



Cattle Bay Marina - Hydrographic Mapping & Marine Mammal Risk Profiles



Prepared on behalf of Eden Resort Hotel Pty Ltd

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SUMMARY

Ocean Environmental was engaged by Eden Resort Hotel Pty Ltd to undertake additional works requested by Bega Valley Shire Council in relation to the proposed development of a marina at Cattle Bay, Eden, New South Wales.

The current study includes:

1. A hydrographic survey of Cattle Bay to include the delineation of identified aquatic habitats, including the in-shore and off-shore limits of *Heterostera seagrass*.
2. Development of up-to-date risk profiles for marine mammal usage of Twofold Bay, Snug Cove and the immediate coastal environments of Twofold Bay.

This report outlines the techniques and findings of the field survey conducted in early July 2014 to develop a bathymetric and habitat map of Cattle Bay, Eden, with particular regard to the seagrass communities. Marine Solutions was engaged to undertake the hydrographic and habitat mapping component with the aid of Ocean Environmental staff. The report also outlines the methods used to determine up to date risk profiles for marine mammal use of Twofold Bay and its immediate coastal environment.

The bathymetry of the area is generally simple, with depth increasing with increasing distance from the shore. The majority of Cattle Bay is covered by marine sediments, with the exclusion of sections of rocky foreshore which extend to the subtidal in a highly rugose manner. Three species of seagrass were noted and their approximate distribution mapped throughout the bay. On the inner margin, seagrasses were found to colonise sediments to the head of Cattle Bay, and to the edge of the rocky reef where suitable substrates were located. Sparse seagrass was found to extend offshore to at least to the 7 m depth contour. Suggestions are made to mitigate against possible impacts on the existing seagrass beds, however it is a possibility that the development of a marina may reduce seabed disturbance by reducing demand for swing moorings which scour the seabed; re-berthing of vessels in a marina will potentially reduce seabed scouring and thereby allow an increased area of habitat to be colonised by seagrasses over time.

Marine mammal use of Twofold Bay was assessed using recent data records obtained from Cat Balou Cruises and up to date threatened species database searches. The timing and location of all marine mammal sightings was plotted to provide information on utilisation of the bay and immediate coastal areas by various whales, dolphins and seals. The potential impacts on marine mammals from the proposed development along with mitigation measures and this up to date data were used to develop risk profiles for each of the identified species.

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1. INTRODUCTION

1.1 Project Background

Eden Resort Hotel Pty Ltd has proposed the construction of a 154 berth floating marina in Cattle Bay, Eden, New South Wales (NSW). In 2013, Inspire Urban Design & Planning and Haskoning Australia (a company of Royal Haskoning DHV) prepared an Environmental Impact Assessment (EIA) under Part 4 of the *Environmental Planning & Assessment Act (EP&A Act 1979)* on behalf of Eden Resort Hotel Pty Ltd. for the proposed development. This was submitted to Bega Valley Shire Council for consideration.

A preliminary assessment of the EIA undertaken by Council found the EIA to be deficient in a number of critical areas. In August 2013, Council advised that the Development Application (DA) did not meet the provisions of the *EP&A Act 1979* and requested that additional information was submitted prior to assessment of the proposal.

In relation to environmental impacts, the EIA had listed a number of further studies which were considered to be required (which Council subsequently requested to be completed). The current study addresses two of these as follows:

1. A hydrographic survey of Cattle Bay to include the delineation of identified aquatic habitats, including the in-shore and off-shore limits of *Heterostera* seagrass.
2. Development of up-to-date risk profiles for marine mammal usage of Twofold Bay, Snug Cove and the immediate coastal environments of Twofold Bay.

1.2 Proposed Development

The proposed marina at Cattle Bay is to include the following features:

- Repair and refurbishment of the existing fish cannery wharf built on the adjacent old fish cannery site.
- A 154 berth floating marina south of the cannery wharf with three marina arms orientated approximately south-east towards Snug Cove and a northern arm extending along the eastern side of the cannery wharf.
- Berthing for 63 x 12 m vessels, 65 x 15 m vessels and 26 x 18 m vessels with temporary berthing for 2 – 3 visiting superyachts and for other vessel pickup and set down needs.
- A wave attenuator to protect the marina from prevailing local seas from the SSW and from refracted ocean swell - this will be a fixed, non-floating structure, approximately 230 m long and aligned roughly parallel to the shore (note that the final alignment will be subject to wave modelling studies). The wave attenuator will comprise a series of raked and vertical piles that support precast concrete panels held off the seabed but with sufficient distance below the water level to provide the required wave attenuation.

- Fixed utilities (i.e. power, communications, fire-fighting and potable water) and the provision of a mobile sewage pump out unit.
- The marina layout provides channel widths >25 m between the eastern ends of the marina and the -2 m ISLW contour offshore from the mainland (Figure 1.1).
- An isolated pinnacle of rock was identified by Marine Pollution Research (2013) and can be seen in Figure 1.1 between the two outer arms of the proposed marina - this may need to be removed for navigational purposes.

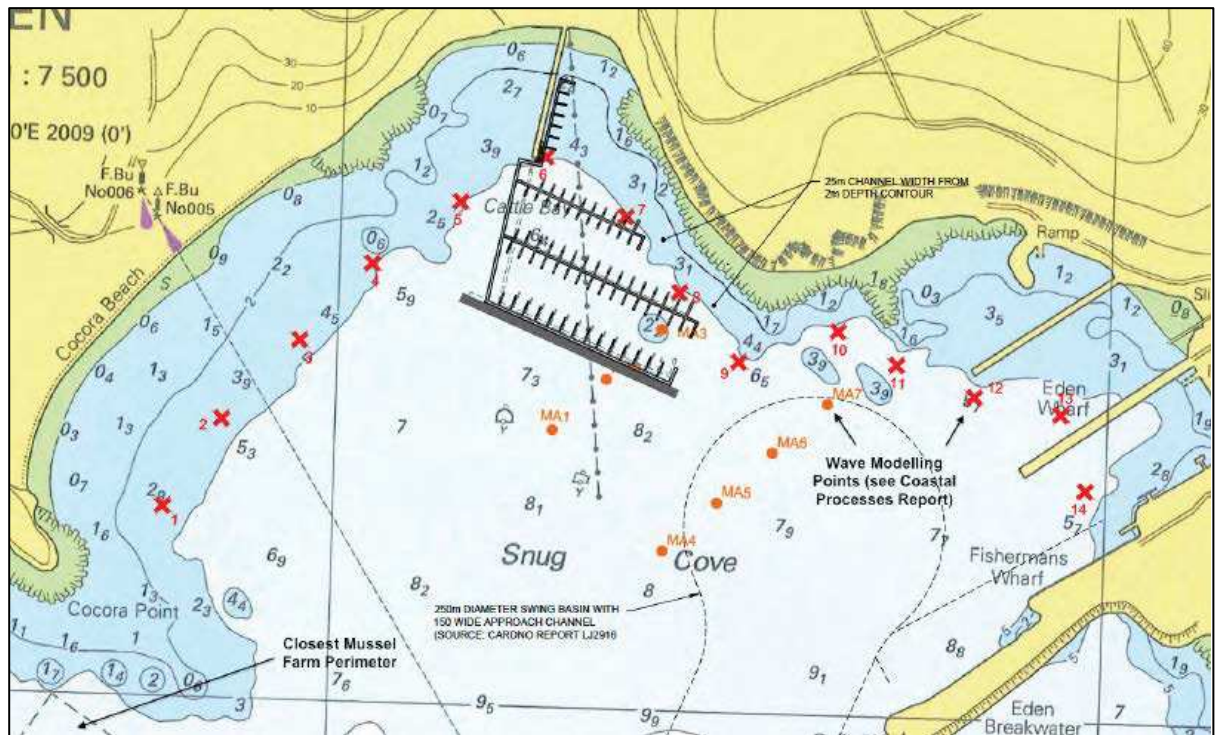


Figure 1.1 Location and layout of proposed marina (note that the final alignment of the wave attenuator will be subject to wave modelling studies) (Haskoning Australia 2013).

1.3 Study Location

Eden is a small coastal town located on the shore of Twofold Bay, on the far South Coast of NSW (Figure 1.2). Twofold Bay is the southern-most of five oceanic bays on the NSW coast. The region is known for its fishing and coastal trading and has a strong maritime heritage including recreational and commercial boating.

The proposed Cattle Bay marina is located in Cattle Bay, within Snug Cove, Eden. Snug Cove and Cattle Bay are both located within Twofold Bay (Figure 1.3).

