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# MCA Redevelopment Seawater Heat Exchange

## Preliminary Marine Risk Assessment

000/00000/0 – 301015-02140

24 March 2010

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## SYNOPSIS

WorleyParsons was engaged by the Museum of Contemporary Art (MCA) to conduct a Preliminary Marine Risk Assessment on a proposed seawater heat exchange building cooling system. The main risks of this development on the marine environment are the thermal differential between the discharge and receiving waters, the impact of the use of the antifouling agent Mexel 432® and the risk of impingement and entrainment of marine organisms within the system.

This assessment concluded that the installation and operation of the proposed system at the MCA in Circular Quay is unlikely to result in any discernible impacts on the water quality of the receiving environment. No threatened marine fauna will be affected by the proposed development as no threatened aquatic fauna are likely to occur in the vicinity of the proposed development.

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REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	DRAFT for client review	NH N Hannaford	HH H Houridis	N/A	12/03/2010	N/A	
0	Final	NH N Hannaford	 Dr A.Cohen	 Dr A.Cohen	24/3/2010		

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**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

---

## CONTENTS

1	INTRODUCTION .....	1
1.1	Study Objectives .....	1
2	METHOD OF ASSESSMENT .....	3
2.1	NSW Habitat Marine Habitat Survey Guidelines .....	3
2.2	Site Inspection .....	3
2.2.1	Underwater Survey .....	4
2.2.2	Water Quality .....	5
2.3	Risk Assessment .....	6
3	SEAWATER HEAT EXCHANGE SYSTEM .....	8
3.1	Sea Water Intake .....	8
3.2	Seawater Discharge .....	9
3.3	Mexel® 432 Antifouling Agent .....	10
3.4	ABS Piping .....	11
4	BACKGROUND INFORMATION .....	12
4.1	Environmental Values and Significance .....	12
4.1.1	Ecological Values .....	12
4.1.2	Water Quality .....	13
5	CIRCULAR QUAY .....	14
5.1	Aquatic Ecology .....	14
5.1.1	Intertidal Habitat .....	15
5.1.2	Subtidal Habitat .....	16
5.2	Water Quality .....	17
6	RISK (IMPACT) ASSESSMENT .....	19
6.1	Impingement and Entrainment .....	19
6.2	Temperature .....	19
6.3	Antifoulant Biocide .....	20
6.4	Construction/Maintenance Activities .....	20



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

---

7 CONCLUSIONS AND RECOMMENDATIONS .....21

8 REFERENCES .....22

Figure 2-1 Drop Camera Locations, Circular Quay, March 2010 4

Figure 2-2 Water Quality Locations.....6

Figure 3-1 General Configuration of (Proposed) Pipework adjacent to Circular Quay, Drawing M1006-A .....8

Figure 3-2 Seawater Intake – Cross Sectional View, Drawing M1007-A.....9

Figure 3-3 Seawater Discharge – Cross Sectional View, Drawing M1007-A ..... 10

Figure 5-1: Circular Quay with Highlighted Study Site Location ..... 14

Figure 5-2:Seawall and Piles, A=facing south, B=facing north, Circular Quay..... 15

Figure 5-3: Intertidal Seawall Habitat with *Saccostrea* (Oyster) and *Ecklonia* (Brown Algae)..... 15

Figure 5-4: Pile Flora and Fauna dominated by *Ecklonia* (Brown Algae)..... 16

Figure 5-5: Sea Bed, A=rocky rubble, B=soft sediment, Circular Quay..... 16

Figure 5-6: The brown alga, *Ecklonia radiata* on seabed, Circular Quay ..... 17

Table 1: Tides at Fort Denistone 15 March 2010.....3

Table 2: Drop Camera Locations .....5

Table 3: Water Quality, Circular Quay, March 2010 ..... 18

Appendix 1: NSW Maritime Marine Habitat Survey Guidelines

Appendix 2: APVMA permit 11612 approving the use of MEXEL® 432

Appendix 3: EPBC Act 1999 Protected Matters Report

Appendix 4: Threatened species listed under the FM Act 1994



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

---

ABS

APVA

ECD

*EPBC Act*

*FM Act*

LAT

MCA

*TSC Act*

Acrylonitrile – Butadiene – Styrene

Australian Pesticides And Veterinary Authority

Eologically Sustainable Design

*Environment Protection And Biodiversity Act 1999*

*NSW Fisheries Management Act 1994*

Lowest Astronomical Tide

Museum of Contemporary Art

*NSW Threatened Species Conservation Act 1995*



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

---

## **1 INTRODUCTION**

The Museum of Contemporary Art (MCA) is located on the western shore of Sydney Cove in Sydney Harbour. As part of the approved MCA redevelopment works the MCA propose to install a sea water heat exchange building cooling system which incorporates seawater pipes running from West Circular Quay to heat exchangers located under the MCA building. This type of system is currently used at five other locations within Sydney Harbor. These being:

- The Sydney Opera House – Sydney Cove;
- Star City Casino – Pyrmont;
- the Australian National Maritime Museum – Darling Harbour;
- Harbourside Shopping Complex – Darling Harbour; and
- North Sydney Olympic Swimming Pool – Milsons Point.

The proposed system will significantly reduce the energy and water usage of the MCA compared to traditional air cooling alternatives and is an example of the MCA's commitment to Ecologically Sustainable Design (ESD).

An assessment of the potential impacts an aquatic ecology associated with the construction and operation of the proposed heat exchange system was undertaken as part of the requirements of the Environmental Assessment to support a modification for planning approval.

### **1.1 Study Objectives**

The objectives of this study were to:

- Describe the aquatic flora and fauna in the vicinity of the proposed intake and outflow pipelines in Sydney Cove by means of a relevant literature review and drop camera deployment;
- Describe the contaminants of interest and key legislation and water quality guidelines;
- Identify the contaminant concentrations discharged in the marine environment, considering the chemical and physico-chemical properties of the thermal water discharge;
- Discuss in general terms the likely contaminant concentrations in receiving waters and identification of contaminant thresholds in the marine environment, based on the ecotoxicology literature;
- Assess the risk of construction activities on the local marine environment;
- Assess the risk of impingement and entrainment of marine organisms in the proposed intake; and



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

---

- Carry out a preliminary risk assessment of the impact that these contaminants and physico-chemical properties of the thermal water discharge will have on the receiving environment, as well as any potential impacts associated with the intake. Discussion of the risk and provision of recommendations.



ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

---

## 2 METHOD OF ASSESSMENT

### 2.1 NSW Habitat Marine Habitat Survey Guidelines

The NSW Maritime *Marine Habitat Survey Guidelines 2009* (**Appendix 1**) State that “when a structure or activity has the potential to impact on a marine habitat” a marine habitat survey must be undertaken and must include the following:

- Scaled plans to showing the existence of any vegetation below the mean high water mark within a minimum 20 m of the proposal;
- Details of the survey area and sampling method;
- Photographs of the sampling area;
- Description of the dominant habitats and species including their sensitivity to change and the incidence of threatened species;
- The nature of the intertidal and subtidal zone;
- Direct and indirect impacts on the marine habitat during and after construction; and
- Proposed monitoring of impacts after construction.

### 2.2 Site Inspection

A site inspection was carried out at Circular Quay, opposite the MCA, on Monday 15<sup>th</sup> March 2010 for the purpose of identifying marine flora and fauna in the vicinity of the proposed development and to also collect background water quality data. The site inspection and observations were taken in accordance with the NSW Maritime *Marine Habitat Survey Guidelines 2009* (**Appendix 1**).

Observations were made of the intertidal communities that colonise the sea wall revetments while piles and drop camera imagery was used to identify and characterise the sea bed habitat.

On the day of the site inspection winds were light, typically <10 knots and water clarity was generally good. Tidal conditions at Fort Denistone (1.5km from the study site) are listed in **Table 1**.

**Table 1: Tides at Fort Denistone 15 March 2010**

Tide	Height	Time
Low	0.4m	2.04am
High	1.53m	8.21am
Low	0.34m	3.13pm
High	1.42m	9.18pm



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

---

## 2.2.1 Underwater Survey

Detailed underwater imagery was recovered at 11 locations within the study area with a drop camera, to ascertain seabed conditions and to determine the presence and extent of any subtidal macroalgae. All images were taken with a Canon Powershot G10, with an Ikelite underwater housing. All water quality readings were taken using a Horiba water quality meter.

At each point, GDA94 datum coordinates were recorded using a Garmin GPS Map 76 with accuracy of  $\pm 5$  m. Depths were recorded using a calibrated tape measure on the drop camera line.

Drop camera locations within Circular Quay are shown in **Figure 2-1**. Site coordinates and depth measurements at the drop camera locations are listed in **Table 2**.



**Figure 2-1 Drop Camera Locations, Circular Quay, March 2010**



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

---

Table 2: Drop Camera Locations

ID	Depth (m)	Latitude	Longitude
D1	3.5	33°51'36.69"S	151°12'34.87"E
D2	3.5	33°51'36.32"S	151°12'34.99"E
D3	4	33°51'35.91"S	151°12'35.10"E
D4	4.5	33°51'35.81"S	151°12'35.04"E
D5	5	33°51'35.73"S	151°12'35.42"E
D6	8	33°51'37.27"S	151°12'35.57"E
D7	8	33°51'37.06"S	151°12'35.68"E
D8	5	33°51'35.84"S	151°12'35.40"E
D9	8	33°51'36.19"S	151°12'35.11"E
D10	6.5	33°51'36.01"S	151°12'34.99"E
D11	5	33°51'35.95"S	151°12'35.09"E

## 2.2.2 Water Quality

Water quality profiling was undertaken at three locations in the study area (**Figure 2-2**) to provide background water quality data. Water quality was measured at the surface, 5 meters, and 1 metre off the sea bed. The parameters measured were temperature (°C), turbidity (NTU), salinity (ppt), pH, dissolved oxygen (DO) (mg/L and % saturation) and conductivity (µS/cm).

Water quality was measured using a Horiba multi-parameter water quality meter. Water quality data was collected between 0700 and 0800 hours. The values recorded were compared to the trigger values for 95% species protection, as specified in the ANZECC/ARMCANZ water quality guidelines for marine waters of south-east Australia (ANZECC/ARMCANZ 2000) and average expected values for estuarine water quality (NSW Government 1992).



