and particles larger than PM10. The impact of dust from a nearby industry on local amenity depends on the distance from the site and climatic conditions such as wind speed and direction. Concern about amenity from dust often relate to “visibility” of dust plumes and dust sources. Visible dust is usually due to short-term episodes of high emissions from material handling, exposed surfaces or dry and windy atmospheric conditions.

Particulate matter also can cause significant environmental problems including reduced visibility and the pollution of air and water. This pollution can result in the acidification of nearby water bodies; changes in nutrient concentrations in coastal waters and large river basins; the depletion of nutrients in soil and can affect the diversity of ecosystems.

Particle pollution can also cause aesthetic damage, staining and damaging stone and other building materials, spoiling property and other belongings.

Dust can become airborne during construction, demolition or when soil and building materials such as aggregates are exposed or left uncovered. Wind then picks up dust particles and carries it off-site. Depending on the size these dust particles can be transported over great distances.

Carbon Monoxide

Carbon monoxide can enter the body by inhalation and be rapidly absorbed by the bloodstream from the lungs. Typical levels in urban and rural settings are unlikely to cause adverse effects, however exposure to extremely high levels of CO can have many adverse consequences including death. Environmental impacts through atmospheric chemical reactions, can affect the amount of other greenhouse gases, which are linked to climate change.

Sulphur Dioxide

SO_2 is a common pollutant to which we are exposed at very low levels regularly by breathing air in cities and some industrial environments. When exposed to elevated levels health effects can include headache, general discomfort and anxiety. Sulphur dioxide in the atmosphere is absorbed by soils and plants. It is also captured within and below clouds and in certain circumstances may raise the acidity of rain.

Nitrogen Dioxide

People living in areas of high motor vehicle usage may be exposed to higher levels of nitrogen oxides. Acute exposure to low levels of NO_2 can irritate eyes, nose, throat and lungs, possibly leading to coughing, shortness of breath, tiredness and nausea. Excessive levels can increase the acidity of rain and consequently lower the pH of surface and ground waters and soil.

Odour

People living in highly urban areas may be occasionally be exposed to a variety of odours from time to time from many sources including natural and generated from human activity. Odour is often a subjective circumstance where some people find certain odours offensive while others might not. Additionally, the strength of the odour and perceptibility to humans can vary by individual.

5. Existing Environment

Meteorology

The ambient air environment surrounding the Proposal site is complex and influenced by a variety of traffic, industrial and commercial uses which is consistent with a highly urbanised area. The area surrounding the site is predominantly commercial (including retail stores, restaurants, cafes and hotels) which generate a variety of point and fugitive emissions. Vehicular activity in the area additionally contributes emissions. There are also residential buildings in the vicinity of the site to the north-west and residences further east of the site across Darling Harbour. Figure 3 shows an aerial image of the local area and surrounding land uses.

Figure 3 Site and Surrounding Land Uses

Meteorology in the area surrounding the MHP is affected by several factors such as terrain and land use. Wind speed and direction are largely affected by topography at the local scale,

while factors such as synoptic scale winds affect wind speed and direction on the larger scale. Wind speed and direction are important variables in assessing potential air quality impacts, as they determine the direction and distance air pollutants travel.

Long-term meteorological data for the surrounding area is available from the Bureau of Meteorology (BoM) operated Automatic Weather Stations (AWS) at Observatory Hill and Fort Denison. The Observatory Hill AWS is located approximately 1,300 metres north of the site and records observations for a variety of meteorological data including temperature, humidity and rainfall. There is no anemometer at Observatory Hill, and therefore; observations of wind speed and direction are taken from the Fort Denison AWS, located approximately 3 kilometres north east of the site.

Windrose plots showing the distribution of wind speed and direction at the Fort Denison BoM AWS from 2013 to 2015 are shown in Figures 4 and 5. It should be noted that the area surrounding the Proposal is well sheltered by nearby developments, and windspeeds would generally be of lower speeds than those presented.

