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Flora & Fauna Assessment Report
Sydney Heritage Fleet
Pyrmont, NSW 2009

Report Number 610.10676-R1R0

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EXECUTIVE SUMMARY

The site of the proposed new base for Sydney Heritage Fleet at Pyrmont has two components, both of which have been highly modified from their original natural conditions. The terrestrial component, which is located primarily beneath the southern part of the Anzac Bridge at Pyrmont, has been entirely clearly, re-worked and modified, and does not contain any relevant native vegetation or habitats. The aquatic component (at the entrance to Blackwattle Bay) is also highly modified from its original condition as a result of the landfilling for the construction of the Anzac Bridge, and long-term changes in the water quality and condition of Blackwattle Bay and Sydney Harbour in general.

There are no constraints on the proposed development which arise from the consideration of ecological issues. In this regard:

- there are no terrestrial (*ie* non-aquatic) native biota of particular relevance or concern;
- there are no threatened biota or habitats which would be adversely affected by the proposed development;
- the additional shading of the harbour floor which will arise as a consequence of the proposed marina and the the Sydney Heritage Fleet vessels, whilst a significant element of the water lease area at Pyrmont, constitutes only a minute proportion of Blackwattle Bay and/or Sydney Harbour;
- there is likely to be some decline in benthic marine biota as a result of the shading from the structures, but there will also be opportunities for a range of additional aquatic biota around the support piles and structures of the marina; and
- it is considered imperative that appropriate measures be implemented to avoid the discharge of contaminants or pollutants, or waste materials, into Sydney Harbour at this location.

A number of particular impact amelioration and environmental management measures are recommended by the authors of this *Report* and the associated *Aquatic Ecology Report*, including *inter alia*:

- the use of appropriate measures to minimise or avoid sediment disturbance and the smothering of nearby benthos during construction of the marina;
- the implementation of 'best practice' measures to control and manage all wastes, oils, fuels, paints or other potential contaminants;
- the provision of mesh materials in parts of the marina to increase the quantity of diffuse light entering the water column; and
- the implementation as specific measures during the operational phase of the project to avoid the discharge of contaminants, wastes or materials into the harbour.

There is no likelihood that the proposed development would impose a "*significant effect*" upon any threatened biota or their habitats, be they aquatic or terrestrial. There would be, consequently, no requirement for the preparation of a *Species Impact Statement* (SIS) or any further consideration of threatened biota or their habitats.

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1 INTRODUCTION

1.1 Background

SLR Consulting Australia Pty Ltd (SLR Consulting) has been commissioned by Crawford Architects on behalf of Sydney Maritime Museum Ltd (Client) to provide environmental assessment reports to support a *Development Application* (DA) for the Sydney Heritage Fleet (SHF), Bank Street, Pyrmont.

This *Flora & Fauna Assessment Report* presents the ecological consideration (terrestrial and aquatic) for the proposed development of the subject site.

This *Report* has been undertaken in accordance with SLR's Offer of Services, Sydney Heritage Fleet Bank Street, Pyrmont; Specialist Building / Environmental Technology Services (Ref. 610.10676 SHF P1 20110823, dated 23 August 2011).

Based on information provided by the Client, the proposed development has the following characteristics.

- The development will comprise a non-profit making working museum and a home for the SHF.
- The site is located under the eastern pylon of the Anzac Bridge with a water frontage to Blackwattle Bay and a street frontage to Bank Street. Approximately half of the site adjacent to the bridge pylon will be occupied by the SHF and the other half to the east will become a community park. The land to be developed as a community park does not form part of this assessment.
- A freestanding Exhibition Pavilion with an attached refreshment kiosk and amenities is to be located to the immediate west of the bridge pylon.
- The land-based component of the project comprises two storage areas at sea wall/water level:
    - the first to store dragon boats operated by Dragon Boats NSW, with direct access to a new boat ramp; and
    - the second to store and operate small vessels owned by the SHF, which will also make use of the boat ramp.
- Directly above the boat storage areas there will be exhibition spaces, meeting rooms, amenities, and entry lobby and reception areas.
- Across from the entry courtyard fronting Bank Street will be a single-storey building with some mezzanine spaces containing the SHF maintenance workshops and storage areas which are required to service the SHF vessels. The roof of the maintenance areas will be "*greened*", to provide sound insulation for the SHF operations and a visually attractive landscape for the adjacent residential buildings.
- Where reference is made to the site being developed for commercial use, this terminology is used to differentiate from residential or industrial uses, and is not intended to construe a commercial (or business) venture.

1.2 Details and Definitions

The site that is the subject of this *Flora & Fauna Assessment Report* comprises Part Lots 19 and 20 in DP 803159, as well as an adjoining 13,120m^2 of *Water Lease Area* along Bank Street, Pyrmont. The subject site is located on the northern side of Blackwattle Bay, within the Local Government Area (LGA) of Sydney City (Figure 1).

The subject site occupies a total area of approximately 16,820 m^2, and is currently zoned '*Public Recreation*' pursuant to *Ultimo-Pyrmont Local Environmental Plan 2005*.

As noted above, the proposed development of the subject site at Pyrmont is for the establishment of a storage facility, museum and exhibition base for the Sydney Heritage Fleet. The development footprint occupies the northern parts of Lots 19 and 20 (Appendix A), as well as a rectangular portion of the Harbour, which extends to the west into Blackwattle Bay.

The site is located beneath the eastern side of the Anzac Bridge (Figure 2), and comprises:

- a 4,642m^2 area of land on Lots 19 and 20, which is proposed to accommodate:
  - a two-storey building with a ground storage level and an upper level with exhibition spaces and meeting rooms (as well as associated amenities, an entry lobby and reception area); and
  - a single storey building with some mezzanine spaces for storage; and
- a 13,120m^2 *Water Lease Area*, which is to facilitate berths for many of the Fleet's vessels, and a free-standing exhibition pavilion with an attached kiosk and amenities.

This *Flora & Fauna Assessment Report* considers both:

- the use of the terrestrial portion of the subject site *inter alia* by migratory and water bird species, as well as terrestrial biota; and
- a detailed aquatic assessment for the *Water Lease Area* provided in a separate Aquatic Report (Rooney 2011) contained in Appendix C.

The terrestrial portion of the subject site is roughly square in shape and is characterised by flattened highly disturbed terrain, which has been subjected to a history of major earthworks (see *Land Contamination Report* by SLR 2011). Other than a few patches of weeds, Swamp Oaks and landscape plants, there is no vegetation on the subject site.

The definitions for relevant terms employed in this *Report* are:

- "*subject site*" part Lots 19 and 20 in DP 803159 and a 13,120m^2 *Water Lease Area* (Appendix A)
- "*locality*" an area of 10km radius around the "*subject site*"

Other terms used in this *Report* conform to the definitions contained in the relevant legislation and planning instruments (see below).

1.3 Scope of Work

The scope of this *Flora & Fauna Assessment Report* with respect to the subject site at Bank Street, Pyrmont is:

- to undertake a site inspection and aquatic site survey to describe and assess the habitats present and to identify the flora and fauna present and/or likely to occur on the site;
- to assess the likely impacts of the proposal on the natural environment in general, and on threatened biota and their habitats in particular; and
- to provide an assessment of likely impacts pursuant to:
  - the *Environmental Planning & Assessment Act 1979* (EP&A Act);

- the *Threatened Species Conservation Act 1995* (TSC Act); and
- the *Environmental Protection & Biodiversity Conservation Act 1999* (EPBC Act).

It is noted that the EPBC Act is not a statutory issue for a consent authority in determining a *Development Application* (DA) for the site pursuant to the EP&A Act. Nevertheless, consideration of this issue has been provided for completeness.

The observations and opinions expressed in this *Report* with respect to the terrestrial element of the Bank Street site are based on:

- a site inspection on the 13th of September 2011, which consisted of:
  - compilation of a plant species list using the 'Random Meander' technique *sensu* Cropper (1993);
  - a qualitative description of the vegetation present on the subject site;
  - a review of habitat quality for fauna species; and
  - opportunistic recording of fauna species within the subject site;
- a review of the Office of Environment & Heritage (OEH) and Commonwealth (EPBC Act) online databases for threatened species;
- the published scientific literature, particularly with respect to threatened biota; and
- the experience and knowledge (local and general) of the SLR consulting team.

The observations and opinions expressed in this *Report* and in Appendix C (Rooney 2011) with respect to the aquatic elements of the proposed development at Bank Street, Pyrmont are based on:

- a review of the relevant threatened species lists of both the OEH and the NSW Department of Industrial & Investment – Fisheries;
- the published scientific literature, particularly with respect to threatened aquatic biota;
- an inspection of the aquatic elements of the subject site using SCUBA equipment on the 15th of September 2011, involving a "*complete parallel linear examination of the entire subtidal shoreline within the water lease boundary out to a water depth of -4m (ZFDTG) .. as well as a brief inspection of the substrate within the remainder of the water lease boundary*"; and
- the considerable experience and knowledge (both local and general) of Mr Bill Rooney in aquatic ecology, including particularly within Sydney Harbour and its associated rivers.

1.4 Assumptions and Limitations

The impact assessments and conclusions contained in this *Report* are based *inter alia* on a number of assumptions, including:

- that the whole of the subject site is to be cleared and re-contoured for development purposes, and that no vegetation will be retained;

- that development of the subject site and the subject land will be undertaken in an environmentally responsible and legal manner;
- that the recommendations contained in this *Report* with respect to impact amelioration and environmental management measures will be implemented as part of the development; and
- that the relevant elements of the proposal with respect to stormwater management and treatment (as detailed in the *Report* of Cardno 2011) will be implemented as identified.

It is a function of all ecological studies, virtually without exception, that the information regarding flora and fauna on any one site is incomplete. That circumstance arises because the natural environment is dynamic not static, and because there will be variations in the flora and fauna assemblage on any one site through seasons and through different climatic circumstances over a few or some tens of years.

As a consequence, all ecological assessments are unavoidably reliant on only a partial and incomplete information base, and rely *inter alia* on:

- various other sources of information, in addition to field investigations;
- the general and scientific knowledge of native biota and their habits and habitats; and
- the experience of the investigators and assessors.

Whilst it is a fundamental assumption of this *Report* and the assessments contained herein that individuals of some threatened fauna species could utilise the subject site, on occasions at least, it is also a basic tenet of the *Report* that the habitats and features present are of limited value because of the extremely high levels of degradation, weed infestation and modification of the site which have occurred over a long period.

It is also a fundamental tenet of the principal author of this *Report* (Mr F Dominic Fanning) that the observations contained within the *Report* and the opinions expressed herein are based on an objective analysis of the relevant circumstances, and are independent of the desires or preferences of the proponent, or of any other persons or authorities. That is, the *Report* has been prepared in an objective and independent manner sufficient to satisfy their requirements of the *Uniform Civil Procedures Rules* (UCPRs) with respect to expert witnesses in the NSW Land & Environment Court.

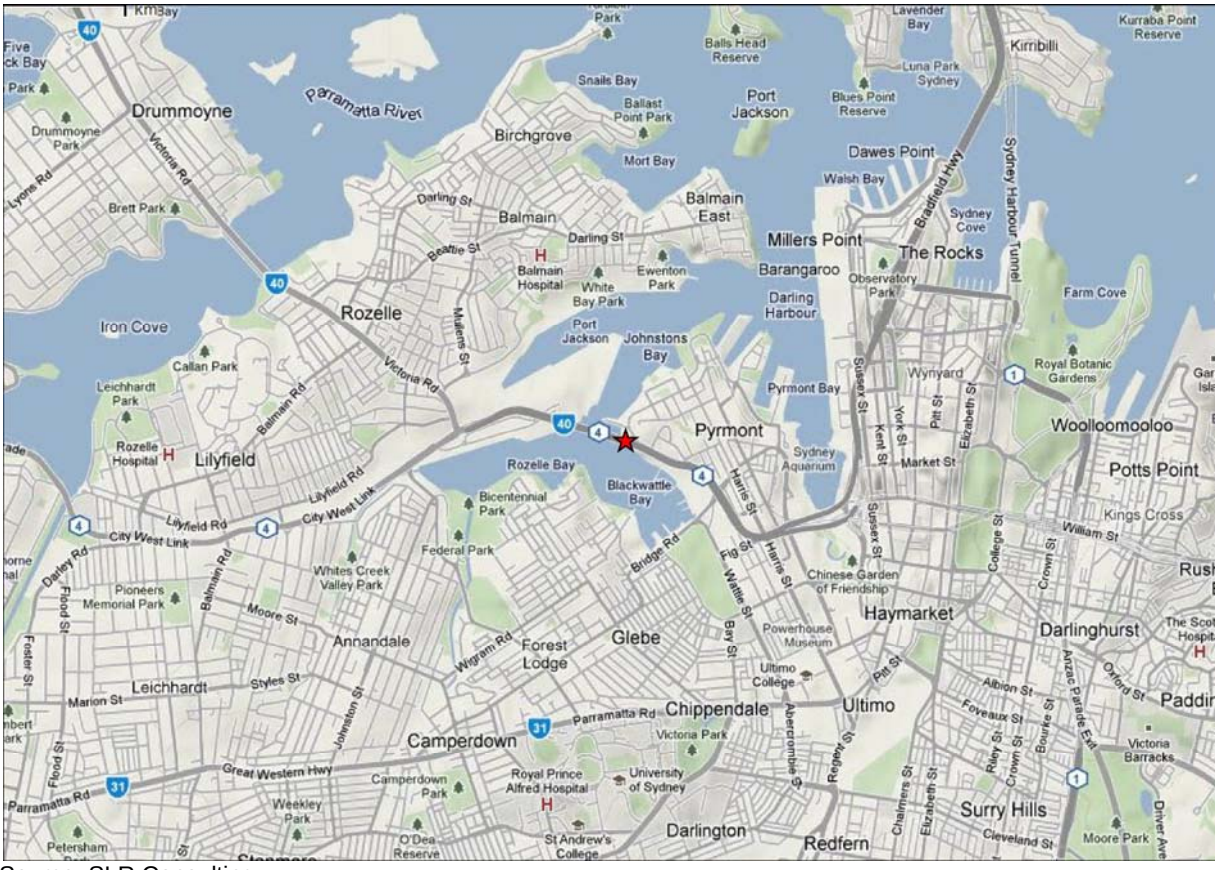
2 SITE DESCRIPTION

2.1 Site Location and Description

The Project Site is located off Bank Street, Pyrmont, NSW 2009, approximately 1.3 kilometres (km) west of Sydney Central Business District (CBD).