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PRELIMINARY MARINE RISK ASSESSMENT

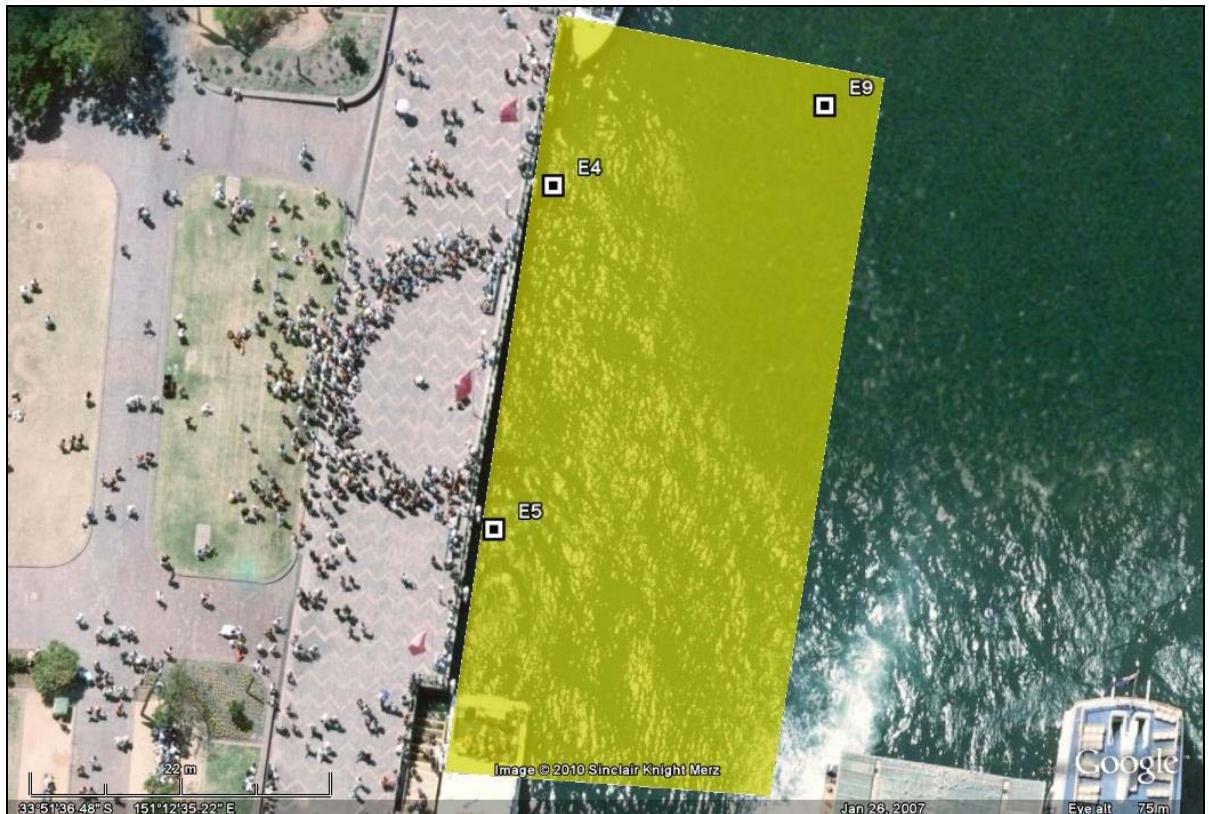


Figure 2-2 Water Quality Locations

## 2.3 Risk Assessment

Assessment of the discharge characteristics was undertaken relative to the water quality objectives defined in the ANZEEC/ARMCANZ (2000) water quality guidelines and expected average water quality values for Australian estuaries (NSW Government 1992).

The approach adopted to assess the risk associated with the discharge, were as follows:

- Describe the proposed activity, which was the cooling water process and proposed discharge;
- Identify the primary management aims, which include:
  - defining the water body and environmental values in the vicinity of the mixing zone;
  - defining the level of protection assigned to the receiving environment; and
  - highlight the applicable water quality criteria and management objectives for protecting the receiving environment.
- Examine the dilutions of additives in the receiving environment of the mixing zone and the risks posed to marine receptors;



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

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- Undertake an impact assessment and gather an understanding of the toxicological risks posed to the marine organisms found in and around the waters of the discharge; and
- Provide conclusions regarding any potential risks posed to the marine environment and recommend appropriate monitoring and management mitigation measures, where applicable.



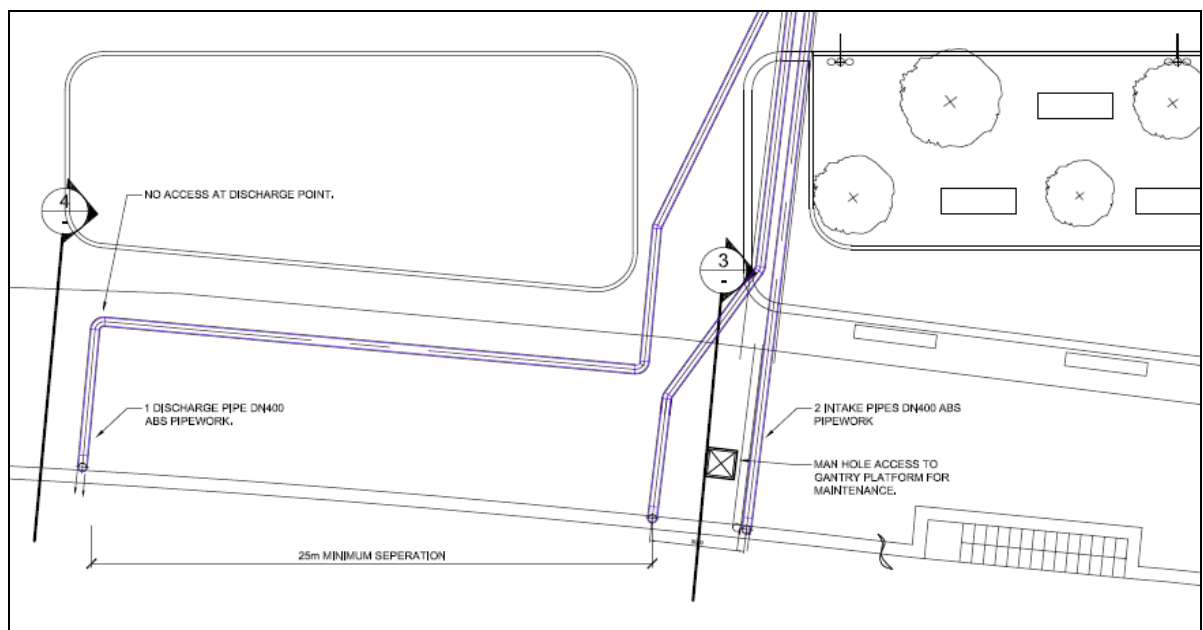
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PRELIMINARY MARINE RISK ASSESSMENT

### 3 SEAWATER HEAT EXCHANGE SYSTEM

The proposed seawater heat exchange system is comprised of the following elements that have the potential to impact on the receiving marine environment:

- two water intake baskets located below the minimum tide level south of Commissioners steps in Sydney Cove and an associated manhole access point in the promenade;
- pipework to and from the building plant room where the pumps and heat exchangers will be located;
- a discharge point located below the minimum tide level; and
- the use of an antifouling agent (Mexel 432®) to prevent the build up of marine growth in the system.

The general configuration of pipelines from the heat exchange system to the intakes and outlet are shown in **Figure 3-1**.



**Figure 3-1 General Configuration of (Proposed) Pipework adjacent to Circular Quay, Drawing M1006-A**

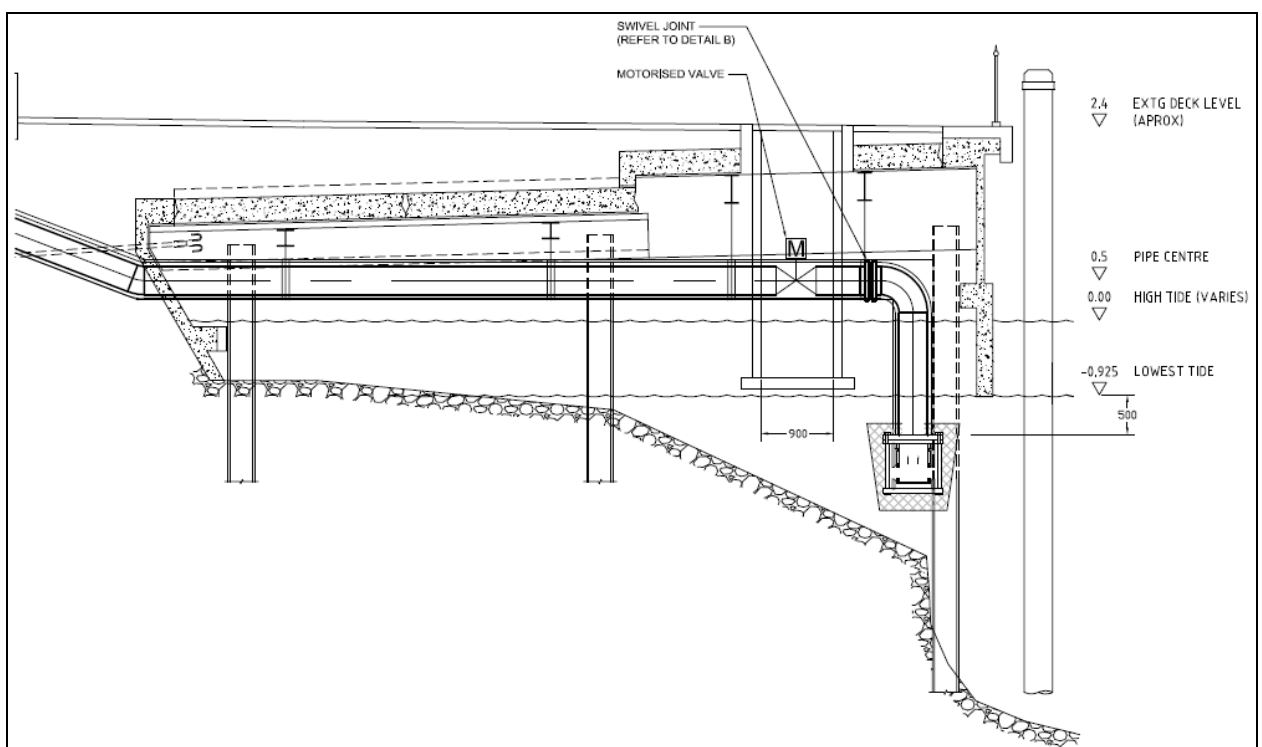
#### 3.1 Sea Water Intake

The intake from the harbour will incorporate ABS (Acrylonitrile – Butadiene – Styrene) piping and an angled mesh basket set out from the intake foot valve. It will act to screen / filter the sea water entering the pipe and will prevent debris / marine life such as fish entering the pipeline. Secondary filters located in a plantroom under the MCA provide a final filter prior to the plate heat exchangers.



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These filters have an automatic backwash which discharges the backwash water back into the sea water system on the downstream side of the heat exchangers. Debris from maintenance cleaning of these filters is not to be disposed of into the harbour but into the local sewer system. The foot valve serves to prevent loss of water if the system is shut down. For ease of servicing and inspection, this will be able to be rotated up and accessed from a maintenance platform under the promenade. The general configuration of the intake pipe and foot valve is shown in **Figure 3-2**.



**Figure 3-2 Seawater Intake – Cross Sectional View, Drawing M1007-A**

### 3.2 Seawater Discharge

The seawater discharge will be located under the promenade below the minimum low tide level **Figure 3-3**. It will incorporate ABS piping and a venturi nozzle to induce a high degree of mixing which will minimise both the velocity of water discharging into the Harbour and further reduce the outlet temperature.

A peak flow rate of 328L/s into the system is expected to occur during the summer period. Normal operation conditions are half this at 162L/s.

Both the intake and discharge for the proposed sea water system will be located under the Circular Quay promenade directly in front of the existing MCA building. To prevent recirculation of the same



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

water, the intake and discharge will be separated an approximate distance of 25 metres (as shown in Figure 3-1).

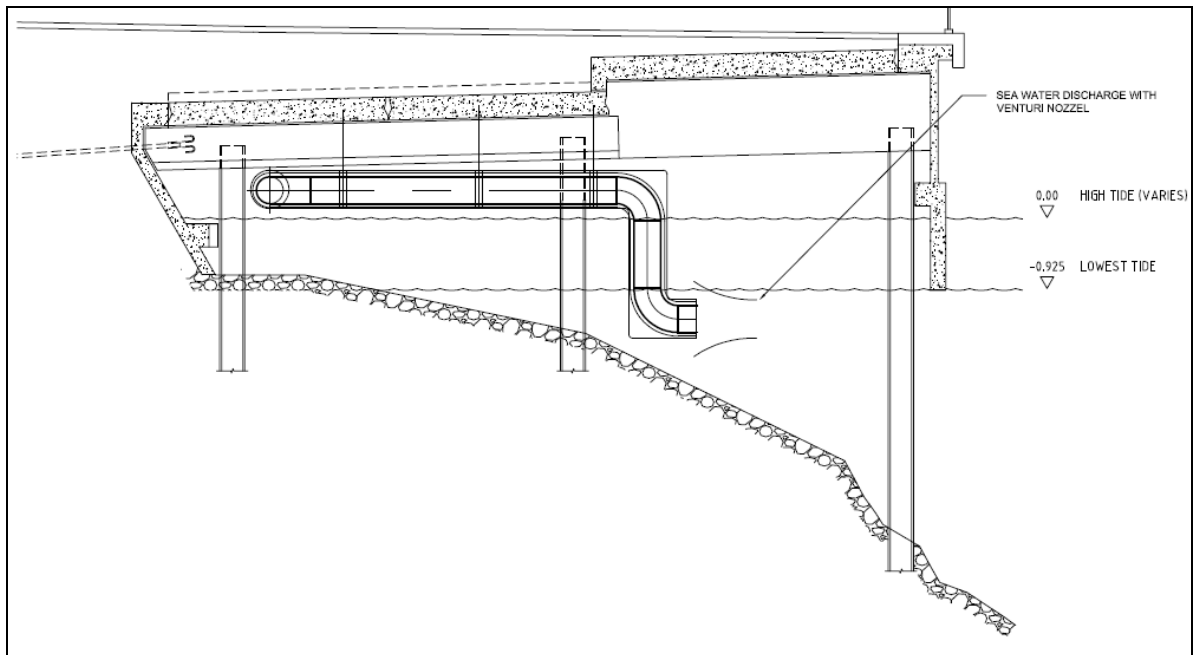


Figure 3-3 Seawater Discharge – Cross Sectional View, Drawing M1007-A

### 3.3 Mexel® 432 Antifouling Agent

Mexel® 432 is an organic biocide that consists of a mixture of aliphatic amine surfactants, in which the main active ingredient is alkylamino-3 aminopropane (1.7%). The alkylamine acts as a surfactant or “filming amine” and adheres to wetted metal, plastic, concrete and glass surfaces to form a film preventing biofouling organisms from forming an attachment (Sprecher and Getsinger 2000).