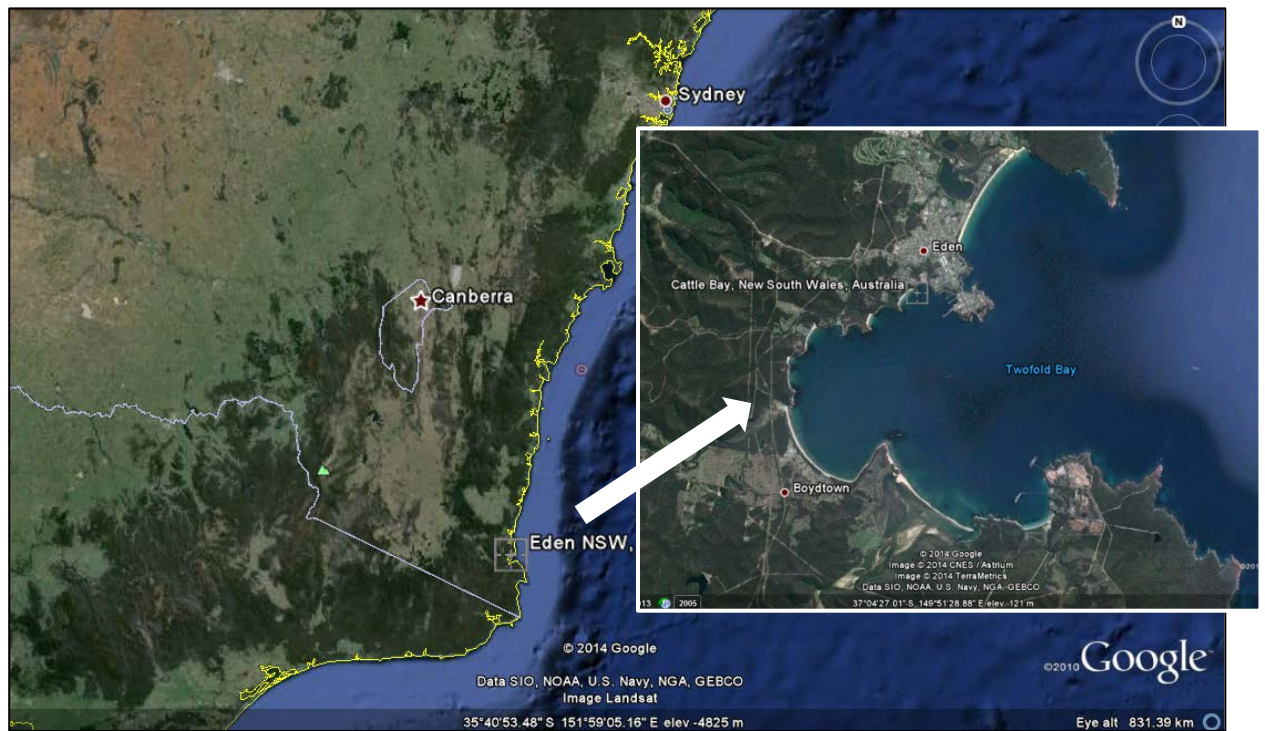


Figure 1.2 Location of Eden and Twofold Bay in relation to the NSW coastline.



Figure 1.3 Location of Cattle Bay, Eden.

1.4 Scope of Works

The current study addresses Council's additional study requirements as follows:

1. A hydrographic survey of Cattle Bay to include the delineation of identified aquatic habitats, including the in-shore and off-shore limits of *Heterostera* seagrass.
2. Development of up-to-date risk profiles for marine mammal usage of Twofold Bay, Snug Cove and the immediate coastal environments of Twofold Bay.

Marine Solutions was engaged to undertake the hydrographic mapping component of this study.

2. STUDY METHODS

2.1 Marine Mammal Risk Profiles

2.1.1 Database Searches

DATABASE SEARCHES

Up to date database searches for threatened and listed marine mammals with the potential to occur in the study area were undertaken on 16 June, 2014. The potential for State and Commonwealth listed threatened and protected marine mammal species, as listed under the *NSW Fisheries Management (FM) Act 1994*, *NSW Threatened Species Conservation (TSC) Act 1995* and *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, to occur in the study area were determined by undertaking online database searches of the following:

- Schedules 4 to 6 of the *NSW FM Act 1994* (for species listed under the *FM Act 1994*) <http://www.legislation.nsw.gov.au/xref/info/re/?xref=Type%3Dact%20AND%20Year%3D1994%20AND%20no%3D38&nohits=y> (see results in **Appendix 1**).
- NSW National Parks and Wildlife Service (NPWS) Atlas of NSW Wildlife (BioNet) (for species listed under the *TSC Act 1995*) (a search area of 10 km radius around the study site is automatically selected by this database) <http://www.bionet.nsw.gov.au/> (see results in **Appendix 2**).
- Department of Sustainability, Environment, Water, Populations and Communities (DSEWPC) Protected Matters Search Tool (for species listed under the *EPBC Act 1999*) (a search area of 10 km radius around the study site was manually selected) <http://www.environment.gov.au/epbc/pmst/index.html> (see results in **Appendix 3**).

The Atlas of NSW Wildlife search tool (for the *FM Act 1994* and *TSC Act 1995*) lists threatened species which have been previously recorded within the selected search area, while the Protected Matters Search Tool (for the *EPBC Act 1999*) lists species whose habitat requirements have the potential to occur within the defined search area. Searches were specifically targeted to marine mammals for purposes of this study.

2.1.2 Review of Previous Studies

A number of recent studies have provided a review of marine mammals with the potential to, or known to, occur in Two Fold Bay and have assessed potential impacts on these species. Relevant information from these studies is summarised.

2.1.3 Cat Balou Whale Watching Records

DATA RECORDS

The local whale watching operator, Cat Balou Cruises, have been operating in Eden since 1990 and are the longest established whale watching operators in NSW. Seasonal marine mammal sighting records are held by Cat Balou Cruises. This locally collected data is vital in the assessment of current marine mammal use of Snug Cove, Twofold Bay and the immediate coastal environment, and in the development of up to date risk profiles for marine mammals in the vicinity of the study area.

Permission was obtained to utilise the Cat Balou Cruises data to provide up to date information on marine mammal use of the local area. At the time of writing, marine mammal sighting data was available between the dates of 20 November, 2010 and 11 July, 2014. For this study, the most recent data records from 2012 - 2014 (inclusive) were analysed. Marine Pollution Research (2013) has previously analysed data from 2010 - 2012 (inclusive) and their findings are summarised in this report.

DATA ANALYSIS

Descriptive data records taken from the Cat Balou Cruises website from 2012 - 2014 <http://www.catbalou.com.au/sightings.htm> were converted into a data spread sheet which included species, sighting date, presence / absence, to total number, location sighted and any behavior witnessed (raw data is included in **Appendix 4**).

Marine Mammal Species

For the most part marine mammal species are identified in the descriptive data. However, on a number of occasions they are only referred to as “whales”, “dolphins” or “seals”. Cat Balou Cruises have indicated that most references to seals are Australian Fur Seals and to dolphins are either Common Dolphins or Bottlenose Dolphins. They have also advised that the majority of whales sighted in the local area are Humpback Whales.

Sighting Location

The descriptive data included sightings at numerous locations. Sightings were allocated to the following: Aslings Beach, Calle Calle Bay, Coastal (East), Coastal (North), Coastal (South), Eden Breakwall, Eden Wharf, Heads of Twofold Bay, Honeysuckle Bay, North Head, South Head, The Lookout, Twofold Bay, Whale Spit and Not specified.

For data analysis purposes Murwaree and South Head to Murwaree were coded as Coastal (South), Leatherjacket was coded as Coastal (East), Leonards Island was coded as Coastal (North) and The Pinnacles were coded as Coastal (North).

Enumeration Protocols

Descriptive text often utilised language such as “a number” or “numerous” or “several”, to vaguely quantify marine mammal counts. This is often the case when large numbers of sightings occurred within a short time frame. During data entry, qualitative descriptive words were captured along with numeric counts of marine mammal individuals and groups. For descriptive, frequently used words, a numeric value was placed on the word based on its perceived intent. The value of that word was added to the total sightings for the taxa being described on that day. In addition, where the text suggests greater numbers of individuals or groups, the specified number of sightings was recorded along with a plus sign to indicate that more sightings were implied but not quantified. In these cases, the plus sign was also allocated a numeric value and added to the total sightings.

Table 2.1 lists the allocated values for each textual descriptor that was frequently encountered. In many diary entries, the number of dolphins and seals was not specified. In these cases, the number of pods / groups was recorded as 1.

Table 2.1 Values allocated to descriptive words used in the Cat Balou marine mammal sighting diary.

| Term utilised in Cat Balou diary entries | Designated value |
|-------------------------------------------------|-------------------------|
| “+” (implied additional sightings) | 1 |
| A couple | 2 |
| A number / a few / more | 3 |
| Several | 4 |
| Many / lots / numerous | 5 |

Data Analysis

Sightings of whales, dolphins and seals was analysed in a series of a) bar charts showing the mean frequency of days that whales, dolphins or seals were sighted in each month as a proportion of total survey days and b) bubble plots overlain onto maps of Two Fold Bay (and immediate coastal environment), showing the relative frequency of sightings at each location for all groups.

2.1.4 Incidental Sightings

Incidental sightings of marine mammals during the hydrographic / habitat mapping surveys were noted.

2.2 Hydrographic & Habitat Mapping

Hydrographic and habitat mapping were undertaken by Marine Solutions. The report for this component is provided in **Appendix 5** and should be read in full. Video and various high resolution mapping files are also available for reference. A summary of the methods and main findings is presented within this report.

2.2.1 Hydrographic Mapping

Bathymetric mapping was undertaken in order to identify any marine features or significant habitat boundaries in the immediate vicinity of the proposed development. The bathymetry of the proposed development area was generated by mounting a Garmin GPSmap 551 S with a 600W RMS sounder onto a vessel and driving a series of pre-determined grids over the area of interest (Figure 2.1). At intervals of 2 seconds, the GPS location and the depth were concurrently recorded, along with any user defined waypoints.

Positions were logged by a Garmin GPSmap 551S and depths were measured to the nearest tenth of a metre. The depth information string was post-processed to tidally correct for chart datum using tidal predictions for Eden, and barometric pressure using observations from local weather stations. The data was interpolated using GIS program Surfer 11.0 and land shape files were constructed using geo-referenced photo imagery. This information is displayed in a variety of output formats which can be modified as required including chart datum and AHD maps and .dxf files for integration into CAD programs.

2.2.2 Habitat Mapping

To determine the extent of seagrass and other benthic habitats habitat classification was conducted using a number of diver-swum and towed video transects. Towed video transects were undertaken in order to cover a large area of potential seagrass habitat rapidly, whereas diver based investigations provided more accurate identification of seagrass species and general habitats. Positions were recorded using a Garmin GPS 72.