A Locality Map is provided below in **Figure 1**.

Figure 1 Locality Map



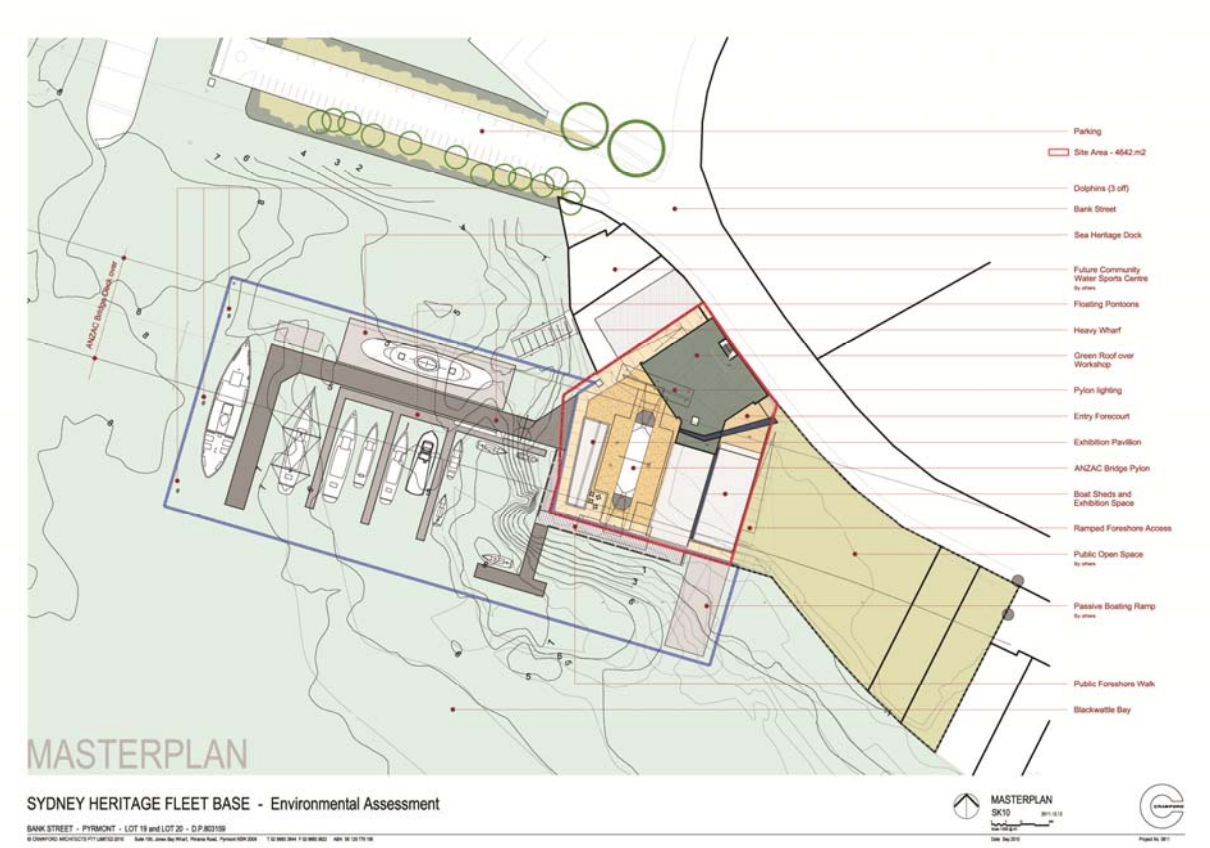
Source: SLR Consulting

The Project Site is a combination of two lots located beneath the eastern pylon of the Anzac Bridge, comprising Lot 19 and Lot 20 of Deposit Plan 803159. The area included within this DA is shown in **Figure 2** and is approximately 4,642 m^2 in area.

For clarity, throughout this report when both lots are being referred to, the term 'Project Site' will be used. If they need to be discussed individually the lots will be referred to by their associated lot and Deposit Plan number.

Two leases exist on the site, a land lease (identified in **Figure 2** by a red boundary) and a water lease (identified by a blue boundary). The public open space (shaded in green in **Figure 2**) is shown, although this is not included within this DA, and does not form part of this assessment.

Figure 2 Site Plan



Source: Crawford Architects

The Project Site is bordered to the south and west by Blackwattle Bay, to the north by Bank Street. The surrounding land uses include:

- North and Northwest: On the other side of Bank Street is Jackson's Landing residential and community estate.
- South and West: Blackwattle Bay borders the Project Site.
- Northeast: There is a small cluster of commercial buildings located on the opposing side of Bank Street.
- Southeast: A series of buildings operated by Poulos Bros Seafoods Pty Ltd, Bidvest Australia Pty Ltd, Hymix Australia Pty Ltd and the Sydney Fish Markets.

2.2 Project Description

The proposed development works shall incorporate the following:

- A two storey building with some mezzanine spaces.
- Located west of the bridge pylon is a freestanding Exhibition Pavilion with an attached kiosk and amenities.
- Boat sheds and vessel storage for dragon boating.

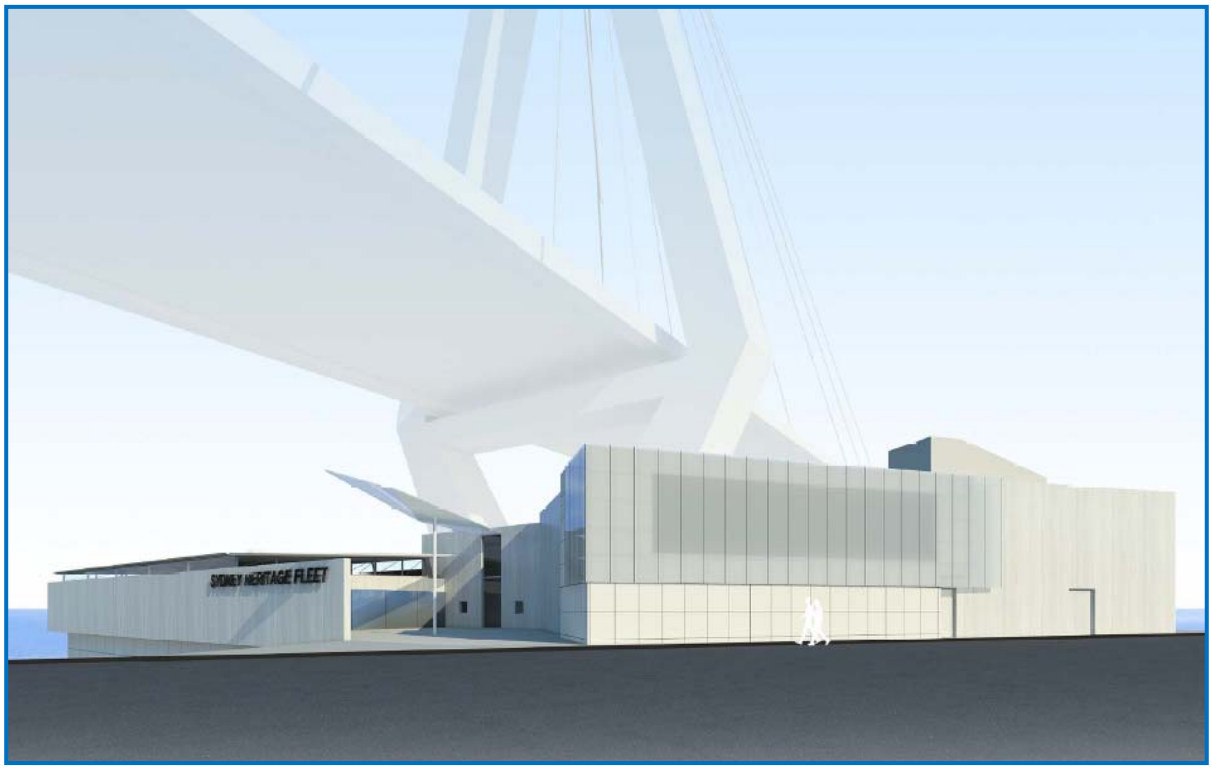
- Shipwrights and boat storage area which includes a machine shop, workshop, timber store, lunch room and amenities.
- Directly above the storage areas are exhibition spaces, meeting rooms, amenities, and entry, lobby and reception areas.
- Restoration and maintenance workshop, including a metal fabrication workshop, coal stores, garbage and recycling stores, paint and flammable goods store.
- Working living museum.
- Lay apart stores and electrical workshop.
- The mezzanine which incorporates amenities.
- Heavy wharf.
- Floating pontoons.

Figure 3 and **Figure 4** below show design perspectives for the proposed development from the proposed public open space and from Bank Street, respectively.

Figure 3 View of Proposed Development from Public open space

Source: Crawford Architects

Figure 4 View of Proposed Development from Bank Street



Source: Crawford Architects

3 THE EXISTING ENVIRONMENT

3.1 General Description

The site of the proposed facility has been highly disturbed as a consequence of an array of historical activities, including land reclamation and the construction of the Anzac Bridge. Recent activities have included both equipment and vehicle storage, as well as the storage of containers and other material, and the grading and consolidation of the site.

As a consequence, the terrestrial portion of the subject site is highly disturbed, modified and degraded, and is of extremely limited ecological value or relevance (Appendix B).

The site is located beneath the eastern side of the Anzac Bridge (Figure 2), and is bound by:

- Blackwattle Bay to the south and west;
- vacant land (which is also owned by NSW Maritime) and other commercially owned land (including the Sydney Fish Markets) which extend along the foreshore to the southeast;
- existing and partially completed hi-rise residential units across Bank Street to the east; and
- government owned land to the north.

The adjoining parts of the Sydney Harbour (Blackwattle Bay) are highly modified, and are not likely to contain important habitat or resources.

3.2 Flora and Vegetation

Given the context of the site and its history, vegetation on the subject site and in the immediate surrounds is sparse, and where present is in the form of heavily manicured gardens, weed-infestations and landscaped road verges. There are a few Port Jackson Figs growing from a retaining wall on the eastern side of Bank Street, and a few small scattered eucalypts on the properties to the southeast, but there is no native canopy on the subject site.

Field surveys on the subject site have identified 23 plant species, of which only one (the Swamp Oak *Casuarina glauca*, which was present as a few relatively immature specimens) is a native species (Appendix C). The remaining 22 species are common, mostly annual, weeds, and do not constitute any form of significant vegetation or plant ecosystem.

None of the threatened plant species recorded in the locality (Appendix D) are currently, or are in the future likely to be, present on the subject site. There is no likelihood of a "*threatened species*" of plant or "*threatened population*" of any plant species being recorded on the subject site or in its vicinity at Pyrmont.

3.3 Fauna and Fauna Habitats

Given the nature of the subject site (being a long-established, heavily urbanised environment), there are no habitats or features which are of any particular relevance or value for any native fauna species.

The only fauna which are likely to occur on the subject land are highly urban-tolerant species which are typical of cityscape environment of Sydney.

Native fauna recorded in the vicinity of the subject site were associated with the waterfront land, and included the Silver Gull (commonly known as the 'Sea-gull'), the Pied Cormorant and Little Black Cormorant. The introduced Common Myna and Common Pigeon were also recorded on the subject site. The array of native fauna likely to utilise the subject site and its vicinity would be extremely limited, given its nature and condition.

None of the "*threatened species*" of fauna or any relevant habitat which have been recorded in the locality were detected on the subject site or its vicinity (Appendix C).

The only "*threatened species*" known to occur in the vicinity of the subject site at Pyrmont is the Grey-headed Flying Fox. This species utilises both planted and self-seeded figs for foraging purposes during the fruiting period, and could utilise such resources along Bank Street.

It is to be noted, however, that there are no potential foraging resources for the Grey-headed Flying Fox on the subject site itself. It is not likely, therefore, that even individuals of that species will occur on the subject site, other than in flying over the site.

Although it is theoretically possible that individuals of the Grey-headed Flying Fox and other threatened biota (microchiropteran bats or birds) could fly over the subject site on occasions, there are no resources or habitat features of any particular relevance for any such species on the site. It is not possible that even an individual of any such species would be dependent upon the subject site for their survival at any scale.

The nature and condition of the subject site and the resources present militate against the likelihood that any threatened species would (or indeed even could) be dependent on the site. It is not likely that populations or even individuals of any such species would be resident upon the subject site at Pyrmont.

3.4 Aquatic Environment

The detailed analysis of the aquatic environment and ecosystems, and potentially relevant native biota, is contained in the *Report* by Bill Rooney 2011 (Appendix C to this *Report*).