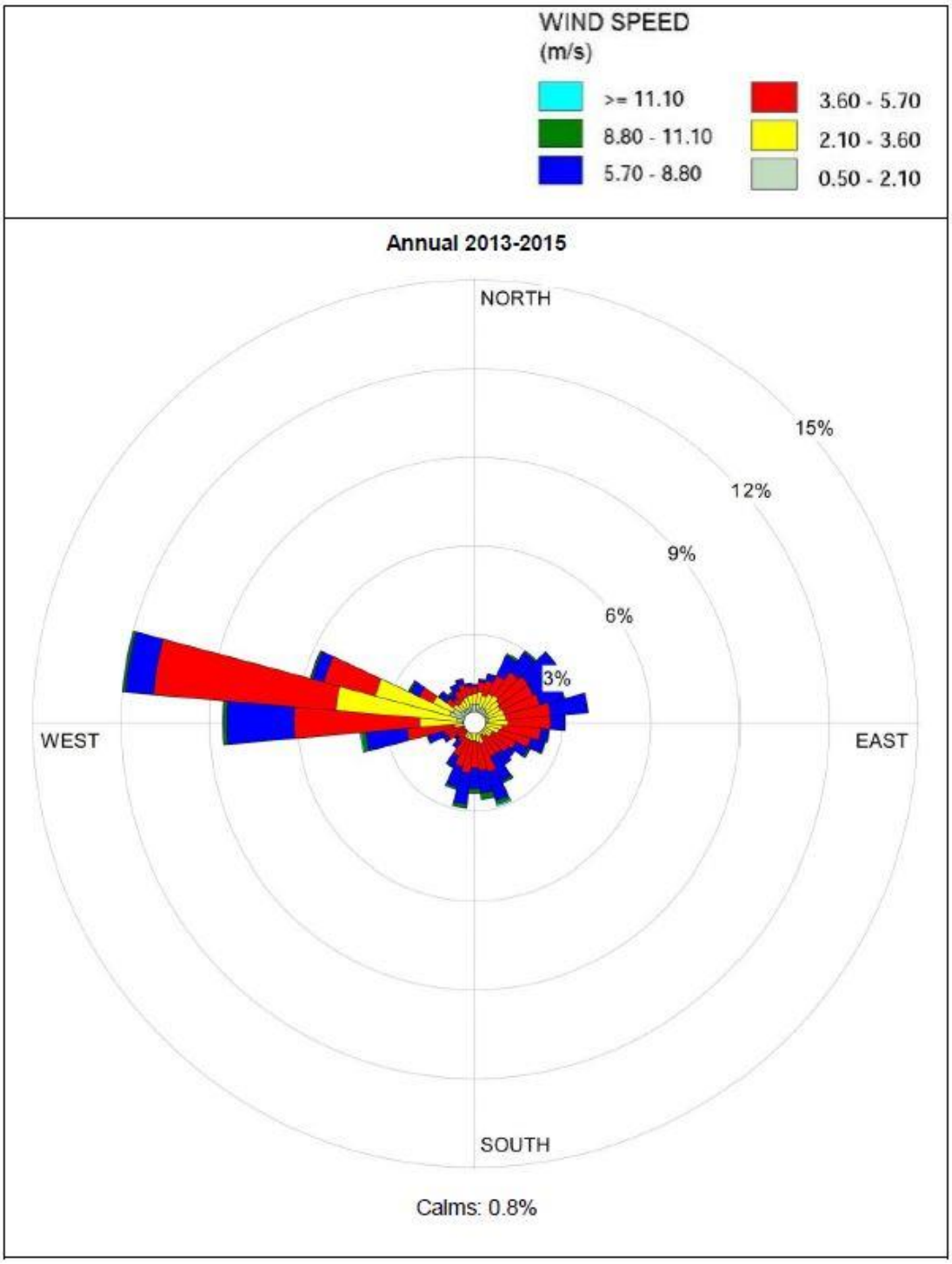

Figure 4 Annual Windroses for Fort Denison 2013-2015

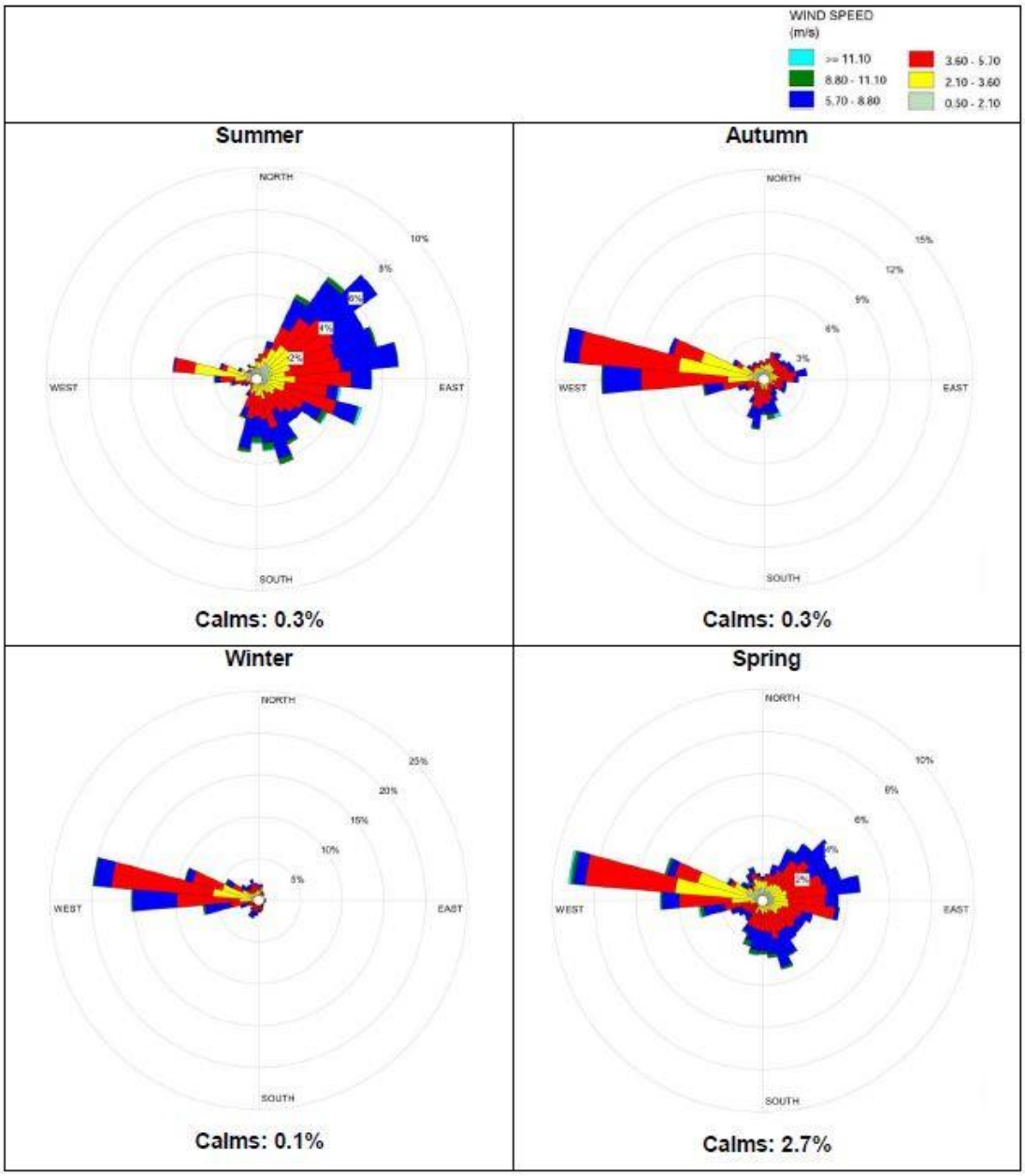

Figure 5 Seasonal Windroses Fort Denison 2013-2015

Local Climate

Long-term climate statistics are provided in Table 5. Temperature data recorded at the Observatory Hill AWS indicates that January is the hottest month of the year, with a mean daily maximum temperature of 26°C. July is the coolest month with a mean daily minimum temperature of 8.1°C. June is the wettest month with an average rainfall of 133 mm.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max Temp (C)	26.0	25.8	24.8	22.5	19.5	17.0	16.4	17.9	20.1	22.2	23.7	25.2
Mean Min Temp (C)	18.7	18.8	17.6	14.7	11.6	9.3	8.1	9.0	11.1	13.6	15.7	17.5

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Rainfall (mm)	102	118	131	129	119	133	97	81	68	76	84	78
Mean 9am Temp (C)	22.5	22.3	21.1	18.2	14.6	11.9	10.9	12.5	15.7	18.5	19.9	21.6
Mean 9am relative humidity (%)	71	74	74	72	74	74	71	66	62	61	66	67
Mean 9am windspeed (km/hr)	.8.6	8.2	7.9	8.8	10.5	11.9	13.1	13.3	12.4	12.2	11.0	9.8
Mean 3pm Temp (C)	24.8	24.9	24.0	22.0	19.4	16.9	16.4	17.5	19.2	20.7	22.1	23.8
Mean 3pm relative humidity (%)	62	64	62	59	57	57	51	49	51	56	58	59
Mean 3pm windspeed (km/hr)	17.9	16.8	15.2	13.8	12.7	13.6	15.3	17.6	18.3	19.1	19.4	19.5