Towed video surveys were conducted along four transects ranging from <1 m to 9 m water depth (Figure 2.2). Video footage was taken on an underwater video camera housed in a towing frame and recording to a viewable portable hard drive. An external GPS antenna and overlay box provides position, speed and direction overlay on the camera imagery and subsequent recordings. The towed camera was deployed from a drifting vessel and lowered to the bottom until an image was registered to upside, and real time visual habitat classification could be conducted. The direction and speed of vessel drift was controlled by utilising local currents, wind and the vessels motor to cover predetermined lines of interest, or features arising from the bathymetry or camera imagery.

Subsequent to the towed video work being completed, diver investigations were undertaken, allowing detailed inspection of mooring scour, seagrass speciation and marine habitats. Divers used a Sony NEX 5 in an Aquapazza underwater housing to film video footage 1 m above the bottom and take high resolution still photos.

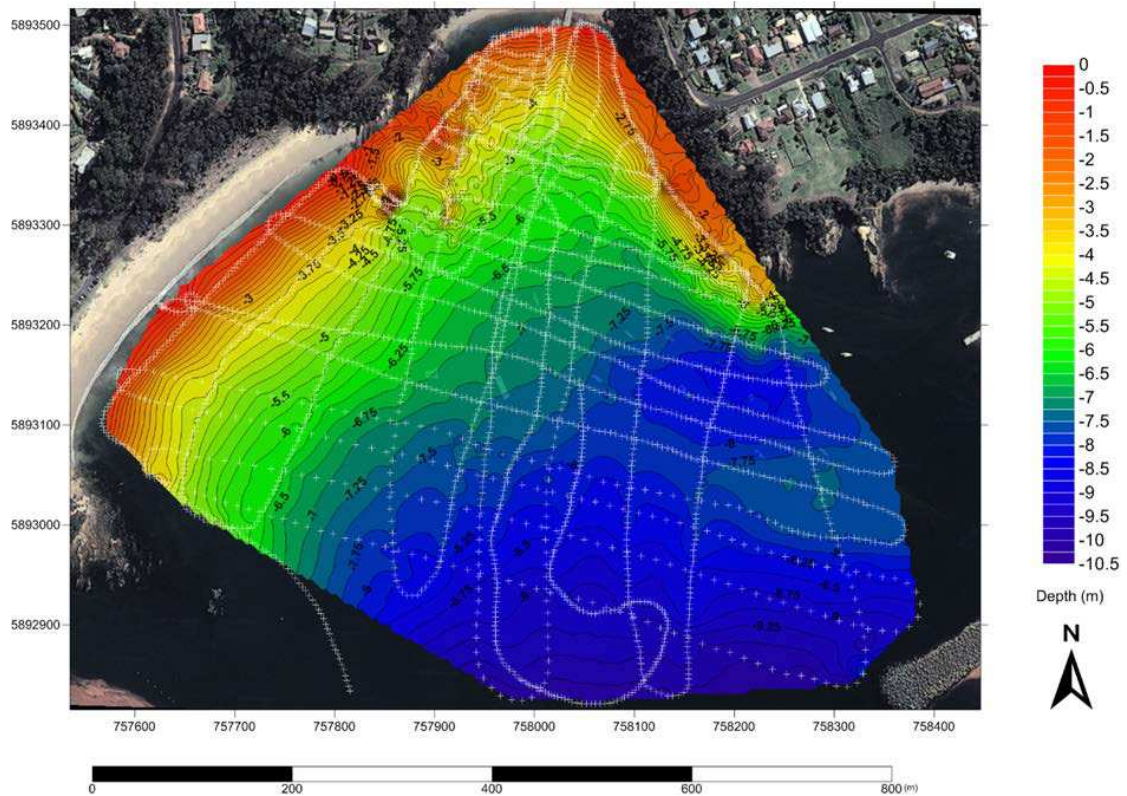


Figure 2.1 Location of bathymetric mapping transects and data points.

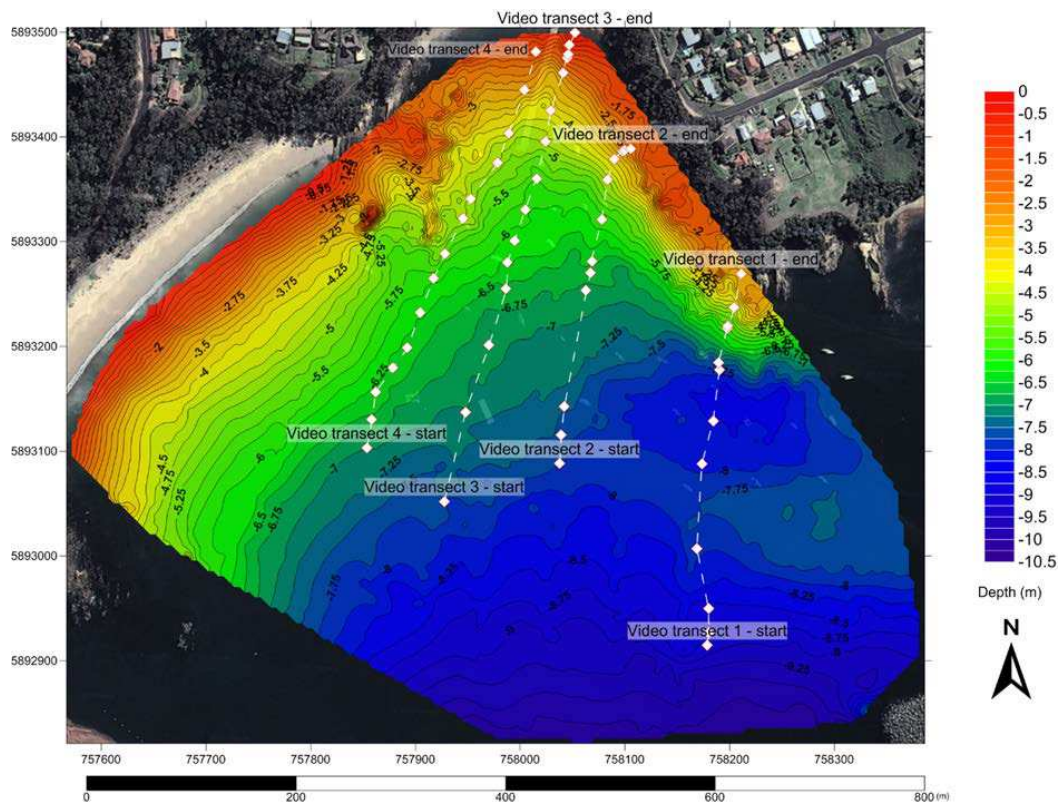


Figure 2.2 Location of video transects to identify benthic habitats.

3. MARINE MAMMAL RISK PROFILES

3.1 Database Searches

Up to date database searches for threatened, protected and listed marine mammals were undertaken on 16 June, 2014. Results are provided below.

FISHERIES MANAGEMENT ACT 1994

No marine mammals are listed 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. In addition, no “key threatening processes” listed under Schedule 6 of the *FM Act* 1994 apply to the current proposal or to marine mammals (**Appendix 1**).

THREATENED SPECIES CONSERVATION ACT 1995

The Atlas of NSW Wildlife Search returned a list of 10 marine mammals which have been recorded within 10 km of the study site (**Appendix 2**). These species along with their conservation status are listed in Table 3.1.

Table 3.1 Marine mammals listed under the NSW TSC Act 1995.

| Species | Conservation Status |
|-----------------------------------------------------|-----------------------|
| Dugong, <i>Dugong dugon</i> | Endangered, Protected |
| New Zealand Fur Seal, <i>Arctocephalus forsteri</i> | Vulnerable, Protected |
| Australian Fur Seal, <i>Arctocephalus pusillus</i> | Vulnerable, Protected |
| Southern Right Whale, <i>Eubalaena australis</i> | Endangered, Protected |
| Blue Whale, <i>Balaenoptera musculus</i> | Endangered, Protected |
| Humpback Whale, <i>Megaptera novaeangliae</i> | Vulnerable, Protected |
| Unidentified Whale, Whale sp. | Protected |
| Pygmy Sperm Whale, <i>Kogia breviceps</i> | Protected |
| Killer Whale (Orca), <i>Orcinus orca</i> | Protected |
| Common Dolphin, <i>Delphinus delphis</i> | Protected |

Appendix 2 provides maps of the sighting locations for the species listed. The majority of whale sightings are for Humpback Whales, which are recorded throughout Two Fold Bay. Pygmy Sperm Whales have been recorded at the mouth of the Twombas River at the southern end of Two Fold Bay, while Blue Whales, Killer Whales and Common Dolphins have been recorded just northeast of the Twombas River entrance. Southern Right Whales have been recorded in the western portion of Two Fold Bay, near Quarantine Bay.

Australian Fur Seals sightings include Snug Cove and Yallungo Cove which are both near Eden and directly east of Cattle Bay. New Zealand Fur Seal sightings are off Aslings Beach to

the north of Eden. A dugong sighting at Weecoon Cove, to the south west of Cattle Bay, may be erroneous as it is not typical that this species would occur this far south.

ENVIRONMENT PROTECTION AND BIO DIVERSITY CONSERVATION ACT 1999

The *EPBC Act* 1999 Protected Matters Search lists 12 “whales and other cetaceans” and 70 “listed marine species” with the potential to occur within 10 km of Cattle Bay (**Appendix 3**). All marine mammals listed are shown in Table 3.2, including their conservation status and type of presence.