The conclusions of that *Report inter alia* are that:

- the subject site is generally characteristic of such sites and substrates within the inner parts of Sydney Harbour;
- the densities of biota and their burrows in the sediments suggest "*healthy, aerobic surface sediments*";
- there is a "*nearly buried coffer dam that is exposed a metre or more above the substrate surface near the northern water lease boundary*";
- there were only a few fish sighted during the dive;
- there are no mangroves or saltmarsh communities present along the foreshore in this area, and there are no seagrasses within the water lease boundary; and
- there were "*no noxious pest species, particularly the introduced green alga Caulerpa taxifolia*" within the study area.

Further, as discussed in Appendix C, no threatened aquatic biota were recorded on the subject site or in its vicinity, and it is not considered likely that any such biota would be dependent on the area proposed for development activities.

4 IMPACT ASSESSMENT

4.1 General Considerations

Given the lack of habitat or features of ecological or biodiversity significance on the subject site at Pyrmont, the proposed development of the site is not likely to involve any relevant adverse ecological impacts upon any native (including any threatened) biota, or their habitats.

The only biota that would be likely to utilise the subject site (given its existing heavily urbanised nature) would be highly urban-tolerant species. There is no likelihood that even individuals of any native species of interest or concern would be dependent upon the subject site in isolation.

The proposed development of the subject site at Pyrmont will impose generally limited impacts upon the aquatic environment, given the artificial nature of the landscape at this location and the long history of commercial use of this part of Sydney Harbour. Nevertheless, the proposed marina and pontoons, and moored boats, will increase the level of shading of the marine substrate, notwithstanding the existing shading created by the Anzac Bridge structure itself. There is, therefore, likely to be some reduction in marine biodiversity within the water lease area, although the marina structures will provide additional substrate for a number of marine invertebrates.

4.2 Section 79C of the EP&A Act

Neither the subject site itself nor surrounding lands are characterised by any relevant elements of the "*natural environment*". The only 'quasi-natural' features that will be affected by the proposed re-development of the site are the few introduced Swamp Oaks and the Elm, but these are of no relevance with respect to biodiversity conservation.

Given those circumstances the proposed re-development of the subject site at Pyrmont does not constitute an activity which could be regarded as unacceptable or unreasonable in terms of Section 79C of EP&A Act, with respect to the "*natural environment*".

As noted above, there are likely to be some impacts on marine biodiversity at this location, due to the effects of shading from the pontoons and moored boats, causing some reduction in benthic invertebrate and plant species. Conversely, the proposed structures will provide a base for a number of marine plants and invertebrates, and would likely facilitate an increase in fish diversity at the site to some extent.

With respect to the relevant considerations of Section 79C of the EP&A Act, the proposed development is not considered to constitute an unreasonable or significant adverse impact upon the native biodiversity of Blackwattle Bay or the inner Sydney Harbour.

4.3 Section 5A of the EP&A Act - Terrestrial

The *Threatened Species Conservation Act 1995* (TSC Act) has modified the *Environmental Planning & Assessment Act 1979* (EP&A Act) by, *inter alia*, including a requirement to determine "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*". The relevant factors of Section 5A of the EP&A Act "*must be taken into account*" by a consent or determining authority when considering a *Development Application*, and in administering Sections 78A, 79B, 79C, 111 and 112 of the EP&A Act, as relevant.

The proposed development of the subject site at Pyrmont will not involve adverse impacts upon any relevant features of the "natural environment" or upon any resources or habitat features of any relevance to any threatened biota.

Whilst highly unlikely, it is theoretically possible that the subject site could provide some limited habitat or occasional resources for some threatened bats and birds. A generic *Section 5A Assessment of Significance* is provided below to give consideration to such species.

4.3.1 The Seven Factors of Section 5A

This *Assessment of Significance*, prepared pursuant to Section 5A of the EP&A Act, deals with those threatened biota individuals of which could theoretically or potentially occur on the subject site at Pyrmont on occasions.

Factor a Threatened Species – Risk of Extinction

It is not likely that even individuals of any listed threatened species would be reliant or dependent upon the subject site for their survival in this locality. The subject site represent only a minute portion of highly modified and degraded habitat for any such potential threatened biota in the vicinity and the locality, and the resources present in any case are extremely limited and widely distributed.

There is no possibility of a "*viable local population*" of any threatened species being reliant or dependent upon the subject site at Pyrmont. There is, consequently, no possibility of a "*viable local population*" of any such biota being "*placed at risk of* ***extinction***" (emphasis added), or indeed adversely affected at all.

Factor b Endangered Populations – Risk of Extinction

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

There is no "*endangered population*" of any species likely to occur or be present on the subject site at Pyrmont or in the immediate locality, or to be dependent upon any of the resources which would be affected.

Factor c Endangered Ecological Communities – Risk of Extinction

The TSC Act defines an "*endangered ecological community*" (EEC) as "*a community specified in Part 3 of Schedule 1*" of the Act. There is no EEC on the subject site at Pyrmont.

The few scattered Swamp Oak on the subject site do not constitute the Swamp Oak Floodplain Forest on Coastal Floodplains, which is listed in the TSC Act as "*endangered ecological community*".

Factor d Impacts on Habitat for Threatened Biota

As noted above, the subject site does not contain significant or important habitat or resources for any of the threatened flora or fauna species which could potentially occur on the land. This is due to the highly modified nature of the site, its context, its location, and its size relative to the extent of similar 'habitat' in the locality.

Those threatened fauna species that could be potentially utilise the subject site, or are likely to occur in the vicinity (*eg* individuals of the Grey-headed Flying Fox on a seasonal basis) are widely distributed in the locality and/or are wide-ranging, highly mobile and adaptable. Further, the subject site does not contain or support significant habitat or resources for any such biota. Development of the subject site as proposed would not remove significant resources or habitat for any such biota, nor would the loss of those limited resources and habitat present adversely affect any such biota to any relevant extent, if at all.

Given the circumstances described above, and given the nature and condition of the subject site, as well as its context and size, "*the action proposed*":

- is not likely to result in the removal or modification of significant areas of potential habitat for any threatened species. The site is not of any particular relevance or significance for any threatened species, and constitutes only a minute proportion of even theoretically suitable habitat for any such biota in the locality;
- is not likely to result in any habitat for threatened species becoming "*fragmented or isolated from other areas of habitat*", given the context and location of the site and the extent of existing and proposed urban development; and
- is not likely to result in any disturbance to important or significant habitat for any threatened species, even if any such species are present. The subject site cannot reasonably be regarded as of importance with respect to "*the long-term survival*" of any threatened species "*in the locality*".

Factor e Critical Habitat

The subject site at Pyrmont does not represent listed "*critical habitat*" for any threatened biota.

Factor f Recovery Plans and Threat Abatement Plans

There are no relevant *Recovery Plans* or *Threat Abatement Plans* which relate to any of the threatened biota or "*Key Threatening Processes*" of potential relevance to the subject site at Pyrmont.

Factor g Key Threatening Processes

The proposed development on the subject site at Pyrmont will not involve the imposition or exacerbation of any "*key threatening process*". There is no "*native vegetation*" to be removed from the site, and none of the other "*key threatening processes*" listed in the TSC Act will be either imposed on the subject site or exacerbated as a result of the proposed activity.

4.3.2 Conclusions

Given the considerations outlined above, the proposed development of the subject site at Pyrmont is not "*likely*" to impose a "*significant effect*" upon any "*threatened species, populations or ecological communities, or their habitats*", pursuant to Section 5A of the EP&A Act.

Even if some threatened biota do use the subject site on occasions, it is not likely that the vegetation present would support a "*viable local population*" of any such biota in isolation. It is not likely that any such "*population*", nor indeed any individuals of any such species, would be dependent or reliant solely, or to any extent, on the subject site.

There is no requirement for the preparation of a *Species Impact Statement* (SIS) for the proposed development at Pyrmont.

4.4 Section 5A Assessment of Significance - Aquatic

As detailed in Appendix C of this *Report* (the *Aquatic Assessment Report* by Mr Bill Rooney dated 2011), it is not likely that even individuals of any threatened marina or aquatic species would be reliant or dependent upon the subject site for their survival. Indeed, it is unlikely that even individuals of any such species would occur at the subject site either at all (for most such species) or on other than occasional transient basis (for a few species). Given those circumstances, there is no likelihood that the proposal will involve the imposition of a "*significant effect*' upon any threatened aquatic biota.

Given those circumstances, there is no requirement through the preparation of a *Species Impact Statement* (SIS) for any threatened aquatic biota.

5 ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT

The *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), relevantly, addresses the likelihood (or otherwise) of impacts to be imposed upon "*Matters of National Environmental Significance*" (MNES). The EPBC Act seeks *inter alia*:

- "*to provide for the protection of the environment, especially those aspects of the environment that are Matters of National Environmental Significance*";
- "*to provide ecologically sustainable development*"; and
- "*to promote the conservation of biodiversity*".

The EPBC Act is not likely to be of any relevance to the re-development of the Bank Street site at Pyrmont, because of the nature and condition of the site itself and because there is no potential for any adverse impacts to be imposed upon any even potentially relevant MNES.

The threatened biota and migratory species listed in the EPBC Act have been considered in this *Report* in the assessment of the potential impacts of residential development of the subject site as currently proposed. The subject site at Bank Street, Pyrmont does not contain or support any habitat or resources which could be considered of significance or even general relevance for threatened biota listed in the EPBC Act, or for any migratory species which are listed in the Act.

Although it is possible that (rare) individuals of some of the more widespread and cosmopolitan species listed in the TSC Act (such as the Grey-headed Flying Fox for example) to occur on the subject site on occasions, there are no resources or habitat features which could be regarded as of significance for the survival of even an individual of any such species. In addition, individuals of those migratory species listed in the EPBC Act which might occur on the subject site would only be present on rare occasions and on a transitory basis. The site does not support habitat or resources of relevance for the conservation of any such species.

Marine mammals are also a MNES protected pursuant to the EPBC Act, and both whales and dolphins are known to occasionally occur within Sydney Harbour. Whilst there are no recent records of such species in Blackwattle Bay, a female Southern Right Whale and calf was sighted in Darling Harbour approximately 6 years ago (F Dominic Fanning *pers obs*). However, it is extremely unlikely that any marine mammals or other relevant marine biota would occur in the vicinity of the proposed works at Pyrmont. It is extremely unlikely that any adverse impact at all, much less a "*significant impact*", would be imposed upon any such biota, even if present in Sydney Harbour on summer occasions.

Given the nature and condition of the subject site, its small size and its local context, it is not likely that any adverse impact would be imposed upon any "*Matters of National Environmental Significance*" listed in the EPBC Act. There is no requirement for a 'referral' of the proposed development of the subject site to the Commonwealth for the purposes of an approval by the Federal Minister for the Environment.

It is to be noted that EPBC Act is not a relevant consideration for a consent authority in NSW with respect to a *Development Application* pursuant to the EP&A Act. The advice provided here within respect of the EPBC Act is provided for completeness, but is not a matter that can be taken into account by a consent authority in determining the current DA.

6 IMPACT AMELIORATION & ENVIRONMENTAL MANAGEMENT

6.1 Terrestrial Considerations

As discussed in detail above, the subject site at Pyrmont does not contain habitat or resources of any relevance for any threatened biota, nor indeed for any non-threatened native biota.

Given the very highly modified nature of the subject site and its urban context, it is not likely that even an individual of any threatened biota would be reliant or dependent upon the subject site, if indeed even individuals of any such biota utilise the subject site at all.

Given those circumstances, there is no requirement for the implementation of any species-specific impact amelioration or environment management measures with respect to threatened biota. It is assumed that development of the subject site will be undertaken in an environmentally responsible manner, as is current 'best practice', and that appropriate measures (such as waste management, the use of silt curtains and/or fences *etc*) will be an integral part of the proposed activity.

There is no requirement for the implementation of any species-specific measures with respect to native or threatened biota.

6.2 Aquatic Considerations

Whilst the water lease area and the proposed marina occupy only a small part of Blackwattle Bay and Sydney Harbour, and the site is already shaded in part by the Anzac Bridge, an array of measures should be implemented both during the construction phase and occupation phase of the proposal to limit potential impacts upon the aquatic environment and biota.

Specific measures which are recommended for implementation as part of the project would include:

- appropriate protection during construction activities to ensure that adverse impacts are not imposed upon adjacent areas of aquatic habitat;
- the use of a "*slow boring technique*" to minimise any "*localised turbidity*" for the installation of support piles for the marina to "*minimise resuspension of surface sediments and the smothering of nearby macroalgae and epifauna on rock rubble*";
- minimising the impacts of shading by the use in places of open grated aluminium decking to "*allow diffuse light to penetrate to the seabed .. to sustain benthic microalgae*"; and
- the employment of current 'best practice' measures associated with any activities either on the land or on the marina in respect of the maintenance and/or repair of boats and of facilities.

7 CONCLUSIONS & RECOMMENDATIONS

7.1 Conclusions

On the basis of the analyses documented above and detailed in Appendix C of this *Report*, the conclusions of this *Report* with respect to terrestrial and aquatic ecology on and adjacent to the subject site at Pyrmont are that:

- there are no elements of terrestrial ecology which are of particular concern, and it is not likely that any adverse impacts upon terrestrial ecology will be imposed;
- there are no threatened 'terrestrial' (*ie* non-aquatic) threatened biota of any relevant with respect to the subject site;
- there is no likelihood of a "*significant effect*" being imposed upon any threatened biota as a result of the proposed development;
- there is a likelihood of additional shading to a 'significant' area of the water lease area, although that constitutes only a very small proportion of Blackwattle Bay and/or Sydney Harbour; and
- there is no likelihood of a "*significant effect*" being imposed upon any threatened aquatic biota.