Table 3 Climate Summary, BOM Station Observatory Hill, 1955 - 2017

5.1 Existing Air Quality

The NSW EPA operates a network of air quality monitoring stations in the vicinity of the site. The closest station to the site is located at Rozelle Hospital. The monitoring site features medium to high-density residential and commercial developments and is close to major arterial roads. Air quality recorded at this station is considered generally representative of air quality at the Proposal site. Table 6 provides air quality data for 2015 and 2016.

Pollutant	Averaging Period	Concentration (ug/m^3)		Criteria ug/m^3
		2015	2016	
PM_{10}	Maximum 24-hour average	60.3	58.8	50
	Annual average	16.7	16.8	25
$PM_{2.5}$	Maximum 24-hour	33.4	49.4	25
	Annual average	7.2	7.4	8
SO_2	Maximum 1-hour average	80.1	57.2	570 ug/m3
	Maximum 24-hour average	14.3	14.3	228 ug/m3
CO	Max 8-hour average	1,375	1,500	10,000
NO_2	Maximum 1-hour Average	123	102.5	246 ug/m3
	Annual average	22.6	22.6	62 ug/m3

Table 4 Ambient Pollutant Concentrations Recorded at Rozelle Air Quality Monitoring Station 2015-2016

It can be seen from Table 6 that for NO_2, CO and SO_2 existing ground level concentrations are well below the relevant ambient air quality criteria for all averaging periods. For particulates annual averages recorded for PM_{10} and $PM_{2.5}$ recorded at Rozelle were below EPA criteria, however the exceedances were recorded for both particle fractions over the 24-hour averaging period. This can happen for a variety of localised reasons and can occur regularly at many monitoring stations throughout NSW while maintaining annual averages that are safely within criteria.

6. Assessment of Potential Impacts

Construction

Air quality impact during construction of the works would include temporary impact associated with dust particles and combustion sources. Anticipated sources of dust and dust-generating activities include dust generated from the loading and transfer of material from trucks or barges and demolition.

Minimal and very localised excavation and 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.

Other potential air quality impacts include emissions of CO, NO_2, SO_2 associated with 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 negligible and would not affect the overall air amenity in the vicinity of the development.

Temporary use of the Casino Wharf during the relocation of the Pyrmont Bay Ferry Pontoon would increase the number of ferry services using the Casino Wharf. However, potential emissions affecting air quality are expected to be negligible and would not affect the overall air amenity in the vicinity of the Casino Wharf, particularly when comparing the local ambient air environment to Table 6 of this report.

Any potential odour emissions during installation of sewerage system pipes are expected to be negligible. It is also expected that potential construction air quality impacts can be managed through the effective implementation of appropriate mitigation measures.

Operation of the marina

Air quality impacts during operation of the marina and the Pyrmont Bay Ferry Pontoon would include emissions of CO, NO_2, SO_2 and compounds associated with the combustion of diesel, steam and coal fuel from vessels.

However, as outlined in Table 3 of this report the operating profiles of the additional heritage vessels are expected to be minimal, intermittent (short-term) and would have a negligible increase if any in the pollutants levels in the local ambient air environment.

There would be about 50 ferry movements, including HCF and MFF, from the relocated Pyrmont Bay Ferry Pontoon each day. The relocated Pyrmont Bay Ferry Pontoon would be closer to the Sydney Wharf Apartments compared to the existing location of the Pyrmont Bay Ferry Pontoon. However, the ferries would be intermittent (short-term) and would have a negligible increase if any in the pollutants levels in the local ambient air environment. Established ambient air quality levels provided in Table 6 are within air quality guidelines. Analysis of windrose data also suggests the majority of wind patterns are favourable for any source emissions to be carried away from nearest receivers rather than being carried towards. However, this can vary. Approximately 50 ferry movements are expected from the Pyrmont Bay Ferry Pontoon daily. It is expected they will operate their engines prior to disembarking. This is expected to be of short duration while moving away from nearest receptors. This is expected to have a minimal if any impact on 24 hour maximum averages for

established air quality in the vicinity. However it is recommended that in the event of complaints regarding concerns over air emissions from the operation of the ferry's, air monitoring be undertaken.