Table 3.2 Marine mammals listed under the *EPBC Act* 1999.

| Species | Conservation Status | Type of Presence |
|---------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------|
| Blue Whale <i>Balaenoptera musculus</i> | Endangered, Migratory, Whales and other cetaceans | Species or species habitat likely to occur within area |
| Southern Right Whale <i>Eubalaena australis</i> | Endangered, Migratory, Whales and other cetaceans | Breeding likely to occur within area |
| Humpback Whale <i>Megaptera novaeangliae</i> | Vulnerable, Migratory, Whales and other cetaceans | Congregation or aggregation known to occur within area |
| Bryde's Whale <i>Balaenoptera edeni</i> | Migratory, Whales and other cetaceans | Species or species habitat may occur within area |
| Pygmy Right Whale <i>Capea marginata</i> | Migratory, Whales and other cetaceans | Species or species habitat may occur within area |
| Killer Whale (Orca) <i>Orcinus orca</i> | Migratory, Whales and other cetaceans | Species or species habitat may occur within area |
| Minke Whale <i>Balaenoptera acutorostrata</i> | Whales and other cetaceans | Species or species habitat may occur within area |
| Common dolphin <i>Delphinus delphis</i> | Whales and other cetaceans | Species or species habitat may occur within area |
| Risso's Dolphin <i>Grampus griseus</i> | Whales and other cetaceans | Species or species habitat may occur within area |
| Bottlenose Dolphin <i>Tursiops truncatus s. str.</i> | Whales and other cetaceans | Species or species habitat may occur within area |
| Indian Ocean Bottlenose <i>Tursiops aduncus</i> | Whales and other cetaceans | Species or species habitat likely to occur within area |
| Dusky Dolphin <i>Lagenorhynchus obscurus</i> | Migratory, Whales and other cetaceans | Species or species habitat may occur within area |
| New Zealand Fur Seal <i>Arctocephalus forsteri</i> | Listed marine mammal | Species or species habitat may occur within area |
| Australian Fur Seal <i>Arctocephalus pusillus</i> | Listed marine mammal | Species or species habitat may occur within area |

3.2 Review of Previous Studies

PREVIOUS STUDIES

Woodward-Clyde (1999/2000)

- Prepared an environmental impact statement (EIS) for the proposed Twofold Bay Multi-Purpose Wharf and Naval Munitions Storage Facility which included a review of potential impacts on marine mammals.

The Ecology Lab (2002)

- Considered the impacts of an earlier marina proposal at Cattle Bay.
- Undertook eight-part testing under the *FM Act* 1994 and *TSC Act* 1995.
- Threatened marine mammal species considered to occur within Twofold Bay included Southern Right Whales, Humpback Whales and Australian Fur Seals.
- Also undertook a generic eight-part test for Blue Whales, Fin Whales, Sperm Whales, Spinner Dolphins and Whale Sharks (oceanic species that would not occur the bay).

Cumberland Ecology (2007)

- Provided an additional impact assessment on the species identified by the Ecology Lab (2002) for the proposed Eden Resort at Cattle Bay.

NGH Environmental (2009)

- Considered the impacts of a proposed powerplant cooling water discharge at the Woodchip Wharf in East Boyd Bay and undertook seven-part tests under the *FM Act* 1994 and *TSC Act* 1995 and Assessments of Significance under the *EPBC Act* 1999 for the Southern Right Whale, Humpback Whale and Australian Fur Seal.

Marine Pollution Research (2013)

- Prepared an Aquatic Ecology Assessment for the proposed Cattle Bay marina including an assessment of impacts on marine mammals.
- Undertook database searches for threatened marine species listed under the *FM Act* 1994, *TSC Act* 1995 and *EPBC Act* 1999 in the study area (searches were undertaken within a 10 km radius of the Cattle Bay marina).
- Thirteen (13) cetaceans (whales and dolphins) were listed including the Humpback Whale, Southern Right Whale, Blue Whale, Dwarf Minke Whale, Bryde's Whale, Pilot Whale, Sperm Whale, Beaked Whale and Killer Whale (Orca). The pinnipeds Australian Fur Seal, New Zealand Fur Seal and Little Penguin were also listed.
- It was noted in this study that a number of non-listed dolphins are commonly seen in the bay and near-shore coastal water off Eden including the Bottlenose Dolphin and Common Dolphins.

Utilising the studies cited above, the following information regarding marine mammal usage of Twofold Bay was determined.

WHALES

- Many species of whales that travel along continental margins can be seen around Eden due to its close proximity to the continental shelf (Marine Pollution Research 2013).
- The majority of whales sighted in the Eden area are Humpback Whales seen on their southern migration. At the start of the season whales are mainly sub adults, followed by mother/ calf pods, which frequently enter Twofold Bay, allowing the calves to rest. Other species including Southern Right Whales, Blue Whales, Dwarf Minke Whales, Bryde's Whales, Orcas, Pilot Whales, Sperm Whales and several species of Beaked Whale have also been sighted off the coast of Eden (Cat Balou data 2010 - 2012).
- The Southern Right Whale, *Eubalaena australis*, had its listing increased from Vulnerable to Endangered under the *TSC Act* 1995 (NSW Scientific Committee 2011) and is also listed as Endangered under the *EPBC Act* 1999. A recovery plan has been recently updated for 2011 - 2021 under the *EPBC Act* (DSEPC 2011):
<http://www.environment.gov.au/system/files/resources/4b8c7f35-e132-401c-85be-6a34c61471dc/files/e-australis-2011-2021.pdf>.
- The major habitats for Southern Right Whales are the feeding areas of the Southern Ocean, the mating and calving aggregation areas in the Great Australian Bight and calving areas along the east (and west) coasts of Australia. Twofold Bay is considered as a potentially biologically important area (BIA) for East Coast Southern Right Whale population recovery (DSEPC 2011) as it is known historically to be an important calving and resting area where calving females or females with young travelling south may remain in shallow waters of 5 to 10 m depth (Pirzl 2008 in NSW Scientific Committee 2011). The majority of Southern Right sightings from 2010 – 2012 (Cat Balou Cruises data) in Twofold Bay occurred from July to September.
- Humpback Whales, *Megaptera novaeangliae*, are listed as Vulnerable under the *TSC Act* 1995 and *EPBC Act* 1999. They feed and grow in the Southern Ocean during the summer months followed by a northwards migration along the east Australian coast between June and October to subtropical waters to mate and calve. The east coast population migrates along the continental shelf north past Twofold Bay from late autumn to winter and south past Twofold Bay in late spring and early summer, accompanied by newborn calves (principally from September through November). On the southern migration Humpbacks regularly enter Twofold Bay or delay their migrations in coastal waters offshore of Twofold Bay to feed on coastal krill and small teleost fish, including sardines, particularly when upwellings provide suitable feeding conditions (Marine Pollution Research 2013).
- Silva *et al.* (2011) combined the Cat Balou Cruises whale watching data with their own data for the years 1995 to 2010 and mapped feeding congregations between 2006 and 2010. They noted that whale concentrations tended to shift from year to year over an area up to 20 km offshore within the study area. About half of the feeding whales (46.7%) were sub-adults and calves were present in most years.
- The Blue Whale, *Balaenopterus musculus*, is listed as Endangered under the *EPBC Act* 1999. It is an oceanic species that may occur rarely in coastal waters off Twofold Bay but is not

expected in Twofold Bay (Cat Balou Cruise Data 1990 to 1994 in PSM 1996 and inspection of on-line cruise log for 2010 to 2012).

- The Killer Whale, *Orcinus orca*, is listed as a migratory species under the *EPBC Act* 1999. It occurs in oceanic and shelf waters and along the continental slope but may also occur around seal colonies and whales with calves.

DOLPHINS

- Two non-listed dolphin species (Common Dolphin and Bottle nose Dolphin) are commonly seen in Twofold Bay and near-shore coastal waters off Eden.
- Marine Pollution Bulletin (2013) notes that the Cat Balou Cruise notes for 2010 through to December 2012 record Common Dolphins, *Delphinus delphis*, both within and outside the bay on almost every day of their three year log (averaging 75 to 90 days per year from June to December) and there are 38 reports of bottle nose dolphins from inside Twofold Bay. The majority of sightings were 'near the wharf or off the breakwater' with 6 from 'Twofold Bay', 5 off The Lookout, 5 in Honeysuckle Bay (including pods of 20 individuals or more and a sighting of a mother and 'tiny' calf), 4 off Aslings Beach and the remainder (6) in the southern bay (East Boyde, Whale Beach and Whale Spit, and off Kiah Inlet (data analysed by Marine Pollution Bulletin 2013).
- Cat Balou records provide no distinction between sightings of Bottle nose Dolphins, *Tursiops truncatus*, that are more common offshore, and the related Indo-Pacific Bottle nose Dolphin, *Taduncus*, that forms large more or less closed population groups in large embayments such as Port Stephens and Jarvis Bay (Moller and Beheregaray 2004). Whilst there do not appear to have been any published surveys of *Taduncus* in Twofold Bay, it is likely that many of the sightings recorded from the bay are from a resident population (Marine Pollution Bulletin 2013).