It is assumed for the purposes of this *Report*, and Appendix C, that all the appropriate measures would be undertaken as part of both the construction phase and subsequent occupation phase of the facility to avoid the imposition of adverse impacts upon the aquatic and/or terrestrial environment.

In this regard, it is critical that appropriate measures be implemented at all times during occupation of the site to prevent and/or control any discharges of oils, fuels, paints, chemicals or other contaminants. Current 'best practice' measures also need to be employed to ensure that litter, rubbish, waste or other materials are not discharged into the harbour or dropped into the water.

7.2 Recommendations

An array of recommendations have been provided (above) with respect to both the terrestrial and aquatic environment.

As noted above, it is critical that during both the construction and operational phases of the project, 'best practice' measures are employed to ensure that adverse impacts are not imposed upon either the terrestrial or (more importantly) the aquatic environment at this location.

It is a recommendation of the author of this *Report* and Mr Bill Rooney (Appendix C) that the impact amelioration and environmental management measures identified in Chapter 6 of this *Report* be implemented as conditions of development approval for the Sydney Heritage Fleet facilities at Pyrmont.

GLOSSARY

DA	*Development Application* prepared pursuant to the EP&A Act.
Development	in relation to land, means: (a) the erection of a building on that land; (b) the carrying out of a work in, on, over or under that land; (c) the use of that land or of a building or work on that land; and (d) the subdivision of that land, but does not include any development of a class or description prescribed by the regulations for the purposes of this definition.
DEC	Department of Environment & Conservation.
DECC	Department of Environment & Climate Change.
DECCW	Department of Environment, Climate Change & Water.
DGRs	*Director-General's Requirements*.
Director-General	the Director-General of the Department of Planning.
Endangered Ecological Community	"*an ecological community specified in Part 3 of Schedule 1*" of the TSC Act.
Endangered Population	"*a population specified in Part 2 of Schedule 1*" of the TSC Act.
	EP&A Act *Environmental Planning & Assessment Act 1979*.
Key Threatening Process	"*a threatening process specified in Schedule 3*" of the TSC Act.
Locality	the area within a 10km radius of the study area.
NPWS	NSW National Parks & Wildlife Service.
OEH	Office of Environment & Heritage (in the Department of Premier & Cabinet).
Proposal	the development, activity or action proposed.
Recovery Plan	"*a plan prepared and approved under Part 4*" of the TSC Act.
Region	"*a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes*" (TSC Act).
SIS	*Species Impact Statement* prepared pursuant to Sections 109, 110 and 111 of the TSC Act.
Threatening Process	"*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*" (TSC Act).
Threatened Species	"*a species specified in Part 1 or 4 of Schedule 1 or in Schedule 2*" of the TSC Act.
TSC Act	*Threatened Species Conservation Act 1995*.

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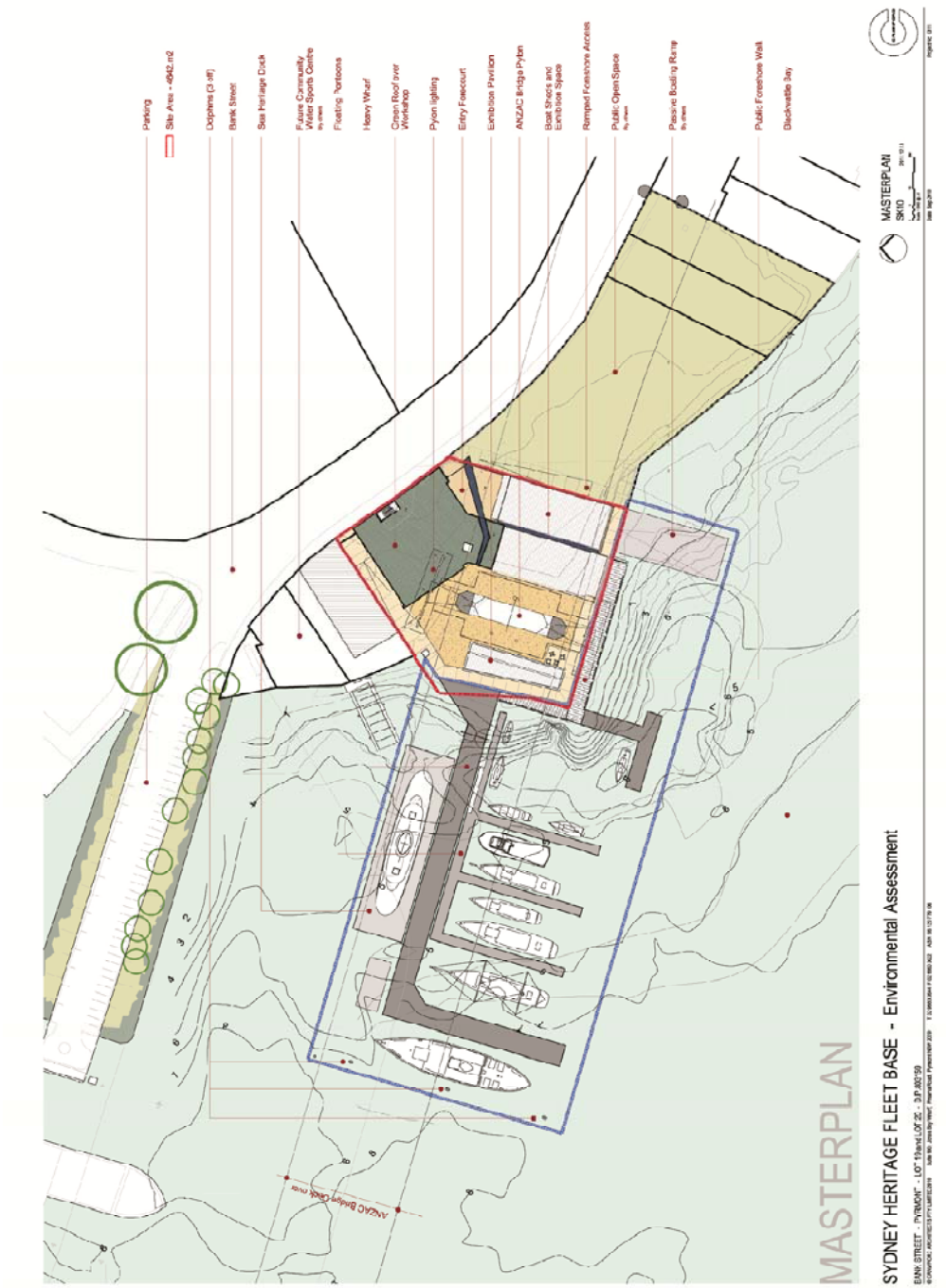
Parking
Site Area = 4642 m2
Dolphins (3 off)
Bank Street
Sea Heritage Dock
Future Community Water Sports Centre
Floating Pontoons
Heavy Wharf
Green Roof over Workshop
Pylon lighting
Entry Forecourt
Exhibition Pavilion
ANZAC Bridge Pylon
Boat Sheds and Exhibition Space
Ramped Foreshore Access
Public Open Space
Passive Boating Ramp
Public Foreshore Walk
Blackwattle Bay
MASTERPLAN
SCALE
SYDNEY HERITAGE FLEET BASE - Environmental Assessment

Photo 1 View of the area which comprises the land-based component of the project, taken from the northeastern corner of the subject site at Pyrmont.

Photo 2 View of the area which comprises the land-based component of the project, taken from the northwestern corner of the subject site at Pyrmont.

Photo 3 Facing northwest along the western boundary of the land-based component of the project, showing the Swamp Oaks which are the only native vegetation on the subject site (although likely planted or introduced with fill).

Photo 4 The few remaining landscape plants on the site, including Poison Ivy and Elm.

Photo 5 The location of the proposed heavy wharf.

Photo 6 The location of the proposed Public Foreshore Walk along the southern boundary of the subject site.

Photo 7 The portion of Anzac Bridge above the site, showing the beams beneath the bridge which might theoretically provide habitat for threatened microchiropteran bats.

Photo 8 The vegetation across Banks Street, including the Port Jackson Fig, which is likely to provide foraging habitat for the threatened Fruit Bat.

Prepared for Sydney Maritime Museum Ltd.

AQUATIC ECOLOGICAL ASSESSMENT OF PROPOSED NEW SYDNEY HERITAGE FLEET BASE, BANK STREET, PYRMONT, NSW

Job No. 1105-080
September, 2011
Version 1

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1. INTRODUCTION

W.S. Rooney & Associates has been commissioned by Crawford Architects Pty Ltd to conduct an aquatic ecological assessment of the proposed new Sydney Heritage Fleet Base at Bank Street, Pyrmont, NSW on behalf of the Sydney Maritime Museum Ltd. We have been provided with the current architectural drawings of the proposed development; and the requirements of the Director General, Department of Planning, as well as the responses of other government agencies with respect to issues to be considered as part of the environmental assessment. This report describes our assessment of the site and the likely impacts of the proposed development on the marine environment.

The proposed new base for the Sydney Heritage Fleet (SHF) at the end of Bank Street, Pyrmont is underneath the eastern pylon of the Anzac Bridge with water frontage onto the north eastern shore of Blackwattle Bay, about 500m from the Sydney Fish Markets. The entire foreshore has been extensively reclaimed over the past century and a half, as it forms part of the historically industrial port of Sydney, including a number of timber mills in the area until the 1960s. The site is near the head of a series of bisected bays extending southward from Port Jackson for about two kilometres. A major side branch of the Parramatta River forms Darling Harbour, which branches into Johnstons Bay and White Bay; Johnstons Bay branches into Rozelle Bay and Blackwattle Bay. All of these bays are deep water anchorages for large vessels and have been used extensively for shipping berths since the colonisation of Sydney.

Our Principal, Mr. Bill Rooney, conducted a site inspection using SCUBA on 15 September 2011 from 1230-1330 hours. The tide was high (1.5m) at 0942 and low (0.4m) at 1551hours. A complete parallel linear examination of the entire subtidal shoreline within the water lease boundary out to a water depth of -4m (ZFDTG) was undertaken, as well as a brief inspection of the substrate within the remainder of the water lease boundary. Water visibility was approximately 2m. Underwater photographs were taken; however, during the downloading of the photos onto a computer the files were accidently deleted. Although this is unfortunate, their quality was poor due to the low water visibility, and the subject matter was not significant to the discussion which follows.

2. DESCRIPTION OF THE PROPOSAL

The reclaimed land on the western half of the site, surrounding the eastern Anzac Bridge pylon, would be occupied by the SHF, consisting of two main storage buildings with associated amenities, meeting rooms, and exhibition space; and a freestanding Exhibition Pavilion. An entry courtyard fronting Bank St would lead to a single storey building with some mezzanine areas, boat maintenance and equipment storage areas. The eastern half of the site would become a community park.

The proposed water lease area is 197m on the southern boundary x 83m on the western boundary, with a section of reclaimed land encroaching on the northeast corner; the total area of the proposed lease is 13,120m^2 (refer to Figure 1 for a plan of the water lease area and major over-water structures). Within the lease area it is proposed to construct two fixed heavy wharves: one extending in an ‘L’ shape out from the western side of the land-based facility for about 108m into Blackwattle Bay and about 8m wide; and a second smaller fixed wharf in an asymmetrical T-shape extending about 23m off the southern seawall and about 5m wide. Attached to the larger western fixed wharf would be a number of floating pontoons to provide easy access to berthed vessels at all stages of the tide.

3. DESCRIPTION OF THE AQUATIC ENVIRONMENT

The seabed surrounding the site consists of an intertidal boulder rubble slope protecting the toe of a concrete seawall which retains the reclaimed land. Beyond the shallow rock rubble, at an average horizontal distance of about six metres from the concrete seawall and a water depth of approximately -2m (ZFDTG), the substrate gradually becomes muddy sand with erratic boulders strewn across the substrate surface. The muddy sand grades into sandy mud at a water depth of about -3m.

The substrate slope increases at a horizontal distance of about 10m out from the seawall, and water depth increases rapidly to -7m before levelling off somewhat; this is particularly true off the southwest corner of the site, where a depression is apparent on the bathymetric mapping shown in Figure 1. This provides a natural deep water anchorage for vessels berthed at the floating pontoon or against the fixed wharf; the design and orientation of the pontoon berths take advantage of the deeper water near the seawall in the southwest corner. The maximum water depth within the water lease area is approximately -8m; this is achieved off the southwest corner in the natural depression near the seawall, and also at far the western end of the water lease area.

The rock rubble zone is colonised by Sydney Rock oysters (*Saccostrea glomerata*) from mid-tide to about the low water mark; these oysters are dense and large in patches, indicating generally good water quality conditions in this area for a few years, since this species is regarded as a sentinel organism for a number of heavy metals and organic compounds, and is fairly intolerant to bacterial and parasite contamination.

Below the oyster zone the rock rubble is colonised primarily by brown macroalgae; the dominant species are Dwarf kelp (*Ecklonia radiata*), *Sargassum sp., and Dictyota dichotoma*. Amongst the predominant brown macroalgae are the occasional encrusting sponges (mainly the yellow encrusting sponge) and tunicates. There are patches of rock rubble on the western facing slope that have little or no brown macroalgae, and are colonised by calcareous red algae, mostly the ubiquitous feather-like *Corallina officinalis*. Also along the western scree slope the *Sargassum* has been covered in a dense settlement of small encrusting spirorbid worms, probably *Janua pseudocorrugata*, producing coiled limy shells forming flat spirals only a couple of millimeters in diameter, and occurring in the many thousands.