Mexel 432® is currently being used in five seawater heat exchange systems elsewhere in Sydney Harbour. The use of Mexel 432® presents several advantages over the use of conventional biocides such as chlorine, which are toxic to marine species, can increase the corrosion potential of metals within flow through systems and are subject to more stringent environmental regulation.

Mexel 432® is less toxic than sodium hypochlorite (Lopex-Galindo *et al.* 2010) and has been approved for use by the Australian Pesticides and Veterinary Authority (APVA) (**Appendix 2**). This permit sets the dosage of Mexel 432® at 8 ml/cubic metre of flow for up to one hour no more than once per day. The critical use comments on the permit state that the dose into the seawater cooling intake is to be via a mechanical dosing pump and the discharge water must not contain more than 0.5 mg/litre of product.



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

---

It is proposed that the Mexel 432® will be dosed daily for 40 minutes at a rate of 6 ml per cubic litre of flow. This equates to 3.1 L of Mexel 432® per dose and a monthly usage of 94.6 litres.

### **3.4 ABS Piping**

All piping related the seawater heat exchange system is constructed of ABS (Acrylonitrile – Butadiene – Styrene) copolymers. This material was chosen for the following reasons:

- ABS piping is free from heavy metal, poses no risk of heavy metal leaching into seawater in the heat exchange system; and
- has a high chemical resistance to seawater.



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

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## 4 BACKGROUND INFORMATION

### 4.1 Environmental Values and Significance

#### 4.1.1 Ecological Values

Searches of the *NSW Fisheries Management Act 1994 (FM Act)*, *NSW Threatened Species Conservation Act 1995 (TSC Act)* (for the Sydney Harbour Local Government Area), and the *Environment Protection and Biodiversity Act 1999 (EPBC Act)* were undertaken to determine any species, populations and matters of national and international significance occurring in the proposed development location.

#### **Threatened Species Conservation Act 1995**

Marine species listed under the *TSC Act 1995* as occurring in the Sydney Harbour (unincorporated) LGA include the following:

- Little Penguin (*Eudyptula minor*) – Endangered Population (E2)
- Southern Right Whale (*Eubalaena australis*) – Vulnerable (V)
- Humpback Whale (*Megaptera novaeangliae*) - V
- New Zealand Fur-seal (*Arctocephalus forsteri*) - V
- Australian Fur-seal (*Arctocephalus pusillus doriferus*) - V
- Green Turtle (*Chelonia mydas*). - Vulnerable

Of these species, the only one with any likelihood of occurring in Sydney Cove is the Little Penguin. The Little Penguin is known to inhabit the Manly Point Area and to utilise the waters throughout Sydney Harbour for foraging and swimming.

#### **Environmental Protection and Biodiversity Conservation Act 1999**

An *EPBC Act* Protected Matters Report for an area of 1 km around the foreshore of Sydney Cove adjacent to the MCA was generated on 10 March 2010 (see **Appendix 3**). In summary, the *Matters of National Environmental Significance* and *Other Matters* listed under the *EPBC Act* for this area included:

- World Heritage Properties x 1 (Sydney Opera House)
- National Heritage Places x 3 (First Government House Site, Sydney Harbour Bridge and the Sydney Opera House)
- Wetlands of International Significance x 1 (Towra Point Nature Reserve – located within the same catchment area)
- No Commonwealth Marine Areas



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

---

- No Threatened Ecological Communities
- 33 Threatened Species (23 terrestrial, 10 marine)
- 48 Migratory Species (6 terrestrial, 19 wetland, 23 marine)
- 69 Listed Marine Species (42 bird species, 2 mammal species, 21 ray finned fish species and 4 reptile species)
- 9 Whales and other Cetaceans
- No Critical Habitats
- No Commonwealth Reserves

#### ***Fisheries Management Act 1994***

With the exception of aquatic vegetation, no threatened species under *Schedule 4 - Endangered species, populations and ecological communities*, *Schedule 4A – Critically endangered species and ecological communities*, or *Schedule 5 – Vulnerable species and ecological communities* of the *FM Act 1994* (as listed in **Appendix 4**) are found in the proposed redevelopment location. Nor do we consider the proposed works to constitute a Key Threatening Process under this Act.

#### **4.1.2 Water Quality**

The ANZECC/ARMCANZ (2000) National Water Quality Guidelines for slightly to highly disturbed estuarine ecosystems in south-east Australia, and expected average water quality values for Australian estuaries (NSW Government 1992) provide the following water quality guideline values:

- Salinity: 35 ppt
- Turbidity: 0.5 – 10 NTU
- pH: 7.0 – 8.5
- DO: 80 – 110% saturation
- Conductivity: 54, 000  $\mu\text{S}/\text{cm}$

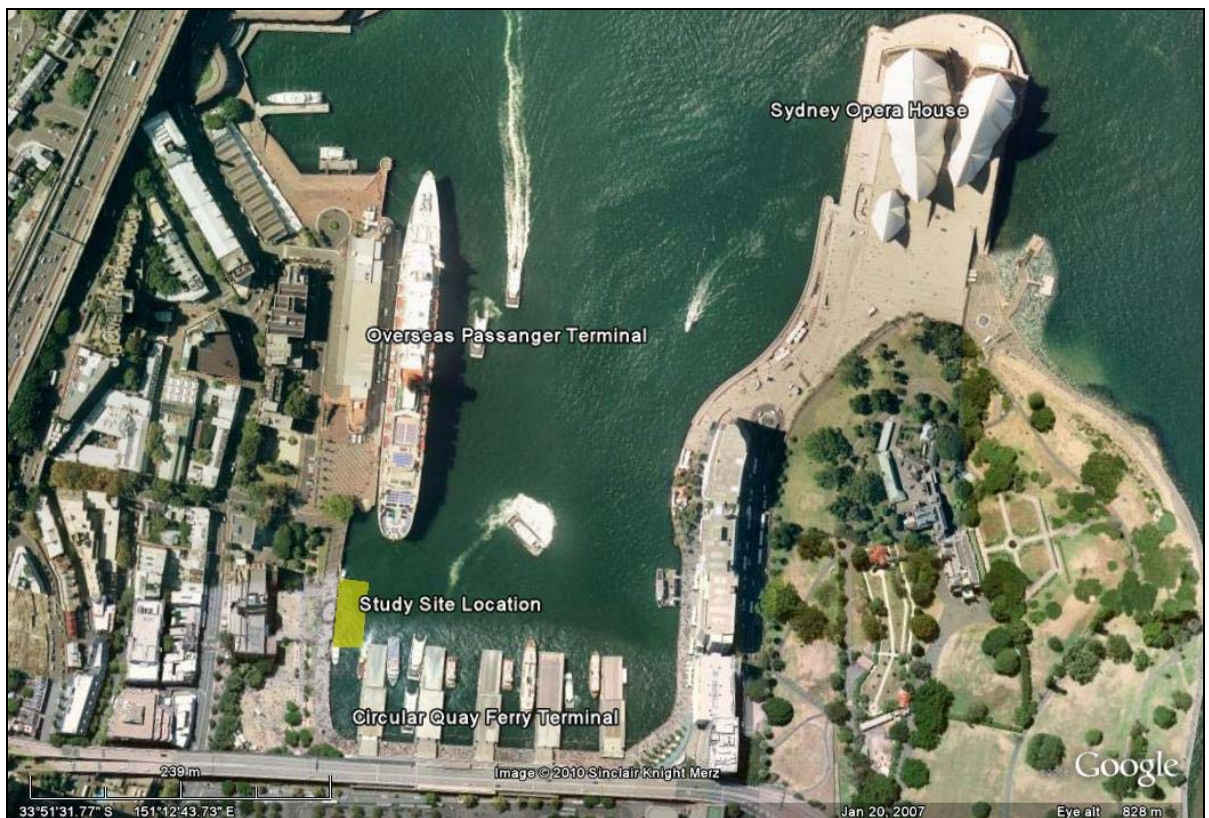
In 2001, Hatje *et al.* (2001) collected data on spatial and temporal variation in water quality parameters in the Port Jackson Estuary. Mean salinity in the estuary ranges from around 18 ppt in the upper reaches to 35 ppt at the estuary mouth. The estuary is generally well mixed and almost entirely saline under low flow conditions. Mean water temperatures in the estuary vary from 15.9 +/- 0.2 °C in winter to 26.5 +/- 1.4 °C in summer. Dissolved oxygen (DO) profiles in the estuary increase with increasing salinity and were saturated at the surface. Low DO values (~3 mg/l) were observed during spring in upper waters of the Parramatta River. The pH increases were observed during summer. Suspended particulate matter (SPM) concentrations (affecting turbidity readings) tended to decrease seaward. They were associated with resuspension of bottom sediments, flood events, tidal resuspension and season (Hatje *et al.* 2001).



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

## 5 CIRCULAR QUAY

Sydney Cove maritime history dates back to 1788 when it was chosen for the site of the first British penal settlement. All natural vegetation has been removed from the foreshore, the western shoreline is bound by the Overseas Passenger Terminal, the head of the Cove is occupied by the Circular Quay Ferry Terminal and Bennelong Point, on the northern tip of the eastern shore is occupied by the Sydney Opera House as illustrated in **Figure 5-1**.



**Figure 5-1: Circular Quay with Highlighted Study Site Location**

On the day of the site inspection water temperature was 21.7-21.8°C. Water clarity was relatively good throughout the study area and winds were light with no discernable current. Swash and turbulence from commercial charter and ferries was common.

### 5.1 Aquatic Ecology

The following habitats were present within the study site:

- Hard artificial structures associated with piles and concrete revetments;
- Sandy seabed; and
- other hard substrate on the seabed within Circular Quay.