PINNIPEDS (SEALS)

- The Australian Fur Seal, *Arctocephalus pusillus doriferus*, is listed as Vulnerable under the *TSC Act* 1995. Whilst fur seals are known from Twofold Bay, particularly basking on the Eden Breakwater, there are no permanent local populations and breeding occurs on exposed oceanic sites in Bass Strait from October to January.
- Fur seals may use the seabed and rocky reefs of Cattle Bay for feeding on fish and cephalopods from time to time, but habitats for these prey species are abundant throughout Twofold Bay so Fur Seals can be expected throughout Twofold Bay (Marine Pollution Bulletin 2013).
- Cat Balou Cruises have indicated that most Fur Seals seen in Twofold Bay are Australian Fur Seals (personal correspondence, July 2014).
- The New Zealand Fur Seal, *Arctocephalus forsteri*, is listed as Vulnerable under the *TSC Act* 1995. It occurs as an occasional non-breeding vagrant in NSW southern coastal waters up to locations north of Sydney. Its use of Twofold Bay would be similar to that of the Australian fur seal (i.e. feeding and basking).
- A Little Penguin, *Eudyptula minor*, breeding colony at Eagles Claw Nature Reserve, with 24 breeding pairs, was decimated by dogs in 1993 and has never recovered. However, Cat Balou records indicate that Little Penguins are regular visitors to Twofold Bay, most

likely originating from the large colonies at Montague Island (6000 breeding pairs) and Gabo Island (18,000 breeding pairs) (Marine Pollution Bulletin 2013).

3.3 Cat Balou Marine Mammal Sighting Data 2012 - 2014

ALL MARINE MAMMALS

Cat Balou marine mammal records from 2012 to 2014 include the following species: Whale (unidentified), Humpback Whales, Dwarf Minke Whales, Southern Right Whales, Orca's, Bryde's Whale, Common Dolphins, Bottlenose Dolphins, Dolphins (unidentified) and Australian Fur Seals (**Appendix 5**). All bar charts used to display data in this section represent the mean frequency of days that whales, dolphins or seals were sighted in each month as a proportion of total survey days. A frequency of one infers that sightings occurred on every survey day in both years. On all bar charts the mean number of survey days for the period is also shown.

Analysis of all marine mammal data from 2012 to 2014 shows that while whales are sighted frequently between August and November (blue bars), the peak months for dolphin (brown bars) and seal (green bars) sightings are September and October (**Figure 3.1**).

As Cat Balou records are only held over the typical whale watching season (during which the vast majority of whales and seals would occur in the area) an indication of occurrence of dolphins during other months of the year is not available. However, it is likely that dolphins would have a year round occurrence as that many of the sightings from Two fold Bay are most likely from a resident population (Marine Pollution Bulletin 2013).

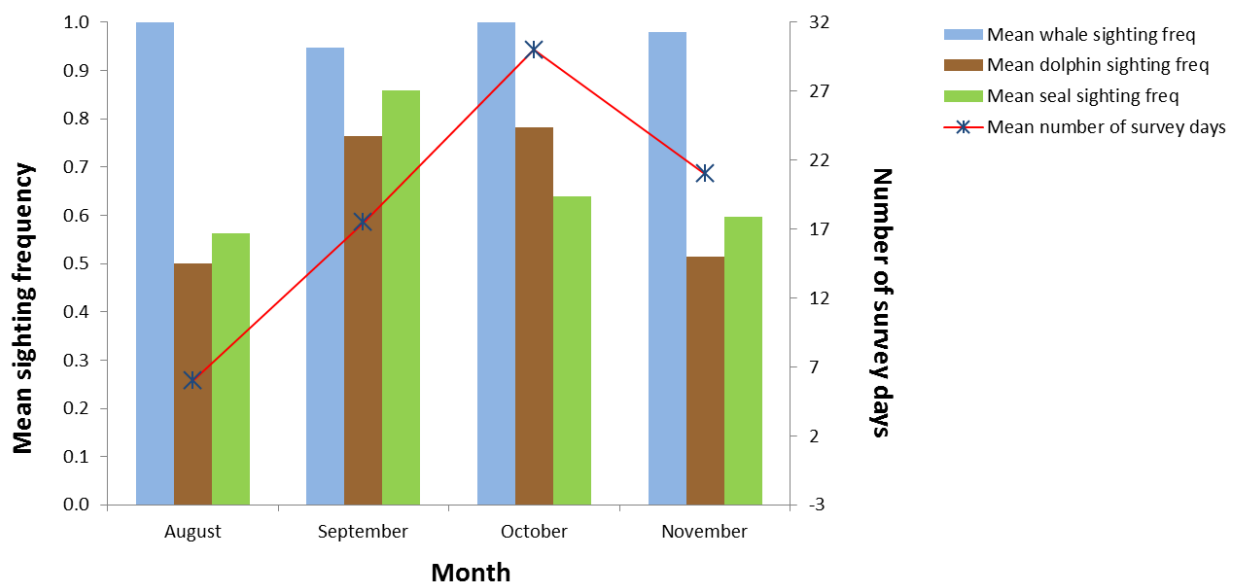


Figure 3.1 Mean relative frequency of all marine mammal sightings for 2012 - 2014.

WHALES

Analysis of whale data (Figure 3.2) by 'pod type' (i.e. occurrence of adults, sub-adults and mother/ calf pairs overtime) shows a peak in juvenile / sub-adult whales around September. Figure 3.2 also suggests that October and November are the highest risk months for mother/ calf pods as the frequency of mother/ calf pod sightings during this time is significantly higher than earlier in the whale season.

A bubble plot showing the relative frequency of whale sightings (2012 - 2014) at different locations around Eden shows that whale sightings occurred and were equally likely within Twofold Bay and the immediate coastal areas to the north and south (Figure 3.3 and Table 3.3). While some whales were sighted around the Eden break-wall and wharf (3 and 4 of 158 survey days), these sightings were infrequent when compared to use of the outer areas of the bay and immediate coastal environment. Therefore, use of Snug Cove and Cattle Bay by whales can be considered to be possible but only occasional. During this period whales were also sighted on 23 occasions where the location was not specified. Species sighted and included within this figure include the Humpback, Dwarf Minke, Southern Right and Bryde's Whales. The total number of whale pods sighted in 2012 and 2013 peaks around October and November (as seen in Figure 3.4 and Figure 3.5).

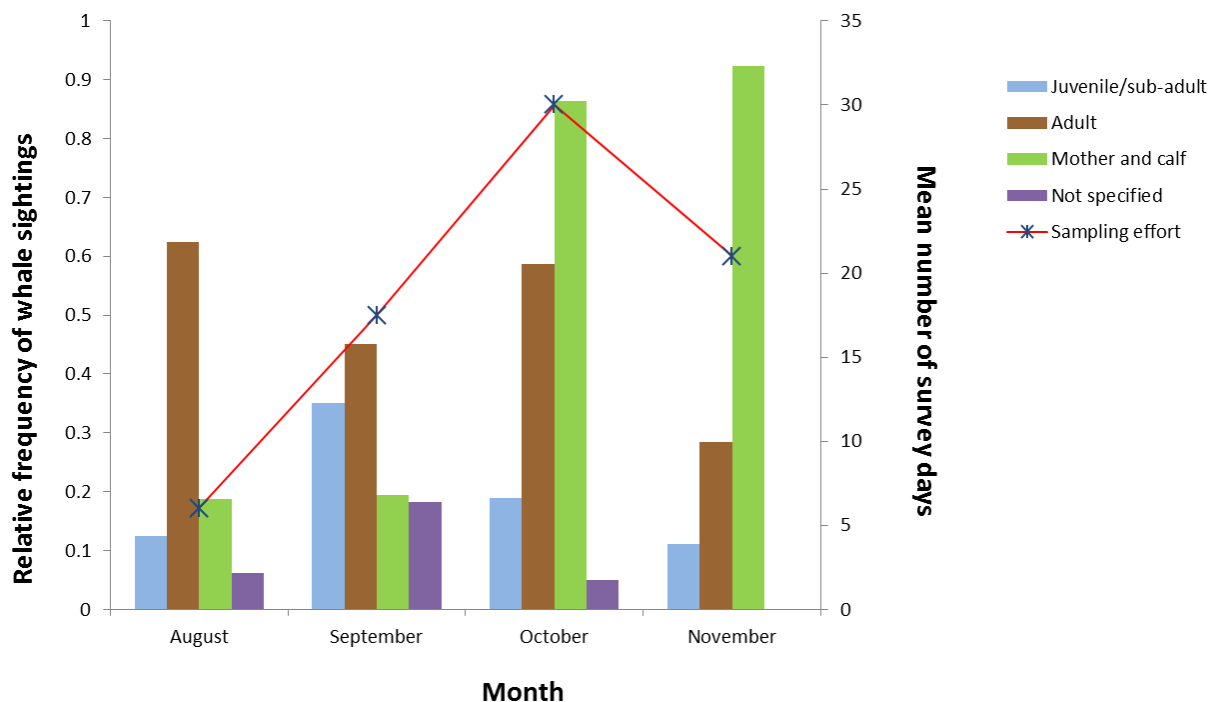


Figure 3.2 Mean relative frequency of whale sightings by pod type for 2012 - 2014.