The soft sediment contains an abundance of burrows and mounds of various sizes. The light brown sandy mud on the surface of the substrate is heavily bioturbated with a variety of burrows created by polychaete worms; small crustaceans (predominantly amphipods, decapods, copepods and isopods), including crabs and the common ghost shrimp *Callianassa australiensis*; and gobiid fish (small demersal fish that burrow into the surface sediments). In our experience, normal healthy estuarine sediment usually contains at least 300-400 burrows/m^2; contaminated and/or anoxic sediments generally contain fewer active burrows. The shallow water surface sediment at this location has a density of approximately 600-800 burrows/m^2, suggesting healthy, aerobic surface sediments. The number of burrows is not a direct indicator of the number of animals living in the sediment, since some organisms may have more than one burrow, and some burrows may not house an animal at the time of our inspection. It merely is a rough guide to the relative health of the sediment and its ability to support infauna.

There is occasional litter and rubbish on the substrate surface, such as construction steel, concrete, a metal chair, and various bottles and cans. However, the most significant man-made object is a nearly buried coffer dam that is exposed a meter or more above the substrate surface near the northern water lease boundary. It is a linear structure that trends northeast to southwest for an estimated 20m in a water depth of -4 to -5m at a distance of about 40m from the western seawall. This solid structure may present a navigation hazard to vessels berthing on the north side of the proposed western heavy wharf.

Few fish were sighted during the inspection dive; the only commonly sighted species was Bream (*Acanthopagrus australis*) in small schools near the outer edge of the rubble zone. Curiously, two dead fish (a catfish and a leatherjacket) were sighted on the bottom near the coffer dam on the western slope. Dead fish are virtually never seen in the waters of Sydney Harbour, as they would be rapidly eaten by scavengers/predators. The only explanation that can be offered is that they had been recently discarded by a fishing trawler as by-catch on its return to the commercial fishing berths at the fish market.

There are no mangroves or saltmarsh along the foreshore in this area due to the intense urbanisation of foreshore land in this CBD area of Sydney. There are no seagrasses within the water lease boundary. This may be due to the generally unsuitable rocky habitat within the euphotic zone in this area of Sydney Harbour. Seagrasses generally do not grow below about -2m in the upper reaches of Sydney Harbour where water clarity is much less than near the entrance to the Harbour and adequate sunlight penetration is reduced to about -2m; rock rubble covers most of the substrate margin down to about -2m. Furthermore, the permanent shading provided by the Anzac Bridge over much of the water area for much of the day could well be causing reduced photosynthesis in the area directly under the bridge. The brown macroalgae will tolerate lower light intensities than seagrasses, and so can survive in this reduced light environment where seagrasses may not. Finally, no noxious pest species, particularly the introduced green alga *Caulerpa taxifolia*, were found within the study area.

4. IMPACT OF THE PROPOSAL ON THE AQUATIC ENVIRONMENT

The SHF proposes to construct two fixed heavy wharves and a contiguous public walkway connected to the seawall and the land-based maintenance facilities; in addition, floating pontoons would be attached to the fixed wharves to provide easy access to vessels berthed alongside. Water depth appears to be sufficient for the draft of vessels anticipated to use the facilities: vessels with a draft up to 8m could be accommodated along the heavy wharves. Therefore, no dredging should be required.

4.1 Construction Activities

Construction of the over-water structures will require piles to be bored into the substrate to support the heavy wharves and to locate and secure the floating pontoons. Placement of the piles can create temporary turbidity during boring of rock or jetting of soft sediment to receive the piles. The use of a slow boring technique can reduce the amount of turbidity created. Minor loss of benthic invertebrate life will occur during preparation and placement of the piles.

However, the placement of new hard structures in the water will create opportunities for settlement of epibiota, both animals and plants. If concrete piles are used, they could be sleeved with rubber or other protective cover to prevent dense colonisation by fouling organisms. But over time

even the best protective barriers will be colonised by some marine animals and plants. The presence of epibiota on piles and floating structures, in addition to the protection offered by the increased shading, will encourage fish to graze and seek refuge under the structures, and possibly bring more fish to this area.

4.2 Shading From Over-water Structures

The main impact of the finished structures is considered to be increased shading in the water column and on the substrate under the fixed wharves and floating pontoon. However, as noted above, there is already considerable shading of direct sunlight as a result of the Anzac Bridge directly overhead. The fixed wharves would be raised above the water level, and so would allow some indirect light to penetrate under them; although the greater than average width of these wharves (about 5-8m) will cause increased light attenuation. In addition, the floating pontoons will further attenuate light penetration, and to a greater degree than the wharves because they are resting directly on the water surface. Because the floating pontoon systems are immediately adjacent to both sides of the larger fixed wharf, the effective barrier to indirect light penetration will be the total width of all the structures, which appears to be on the order of 28m when scaled off the plan (Figure 1). This is likely to result in the substrate under the structures being in virtual darkness most of the time; late afternoon sun may allow some indirect light to reach the substrate, particularly in the winter. Early morning sunlight will be impeded by the old Glebe Island Bridge abutment and the relatively tall buildings and structures on the land to the northeast.

The long-term, or 'press' impact of additional permanent shading may change the mix of species living directly under the newly covered areas. Because the new public walkway, fixed wharves, and floating pontoon areas will be contiguous with each other and with the a portion of the shoreline and new buildings, there will be a significantly large area of shallow substrate that will be permanently shaded (4350m^2 or more). The substrate further under the covered structure will receive less diffuse light than the substrate near the edges; the areas furthest from the outer edge will be quite dark at all times.

The effects of shading on benthic macroinvertebrates have been widely studied (e.g. Stocks and Grassle, 2001; Underwood and Kromkamp, 1999; Zajac and Whitlatch, 1982). Many studies have shown a strong positive correlation between shading and a reduction in benthic macrofauna; for example, experiments by Stocks and Grassle (2001) demonstrated a 62% reduction in total density of benthic macrofauna in shaded sediment vs. unshaded, with all other environmental characteristics remaining the same. The effect of shading is to reduce food availability, in the form of benthic microalgae, and to reduce dissolved oxygen levels in the sediment, also as a result of reduced photosynthesis by microalgae. There is strong evidence (e.g. Miller *et al*, 1996; Olafsson *et al*, 1994; Whitlatch, 1981) that food supply to the benthos plays a fundamentally important role in determining the biological properties of benthic infaunal communities; and that benthic microalgae, diatoms in particular, are primary food resources in shallow coastal areas.

Since no seagrasses occur in the area, and the diversity of macroalgae is relatively depauperate, the impact of the reduced light penetration on aquatic flora is not considered to be ecologically significant. However, the infauna within the substrate and epifauna on the rocks and other hard surfaces are more likely to be seriously affected if they are sessile and could not move out from under the structures if warranted. Epifaunal species like oysters are filter feeders and so do not depend on food availability from the surrounding soft sediment or hard substrate, but rather on the quality and suspended food content of water that circulates over them.

However, it is probably reasonable to assume that there would be a reduction in benthic faunal density within soft sediment under the newly shaded area, commensurate with a reduction in benthic microalgae, a major food resource. Dissolved oxygen is unlikely to be a major issue since the overlying waters are assumed to be well-oxygenated and circulation will remain good.

The significance of this limitation in food supply and subsequent reduction in benthic macrofaunal density has to be placed in the context of the amount of area to be affected vs. nearby areas unaffected; the existing quality of substrate in the affected area; and the cumulative effect of a reduction in food supply under all areas of permanent shading.

The area of substrate to be permanently shaded is on the order of 4350m^2 including the public walkway around the seawall. This compares to an over-water lease area of 16,350m^2. Thus the new shaded area comprises approximately 26% of the lease area, which is quite significant.

The soft substrate appears to be in excellent biological condition prior to construction, given the measured density of active burrows per square meter, noted above. Therefore, a reduction in benthic biomass and diversity in soft sediments, and also possibly on, under and around the hard surfaces of rock rubble, over 26% of the site is likely to occur given the likely reduction in food supply under all areas of permanent shading. This is regarded as a significant adverse impact.

4.3 Intended Use of the Site

Another potential impact which may be of concern could result from the intended use of the wharves and pontoons: maintenance of heritage vessels. The spillage of paints, solvents, oils, tars, and other contaminants into the waters of Blackwattle Bay could create adverse impacts on water quality. The accidental dropping of materials, tools, and other maintenance items could increase the amount of litter on the substrate, and the potential escape of harmful chemicals to the marine environment due to leakage and/or decay.

We are not aware of any slipway and associated containment and collection facilities for the waste produced from careening of vessels, bulk fuel storage, spilled oils, and antifoulant paints etc. These are important and essential components of any boat maintenance facility and should be described in detail in the EIS. It is to be expected that any modern boat maintenance facility operating in one of the cleanest harbours in the world should conform to world's best practice for the maintenance of vessels and protection of the environment.

5. IMPACT ON THREATENED AND PROTECTED SPECIES

5.1 Matters of State Significance

In NSW, the responsibility for threatened and protected aquatic species is divided between NSW Industry and Investment (I&I NSW) and the NSW Department of Environment, Climate Change and Water (DECCW). NSW I&I is responsible for threatened and protected freshwater and saltwater fish and invertebrates, and saltwater plants. Other types of animals, including whales, dolphins, seals and water birds, and plants, including freshwater plants, are the responsibility of DECCW.

We reviewed the current NSW Threatened Species lists as part of this study. It appears that the NSW I&I list was last updated in late 2010 (no date given); the DECCW list was last updated on

8 July 2011. We also referred to the Threatened Species Assessment Guidelines (NSW I&I, Feb. 2008) when preparing an assessment of the significance of potential impacts on threatened aquatic species. The discussion that follows refers only to relevant marine species; there are many freshwater plants and animals that are listed on the various schedules of threatened species, but since they would not inhabit our estuarine study area, they are not listed or discussed here.

The identification, conservation and recovery of threatened fish, aquatic invertebrates, and marine plants in NSW are covered by the Fisheries Management Act, 1994 (FM Act). There are currently four marine species listed as Critically Endangered or Endangered in NSW waters in Schedule 4 of that Act:

- Grey nurse shark (*Carcharias taurus*) – Critically Endangered
- Southern bluefin tuna (*Thunnus maccoyii*) - Endangered
- Marine brown alga (*Nereia lophocladia*) – Critically Endangered
- Marine slug (*Smeagol hilaris*) – Critically Endangered

Critically Endangered species face an extremely high risk of extinction in the immediate future as determined by the Fisheries Scientific Committee. Endangered species face a very high risk of extinction in the near future as determined by the Fisheries Scientific Committee. A Critically Endangered or Endangered species is eligible for listing if it has undergone an extremely large (in the case of Critically Endangered) or very large (in the case of Endangered) reduction in abundance, geographic distribution or genetic diversity and is affected by a threatening process.

The Grey nurse shark is found primarily in warm-temperate (from sub-tropical to cool-temperate) inshore waters around the main continental land masses; in Australia, it has been recorded regularly on the east coast from southern Queensland to about the Victorian border, and from southwestern Australia northwards to Shark Bay, Western Australia. Its habitat ranges from rocky inshore reefs (but also occasionally found in the surf zone and in shallow bays) to southerly coral reefs, and down to around 200m depth on the continental shelf. In NSW it is most frequently sighted in or near sandy-bottom gutters or in rocky caves, often around inshore rocky reefs and islands at depths between 15-25m (In Pogonoski *et al*, 2002). Because the preferred habitat for this species is deeper gutters and rocky reefs and offshore islands along the coast, and it is not known to utilise estuaries at any stage of its life cycle, it is very unlikely that the Grey nurse shark would be found at, or near, this estuarine study area.

The Southern bluefin tuna is a pelagic species, occurring in oceanic waters on the seaward side of the continental shelf. The only known spawning ground is between Australia and Java (7-20ºS). They are long-lived (up to 40 years) and highly migratory; they typically migrate around southern Australia and up the east coast to about 30ºS (northern NSW). The Southern bluefin tuna is historically considered to be rare within the NSW state waters boundary of three nautical miles, except for occasional surface schools within three nautical miles in the spring of some years. It does not utilise the estuary for any stage of its life cycle. Therefore, this species would not be expected to occur within the upper Sydney Harbour estuary or be affected by this development.

The marine brown alga, *Nereia lophocladia* has only ever been collected from two localities: Port Phillip Heads in the 1800s, and the north and south sides of Muttonbird Island, Coffs Harbour from 1980 to the present. The species has not since been collected from southern Australia, despite concerted efforts by phycological experts over the past 50 years; it is thus now considered endemic to NSW. Clearly, this species is not likely to occur at, or near, our study area and can be discounted from further assessment.

The marine pulmonate slug, *Smeagol hilaris* has only been collected from a small isolated location at Merry Beach, south of Ulladulla, NSW. It lives in gravel and cobble filled rocky crevices at Merry Beach; little is known about its ecology or reproductive biology. It is most unlikely to occur in this upper estuary study site in Sydney.

There are currently two marine fish species listed in Schedule 5 of the FM Act as Vulnerable in NSW waters. A Vulnerable species is one that is likely to become Endangered if threats continue. The Vulnerable marine species are as follows:

- Black cod (*Epinephelus daemelii*)
- Great white shark (*Carcharodon carcharias*)

The Black cod, or Black rockcod, is a large, reef-dwelling, carnivorous grouper species. Large Black cod are slow moving, territorial, and curious, which makes them very susceptible to line and spearfishing, and their populations have been greatly reduced over the last two centuries. Adult Black cod are usually found in caves, gutters and beneath bommies on rocky reefs. They are territorial and often occupy a particular cave for life. Small juveniles are often found in coastal rock pools; larger juveniles around rocky shores in estuaries. Although there are many earlier records of the Black cod occurring in lower Sydney Harbour in the last 100+ years, there have been no confirmed sightings for at least 30 years. Since this study area has no natural rocky shores or large rock outcrops within the immediate vicinity, it is unlikely that this species would be found within any area of impact resulting from this proposal. The nearest suitable habitat for large juveniles of this species is the rocky slopes surrounding Goat Island at the mouth of Darling Harbour, and along the northern and southern shorelines of Sydney Harbour east of the Harbour Bridge.