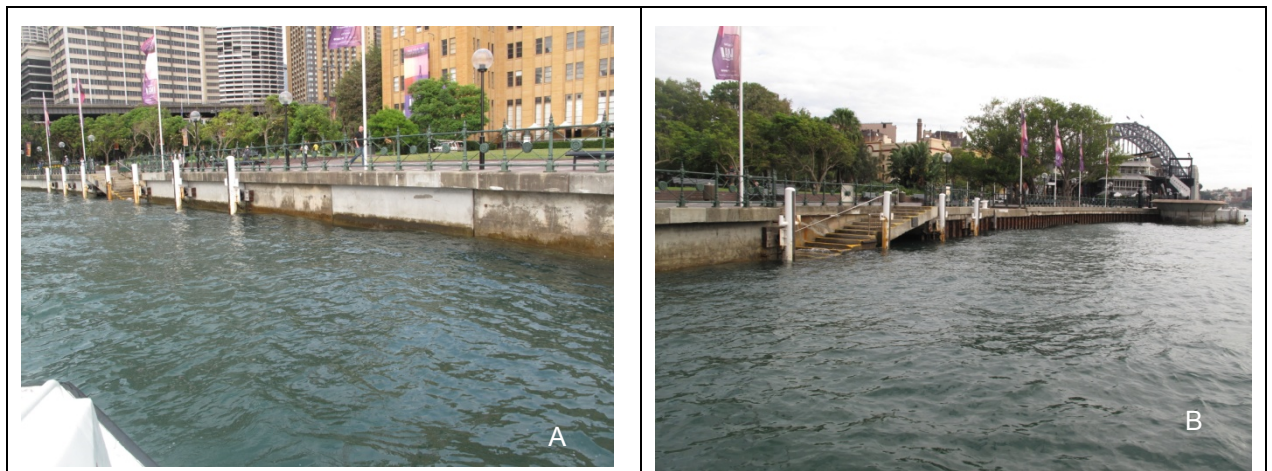


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PRELIMINARY MARINE RISK ASSESSMENT

---

## 5.1.1 Intertidal Habitat

A sea wall runs in a north south direction along the promenade (**Figure 5-2**). The concrete facing wall drops from the promenade and ends below Lowest Astronomical Tide (LAT). The intertidal zone is narrow, existing only on the vertical piles, sea walls and revetments.



**Figure 5-2: Seawall and Piles, A=facing south, B=facing north, Circular Quay**

The intertidal zone along this concrete face and piles is colonised by an upper band of Sydney Rock Oyster *Saccostrea glomerata*. Coralline algae, mussel beds and the large brown macroalgae, *Ecklonia radiata* were observed (**Figure 5-3**).



**Figure 5-3: Intertidal Seawall Habitat with *Saccostrea glomerata* (Oyster) and *Ecklonia radiata* (Brown Algae)**

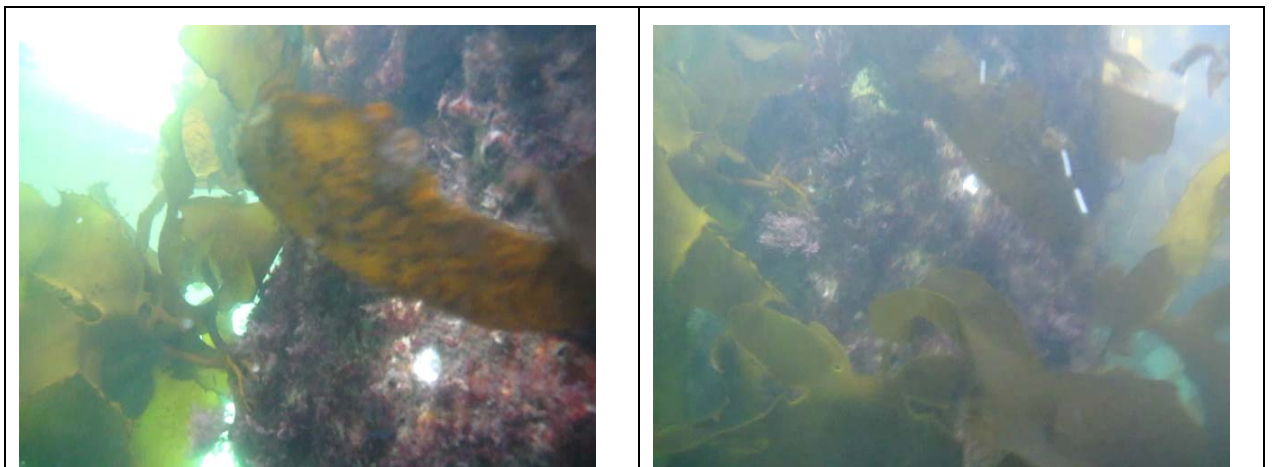


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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

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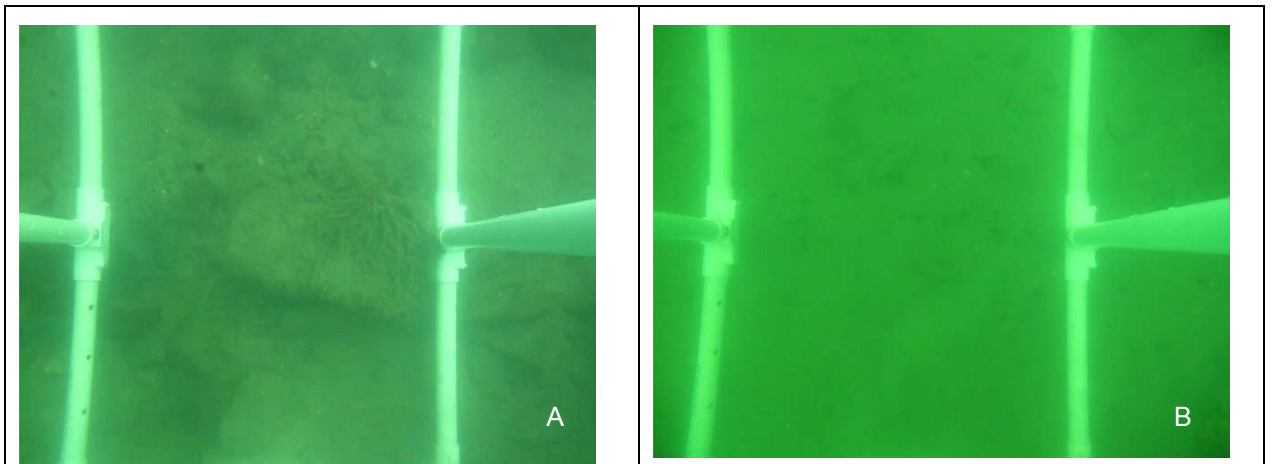
## 5.1.2 Subtidal Habitat

Piles associated with the seawall and landings provide vertical substrate for the attachment of a range of sessile flora and fauna. The most common species noted on the piles was the brown macroalga, *Ecklonia radiata* **Figure 5-4** which forms a dense canopy over the substrate. Encrusting coralline algae occur beneath the canopy.



**Figure 5-4: Pile Flora and Fauna dominated by *Ecklonia* (Brown Algae)**

Away from the seawall, the seabed consisted of either rocky/rubble or soft sediment (**Figure 5-5**).



**Figure 5-5: Sea Bed, A=rocky rubble, B=soft sediment, Circular Quay**

The seabed at most of the sites inspected is covered by the brown macroalga, *Ecklonia radiata* (**Figure 5-6**). Areas of seabed that are covered by rock and rubble provide suitable substrate for *Ecklonia* to attach and grow. Elsewhere, areas of soft sediment habitat surveyed appear flat and featureless and were devoid of any epibenthic species.



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT

---



**Figure 5-6: The brown alga, *Ecklonia radiata* on seabed, Circular Quay**

No marine pests were observed in any camera drops and no threatened or protected species were identified during the site inspection.

## 5.2 Water Quality

Water quality profiling was undertaken at three locations in the study area to provide background water quality data. Results from the survey are summarised in **Table 3** and show that water quality values are consistent between locations as well as through the water column. Dissolved oxygen data is not included as values were erroneous, most likely due to a faulty sensor.

Recent water quality surveys undertaken elsewhere in Sydney Harbour (at Woolwich and Walsh Bay) show that dissolved oxygen values typically range between 7.8 and 10.6 mg/L and 91 to 122% saturation.



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

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**Table 3: Water Quality, Circular Quay, March 2010**

Location	Depth	pH	Cond. (µS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l) and % saturation	Temp. (°C)	Salinity (ppt)
<b>E4</b>	Surface	7.86	52,600	1	ND	21.7	34.6
	5 meters	7.86	52,700	1	ND	21.8	34.7
	6 meters	7.86	52,700	1	ND	21.8	34.8
<b>E5</b>	Surface	7.88	52,700	1	ND	21.7	34.6
	5 meters	7.87	52,800	6	ND	21.8	34.8
<b>E9</b>	Surface	7.9	52,600	1	ND	21.7	34.7
	5 meters	7.89	52,300	1	ND	21.7	34.7
	9 meters	7.91	52,600	2	ND	21.7	34.7
ANZECC / ARMCANZ (2000), NSW Government (1992)		7.0 – 8.5	54,000	0.5 – 10	80 – 110% saturation	N/A	35 ppt

ND = no data

Overall, water quality at Circular Quay was indicative of a healthy marine / estuarine ecosystem, with all values falling within, or close to, the water quality guidelines (ANZECC/ARMCANZ 2000).



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MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

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## **6 RISK (IMPACT) ASSESSMENT**

The proposed seawater heat exchange system has the potential to impact the receiving marine environment through the impingement of species present in the intake water, the discharge of heated water and the use of antifoulant to control marine growth in the system. Potential impacts from construction related activities are also discussed.

### **6.1 Impingement and Entrainment**

Entrainment occurs when smaller organisms pass through an intake screen and into the processing equipment (usually) resulting in mortality, whereas impingement occurs when marine organisms are trapped against the intake screens by the velocity and force of the water flow.

During normal operating conditions, 162L/s of seawater is passing through the system with a resonance time of 195 seconds. This decreases during peak flow periods, where 328L/s of seawater are passing through the system, to 95 seconds. Given the short resonance times that seawater is in the system. The 7000L priming tank is to be flushed daily during antifouling operations placing the resonance time of seawater in this tank at no more than 24 hours. Entrainment during operational periods of the system is unlikely given the short resonance times that any organisms are within the system. Entrainment may occur to some marine life present in the header tank between antifouling operations, however this is not likely to be significant given the brief holding time (i.e < 24 hours).

The intake from the harbour incorporates an angled mesh basket set out from the intake foot valve, which will screen / filter the sea water entering the pipe and prevent debris / marine life such as fish entering the pipeline. The mesh screen diameter is 15 mm. Impingement is also unlikely to be significant, as the intake flows are of a relatively low velocity, which would allow for larger marine fauna to swim away from the screens.

### **6.2 Temperature**

Temperature closely regulates ecosystem functioning both directly e.g. by influencing primary production, and indirectly e.g. loss of biota as a consequence of loss of habitat. The growth, metabolism, reproduction, mobility and migration patterns of an organism may all be altered by changes in ambient water temperature. As temperature is increased 10°C within the tolerance range of a resting animal, its physiological demands (as measured by oxygen consumption) will usually double (ANZECC/ARMCANZ, 2000).

Ambient water temperature in Sydney Harbour varies from 16°C to 24°C.

If the difference between the intake and discharge water temperature is consistently less than two degrees as stipulated by DECCW, then the temperature of the cooling water discharge is expected to range from 14 °C to 26 °C. This small amount of variation in water temperature is unlikely to have any discernible impact on aquatic species that may be present in Circular Quay and is likely to be well within their tolerance limits. Furthermore, the increase in water temperature is likely to be localised



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

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around the discharge point and any residual elevated temperature is likely to be dissipated rapidly due to the venturi nozzle which will promote rapid mixing.

The discharge of slightly warmer water may also result in the formation of a surface plume that will be rapidly dispersed by wind and the turbulence generated by boat traffic and tidal conditions.

### **6.3 Antifoulant Biocide**

Mexel® 432 is an organic biocide that acts as a filming surfactant to prevent biofouling organisms from forming an attachment. If the discharge water is required to contain no greater than 0.5 mg/L of Mexel® 432 at any one time, then no toxic effect from the release of Mexel® 432 in the discharge water is anticipated.

Recent toxicity testing undertaken by Lopez-Galindo *et. al* (2010) found a NOEC of 2.12 mg/L for Mexel® 432 confirming that concentrations likely to be present in the discharge water from the seawater exchange system are unlikely to be toxic. The study involved testing of microalgae and invertebrates using growth inhibition and mortality tests as bioindicators of a toxic response.

The product is currently in use elsewhere in Sydney Harbour and has been approved for use by the APVA.