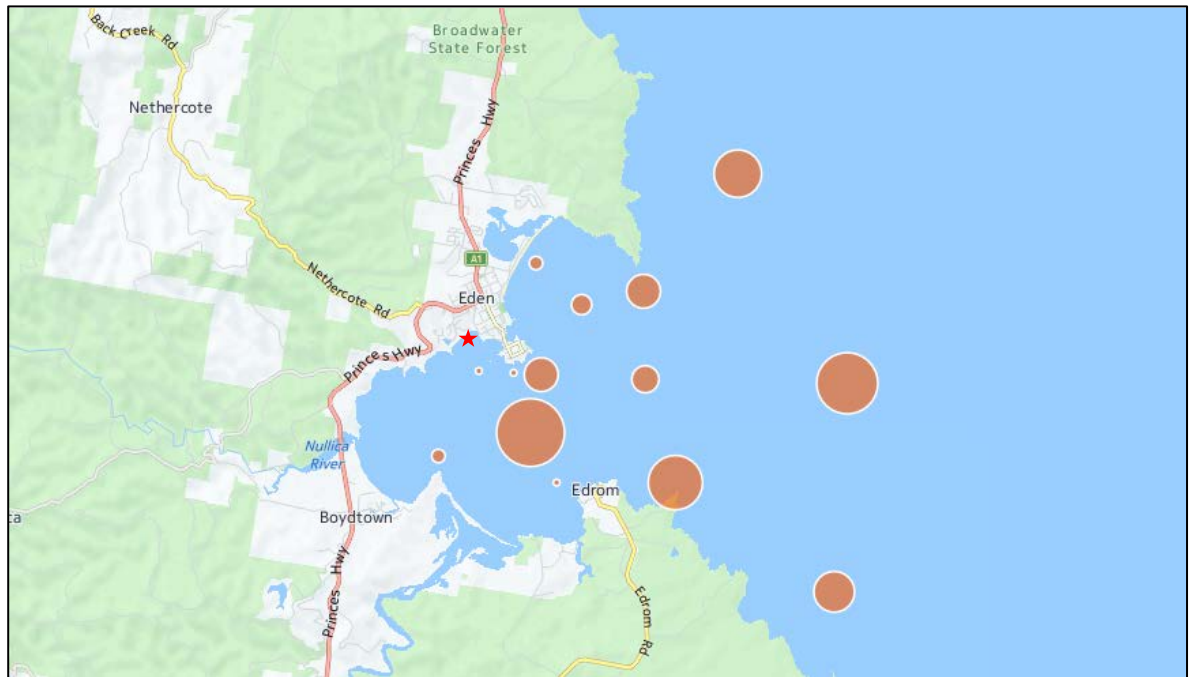


Figure 3.3 Relative frequency of whale sightings at locations around Eden from July 2012 to July 2014. The location of Cattle Bay is indicated with the red star.

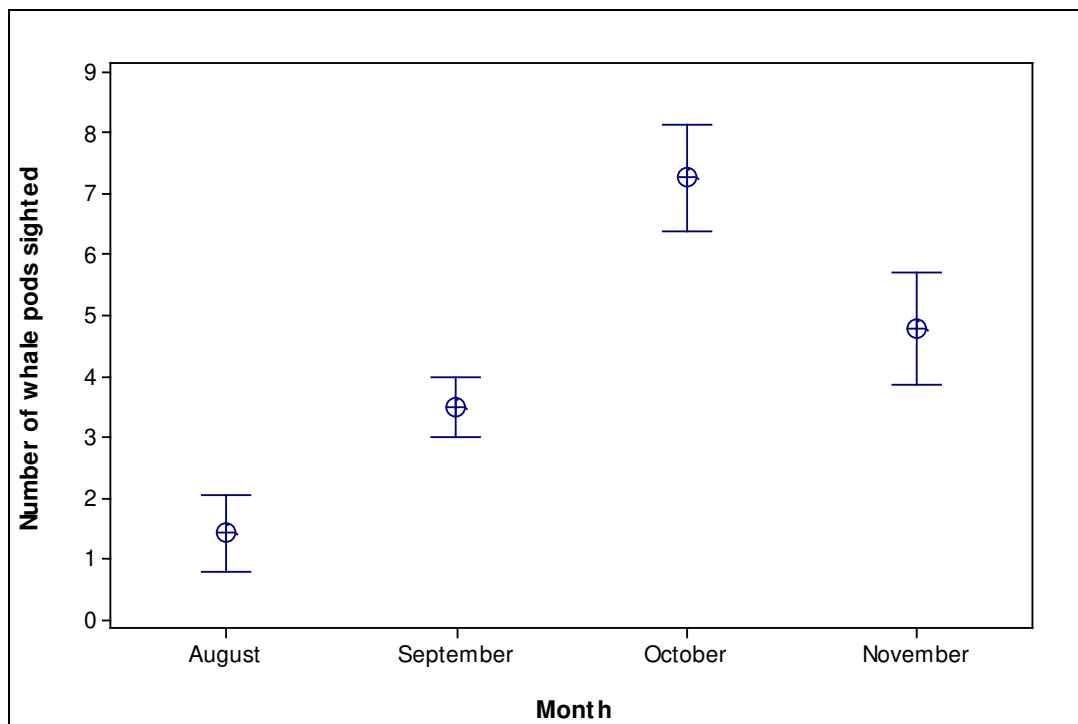
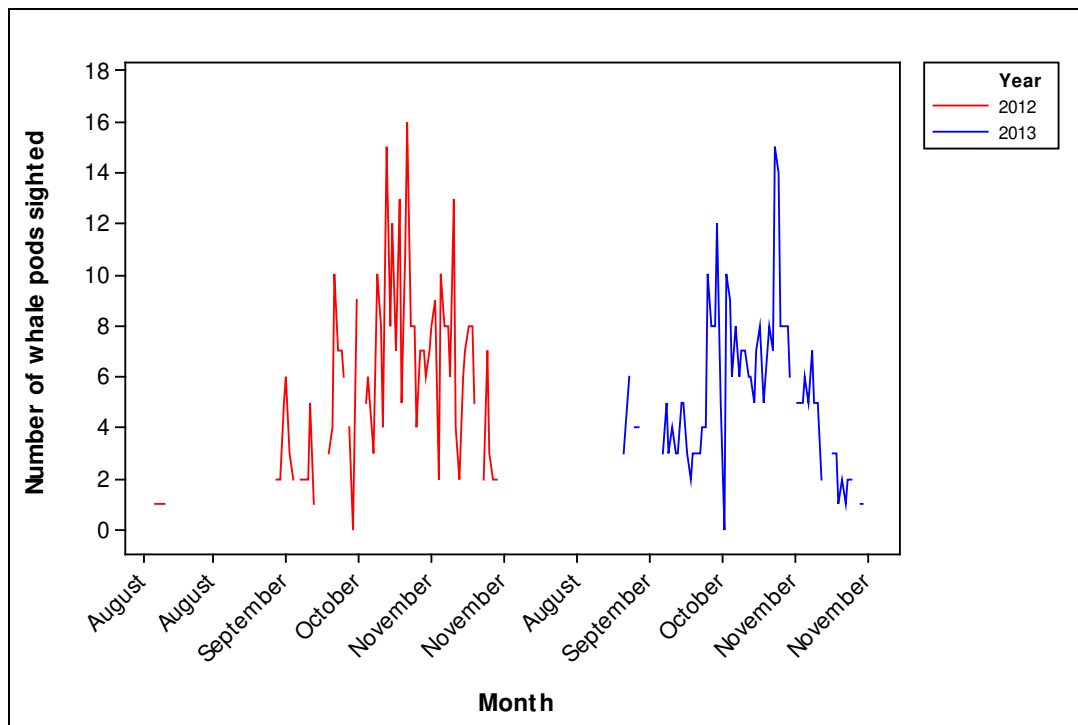


Table 3.3 Number of days whales were sighted by the Cat Balou at each location during 158 survey days.

| Location | July 2012 | Aug 2012 | Sept 2012 | Oct 2012 | Nov 2012 | Aug 2013 | Sept 2013 | Oct 2013 | Nov 2013 | May 2014 | July 2014 | Total days sighted |
|-----------------------------|------------------|-----------------|------------------|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|-----------------|------------------|---------------------------|
| Aslings Beach | 1 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 6 |
| Calle Calle Bay | 0 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 3 | 0 | 0 | 9 |
| Coastal (East) | 0 | 0 | 9 | 11 | 7 | 3 | 11 | 3 | 2 | 0 | 1 | 47 |
| Coastal (North) | 0 | 0 | 7 | 8 | 2 | 2 | 6 | 4 | 5 | 0 | 0 | 34 |
| Coastal (South) | 0 | 0 | 2 | 8 | 3 | 1 | 3 | 14 | 1 | 0 | 0 | 32 |
| Eden Break-wall | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Eden Wharf | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 4 |
| Heads of Twofold Bay | 0 | 0 | 2 | 3 | 3 | 0 | 3 | 1 | 0 | 1 | 0 | 13 |
| Honeysuckle Bay | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 3 |
| North Head | 0 | 0 | 2 | 2 | 2 | 0 | 5 | 4 | 2 | 0 | 0 | 17 |
| South Head | 0 | 0 | 6 | 6 | 4 | 2 | 9 | 15 | 4 | 0 | 0 | 46 |
| The Lookout | 0 | 1 | 0 | 4 | 6 | 0 | 2 | 7 | 0 | 0 | 0 | 20 |
| Twofold Bay | 1 | 1 | 3 | 20 | 16 | 0 | 7 | 20 | 10 | 1 | 0 | 79 |
| Whale Spit | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 6 |
| Not specified | 0 | 0 | 0 | 2 | 1 | 3 | 1 | 11 | 5 | 0 | 2 | 25 |

DOLPHINS

The majority of dolphin sightings from 2012 - 2014 occurred within Twofold Bay (unspecified location) and immediate coastal areas while some dolphin sightings occurred around Snug Cove, Eden (Figure 3.6 and Table 3.4). During this period dolphins were also sighted on 40 occasions where the location was not specified. Species sighted included Common and Bottlenose Dolphins. The majority of dolphin sightings were in the months of September and October (Figure 3.7 and Figure 3.8).