The Great white shark is found throughout the world in temperate and sub-tropical oceans, with a preference for cooler waters. They are normally found in inshore coastal waters around rocky reefs and islands, and often near seal colonies. They have been recorded at varying depths down to 1200m. There are at least two records of the Great white shark inside Sydney Heads over 100 years ago, but they are not known to require estuarine habitat for any stage of their life cycle and, therefore, are not expected to occur at or near our study area.

There are currently three marine animal species that are presumed to be extinct (Schedule 4, Part 4):

- Green sawfish (*Pristis zijsron*)
- Haswells caprellid (*Metaprotella haswelliana*)
- Marine worm (*Hadrachaeta aspeta*)

The Green sawfish (*Pristis zijsron*) was a widely distributed species, found predominantly in the tropics, but has occasionally been caught as far south as Sydney and Jervis Bay; there is a museum specimen reported to be from the Parramatta River, in Sydney (In Pogonoski *et al*, 2002). The Green sawfish inhabits muddy bottoms, and enters estuaries; it was frequently found in shallow water, but has been extremely rare along the east coast of Australia for the past 30-35 years. The last Green sawfish caught in NSW was at the Clarence River in 1972. It would seem unlikely that this species would be found in our study area; but since it is known to prefer shallow estuarine habitat and it has been collected from upper Sydney Harbour in the past, it cannot be completely excluded from ever occurring within or near our study area.

Haswells caprellid (*Metaprotella haswelliana*) was first described from a specimen discovered in 1882 from Port Jackson. The species has also been recorded from Port Phillip, Victoria and Emu Point, Western Australia. It has not been recorded from southern Australia despite

targeted research for the past 35 years. Haswells caprellid is a very small marine amphipod, only a few millimeters long. It could be equated to a very small preying mantis, although a creature of the sea. They attach themselves to marine algae and seaweeds, where they prey on small organisms moving or carried past in the water.

The marine worm *Hadrachaeta aspeta* is a polychaete in the family Terebellidae, and is the only known species in the genus. It is not known outside of eastern Australia, and has been recorded only from central NSW to Moreton Bay, Qld. Recorded locations where it has been found are Patonga Creek, lower Hawkesbury River; Yamba, NSW; and Serpentine Creek, Brisbane, Qld. The species has not been collected since 1975. It is a benthic tubicolous living species preferring enclosed bays estuaries where it lives in intertidal muddy habitats on the seaward side of mangroves; nothing is known about its life history. It attains 25mm in length. Targeted surveys along the NSW coast have failed to find it; the last specimen from the Sydney area was taken at Brooklyn in 1975. Because it apparently prefers intertidal mud adjacent to mangroves and may have been affected by threatening processes that still operate in Sydney Harbour, such as the accumulation of toxins, including antifoulants, in the sediments of enclosed waters, it is not considered likely that this species would occur at or near this site.

There is one marine plant species, previously found in Sydney Harbour, which is now presumed to be extinct (Schedule 4, Part 4):

- Bennetts seaweed (*Vanvoorstia bennettiana*)

This species of red alga hasn't been definitely located in nature during the previous 100+ years, despite considerable searching of known and likely habitat during that period.

Bennetts seaweed (*Vanvoorstia bennettiana*) is a marine red algal species that has only ever been collected from two localities in Port Jackson, Sydney Harbour. The species was first discovered in 1855 from Spectacle Island (about five kilometers via water from this study area) and was subsequently collected in large quantities from Shark Island (about three kilometers from the entrance to Sydney Harbour) in 1886. At that time the species was considered abundant.

Bennetts seaweed has suffered a complete population decline. The species is likely to have disappeared as a result of human activities such as shipping traffic, dredging, and urban runoff, all of which may cause heavy siltation. Extensive surveys of Port Jackson (particularly the two known collection areas) and the entire NSW coastline have failed to rediscover it since its last collection in 1886. Bennetts seaweed is currently listed as a 'species presumed extinct' in NSW. Although Bennetts seaweed is presumed extinct, there is a possibility that it may still exist in some areas of Sydney Harbour. However, our surveys within the Harbour over many years, including the inspection at this site, have not observed anything that approaches the description of this species by I&I Fisheries (Schedule 4 of the FM Act).

There is one endangered marine population listed in Schedules 4, 4A, or 5 of the FM Act. Endangered populations face a very high risk of extinction in the near future as determined by the Fisheries Scientific Committee. The population must have undergone a very large reduction in abundance, distribution or genetic diversity and be affected by a threatening process. The population is the seagrass *Posidonia australis* in Sydney Harbour. The growth and restoration of *Posidonia* is very slow and regeneration is often unsuccessful.

The slow development of individual plants, the likely low level of dispersal of fruit and seeds and the slow expansion rate of meadows mean that existing areas of *Posidonia australis* within the

estuaries and embayments of NSW can effectively be considered as isolated populations in respect to their long-term survival. A combination of anecdotal and scientific information is available that indicates that significant losses in area have occurred in the populations of the seagrass *Posidonia australis* within a number of estuaries and embayments in the Sydney and Central Coast regions of NSW.

There are no seagrass beds within this study area; the nearest known *Posidonia* beds are east of the Sydney Harbour Bridge. The reduced sunlight caused by the Anzac Bridge is unlikely to encourage the establishment of seagrass beds in this area. Therefore, it is unlikely that this proposal would adversely affect this threatened population.

There are three Key Threatening Processes in NSW marine waters (Schedule 6 of the FM Act) that each adversely affect at least two threatened species, populations or communities, or could make other species become threatened:

- Shark meshing program in NSW waters;
- Introduction of non-indigenous fish and marine vegetation species to the coastal waters of NSW;
- Hook and line fishing in areas important for the survival of threatened fish species.

The shark meshing program in NSW does not affect this proposal nor does this proposal affect shark meshing in any way, so it can be eliminated from further consideration.

The introduction of non-indigenous fish and marine vegetation species to coastal waters of NSW is a Key Threatening Process that could potentially be abetted by the operation of a boat maintenance area if vessels were to discharge bilge water or ballast water that contained non-indigenous species; or fishing equipment (particularly nets or traps) brought into the marina area from elsewhere could inadvertently transport non-indigenous species such as the noxious weed *Caulerpa taxifolia*.

Hook and line fishing in areas important for the survival of threatened fish species could become an issue at a boat berthing facility if fishing were allowed off the hardstand and pontoon areas, since our research has indicated that the habitats at or near the marina complex could conceivably support a limited number of protected species (see following paragraphs). However, it is also true that this facility would not be recognised as <u>important</u> for the survival of any threatened or protected species, in the sense that it is not regarded as critical habitat for any local species or population. Furthermore, fishing is not likely to be permitted on or around this proposed storage and maintenance complex.

Threatened species are one category of protected fish. There are also a number of other rare fish that are protected from fishing or collecting. Although populations of these species are not currently declining, they must be protected so that they do not become threatened with extinction at some time in the future.

Marine and estuarine fish listed as protected by I&I Fisheries are:

- Ballina angelfish (*Chaetodontoplus ballinae*)
- Bluefish (*Girella cyanea*)
- Eastern blue devil fish (or Bleekers devil fish) (*Paraplesiops bleekeri*)
- Elegant wrasse (*Anampses elegans*)

- Estuary cod (*Epinephelus coioides*)
- Giant Queensland groper (*Epinephelus lanceolatus*)
- Herbsts nurse shark (*Odontaspis ferox*)
- All Syngnathiformes
  Species in the families Syngnathidae, Solenostomidae and Pegasidae are collectively known as Syngnathiformes. This includes seahorses, seadragons, pipehorses, pipefish, ghost pipefish and seamoths.

The Ballina angelfish occurs in northern NSW around Coffs Harbour, Ballina, Northern Solitary Islands, and the Balls Pyramid area at Lord Howe Island. It is generally found in deeper water (25-125m) around rocky reefs. Because of its distribution and habitat requirements, it would not be found at, or near, this study area.

The Bluefish is an ocean dwelling species, and does not normally enter estuaries or rivers. It has been reported from southern Queensland to about Eden on the south coast of NSW on coastal and offshore rocky reefs in water depths of 5-25m. It is common at Lord Howe Island. However, it is never common along the NSW coast; more frequent occurrences have been reported within the Solitary Islands Marine Park and off Port Stephens. Since Bluefish seem to prefer deeper offshore island habitats, particularly further north in NSW, and may never have been very common in NSW, it is very unlikely to occur at or near our study area.

The Eastern blue devil fish is a shy, secretive species found in caves, crevices and under ledges on inshore reefs and estuaries. They are distributed along the NSW coast from southern Queensland to Montague Island on the NSW south coast. They are a benthic inshore reef inhabitant, and can be found in shallow water in estuaries as well as in deep waters offshore, in depths ranging from 3-30m. Because they are a rocky reef species, and they are not known to utilise soft bottom or seagrass beds for foraging or as juveniles, it is highly unlikely that this species would be found at or near this study area. It may occur nearby along the rocky northern shoreline of Sydney Harbour, Grotto Point, and/or at Middle Head, but the unnatural habitat at Blackwattle Bay is not suitable.

The Elegant wrasse is a widespread but uncommon species distributed from southern Queensland to Montague Island on the NSW south coast, particularly around inshore islands and reefs. They are also common on Lord Howe Island. They are found in different habitats depending on the stage of their life cycle: juveniles are often found among seaweeds (macroalgae) in coastal bays and harbours. Juveniles travel in small schools and feed in short bouts. Larger juveniles are most common around inshore islands and rocky reefs along the coast. Adults occupy deeper rocky reef habitat to over 30m. Thus, their habitat preference for coral and rocky reefs as sub-adults and adults, and macroalgae beds in open bays and harbours as juveniles, implies that this species is unlikely to be found at this study area, although it may occur nearer the entrance to Sydney Harbour.

Estuary cod occur primarily in the tropical and warm temperate waters of Queensland and Northern Territory, but are known to occur southward as far as the Sydney area. They inhabit turbid coastal reefs, and are often found in brackish water over mud and rubble. They are usually found in the lower reaches of estuaries and protected silty reef habitats; they are also taken offshore to depths of 100m. Adults are usually found at the base of small drop-offs associated with large caves or wrecks in deeper water. Juveniles are common in the shallow waters of estuaries over sand, seagrass, mud, or gravel, and among mangroves. This species is more common in tropical waters, and the central NSW coast is the southern extreme of its range. The nearest collected specimen was from Lake Budgewoi (33ºS). For this reason, as well as its habitat preference as adults suggest, it is

unlikely to be present near Blackwattle Bay, even though juveniles could conceivably utilise the habitats found in this study area.

The Giant Queensland groper, or Queensland grouper, is one of the largest reef-dwelling fish in the world and has a wide distribution throughout the tropical waters of the Indo-West Pacific. It rarely strays into cool temperate waters; however, a museum specimen has been collected from the Hawkesbury River. This species has been caught in water up to 100m deep, but more often is found in shallower water. It is commonly seen in caves on reefs and around wrecks; adults, as well as juveniles, are found in estuaries. Juveniles may occur in brackish water and adults may be found in deep estuaries. Therefore, estuaries and coral reefs are important habitat for its survival; however, it is unlikely to be a regular inhabitant of the cooler water around Sydney, nor to breed here; and the narrow entrance to Darling Harbour would preclude larger Queensland groupers from passing up to the other embayments.

Herbsts nurse sharks are a rarely encountered species that looks very similar to the Grey nurse shark. It lives on or closely associated with the bottom in deep water on the continental shelf and upper slopes to depths of about 850m. It is only very occasionally found in shallower waters. It is a large shark (up to 3.76m long; over 300kg) that prefers the deeper open waters off the NSW coast; therefore, it is very unlikely to venture into an estuary, especially one with a narrow entrance such as Darling Harbour.

The Syngnathiformes, or seahorses and pipefish-like fishes, comprise three families: the Syngnathidae, Solenostomidae, and Pegasidae; these include 37 species that are known to occur in NSW. They are all protected in NSW since July 2004. Along the NSW coast Syngnathiformes are found in a variety of habitats ranging from deep reefs to coastal algae, seagrass habitat, and around man-made structures such as jetties, piles and mesh nets. Since none of these habitats or man-made structures presently exist in the study area, it is unlikely that any Syngnathiformes presently occur at the site; but they may become resident around the proposed fixed wharves in the future.

Marine vegetation such as mangroves, seagrasses and seaweeds are important fish habitat and must also be protected to maintain the health of aquatic communities and the productivity of our fisheries.

Marine vegetation listed as protected by I&I Fisheries:

- All seagrass, seaweed and mangrove species are protected.

The NSW Threatened Species Conservation (TSC) Act 1995 is administered by the DECCW; Schedules 1 and 2 of that Act list the endangered and vulnerable (respectively) species, populations and ecological communities in NSW. It was last updated on 8 July 2011.