### **6.4 Construction/Maintenance Activities**

The majority of construction works will be undertaken on land and only the intake and discharge pipes will be placed permanently in the water. The potential for disturbance and impact on the aquatic environment within Circular Quay is considered low given the existing level of disturbance from boat traffic and ferry movements that currently exists.

The extent of *Ecklonia radiata* that is present along the seawall and part of the seabed indicate that this species is tolerant to some level of disturbance and that it is unlikely to be affected by transient increases in turbidity. It seems more likely to be vulnerable to physical disturbance that could be caused by anchoring of boats and barges or excessive prop wash.



## 7 CONCLUSIONS AND RECOMMENDATIONS

The installation and operation of a seawater exchange cooling system at the MCA in Circular Quay is unlikely to result in any discernible impacts on the water quality of the receiving environment. No threatened marine fauna will be affected by the proposed development, as no threatened aquatic fauna are likely to occur in the vicinity of the proposed development.

Some post commissioning monitoring should be undertaken to confirm that water temperature of the discharge water is within +/- 2°C of the receiving water temperature and that concentrations of Mexel® 432 within and immediately surrounding the discharge water are less than 0.5 mg/L, as prescribed.



**ROOT PROJECTS AUSTRALIA  
MCA SEAWATER HEAT EXCHANGE  
PRELIMINARY MARINE RISK ASSESSMENT**

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## **8 REFERENCES**

Australian and New Zealand Environment Conservation Council. *Australian and New Zealand guidelines for fresh and marine water quality* (2000).

Hatje, V., Birch, G. F., Hill, D. M. (2001). Spatial and Temporal Variability of Particulate Trace Metals in Port Jackson Estuary, Australia. *Estuarine and Coastal Science* 53: 63-77.

Lopez-Galindo, C., Garrido, M.C., Casanueva, J.F., Nebot, E. (2010). Degradation models and ecotoxicity in marine waters of two antifouling compounds: Sodium hypochlorite and an alkylamine surfactant. *Science of the Total Environment* 408: 1779-1785.

Sprecher, S.L. Getsinger, K.D. (2000). Zebra mussel chemical control guide. Environmental Laboratory U.S Army Engineer Research and Development Centre, pp.87-92

NSW Department of Environment Climate Change and Water. *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (2006).



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## **Appendix 1: NSW Maritime Marine Habitat Survey Guidelines**



## Marine Habitat Survey

### *Why is it required?*

- NSW Maritime owns the bed of Sydney Harbour and its tributaries, and is responsible for the conservation of and protection of the marine environment.
- There has been a significant loss of habitat, and NSW Maritime requires information to assess impacts in the marine environment.

### *When do applicants need to provide a marine habitat survey?*

- When applying for Land Owner's Consent or development under Part 5 of the Environmental Planning and Assessment Act 1979.
- Where a structure or activity has the potential to impact on marine habitat.

### *What information is required?*

- scaled plans showing the existence of any vegetation below mean high water mark (mangroves, seagrass varieties etc) within a minimum of 20m of the proposal
- details of the survey area and sampling method
- photographs of the sampling area
- description of dominant habitats and species, including their sensitivity to change and the incidence of threatened species
- the nature of the inter-tidal and sub-tidal zone (sand, rock etc)
- direct and indirect impacts on marine habitat of the proposal both during and after construction
- proposed mitigation measures both during and after construction
- proposed monitoring of impacts after construction

### *Who conducts the habitat surveys?*

- Suitably qualified marine ecologists.
- You can refer to the Yellow Pages under Environmental Consultants or Natural Resource Consultants.



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## **Appendix 2: APVMA permit 11612 approving the use of Mexel® 432**



**Australian Government**  
**Australian Pesticides and  
Veterinary Medicines Authority**

- 1 SEP 2009

Contact Telephone: (02) 6210 4700  
Contact Facsimile: (02) 6210 4721

INTEGRA WATER TREATMENT SOLUTIONS  
PO Box 818  
CARINGBAH NSW 1495

ATTN:RALPH ARRUZZA

**ISSUE OF PERMIT: 11612.**  
**EFFECTIVE FROM 1 OCTOBER 2009 TO 30 SEPTEMBER 2011.**

**Mexel 432 / Sites within Australia / Seawater Cooling Systems**

The APVMA has issued the above permit.

Please note the **DETAILS** and **CONDITIONS** of the permit. A copy of this permit has also been sent to the appropriate State Co-ordinators for their information.

Yours sincerely

for Vasanth Vithanage  
27 August, 2009

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18 Wormald Street, Symonston ACT 2609  
PO Box 6182, Kingston ACT 2604 Australia  
Tel: +61 2 6210 4700 Fax: +61 2 6210 4874  
[www.apvma.gov.au](http://www.apvma.gov.au) ABN 19 495 043 447



**Australian Government**  
**Australian Pesticides and  
Veterinary Medicines Authority**

**PERMIT TO ALLOW RESEARCH USE AND SUPPLY  
OF AN AGVET CHEMICAL PRODUCT**

**FOR THE CONTROL OF BIOFILM FORMATION AND ATTACHMENT OF  
SEAWATER ORGANISMS IN COOLING SYSTEMS THAT USE SEAWATER**

**PERMIT NUMBER –PER11612**

This permit is issued to the Permit Holder in response to an application granted by the APVMA under section 112 of the Agvet Codes of the jurisdictions set out below. This permit allows a Supplier (as indicated) to possess the product for the purposes of supply and to supply the product to a person who can use the product under permit. This permit also allows a person, as stipulated below, to use the product in the manner specified in this permit in the designated jurisdictions. This permit also allows the Permit Holder, the Supplier (if not one and the same) and any person stipulated below to claim that the product can be used in the manner specified in this permit.

**THIS PERMIT IS IN FORCE FROM 1 OCTOBER 2009 TO 30 SEPTEMBER 2011.**

**Permit Holder:**

INTEGRA WATER TREATMENT SOLUTIONS  
B/195 Port Hacking Road  
Miranda , NSW. 2228

**Supplier:**

Integra Water Treatment Solutions

**Persons who can use the product under this permit:**

System operators at the 10 selected treatment sites

## CONDITIONS OF USE

### Product to be used:

MEXEL 432 DISPERSANT

Containing: 17 g/kg N-COCO-ALKYLTRIMETHYLENEDIAMINES

117 g/kg N-OLEYL-1,3-DIAMINOPROPANE as its only active constituent.

### Directions for Use:

Situation	Purpose	Rate
Once through seawater based cooling systems	To prevent corrosion, biofilm formation and attachment of sea water organisms	Mexel 432 to be dosed at 8 mL/cubic m of flow for up to one hour no more than once per day.

### Critical Use Comments:

- Dose into the seawater cooling intake via mechanical dosing pump.
- Discharged water must not contain more than 0.5mg/L of product.

### Withholding Period:

NOT REQUIRED WHEN USED AS DIRECTED

### Jurisdiction:

NSW, QLD, SA, TAS, VIC, NT, WA only.

### Additional Conditions:

#### Supply:

The supplier must supply the product in a container that complies with the requirements of section 18(1) of the Agricultural and Veterinary Chemicals Code Regulations. Attached to this container must be a label which is identical in content and format to the label in Attachment 1.

The supplier must supply the product in a container which must:

- (a) be impervious to, and incapable of chemical reaction with, its contents when under conditions of temperature and pressure that are likely to be encountered in normal service; and
- (b) have sufficient strength and impermeability to prevent leakage of its contents during handling, transport and storage under normal handling conditions; and
- (c) if its is intended to be opened more than once-be able to be securely and readily closed and reclosed; and
- (d) have sufficient excess capacity to prevent it from breaking if its contents expand during handling, transport or storage; and
- (e) enable all or any part of its contents to be removed or discharged in such a way that, with the exercise of no more than reasonable care, the contents cannot:
  - (i) harm any person; or
  - (ii) have an unintended effect that is harmful to the environment.

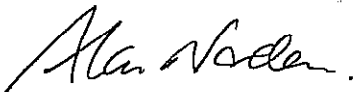
*Trial records:*

The permit holder must maintain records of the trials performed under this permit. Specifically details must include the date and location where the trials were conducted, rates and frequency of application, total amount of product used and the names and addresses of the persons conducting the trial. These details must be maintained for a minimum period of two years from the date of expiry of this permit and must be made available to the APVMA upon request.

**Maximum Number of Treatment Sites:**

10

Issued by



Delegated Officer

**Note:**

Permit amended 26<sup>th</sup> August 2009, to include the new address and the correct dose rate (Permit Version 2).





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## **Appendix 3: *EPBC Act 1999* Protected Matters Report**



Australian Government

Department of the Environment, Water, Heritage and the Arts

## Protected Matters Search Tool

You are here: [Environment Home](#) > [EPBC Act](#) > [Search](#)

10 March 2010 12:05

# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the [caveat](#) at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at <http://www.environment.gov.au/atlas> may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

**Search Type:** Point  
**Buffer:** 1 km  
**Coordinates:** -33.86,151.2097



**Report Contents:** [Summary](#)  
[Details](#)

- [Matters of NES](#)
- [Other matters protected by the EPBC Act](#)
- [Extra Information](#)

[Caveat](#)  
[Acknowledgments](#)



This map may contain data which are  
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© PSMA Australia Limited

## Summary

### Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail

part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see

<http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

<b><u>World Heritage Properties:</u></b>	1
<b><u>National Heritage Places:</u></b>	3
<b><u>Wetlands of International Significance: (Ramsar Sites)</u></b>	1
<b>Commonwealth Marine Areas:</b>	None
<b>Threatened Ecological Communities:</b>	None
<b><u>Threatened Species:</u></b>	33
<b><u>Migratory Species:</u></b>	48

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at

<http://www.environment.gov.au/epbc/permits/index.html>.

<b><u>Commonwealth Lands:</u></b>	7
<b><u>Commonwealth Heritage Places:</u></b>	3
<b><u>Places on the RNE:</u></b>	268
<b><u>Listed Marine Species:</u></b>	69
<b><u>Whales and Other Cetaceans:</u></b>	9
<b>Critical Habitats:</b>	None
<b>Commonwealth Reserves:</b>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<b>State and Territory Reserves:</b>	None
<b>Other Commonwealth Reserves:</b>	None
<b>Regional Forest Agreements:</b>	None

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## Details

### Matters of National Environmental Significance

World Heritage Properties [ [Dataset Information](#) ]

[Sydney Opera House NSW](#)

National Heritage Places [ [Dataset Information](#) ]

[First Government House Site NSW](#)

[Sydney Harbour Bridge NSW](#)

[Sydney Opera House NSW](#)

Wetlands of International Significance [ [Dataset Information](#) ]  
(Ramsar Sites)

[TOWRA POINT NATURE RESERVE](#)

Within same catchment as Ramsar site

Threatened Species [ [Dataset Information](#) ]

Status

Type of Presence

#### Birds

[Diomedea exulans antipodensis](#)

Antipodean Albatross

Vulnerable

Species or species habitat may occur within area

[Diomedea exulans gibsoni](#)

Gibson's Albatross

Vulnerable

Species or species habitat may occur within area

[Lathamus discolor](#)

Swift Parrot

Endangered

Species or species habitat may occur within area

[Macronectes giganteus](#)

Southern Giant-Petrel

Endangered

Species or species habitat may occur within area

[Macronectes halli](#)

Northern Giant-Petrel

Vulnerable

Species or species habitat may occur within area

[Pterodroma neglecta neglecta](#)

Kermadec Petrel (western)

Vulnerable

Species or species habitat may occur within area

[Rostratula australis](#)

Australian Painted Snipe

Vulnerable

Species or species habitat may occur within area

[Thalassarche bulleri](#)

Buller's Albatross

Vulnerable

Species or species habitat may occur within area

[Thalassarche cauta cauta](#)

Shy Albatross, Tasmanian Shy Albatross

Vulnerable

Species or species habitat may occur within area

[Thalassarche cauta salvini](#)

Salvin's Albatross

Vulnerable

Species or species habitat may occur within area

[Thalassarche cauta steadi](#)