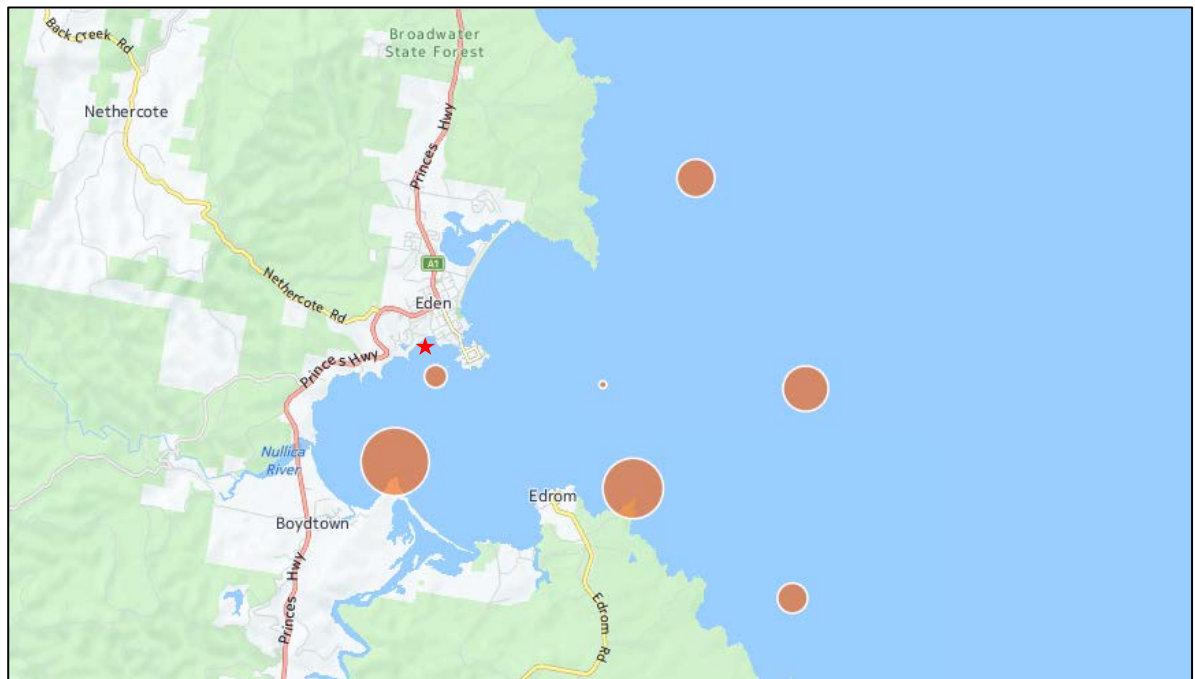


Figure 3.6 Relative frequency of dolphin sightings at locations around Eden from July 2012 to July 2014. The location of Cattle Bay is indicated with the red star.

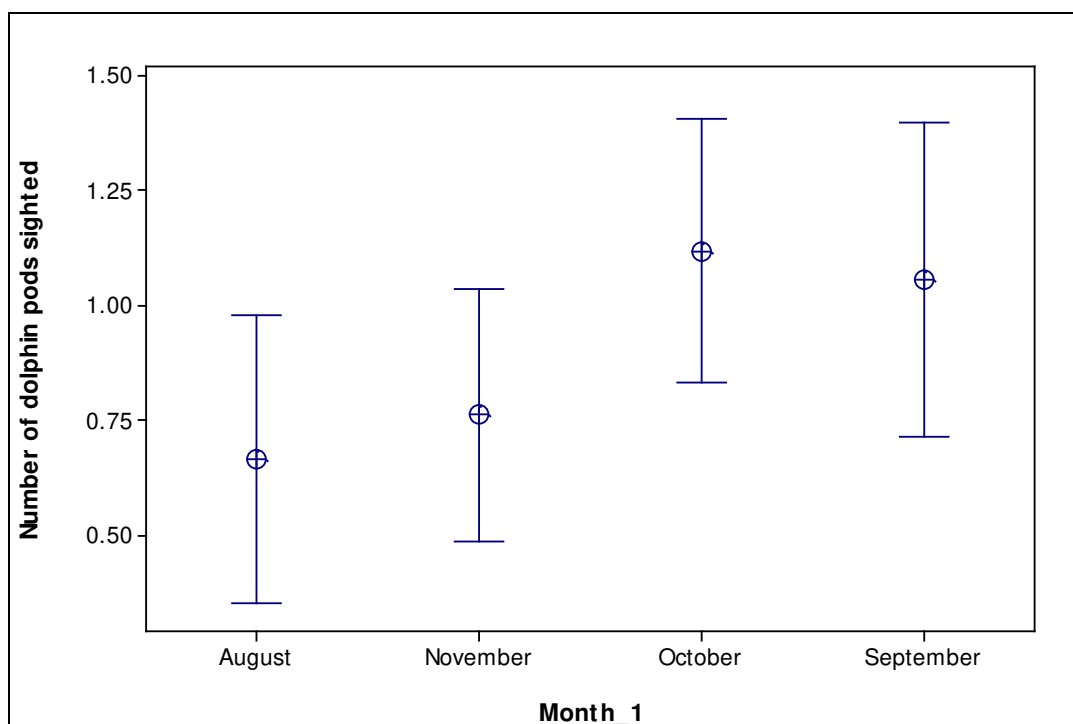
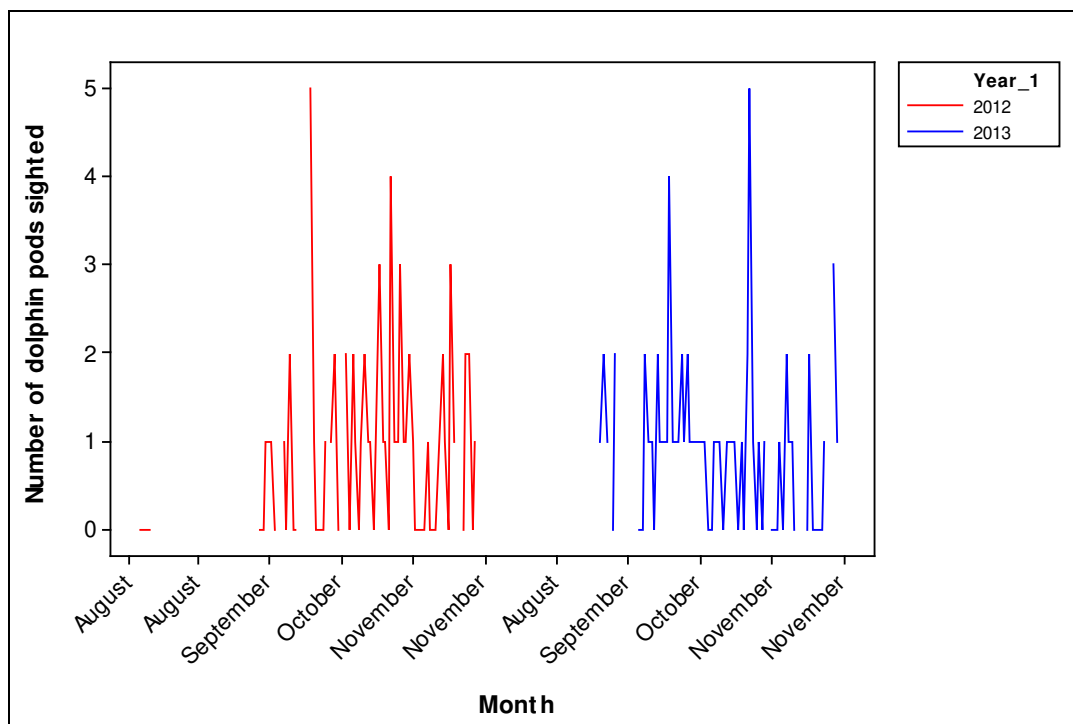


Table 3.4 Number of days dolphins were sighted by the Cat Balou at each location during 158 survey days.

| Location | July 2012 | Aug 2012 | Sept 2012 | Oct 2012 | Nov 2012 | Aug 2013 | Sept 2013 | Oct 2013 | Nov 2013 | May 2014 | July 2014 | Total days sighted |
|----------------------|-----------|----------|-----------|----------|----------|----------|-----------|----------|----------|----------|-----------|--------------------|
| Aslings Beach | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 3 |
| Calle Calle Bay | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Coastal (East) | 0 | 0 | 0 | 0 | 6 | 1 | 2 | 4 | 1 | 0 | 0 | 14 |
| Coastal (North) | 0 | 0 | 1 | 2 | 5 | 1 | 0 | 2 | 1 | 0 | 0 | 12 |
| Coastal (South) | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 4 | 2 | 0 | 0 | 10 |
| Eden Break wall | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Eden Wharf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Heads of Twofold Bay | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 2 | 0 | 0 | 7 |
| Honeysuckle Bay | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 4 |
| North Head | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| South Head | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 0 | 4 |
| The Lookout | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 3 |
| Twofold Bay | 0 | 0 | 1 | 7 | 6 | 0 | 6 | 7 | 5 | 0 | 0 | 32 |
| Whale Spit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Not specified | 2 | 0 | 3 | 15 | 4 | 6 | 2 | 7 | 1 | 0 | 0 | 40 |

PINNIPEDS (SEALS)

The majority of Australian Fur Seal sightings were from within Twofold Bay and in particular, areas close to Eden (e.g. Eden break wall) (Figure 3.9 and Table 3.5). These locations are nearby to Snug Cove and Cattle Bay and it is considered from this data that seals are the most likely to be impacted by the proposed marina development, especially during the construction phase. Seals were sighted most frequently in the months of September and November (Figure 3.10 and Figure 3.11). During this period seals were also sighted on 38 occasions where the location was not specified.