The marine species listed as endangered in Schedule 1 are one reptile and two mammals:

- Loggerhead turtle (*Caretta caretta*)
- Dugong (*Dugong dugon*)
- Blue whale (*Balaenoptera musculus*)

The marine species listed as vulnerable in Schedule 2 of the TSC Act are two reptiles and five mammals:

- Green turtle (*Chelonia mydas*)

- Leathery turtle (*Dermochelys coriacea*)
- Australian Fur seal (*Arctocephalus pusillus doriferus*)
- New Zealand Fur seal (*Arctocephalus forsteri*)
- Sperm whale (*Physeter macrocephalus*)
- Humpback whale (*Magaptera novaeangliae*)
- Southern right whale (*Eubalaena australis*)

There is one endangered population that lives in and adjacent to the marine environment and is listed by the TSC Act:

- Little penguin (*Eudyptula minor*).

There is a breeding colony of Little penguins in the Little Manly Point area; and their breeding areas around Manly Cove, Little Manly Cove, and Spring Cove are declared critical habitat by the TSC Act. Although there are no areas of critical habitat known to occur near the area of this proposal, the Little penguin forages all over Sydney Harbour, including most of the large seagrass beds. Since there are no suitable foraging areas for this penguin in our study area, it is unlikely to be found there.

None of the other reptile and mammal species listed in Schedules 1 and 2 of the TSC Act are likely to utilise the habitats within this study area because they are all open ocean or coastal species, with breeding habitat preferences for offshore islands in more southern waters, in the case of the fur seals, and in more tropical waters, in the case of the turtles and dugong. Whales and turtles migrate very long distances and may only visit or pass by the Sydney region for brief periods during each migration. However, it is possible, and has been occasionally documented, that an individual from one or more of these species might stray into the protected habitat of lower Sydney and Middle Harbours during their annual migrations along the coast, or to seek refuge from storms at sea. But it is most unlikely that they would stray into Darling Harbour and continue on to Blackwattle Bay.

5.2 Matters of National Environmental Significance

If the proposal were deemed to have a significant impact upon matters of national environmental significance, it would require approval under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), in addition to any approvals required under NSW legislation.

The EPBC Act currently identifies six matters of national environmental significance:

- World Heritage areas;
- Ramsar Wetlands of international significance;
- Listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth marine areas, defined as that part of the Exclusive Economic Zone (EEZ) that is not part of any state or territory waters, i.e. from 3-200 nautical miles from the shoreline;
- Nuclear actions, involving the mining, milling, transport, or use of uranium.

There are no World Heritage areas, Ramsar Wetlands, or nuclear activities near this proposed development; the Commonwealth marine areas of interest are more than three nautical miles (5.55km) from this study area.

However, the EPBC Act lists a number of threatened and/or migratory marine species that occur in NSW and must be acknowledged in any impact assessment. In addition to the marine, aquatic and/or migratory and pelagic birds that are listed, the gazetted threatened marine and/or migratory species lists includes all seasnakes, seals, crocodiles, whales, marine turtles, Syngnathiformes (includes seahorses, seadragons, pipehorses, pipefish, ghost pipefish and seamoths), penguins (including the Little penguin, *Eudyptula minor*), Grey nurse shark, Green sawfish, Great white shark, Whale shark, and the dugong. The threatened marine species list was last updated on 7 March 2008; the migratory species list was last updated on 21 June 2007.

Seals, whales, marine turtles, Syngnathiformes, Grey nurse shark, Green sawfish, Great white shark, and dugong have been addressed under state legislation (above).

Most seasnakes naturally occur in the northern tropical waters of Australia. However, some of these more northerly species are occasionally found in waters around Sydney or are washed up on our shores during storms, as a result of being carried south on the East Australia Current. They are usually injured or sick and do not survive. There are 32 species of seasnakes listed on the EPBC Act; of these, only three naturally occur in NSW waters, and only one species, the Yellow-bellied seasnake (*Pelamis platurus*) naturally occurs as far south as the Sydney area. However, this is a pelagic species that spends its entire life at sea; it is therefore, very unlikely to occur in upper Sydney Harbour and our study area.

There is one species of salt water crocodile in Australia, *Crocodylus porosus*. It is naturally found across northern Australia and down the east coast to about Frazer Island in southern Queensland, but does not naturally occur in NSW waters.

A single individual of the migratory Whale shark (*Rhincodon typus*) was collected off Sydney (34º00'S) in 1965 (Pogonoski *et al*, 2002). The Whale shark is an oceanic and coastal, tropical to warm-temperate pelagic shark often seen far offshore but coming close inshore and sometimes entering the lagoons of coral atolls. It is generally found in warmer and more open waters and is unlikely to occur in our highly altered and constricted estuarine study area.

The Australian Department of Environment and Heritage commissioned a review of the biological characteristics and conservation status of 114 species of threatened and potentially threatened marine and estuarine fish (Pogonoski *et al.*, 2002). Of the 114 species reviewed in that document, 66 species are reported to occur in NSW waters; and of the 66 potential NSW species, 15 species do not have synopses of biological characteristics and habitat requirements upon which to base a risk assessment, and 21 species are listed as data deficient. Many of the remaining 30 NSW species are already included in the threatened species lists of state legislation discussed above, and so need not be listed a second time here. However, the following species (a few of which may be data deficient) do not appear to be listed elsewhere and warrant further consideration:

- Harrisson's deepsea dogfish (*Centrophorus harrisoni*)
- Southern dogfish (*Centrophorus uyato*)
- School shark (*Galeorhinus galeus*)
- Common sawshark (*Pristiophorus cirratus*)
- Eastern blue groper (*Achoerodus viridis*)
- Double-header (*Coris bulbifrons*)
- Gemfish (Eastern stock) (*Rexea solandri*)

- Orange roughy (*Hoplostethus atlanticus*)
- Dusky shark (*Carcharhinus obscurus*)
- Sandbar shark (*Carcharhinus plumbeus*)
- Broadnose sevengill shark (*Notorynchus cepedianus*)
- Estuary stingray (*Dasyatis fluviorum*)
- Sculptured frogfish (*Halophryne queenslandiae*)
- Australian handfish (*Brachionichthys sp.*)
- Malabar grouper (*Epinephelus malabaricus*)
- Greasy grouper (*Epinephelus tauvina*)
- Striated wirrah (*Acanthistius paxtoni*)
- Elegant wrasse (*Anampses elegans*)
- Spotted wobbegong shark (*Orectolobus maculatus*)
- Banded wobbegong shark (*Orectolobus ornatus*)

A number of these species are very unlikely to occur at, or near, our study area because their range does not include the Sydney Region and/or their habitat requirements are entirely different to the estuarine conditions encountered at Blackwattle Bay. For these reasons they can be eliminated from further consideration.

The dogfishes (type of shark) are demersal deep water species of the continental slope, found in depths exceeding 220m off the NSW coast; they do not appear to utilise estuaries at any stage of their life cycle, and therefore are unlikely to occur in the study area. Similarly, the Common sawshark (*Pristiophorus cirratus*) is a demersal deep water (20 to at least 450m) species of the continental shelf and upper slopes; it is found generally south of Sydney, does not appear to utilise estuaries in any stage of its life cycle, and is unlikely to occur in this estuarine habitat.

The School shark (*Galeorhinus galeus*) occurs demersally and in midwater over the continental shelf and upper slopes from inshore to at least 600m and probably deeper. However, pregnant females move into shallow, partly enclosed bays and estuaries in late spring and early summer to pup (by ovoviviparity) before moving to offshore feeding grounds. Most juvenile sharks depart the pupping grounds in late summer and move offshore, but many return to the estuary of their birth the following spring before permanently departing for offshore waters. Because nursery areas are in bays and estuaries, they are vulnerable to habitat destruction, such as loss of seagrass beds and water pollution. It is not known whether the seabed within, or near, the proposed development are utilised by juvenile School sharks, but habitat degradation of any suitable inshore nursery area is a potential threat to juveniles and breeding females in south-eastern Australia.

The Eastern blue groper (*Achoerodus viridis*) inhabits estuaries as well as inshore rocky reefs all along the NSW coast. Juveniles up to 10cm will inhabit seagrass beds, and then move to vegetated rocky reefs. Adults venture over large areas of rocky reef, and out to a depth of 60m. Therefore, seagrasses are important habitat for juveniles; since none are found in this study area it is unlikely that any of this groper species are found at or near this site.

The Double-header (*Coris bulbifrons*) has a very restricted distribution, and is found only at Lord Howe Island and on the north-central coast of NSW from Byron Bay south to about Port Macquarie; it has never been found in the Sydney Region, and its preferred habitat is shallow rocky and coral reefs and rubble. No mainland specimens have been documented since 1970. It is therefore, most unlikely to occur in the upper estuary of Sydney Harbour.

The Gemfish (*Rexea solandri*) is found in deeper continental shelf waters (100-700m) and does not appear to utilise the estuaries for any part of its life cycle. It is, therefore, unlikely to occur near our study area.

The Orange roughy (*Hoplostethus atlanticus*) is found only in very deep water along the central NSW coast southward, around the Tasmanian continental shelf and rise and westward to south western Australia. They form demersal schools on the mid-slope and seamounts at depths of between 500-1400m, but they are most common between 800-1000m. They have an aggregating behaviour for spawning in the open ocean, and do not utilise shallow water or estuaries for any stage of their life cycle. They would not be found in any part of Sydney Harbour and need not be assessed any further.

The Dusky shark (*Carcharhinus obscurus*) occurs on the continental shelf from shallow to open oceanic waters in tropical to warm-temperate seas, and has been recorded as far south as 34º56'S, just south of Sydney. It apparently avoids areas of low salinity, and is not known to enter estuaries, and would not be expected to occur near our study area.

The Sandbar shark (*Carcharhinus plumbeus*) has a cosmopolitan but patchy distribution in tropical and warm-temperate waters, and has only been recorded as far south as Coffs Harbour, NSW. Therefore, it is unlikely to find this species at, or near, the study area.

The Broadnose sevengill shark (*Notorynchus cepedianus*) is a wide-ranging species that occurs in temperate waters of Australia from Sydney southward and westward to Esperance, W.A. It inhabits inshore bays and estuaries, but is also found offshore to depths of at least 200m. It occurs on or near the bottom, but may come to the surface in inshore waters.

A relatively large number of sevengill sharks have been caught in the beach meshing program off Sydney's beaches in the past 30 years or so, and it is thought that inshore bays and estuaries are important nursery areas for this species. Little is known of the biology of this species, but there is no direct evidence of a decline in numbers. However, because it is slow growing and late maturing, it could well have a low recovery capability; for this reason it is listed as Data Deficient, with the recommendation for further biological studies. Since it has commonly been caught along Sydney's beaches, and with the knowledge that it probably utilises estuaries as nursery areas, it is considered possible that it could occasionally be found in the lower harbour but would not be expected near this study area.

The Estuary stingray (*Dasyatis fluviorum*) has an inshore tropical to subtropical distribution from Forster, NSW north to at least the central Queensland coast. The range of this species appears to have contracted in the last 100 years, as there are records of it from Port Jackson, NSW in the late 1880's, but it has not been recorded here since. Although it does inhabit mangrove-fringed rivers and estuaries, its contracted range to more northerly latitudes suggests it is very unlikely to occur within our study area.

The Sculptured frogfish (*Halophryne queenslandiae*) has a very sparse distribution between Dunk Island, Qld and South Solitary Island, NSW (near Coffs Harbour); although it has been recorded in estuaries, it is more likely to be found in clear water around offshore islands in sandy gutters and among rocks and algae at depths of 20m or more. Therefore, it is not likely that this species would be found at or near our study area.

The Australian handfish (*Brachionichthys sp.*) occurs from southern Queensland to South Australia and Tasmania, but its preferred habitat is a soft muddy or shelly bottom on the continental shelf from 40-200m water depth; it is rarely seen in shallow water. Therefore, because of its mainly offshore habitat, we consider it very unlikely that it would be found in the shallow, sandy estuarine environment of upper Sydney Harbour.

The Malabar grouper (*Epinephelus malabaricus*) is strongly territorial and solitary, and occurs all around tropical northern Australia and down the east coast as far as the Sydney area in NSW. Adult habitat is rock ledges and caves along the coast, but smaller juveniles are recorded from estuaries. However, they are not tolerant of excessive salinity changes, so would probably depart an estuary during a significant rain event. They are assumed to spawn offshore. The closest museum record of this species is from Brisbane Waters at the mouth of the Hawkesbury River. Although estuarine habitats are important nursery areas for this species, it is considered unlikely that it would be impacted by this development proposal because of the lack of suitable rocky ledges and overhangs in the immediate area.

The Greasy grouper (*Epinephelus tauvina*) occurs in NSW northward from near the Manning River Heads (Taree); its preferred habitat is clear water around coral reefs. Therefore, it range and habitat requirements do not suit the estuarine habitat and location of this study area, and so it is not likely to occur here.

The Striated (or Orange-lined) wirrah (*Acanthistius paxtoni*) is a rare species, only recorded from Sydney Harbour (Watsons Bay) and Seal Rocks in NSW. Almost nothing is known of its biology but it is thought to prefer deeper rock reefs than other species of the serranid family. More specimens and more information is required to make any judgements about the ecology and distribution of this species, but based on what is known, it is considered unlikely that it would be impacted by the shallow water development of this proposal.

The Elegant wrasse (*Anampses elegans*) is basically a coral reef species, found mainly in sub-tropical and warm-temperate waters, with stragglers pushed further south on the warm East Australia Current. It is abundant at Lord Howe Island, and it is apparently recorded as far south as Montague Island as well as Sydney Harbour, although the middle of its range is between Coffs Harbour and Port Stephens. In these habitats it occurs on rocky reefs as adults; juveniles are found in algal beds in coastal bays and harbours. Adults and sub-adults are more prevalent around inshore islands along the NSW coast than directly on the coast or in rivers or estuaries. Because there are no significant rocky reefs or algal beds surrounding this proposed development, and it is near the southern limit of its range, this species is unlikely to occur at or near the development site.