White-capped Albatross

Vulnerable

Species or species habitat may occur within area

<a href="#"><i>Thalassarche melanophris impavida</i></a> Campbell Albatross	Vulnerable	Species or species habitat may occur within area
<b>Frogs</b>		
<a href="#"><i>Heleioporus australiacus</i></a> Giant Burrowing Frog	Vulnerable	Species or species habitat likely to occur within area
<a href="#"><i>Litoria aurea</i></a> Green and Golden Bell Frog	Vulnerable	Species or species habitat may occur within area
<b>Mammals</b>		
<a href="#"><i>Chalinolobus dwyeri</i></a> Large-eared Pied Bat, Large Pied Bat	Vulnerable	Species or species habitat may occur within area
<a href="#"><i>Dasyurus maculatus maculatus (SE mainland population)</i></a> Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
<a href="#"><i>Eubalaena australis</i></a> Southern Right Whale	Endangered	Species or species habitat likely to occur within area
<a href="#"><i>Megaptera novaeangliae</i></a> Humpback Whale	Vulnerable	Species or species habitat known to occur within area
<a href="#"><i>Potorous tridactylus tridactylus</i></a> Long-nosed Potoroo (SE mainland)	Vulnerable	Species or species habitat may occur within area
<a href="#"><i>Pteropus poliocephalus</i></a> Grey-headed Flying-fox	Vulnerable	Roosting known to occur within area
<b>Ray-finned fishes</b>		
<a href="#"><i>Prototroctes maraena</i></a> Australian Grayling	Vulnerable	Species or species habitat likely to occur within area
<b>Reptiles</b>		
<a href="#"><i>Chelonia mydas</i></a> Green Turtle	Vulnerable	Species or species habitat may occur within area
<a href="#"><i>Dermochelys coriacea</i></a> Leatherback Turtle, Leathery Turtle, Luth	Endangered	Species or species habitat may occur within area
<a href="#"><i>Hoplocephalus bungaroides</i></a> Broad-headed Snake	Vulnerable	Species or species habitat likely to occur within area
<a href="#"><i>Natator depressus</i></a> Flatback Turtle	Vulnerable	Species or species habitat likely to occur within area
<b>Sharks</b>		
<a href="#"><i>Carcharias taurus (east coast population)</i></a> Grey Nurse Shark (east coast population)	Critically Endangered	Species or species habitat may occur within area
<a href="#"><i>Carcharodon carcharias</i></a> Great White Shark	Vulnerable	Species or species habitat may occur within area
<a href="#"><i>Galeorhinus galeus</i></a> School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark	Conservation Dependent	Species or species habitat may occur within area
<a href="#"><i>Pristis zijsron</i></a> Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	Species or species habitat may occur within area
<a href="#"><i>Rhincodon typus</i></a> Whale Shark	Vulnerable	Species or species habitat may occur within area

**Plants**

<a href="#">Caladenia tessellata</a> Thick-lipped Spider-orchid, Daddy Long-legs	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Cryptostylis hunteriana</a> Leafless Tongue-orchid	Vulnerable	Species or species habitat may occur within area
<a href="#">Pimelea curviflora var. curviflora</a>	Vulnerable	Species or species habitat may occur within area
Migratory Species [ <a href="#">Dataset Information</a> ]	Status	Type of Presence

**Migratory Terrestrial Species****Birds**

<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
<a href="#">Hirundapus caudacutus</a> White-throated Needletail	Migratory	Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
<a href="#">Monarcha melanopsis</a> Black-faced Monarch	Migratory	Breeding may occur within area
<a href="#">Myiagra cyanoleuca</a> Satin Flycatcher	Migratory	Breeding likely to occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail	Migratory	Breeding may occur within area

**Migratory Wetland Species****Birds**

<a href="#">Ardea alba</a> Great Egret, White Egret	Migratory	Species or species habitat may occur within area
<a href="#">Ardea ibis</a> Cattle Egret	Migratory	Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper	Migratory	Species or species habitat known to occur within area
<a href="#">Calidris canutus</a> Red Knot, Knot	Migratory	Species or species habitat known to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper	Migratory	Species or species habitat known to occur within area
<a href="#">Calidris ruficollis</a> Red-necked Stint	Migratory	Species or species habitat known to occur within area
<a href="#">Calidris tenuirostris</a> Great Knot	Migratory	Species or species habitat known to occur within area
<a href="#">Charadrius bicinctus</a> Double-banded Plover	Migratory	Species or species habitat known to occur within area
<a href="#">Charadrius leschenaultii</a> Greater Sand Plover, Large Sand Plover	Migratory	Species or species habitat known to occur within area
<a href="#">Charadrius mongolus</a> Lesser Sand Plover, Mongolian Plover	Migratory	Species or species habitat known to occur within area
<a href="#">Gallinago hardwickii</a> Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat known to occur within area

<a href="#"><i>Heteroscelus brevipes</i></a> Grey-tailed Tattler	Migratory	Species or species habitat known to occur within area
<a href="#"><i>Limosa lapponica</i></a> Bar-tailed Godwit	Migratory	Species or species habitat known to occur within area
<a href="#"><i>Limosa limosa</i></a> Black-tailed Godwit	Migratory	Species or species habitat known to occur within area
<a href="#"><i>Numenius madagascariensis</i></a> Eastern Curlew	Migratory	Species or species habitat known to occur within area
<a href="#"><i>Numenius phaeopus</i></a> Whimbrel	Migratory	Species or species habitat known to occur within area
<a href="#"><i>Pluvialis fulva</i></a> Pacific Golden Plover	Migratory	Species or species habitat known to occur within area
<a href="#"><i>Rostratula benghalensis s. lat.</i></a> Painted Snipe	Migratory	Species or species habitat may occur within area
<a href="#"><i>Tringa stagnatilis</i></a> Marsh Sandpiper, Little Greenshank	Migratory	Species or species habitat known to occur within area
<b>Migratory Marine Birds</b>		
<a href="#"><i>Apus pacificus</i></a> Fork-tailed Swift	Migratory	Species or species habitat may occur within area
<a href="#"><i>Ardea alba</i></a> Great Egret, White Egret	Migratory	Species or species habitat may occur within area
<a href="#"><i>Ardea ibis</i></a> Cattle Egret	Migratory	Species or species habitat may occur within area
<a href="#"><i>Diomedea antipodensis</i></a> Antipodean Albatross	Migratory	Species or species habitat may occur within area
<a href="#"><i>Diomedea gibsoni</i></a> Gibson's Albatross	Migratory	Species or species habitat may occur within area
<a href="#"><i>Macronectes giganteus</i></a> Southern Giant-Petrel	Migratory	Species or species habitat may occur within area
<a href="#"><i>Macronectes halli</i></a> Northern Giant-Petrel	Migratory	Species or species habitat may occur within area
<a href="#"><i>Sterna albifrons</i></a> Little Tern	Migratory	Species or species habitat may occur within area
<a href="#"><i>Thalassarche bulleri</i></a> Buller's Albatross	Migratory	Species or species habitat may occur within area
<a href="#"><i>Thalassarche cauta (sensu stricto)</i></a> Shy Albatross, Tasmanian Shy Albatross	Migratory	Species or species habitat may occur within area
<a href="#"><i>Thalassarche impavida</i></a> Campbell Albatross	Migratory	Species or species habitat may occur within area
<a href="#"><i>Thalassarche salvini</i></a> Salvin's Albatross	Migratory	Species or species habitat may occur within area
<a href="#"><i>Thalassarche steadi</i></a> White-capped Albatross	Migratory	Species or species habitat may occur within area
<b>Migratory Marine Species</b>		
<b>Mammals</b>		
<a href="#"><i>Balaenoptera edeni</i></a> Bryde's Whale	Migratory	Species or species habitat may occur within area

<a href="#"><i>Caperea marginata</i></a> Pygmy Right Whale	Migratory	Species or species habitat may occur within area
<a href="#"><i>Eubalaena australis</i></a> Southern Right Whale	Migratory	Species or species habitat likely to occur within area
<a href="#"><i>Lagenorhynchus obscurus</i></a> Dusky Dolphin	Migratory	Species or species habitat may occur within area
<a href="#"><i>Megaptera novaeangliae</i></a> Humpback Whale	Migratory	Species or species habitat known to occur within area

**Reptiles**

<a href="#"><i>Chelonia mydas</i></a> Green Turtle	Migratory	Species or species habitat may occur within area
<a href="#"><i>Dermochelys coriacea</i></a> Leatherback Turtle, Leathery Turtle, Luth	Migratory	Species or species habitat may occur within area
<a href="#"><i>Natator depressus</i></a> Flatback Turtle	Migratory	Species or species habitat likely to occur within area

**Sharks**

<a href="#"><i>Carcharodon carcharias</i></a> Great White Shark	Migratory	Species or species habitat may occur within area
<a href="#"><i>Rhincodon typus</i></a> Whale Shark	Migratory	Species or species habitat may occur within area

**Other Matters Protected by the EPBC Act**

Listed Marine Species [ [Dataset Information](#) ]      Status      Type of Presence

**Birds**

<a href="#"><i>Apus pacificus</i></a> Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
<a href="#"><i>Ardea alba</i></a> Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
<a href="#"><i>Ardea ibis</i></a> Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
<a href="#"><i>Calidris acuminata</i></a> Sharp-tailed Sandpiper	Listed	Species or species habitat known to occur within area
<a href="#"><i>Calidris canutus</i></a> Red Knot, Knot	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><i>Calidris ferruginea</i></a> Curlew Sandpiper	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><i>Calidris melanotos</i></a> Pectoral Sandpiper	Listed - overfly marine area	Species or species habitat known to occur within area

<a href="#"><u><i>Calidris ruficollis</i></u></a> Red-necked Stint	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><u><i>Calidris tenuirostris</i></u></a> Great Knot	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><u><i>Charadrius bicinctus</i></u></a> Double-banded Plover	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><u><i>Charadrius leschenaultii</i></u></a> Greater Sand Plover, Large Sand Plover	Listed	Species or species habitat known to occur within area
<a href="#"><u><i>Charadrius mongolus</i></u></a> Lesser Sand Plover, Mongolian Plover	Listed	Species or species habitat known to occur within area
<a href="#"><u><i>Charadrius ruficapillus</i></u></a> Red-capped Plover	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><u><i>Diomedea antipodensis</i></u></a> Antipodean Albatross	Listed	Species or species habitat may occur within area
<a href="#"><u><i>Diomedea gibsoni</i></u></a> Gibson's Albatross	Listed	Species or species habitat may occur within area
<a href="#"><u><i>Gallinago hardwickii</i></u></a> Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><u><i>Haliaeetus leucogaster</i></u></a> White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
<a href="#"><u><i>Heteroscelus brevipes</i></u></a> Grey-tailed Tattler	Listed	Species or species habitat known to occur within area
<a href="#"><u><i>Himantopus himantopus</i></u></a> Black-winged Stilt	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><u><i>Hirundapus caudacutus</i></u></a> White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
<a href="#"><u><i>Lathamus discolor</i></u></a> Swift Parrot	Listed - overfly marine area	Species or species habitat may occur within area
<a href="#"><u><i>Limosa lapponica</i></u></a> Bar-tailed Godwit	Listed	Species or species habitat known to occur within area
<a href="#"><u><i>Limosa limosa</i></u></a> Black-tailed Godwit	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><u><i>Macronectes giganteus</i></u></a>	Listed	Species or species habitat may occur