The vessels moored at the marina and vessels using the Pyrmont Bay Ferry Pontoon are unlikely to emit odours that would affect local air quality.

Heritage vessels moored at the marina may include the:

- James Craig
- Waratah
- John Oxley
- SS South Steyne
- Lady Hopetoun
- Boomerang

The James Craig Sails once a fortnight departing at 1000, returning at 1600. Also, periodic cruises on the harbour or at sea. The diesel engines are generally started about 20 minutes before departure, during which a small amount of diesel exhaust is emitted.

Waratah and *Lady Hopetoun* would be in steam every second weekend on Friday to Sunday cruises from the precinct and would also conduct periodic charters. Raising steam on both *Waratah* and *Lady Hopetoun* will only be completed off-site in Rozelle Bay. Both vessels will be towed 'dead ship' from Pyrmont Bay on Fridays and back to Pyrmont Bay on Sundays. The tows will be scheduled for early morning, in daylight, to minimise impact with other vessels in the area. Weather conditions will impact timing of the tows which may occur earlier in the week to avoid adverse conditions.

The John Oxley is currently onside on display. Once in its berth, and as a static display, the ship would rarely be moved except for deep maintenance and dockings. On these occasions, the ship would be cold moved using tugs. If operated, as a diesel fired boiler, there would be little or no smoke and only a small amount of exhaust emission.

The SS South Steyne would be a static display with proposed multi-functional uses that would have no emissions affecting air quality including odour. The SS South Steyne would almost never be moved except for deep maintenance and dockings. On these occasions, the ship would be cold moved using tugs. There would be negligible emissions from the SS South Steyne.

The Boomerang would have periodic member/sponsor cruises. The diesel engine is run for short periods before departing and after returning alongside. Exhaust emissions would be very limited and short term with no noticeable impact on the Darling Harbour environment.

Coal to and ash from the steam ships will be handled only in bags and transported by barge fitted with a crane for transhipment.

Except for major events it is expected that around four visiting vessels per year will come and go.

It is also envisaged one or two vessels would be operating daily on harbour cruises. The small diesel engines used in these craft run for short periods before departing and after returning alongside. Exhaust emissions would be very limited and short term with no noticeable impact on the Darling Harbour Environment.

Visiting ships berthed at the MHP will be able to take advantage of shore power which would enable them to turn off all onboard diesel fuelled power generation systems. Therefore, the provision of shore power would minimise diesel engine exhaust emissions from visiting ships.

Mitigation Measures

The following mitigation measures are recommended as part of a Construction Environmental Management Plan 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 would be visually monitored and where necessary the following measures implemented;
- Loads on vessels and trucks transporting material to and from the construction work area would be appropriately covered;
- Tailgates of road transport trucks would 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. An Air Quality Management Plan (AQMP) should be prepared for the Project and should include the following information:

- Potential sensitive receptors in proximity to the site;
- The legislative framework and standards applicable to the operation;
- Potential contributors to off-site pollutant impacts, including the pollutants that are of concern;
- Mitigation measures to minimise the operation's effects on local air quality would include;
    - Maintaining vehicles, plant and equipment in good working condition and turning off when not in use;
    - Vessel engines would be switched off while alongside and would use shore power when berthed;
    - Establish procedures to manage vessels if idling while alongside if necessary;

- Ensuring that the *Waratah* and *Lady Hopetoun* continue to raise steam off-site.

7. Conclusion

RAPT Consulting has undertaken a qualitative air quality impact assessment for NGH as part of a REF for the proposed Maritime Heritage Precinct (MHP) in Darling Harbour. The assessment addressed the potential air quality impacts associated with the construction and the operation of the marina.

Given the nature of the construction and operational works associated with the development and the existing local ambient air environment it is expected that the proposal would have a negligible if any impact on the local air amenity. It is recommended that an AQMP be implemented as part of the facility CEMP and OEMP to minimise any risk of unnecessary air impacts.

The assessment has found that the potential air quality impacts associated with the construction and operation of the Proposal are minimal and can be effectively managed through the implementation of a series of mitigation measures similar to those mentioned in Section 6 of this report.

Should you have any further questions regarding this report, please do not hesitate to contact Greg Collins on 0488512224 or greg@raptconsulting.com.au.

Thank you,

Greg Collins

Director – RAPT Consulting