The Spotted wobbegong shark (*Orectolobus maculatus*) is most common on algal-covered rocky reefs, but has been trawled to 110m water depth. It occurs mainly on rocky reefs around southern Australia, but occasionally over seagrass meadows and bare sand, and also over coral reefs, and under piers. Juveniles occur in estuaries and are occasionally found over seagrass beds. Therefore, estuaries and seagrass beds may be important nursery areas for this species; since no seagrass beds occur at this site it is very unlikely that this species of shark would occur within our study area.

The Banded wobbegong shark (*Orectolobus ornatus*) is usually found in more offshore environments around rocky reefs, coral reefs, offshore islands, and on the continental shelf to at least 100m depth. It seems to prefer clearer water reefs than the Spotted wobbegong, and there is no

evidence of juveniles utilising seagrass beds or the protection of estuaries. For these reasons it is not considered likely to occur at, or near, this estuarine study site.

In summary, we have examined in this section the distribution and habitat requirements of the Australian threatened and potentially threatened marine and estuarine fishes (Pogonoski *et al*, 2002), excluding those species already listed in Schedules of state legislation. We conclude from that research that most of these species can be eliminated from further consideration of impact from this proposal, based on known distribution and/or habitat requirements. However, there is possibly one fish species on that modified Commonwealth list that could utilise some of the habitats found at and near this development proposal at one or more stages of its life cycle (usually the juvenile stages):

- School shark (*Galeorhinus galeus*)

This species is not deemed Endangered or Vulnerable, based on IUCN criteria, and so is not listed as such by the EPBC Act. Therefore, a permit is not required by the Commonwealth EPBC Act. The School shark is listed as LR(cd): Lower Risk (conservation dependent). This means that careful monitoring of catch data, stock assessments, and continual review of management arrangements are needed.

6. ASSESSMENT OF IMPACT

The potentially significant impacts of the proposal on aquatic ecology can be summarised as follows:

- There will be significant increased shading of the water lease area (approximately 26%) which is likely to reduce the diversity and density of benthic infauna living under the shaded area. This would be caused by a reduction in the primary food source for these invertebrate animals, benthic microalgae. It is also likely to cause a reduction in dissolved oxygen in the sediment, also caused by a reduction in benthic microalgae. The area is already subject to light attenuation from the overhead Anzac Bridge, which prevents direct sunlight from penetrating much of the water lease area for much of the day.
- The intended use of the over-water structures and nearby hardstand areas is the maintenance of boats, which inherently poses a risk to the water and sediment quality in the immediate area.
- There are no known threatened or protected species living in or utilising the waters within the lease boundary; however, it is remotely possible that the School shark (declared potentially threatened by the Commonwealth EPBC Act) could occasionally be found at or near the site. For this reason, every effort should be made to maintain excellent water quality and prevent any accumulation of toxic compounds in the surface sediments.

7. RECOMMENDATIONS TO MITIGATE ECOLOGICAL IMPACTS

During construction of the wharves localised turbidity is likely when preparing the substrate to receive support piles. A slow boring technique can minimise resuspension of surface sediments and the smothering of nearby macroalgae and epifauna on rock rubble.

The impact of shading could be minimised by the use of open grated aluminium on the deck of the wharves, if not continuously then at least at regular intervals of say two meters every ten

meters of decking. This would allow diffuse light to penetrate to the seabed and may well provide sufficient light to sustain benthic microalgae. Some additional research into the adequate amount of light penetration and the effectiveness of such a measure could be undertaken prior to commencement of construction.

The prevention of spillages and losses of liquids and solids from the continual maintenance activities could be controlled by prohibiting any activity on berthed vessels that could produce such a discharge into the water; and employing best practice containment, collection, and treatment facilities in hardstand or slipway areas where boat maintenance can be safely undertaken.

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KEY	
+	Non-indigenous native
*	Introduced Species
X	Species native and detected in close proximity to the subject site

STATUS	SCIENTIFIC NAME	COMMON NAME
FLORA		
	Apiaceae	
*	*Bifora testiculata*	Bird's-eye
	Araliaceae	
*	*Hedera helix*	
	Asteraceae	
*	*Conyza bonariensis*	Flaxleaf Fleabane
*	*Gamochaeta americana*	Cudweed
*	*Sonchus oleraceus*	Common Sowthistle
*	*Taraxacum officinale*	Dandelion
	Brassicaceae	
*	*Lepidium africanum*	-
	Caryophyllaceae	
*	*Cerastium glomeratum*	Mouse-ear Chickweed
	Casuarinaceae	
	Casuarina glauca	Swamp Oak
	Euphorbiaceae	
*	*Euphorbia peplus*	
	Fabaceae - Faboideae	
*	*Trifolium repens*	White Clover
	Gentianaceae	
*	*Centaurium erythraea*	Common Centaury
	Moraceae	
X	*Ficus rubiginosa*	Port Jackson Fig
	Plantaginaceae	
*	*Plantago lanceolata*	Lamb's Tongues
	Poaceae	
*	*Avena barbata*	Bearded Oats
*	*Bromus catharticus*	Prairie Grass
+	*Cynodon dactylon*	Common Couch
*	*Eragrostis curvula*	African Lovegrass
*	*Lolium perenne*	Perennial Ryegrass
*	*Pennisetum clandestinum*	Kikuyu Grass
*	*Poa annua*	Winter Grass
*	*Sporobolus africanus*	Parramatta Grass
	Ulmaceae	
*	*Celtis sinensis*	Japanese Hackberry
FAUNA		
	Columbidae	
X	*Ocyphaps lophotes*	Crested Pigeon
	Laridae	
X	*Larus novaehollandiae*	Silver Gull
	Phalacrocoracidae	
X	*Phalacrocorax varius*	Pied Cormorant
X	*Phalacrocorax sulcirostris*	Little Black Cormorant
	Sturnidae	
*	*Acridotheres tristis*	Common Myna

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Search Results

Your selection: Fauna, threatened species, LGA - SYDNEY returned a total of 572 records of 6 species.
Report generated on 17/10/2011 - 09:57 (Data valid to 25/04/2010)

view map | search again | clear selection

Choose up to 3 species to map.

** Exotic (non-native) species*

Amphibia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Hylidae						
	☐	Litoria aurea	Green and Golden Bell Frog	E1	5	

Aves	Map	Scientific Name	Common Name	Legal Status	Count	Info
Accipitridae						
	☐	Erythrotriorchis radiatus	Red Goshawk	E4A	1	
Columbidae						
	☐	Ptilinopus superbus	Superb Fruit-Dove	V	1	
Laridae						
	☐	Sterna albifrons	Little Tern	E1	246	
Strigidae						
	☐	Ninox strenua	Powerful Owl	V	2	

Mammalia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Pteropodidae						
	☐	Pteropus poliocephalus	Grey-headed Flying-fox	V	317	

** Exotic (non-native) species*

Choose up to 3 species to map.

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Search Results

Your selection: Flora, threatened species, LGA - SYDNEY returned a total of 13 records of 10 species.
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Choose up to 3 species to map.

** Exotic (non-native) species*

Plants	Map	Scientific Name	Common Name	Legal Status	Count	Info
Dilleniaceae						
	☐	Hibbertia puberula		E1	1	
Fabaceae (Mimosoideae)						
	☐	Acacia gordonii		E1	1	
	☐	Acacia terminalis subsp. terminalis	Sunshine Wattle	E1	2	
Lamiaceae						
	☐	Prostanthera marifolia	Seaforth Mintbush	E4A	3	
Myrtaceae						
	☐	Eucalyptus fracta	Broken Back Ironbark	V	1	
	☐	Eucalyptus pulverulenta	Silver-leafed Gum	V	1	
	☐	Syzygium paniculatum	Magenta Lilly Pilly	E1	1	
Poaceae						
	☐	Dichanthium setosum	Bluegrass	V	1	
Proteaceae						
	☐	Grevillea parviflora		V	1	
	☐	Persoonia hirsuta	Hairy Geebung	E1	1	

** Exotic (non-native) species*

Choose up to 3 species to map.

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Search Results

Your selection: Fauna, threatened species, LGA - SYDNEY HARBOUR (UNINCORPORATED) returned a total of 54 records of 24 species.
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view map | search again | clear selection

Choose up to 3 species to map.
** Exotic (non-native) species*

Aves	Map	Scientific Name	Common Name	Legal Status	Count	Info
Accipitridae						
	☐	Pandion haliaetus	Osprey	V	2	
Anseranatidae						
	☐	Anseranas semipalmata	Magpie Goose	V	1	
Ardeidae						
	☐	Ixobrychus flavicollis	Black Bittern	V	1	
Burhinidae						
	☐	Burhinus grallarius	Bush Stone-curlew	E1	1	
Charadriidae						
	☐	Charadrius mongolus	Lesser Sand-plover	V	1	
Diomedeidae						
	☐	Diomedea exulans	Wandering Albatross	E1	1	
	☐	Thalassarche melanophris	Black-browed Albatross	V	1	
Haematopodidae						
	☐	Haematopus fuliginosus	Sooty Oystercatcher	V	2	
	☐	Haematopus longirostris	Pied Oystercatcher	E1	1	
Laridae						
	☐	Sterna albifrons	Little Tern	E1	1	
	☐	Sterna fuscata	Sooty Tern	V	2	
Procellariidae						
	☐	Puffinus carneipes	Flesh-footed Shearwater	V	1	
Psittacidae						
	☐	Lathamus discolor	Swift Parrot	E1	1	
Spheniscidae						
	☐	Eudyptula minor	Little Penguin in the Manly Point Area (being the area on and near the shoreline from Cannae Point generally northward to the point near the intersection of Stuart Street and Oyama Cove Avenue, and extending 100 metres offshore from that shoreline)	E2	5	
Strigidae						
	☐	Ninox strenua	Powerful Owl	V	2	

Mammalia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Balaenidae						

	Eubalaena australis	Southern Right Whale	V	3	
Balaenopteridae					
	Megaptera novaeangliae	Humpback Whale	V	1	
Otariidae					
	Arctocephalus forsteri	New Zealand Fur-seal	V	2	
	Arctocephalus pusillus doriferus	Australian Fur-seal	V	8	
Peramelidae					
	Perameles nasuta	Long-nosed Bandicoot, North Head	E2	2	
Pteropodidae					
	Pteropus poliocephalus	Grey-headed Flying-fox	V	9	
Vespertilionidae					
	Miniopterus australis	Little Bentwing-bat	V	1	
	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	3	

Reptilia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Cheloniidae						
		Chelonia mydas	Green Turtle	V	2	

** Exotic (non-native) species*

Choose up to 3 species to map.

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Search Results

Your selection: Flora, threatened species, LGA - SYDNEY HARBOUR (UNINCORPORATED) returned a total of 113 records of 29 species.
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Choose up to 3 species to map.
** Exotic (non-native) species*

Plants	Map	Scientific Name	Common Name	Legal Status	Count	Info
Casuarinaceae						
	☐	Allocasuarina portuensis	Nielsen Park She-oak	E1	38	ℹ
Convolvulaceae						
	☐	Wilsonia backhousei	Narrow-leafed Wilsonia	V	3	ℹ
Elaeocarpaceae						
	☐	Tetratheca glandulosa		V	5	ℹ
	☐	Tetratheca juncea	Black-eyed Susan	V	2	ℹ
Ericaceae						
	☐	Epacris purpurascens var. purpurascens		V	1	ℹ
Euphorbiaceae						
	☐	Amperea xiphoclada var. pedicellata		E4	1	
	☐	Chamaesyce psammogeton	Sand Spurge	E1	2	ℹ
Fabaceae (Faboideae)						
	☐	Pultenaea parviflora		E1	1	ℹ
Fabaceae (Mimosoideae)						
	☐	Acacia bynoeana	Bynoe's Wattle	E1	2	ℹ
	☐	Acacia pubescens	Downy Wattle	V	1	ℹ
	☐	Acacia terminalis subsp. terminalis	Sunshine Wattle	E1	23	ℹ
Grammitidaceae						
	☐	Grammitis stenophylla	Narrow-leaf Finger Fern	E1	1	ℹ
Lamiaceae						
	☐	Prostanthera marifolia	Seaforth Mintbush	E4A	4	
Myrtaceae						
	☐	Callistemon linearifolius	Netted Bottle Brush	V	2	ℹ
	☐	Eucalyptus camfieldii	Heart-leaved Stringybark	V	3	ℹ
	☐	Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	2	ℹ
	☐	Melaleuca deanei	Deane's Paperbark	V	1	ℹ
	☐	Syzygium paniculatum	Magenta Lilly Pilly	E1	3	ℹ
	☐	Triplarina imbricata	Creek Triplarina	E1	1	ℹ
Orchidaceae						
	☐	Caladenia tessellata	Thick Lip Spider Orchid	E1	1	ℹ
	☐	Prasophyllum fuscum	Slaty Leek Orchid	E4A	1	ℹ
Proteaceae						
	☐	Grevillea caleyi	Caley's Grevillea	E1	2	ℹ

	Persoonia hirsuta	Hairy Geebung	E1	2	
	Persoonia laxa		E4	1	
	Persoonia nutans	Nodding Geebung	E1	1	
Rutaceae					
	Asterolasia buxifolia		E1	1	
Santalaceae					
	Thesium australe	Austral Toadflax	V	1	
Thymelaeaceae					
	Pimelea curviflora var. curviflora		V	5	
	Pimelea spicata	Spiked Rice-flower	E1	2	

** Exotic (non-native) species*

Choose up to 3 species to map.

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