Southern Giant-Petrel		within area
<a href="#"><i>Macronectes halli</i></a> Northern Giant-Petrel	Listed	Species or species habitat may occur within area
<a href="#"><i>Merops ornatus</i></a> Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
<a href="#"><i>Monarcha melanopsis</i></a> Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
<a href="#"><i>Myiagra cyanoleuca</i></a> Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
<a href="#"><i>Numenius madagascariensis</i></a> Eastern Curlew	Listed	Species or species habitat known to occur within area
<a href="#"><i>Numenius phaeopus</i></a> Whimbrel	Listed	Species or species habitat known to occur within area
<a href="#"><i>Philomachus pugnax</i></a> Ruff (Reeve)	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><i>Pluvialis fulva</i></a> Pacific Golden Plover	Listed	Species or species habitat known to occur within area
<a href="#"><i>Recurvirostra novaehollandiae</i></a> Red-necked Avocet	Listed - overfly marine area	Species or species habitat known to occur within area
<a href="#"><i>Rhipidura rufifrons</i></a> Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
<a href="#"><i>Rostratula benghalensis s. lat.</i></a> Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
<a href="#"><i>Sterna albifrons</i></a> Little Tern	Listed	Species or species habitat may occur within area
<a href="#"><i>Thalassarche bulleri</i></a> Buller's Albatross	Listed	Species or species habitat may occur within area
<a href="#"><i>Thalassarche cauta (sensu stricto)</i></a> Shy Albatross, Tasmanian Shy Albatross	Listed	Species or species habitat may occur within area
<a href="#"><i>Thalassarche impavida</i></a> Campbell Albatross	Listed	Species or species habitat may occur within area
<a href="#"><i>Thalassarche salvini</i></a> Salvin's Albatross	Listed	Species or species habitat may occur within area
<a href="#"><i>Thalassarche steadi</i></a> White-capped Albatross	Listed	Species or species habitat may occur within area
<a href="#"><i>Tringa stagnatilis</i></a>	Listed -	Species or species habitat known to

Marsh Sandpiper, Little Greenshank  
 overfly  
 marine  
 area occur within area

### Mammals

[\*Arctocephalus forsteri\*](#)  
 New Zealand Fur-seal Listed Species or species habitat may occur within area

[\*Arctocephalus pusillus\*](#)  
 Australian Fur-seal, Australo-African Fur-seal Listed Species or species habitat may occur within area

### Ray-finned fishes

[\*Acentronura tentaculata\*](#)  
 Hairy Pygmy Pipehorse Listed Species or species habitat may occur within area

[\*Festucalex cinctus\*](#)  
 Girdled Pipefish Listed Species or species habitat may occur within area

[\*Filicampus tigris\*](#)  
 Tiger Pipefish Listed Species or species habitat may occur within area

[\*Heraldia nocturna\*](#)  
 Upside-down Pipefish Listed Species or species habitat may occur within area

[\*Hippichthys penicillus\*](#)  
 Beady Pipefish, Steep-nosed Pipefish Listed Species or species habitat may occur within area

[\*Hippocampus abdominalis\*](#)  
 Eastern Potbelly Seahorse, New Zealand Potbelly, Seahorse, Bigbelly Seahorse Listed Species or species habitat may occur within area

[\*Hippocampus whitei\*](#)  
 White's Seahorse, Crowned Seahorse, Sydney Seahorse Listed Species or species habitat may occur within area

[\*Histiogamphelus briggsii\*](#)  
 Briggs' Crested Pipefish, Briggs' Pipefish Listed Species or species habitat may occur within area

[\*Lissocampus runa\*](#)  
 Javelin Pipefish Listed Species or species habitat may occur within area

[\*Maroubra perserrata\*](#)  
 Sawtooth Pipefish Listed Species or species habitat may occur within area

[\*Notiocampus ruber\*](#)  
 Red Pipefish Listed Species or species habitat may occur within area

[\*Phyllopteryx taeniolatus\*](#)  
 Weedy Seadragon, Common Seadragon Listed Species or species habitat may occur within area

[\*Solegnathus spinosissimus\*](#)  
 Spiny Pipehorse, Australian Spiny Pipehorse Listed Species or species habitat may occur within area

[\*Solenostomus cyanopterus\*](#)  
 Blue-finned Ghost Pipefish, Robust Ghost Pipefish Listed Species or species habitat may occur within area

[\*Solenostomus paradoxus\*](#)  
 Harlequin Ghost Pipefish, Ornate Ghost Pipefish Listed Species or species habitat may occur within area

[\*Stigmatopora argus\*](#)  
 Spotted Pipefish Listed Species or species habitat may occur within area

[\*Stigmatopora nigra\*](#)  
 Wide-bodied Pipefish, Black Pipefish Listed Species or species habitat may occur within area

[\*Syngnathoides biaculeatus\*](#)  
 Listed Species or species habitat may occur

Double-ended Pipehorse, Alligator Pipefish <a href="#">Trachyrhamphus bicoarctatus</a>	Listed	within area Species or species habitat may occur within area
Bend Stick Pipefish, Short-tailed Pipefish <a href="#">Urocampus carinirostris</a>	Listed	Species or species habitat may occur within area
Hairy Pipefish <a href="#">Vanacampus margaritifer</a>	Listed	Species or species habitat may occur within area
Mother-of-pearl Pipefish		
<b>Reptiles</b>		
<a href="#">Chelonia mydas</a> Green Turtle	Listed	Species or species habitat may occur within area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth	Listed	Species or species habitat may occur within area
<a href="#">Natator depressus</a> Flatback Turtle	Listed	Species or species habitat likely to occur within area
<a href="#">Pelamis platurus</a> Yellow-bellied Seasnake	Listed	Species or species habitat may occur within area
Whales and Other Cetaceans [ <a href="#">Dataset Information</a> ]	Status	Type of Presence
<a href="#">Balaenoptera edeni</a> Bryde's Whale	Cetacean	Species or species habitat may occur within area
<a href="#">Caperea marginata</a> Pygmy Right Whale	Cetacean	Species or species habitat may occur within area
<a href="#">Delphinus delphis</a> Common Dolphin, Short-beaked Common Dolphin	Cetacean	Species or species habitat may occur within area
<a href="#">Eubalaena australis</a> Southern Right Whale	Cetacean	Species or species habitat likely to occur within area
<a href="#">Lagenorhynchus obscurus</a> Dusky Dolphin	Cetacean	Species or species habitat may occur within area
<a href="#">Megaptera novaeangliae</a> Humpback Whale	Cetacean	Species or species habitat known to occur within area
<a href="#">Stenella attenuata</a> Spotted Dolphin, Pantropical Spotted Dolphin	Cetacean	Species or species habitat may occur within area
<a href="#">Tursiops aduncus</a> Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
<a href="#">Tursiops truncatus s. str.</a> Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area
Commonwealth Lands [ <a href="#">Dataset Information</a> ]		
Australian National University		
Commonwealth Bank of Australia		
Communications, Information Technology and the Arts - Australian Postal Corporation		
Communications, Information Technology and the Arts - Telstra Corporation Limited		
Defence		

Treasury - Reserve Bank of Australia

Unknown

Commonwealth Heritage Places [ [Dataset Information](#) ]

[General Post Office NSW](#)

[Reserve Bank NSW](#)

[Sydney Customs House \(former\) NSW](#)

Places on the RNE [ [Dataset Information](#) ]

Note that not all Indigenous sites may be listed.

### **Historic**

[ANZ Bank \(former\) NSW](#)

[ANZ Bank NSW](#)

[ASN Hotel \(former\) NSW](#)

[Accountants House NSW](#)

[Agar Steps & Adjacent Trees NSW](#)

[Agar Steps Houses NSW](#)

[Alfreds Terrace NSW](#)

[American Express Tower \(former\) NSW](#)

[Angel Hotel \(former\) NSW](#)

[Argyle Cut and Argyle Street Space NSW](#)

[Argyle House NSW](#)

[Argyle Place Park NSW](#)

[Argyle Place Precinct NSW](#)

[Argyle Precinct NSW](#)

[Argyle Stores NSW](#)

[Argyle Sub-Station NSW](#)

[Argyle Terrace NSW](#)

[Astor Apartment Building NSW](#)

[Australasian Steam Navigation Company Building NSW](#)

[Australian Hotel NSW](#)

[BMA House NSW](#)

[Bakery House and Loft \(former\) NSW](#)

[Barrack House NSW](#)

[Beneficial House NSW](#)

[Bettington and Merriman Streets Group NSW](#)

[Booth House \(former\) NSW](#)

[Brooklyn Hotel NSW](#)

[Buildings NSW](#)

[Burns Philp Building \(former\) NSW](#)

[CBC Bank Facade \(former\) NSW](#)

[Cadmans Cottage Space NSW](#)

[Cadmans Cottage including Grounds and Trees NSW](#)  
[Cahill Expressway Space NSW](#)  
[Cambridge Street Precinct NSW](#)  
[Campbells Cove Space NSW](#)  
[Campbells Storehouse NSW](#)  
[Captain Arthur Phillip Fountain NSW](#)  
[Carlson Terrace NSW](#)  
[Chamber of Commerce Building \(former\) NSW](#)  
[Chief Secretarys Building NSW](#)  
[Circular Quay West / Campbells Storehouse Space NSW](#)  
[City Mutual Life Assurance Building NSW](#)  
[Cleland Bond Store NSW](#)  
[Clyde Bank NSW](#)  
[Colonial Mutual Building Facade NSW](#)  
[Commercial Buildings NSW](#)  
[Commonwealth Bank NSW](#)  
[Commonwealth Bank NSW](#)  
[Commonwealth Bank and Gallipoli Club NSW](#)  
[Commonwealth Trading Bank Building NSW](#)  
[Conservatorium of Music NSW](#)  
[Coroners Court \(former\) NSW](#)  
[Cumberland Street Group NSW](#)  
[Cunningham Monument NSW](#)  
[Customs House Hotel NSW](#)  
[Dalgety Terrace NSW](#)  
[Dalgetys Bond Store \(former\) NSW](#)  
[Dawes Point Park and Reserve NSW](#)  
[Delphin House NSW](#)  
[Drill Hall \(former\) NSW](#)  
[ES&A Bank \(former\) NSW](#)  
[Education Department Building NSW](#)  
[Edwardian Buildings Group NSW](#)  
[Edwardian Commercial Group NSW](#)  
[Erskine Street Watch House Group NSW](#)  
[First Government House Site NSW](#)  
[Five Storey Building NSW](#)  
[Fort Street School \(former\) \(western addition\) NSW](#)  
[Four Dwellings and former Shop NSW](#)  
[Garden Palace Gates \(original work\) NSW](#)  
[General Post Office NSW](#)

[Gents Lavatory and Stone Walls NSW](#)  
[Geological and Mining Museum NSW](#)  
[George Patterson House NSW](#)  
[George Street / Kendall Lane Precinct NSW](#)  
[George Street Business Precinct NSW](#)  
[Georgian Townhouses NSW](#)  
[Georgian Warehouse \(former\) NSW](#)  
[Gloucester Street North Precinct NSW](#)  
[Gloucester Street North, Gloucester Walk and Escarpment Space NSW](#)  
[Glover Cottages NSW](#)  
[Government House NSW](#)  
[Government House, Associated Buildings and Garden NSW](#)  
[Grafton Bond Store \(former\) NSW](#)  
[Harrington Argyle Precinct NSW](#)  
[Harrington Place Space NSW](#)  
[Health Commission Building \(former\) NSW](#)  
[Health Department Building \(former\) NSW](#)  
[Herbarium Seed House NSW](#)  
[Hero of Waterloo Hotel NSW](#)  
[Hexam Terrace NSW](#)  
[History House NSW](#)  
[Hitching Posts \(two\) NSW](#)  
[Holy Trinity Anglican Church Hall NSW](#)  
[Horbury Terrace \(former\) NSW](#)  
[House NSW](#)  
[House NSW](#)  
[House NSW](#)  
[Houses NSW](#)  
[Housing Board Building NSW](#)  
[Italianate House NSW](#)  
[Italianate Terrace NSW](#)  
[Italianate Terrace NSW](#)  
[Jobbins Terrace NSW](#)  
[Kent Street Terrace Group East Side NSW](#)  
[Kent Street Terrace Group West Side NSW](#)  
[Kyle House NSW](#)  
[Lands Department Building NSW](#)  
[Lilyvale NSW](#)  
[Linsley Terrace NSW](#)  
[Lisgar House NSW](#)

[Longs Lane Precinct NSW](#)

[Lord Nelson Hotel NSW](#)

[Lower Fort Street West Side Group NSW](#)

[Lower Fort Street East Side Group NSW](#)

[Macknade House \(former\) NSW](#)

[Macquarie House NSW](#)

[Macquarie Place Buildings Group NSW](#)

[Macquarie Place Park & Structures NSW](#)

[Macquaries Obelisk NSW](#)

[Macquaries Wall and Gateway NSW](#)

[Maritime Services Board Building \(former\) NSW](#)

[Martin Place GPO Precinct NSW](#)

[Martin Place Urban Conservation Area NSW](#)

[Mens Lavatory NSW](#)

[Mercantile Hotel NSW](#)

[Merriman Street Precinct NSW](#)

[Millers Point Post Office NSW](#)

[Milton Terrace NSW](#)

[Moore Stairs NSW](#)

[NSW Department of Labour & Industry Building \(former\) NSW](#)

[NSW Government Railway Administrative Building NSW](#)

[NSW Sports Club Five Storey Building NSW](#)

[NSW Sports Club Four Storey Building NSW](#)

[National Trust Centre NSW](#)

[New Metcalfe Bond / George Street Precinct NSW](#)

[New Metcalfe Bond NSW](#)

[New South Wales Club House \(former\) NSW](#)

[Observatory Park NSW](#)

[Observer Hotel NSW](#)

[Old Training Block, Fort Street School \(former\) NSW](#)

[Opera House Gate Royal Botanic Gardens NSW](#)

[Orient Hotel NSW](#)

[Osborne House NSW](#)

[Ozanam House and Marist Chapel NSW](#)

[Pair of Neo Classic Town Houses NSW](#)

[Pair of Stone Houses NSW](#)

[Pair of Stone Houses NSW](#)

[Palisade Hotel NSW](#)

[Palisade Hotel and adjoining Terraces NSW](#)

[Pangas House NSW](#)

[Paragon Hotel \(former\) NSW](#)  
[Parker Galleries NSW](#)  
[Parliament House NSW](#)  
[Perpetual Trustee Company Building NSW](#)  
[Pinnacle House NSW](#)  
[Pitt / King Street Group NSW](#)  
[Playfair, George, Hickson Space NSW](#)  
[Police Station \(former\) NSW](#)  
[Police Station \(former\) NSW](#)  
[Premises NSW](#)  
[Queensland Insurance Building NSW](#)  
[Rawson Institute for Seamen \(former\) NSW](#)  
[Regency Townhouses NSW](#)  
[Reserve Bank NSW](#)  
[Residence and Shop NSW](#)  
[Reynolds Cottage and Shop NSW](#)  
[Richard Johnson Memorial NSW](#)  
[Richmond Villa NSW](#)  
[Royal Australian College of Physicians Building NSW](#)  
[Royal Australian Naval House NSW](#)  
[Royal Automobile Club NSW](#)  
[Royal Botanic Gardens and Domain NSW](#)  
[Royal College of Radiologists Building NSW](#)  
[Royal Exchange Assurance Building \(former\) NSW](#)  
[Seaforth House NSW](#)  
[Semi detached Houses NSW](#)  
[Sergeant Majors Row Terraces NSW](#)  
[Shelter House NSW](#)  
[Ship Inn Hotel \(former\) NSW](#)  
[Shipping Agents Office \(former\) NSW](#)  
[Shipwrights Arms Hotel \(former\) NSW](#)  
[Shops Residences and Offices NSW](#)  
[Shops and Hotel Group NSW](#)  
[Shops and Offices NSW](#)  
[Sirius Anchor and Cannon NSW](#)  
[Sirius House NSW](#)  
[Skinnners Family Hotel \(former\) NSW](#)  
[Societe Generale House NSW](#)  
[Sport House including Original Interiors NSW](#)  
[St Brigids Catholic Church & School NSW](#)

[St John House NSW](#)  
[St Patricks Catholic Church NSW](#)  
[St Patricks Convent Chapel NSW](#)  
[St Patricks Convent NSW](#)  
[St Patricks Hall and School NSW](#)  
[St Philips Anglican Church NSW](#)  
[Stafford Terrace \(part\) NSW](#)  
[State Library of NSW Forecourt NSW](#)  
[State Library of NSW NSW](#)  
[Statue of Albert the Good NSW](#)  
[Statue of Dunmore Lang NSW](#)  
[Statue of King Edward VII NSW](#)  
[Stone Cottage and Adjacent Stone Wall NSW](#)  
[Sugar House NSW](#)  
[Susannah Place Terrace NSW](#)  
[Sydney Customs House \(former\) NSW](#)  
[Sydney Harbour Bridge NSW](#)  
[Sydney Hospital NSW](#)  
[Sydney Hospital Nurses Annex NSW](#)  
[Sydney Observatory NSW](#)  
[Sydney Opera House and Surrounds NSW](#)  
[Sydney Sailors Home \(former\) NSW](#)  
[T S Mort Statue NSW](#)  
[Tank Stream Tunnel NSW](#)  
[Telford Trust Building NSW](#)  
[Terrace Facade NSW](#)  
[Terrace Houses NSW](#)  
[Terrace Houses NSW](#)  
[Terrace Houses NSW](#)  
[Terrace NSW](#)  
[Terrace NSW](#)  
[Terrace NSW](#)  
[Terrace NSW](#)  
[Terrace NSW](#)  
[Terrace NSW](#)  
[Terrace NSW](#)  
[Terrace and Commercial Building NSW](#)  
[Terrace and Townhouses NSW](#)  
[Terrace of Three Shops NSW](#)  
[Terraced Houses NSW](#)  
[Terraces Facade NSW](#)

[Terraces Facade NSW](#)  
[Terraces NSW](#)  
[Terraces NSW](#)  
[Terraces NSW](#)  
[Terraces NSW](#)  
[Terraces and Retaining Wall NSW](#)  
[Terraces and Townhouses NSW](#)  
[The Bushells Building NSW](#)  
[The Counting House NSW](#)  
[The Garrison Church NSW](#)  
[The Rocks Conservation Area NSW](#)  
[Three Victorian Residences NSW](#)  
[Town House NSW](#)  
[Townhouse NSW](#)  
[Townhouses NSW](#)  
[Towns Store NSW](#)  
[Traffic Court Group \(former\) NSW](#)  
[Traffic Court No 1 \(former\) NSW](#)  
[Traffic Court No 2 \(former\) NSW](#)  
[Transport House NSW](#)  
[Treasury Building & Premiers Office NSW](#)  
[Undercliff Cottage \(former\) NSW](#)  
[Union Bond Store NSW](#)  
[Unwins Coach House NSW](#)  
[Unwins Store NSW](#)  
[Victorian Shops NSW](#)  
[View Terrace Facade NSW](#)  
[Wales House NSW](#)  
[Walsh Bay Wharves NSW](#)  
[Warehouse NSW](#)  
[Watch House \(former\) NSW](#)  
[Westpac Bank NSW](#)  
[Windmill Street North Side Group NSW](#)  
[Windmill Street Southside Group NSW](#)  
[Winery Warehouse NSW](#)  
[Winsbury Terrace NSW](#)  
[Young Princess Hotel \(former\) NSW](#)

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## Caveat

The information presented in this report has been provided by a range of data sources as [acknowledged](#) at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the [migratory](#) and [marine](#) provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as [extinct or considered as vagrants](#)
- some species and ecological communities that have only recently been listed
- [some terrestrial species](#) that overfly the Commonwealth marine area
- migratory species that are very [widespread, vagrant, or only occur in small numbers](#).

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

## Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- [New South Wales National Parks and Wildlife Service](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Water and Environment, Tasmania](#)
- [Department of Environment and Heritage, South Australia Planning SA](#)
- [Parks and Wildlife Commission of the Northern Territory](#)
- [Environmental Protection Agency, Queensland](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- Other groups and individuals

[ANUCLiM Version 1.8, Centre for Resource and Environmental Studies, Australian National University](#) was used extensively for the production of draft maps of species distribution.

Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Last updated: Thursday, 20-Nov-2008 14:17:56 EST

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Heritage and the Arts](#)

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## **Appendix 4: Threatened species listed under the *FM Act* 1999**



[Whole title](#) | [Regulations](#) | [Historical versions](#) | [Historical notes](#) | [Search title](#)

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## Fisheries Management Act 1994 No 38

Current version for 8 January 2010 to date (accessed 14 March 2010 at 19:08)

[Schedule 4](#)

<< page >>

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### Schedule 4 Endangered species, populations and ecological communities

(Section 220C)

#### Part 1 Endangered species

##### Fish

*Archaeophya adamsi* Fraser, 1959

*Austrocordulia leonardi*

\**Maccullochella ikei* Rowland

\**Maccullochella macquariensis* (Cuvier)

*Macquaria australasica* (Cuvier, 1830)

*Mogurnda adspersa* (Castelnau, 1878)

*Nannoperca australis* Günther, 1861

\**Nannoperca oxleyana* Whitley

*Notopala sublineata* (Conrad, 1850)

*Thunnus maccoyii*

Adam's emerald dragonfly

Sydney Hawk dragonfly

eastern freshwater cod

trout cod

Macquarie perch

purple spotted gudgeon

southern pygmy perch

Oxleyan pygmy perch

river snail

southern bluefin tuna

##### Marine vegetation

#### Part 2 Endangered populations

##### Fish

*Ambassis agassizii* Steindachner, 1866, olive perchlet, western New South Wales population

*Gadopsis marmoratus*, river blackfish, Snowy River population

*Tandanus tandanus* (Mitchell, 1838), eel tailed catfish, Murray-Darling Basin population

##### Marine vegetation

#### Part 3 Endangered ecological communities

Aquatic ecological community in the natural drainage system of the lower Murray River catchment (as described in the recommendation of the Fisheries Scientific Committee to list the ecological community)

Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River (described in the recommendation of the Fisheries Scientific Committee to list that aquatic ecological community, as the area covered by that recommendation)

Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River (described in the recommendation of the Fisheries Scientific Committee to list that aquatic ecological community, as the area covered by that recommendation)

#### **Part 4 Species presumed extinct**

##### **Fish**

*Pristis zijsron* Bleeker, 1851

green sawfish

*Metaprotella haswelliana* Mayer, 1882

Haswells caprellid

##### **Marine vegetation**

*Vanvoorstia bennettiana* (Harvey) Papenfuss  
(1956)

Bennetts seaweed

[Top of page](#)



[Whole title](#) | [Regulations](#) | [Historical versions](#) | [Historical notes](#) | [Search title](#)

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## Fisheries Management Act 1994 No 38

Current version for 8 January 2010 to date (accessed 14 March 2010 at 19:14)

[Schedule 4A](#)

<< page >>

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### Schedule 4A Critically endangered species and ecological communities

(Section 220C)

#### Part 1 Critically endangered species

##### Fish

<i>*Carcharias taurus</i> Rafinesque, 1810	grey nurse shark
<i>Craterocephalus fluviatilis</i> (McCulloch, 1913)	Murray hardyhead
<i>Galaxias rostratus</i>	flathead galaxias
<i>Smeagol hiliaris</i> Tillier & Ponder, 1992	marine slug

##### Marine vegetation

<i>Nereia lophocladia</i> J. Agardh (1897)	marine brown alga
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#### Part 2 Critically endangered ecological communities

[Top of page](#)



[Whole title](#) | [Regulations](#) | [Historical versions](#) | [Historical notes](#) | [Search title](#)

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## Fisheries Management Act 1994 No 38

Current version for 8 January 2010 to date (accessed 24 March 2010 at 14:49)

[Schedule 5](#)

<< page >>

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### Schedule 5 Vulnerable species and ecological communities

(Section 220C)

#### Part 1 Vulnerable species

##### Fish

*Bidyanus bidyanus* (Mitchell, 1838)

silver perch

*Branchinella buchananensis* Geddes, 1981

Buchanans fairy shrimp

\**Carcharodon carcharias* (Linnaeus, 1758)

great white shark

*Epinephelus daemeli* (Günther, 1876)

black cod

##### Marine vegetation

#### Part 2 Vulnerable ecological communities

[Top of page](#)