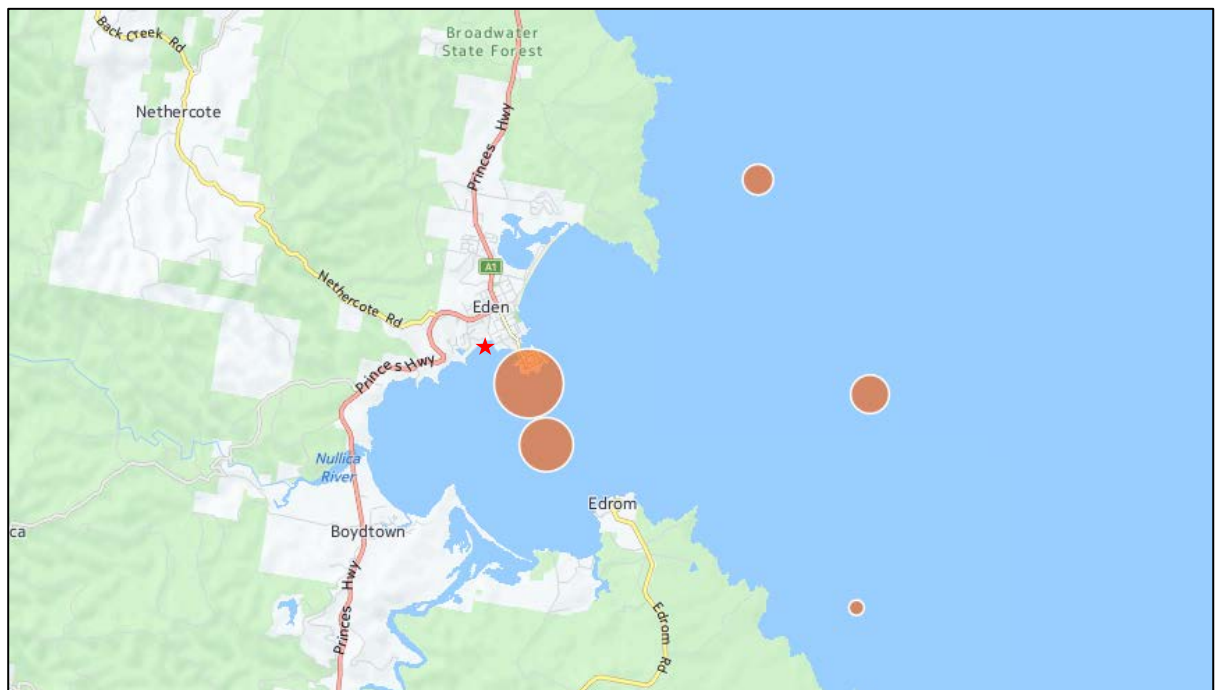


Figure 3.9 Relative frequency of Australian fur seal sightings at locations around Eden from July 2012 to July 2014. The location of Cattle Bay is indicated with the red star.

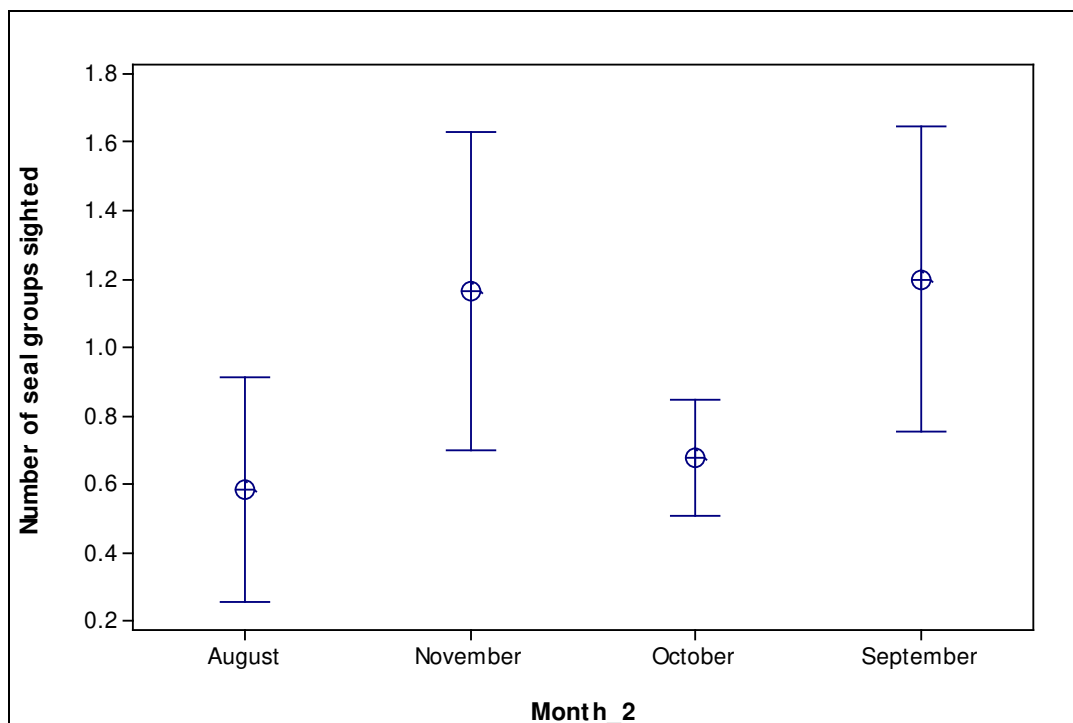
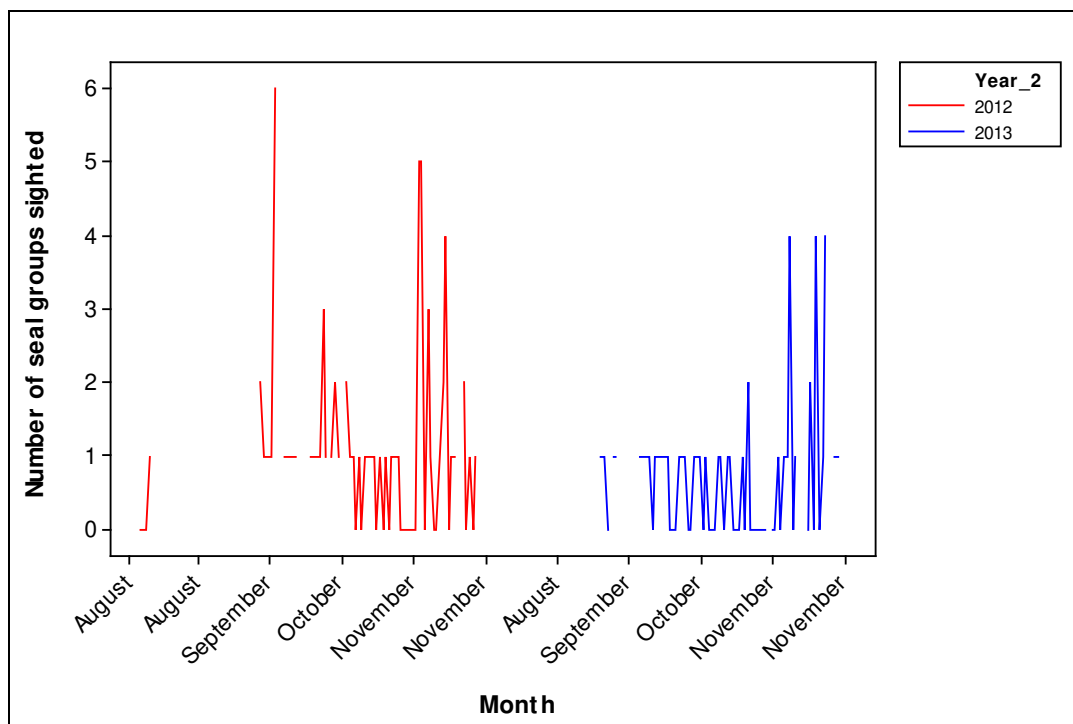


Table 3.5 Number of days seals were sighted by the Cat Balou at each location during 158 survey days.

| Location | July 2012 | Aug 2012 | Sept 2012 | Oct 2012 | Nov 2012 | Aug 2013 | Sept 2013 | Oct 2013 | Nov 2013 | May 2014 | July 2014 | Total days sighted |
|-----------------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|-------------------------------|
| Aslings Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Calle Calle Bay | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Coastal (East) | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 3 | 0 | 0 | 7 |
| Coastal (North) | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 6 |
| Coastal (South) | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 3 |
| Eden Break wall | 0 | 1 | 3 | 3 | 11 | 1 | 6 | 14 | 25 | 0 | 1 | 65 |
| Eden Wharf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heads of Twofold Bay | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Honeysuckle Bay | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North Head | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| South Head | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| The Lookout | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Twofold Bay | 0 | 0 | 0 | 0 | 1 | 0 | 6 | 0 | 2 | 0 | 0 | 9 |
| Whale Spit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Not specified | 1 | 0 | 3 | 9 | 4 | 5 | 3 | 9 | 2 | 0 | 2 | 38 |

3.4 Incidental Sightings

Two Australian Fur Seals were sighted during the hydrographic and habitat surveys in July, 2014. The location of these included:

1. Cattle Bay (swimming amongst the moorings).
2. Quarantine Bay (close to boat ramp, inquisitive behavior around a small boat offloading on the public jetty).

No whales or dolphins were sighted in Twofold Bay during the surveys although unidentified whales were sighted breaching near South Head from Lookout Point, Eden.

3.5 Potential Impacts & Mitigation

Potential impacts on marine mammals resulting from the construction and operation of the Cattle Bay marina have been well addressed in the most recent Aquatic Ecology Assessment for the proposed development (Marine Pollution Research 2013). Potential impacts and mitigation measures relating specifically to marine mammals as identified by Marine Pollution Research (2013), including any additional notes thought relevant, are summarised below.

CONSTRUCTION IMPACTS

- **Displacement of benthic habitat** through piling works will cause some minor loss of benthic habitat and associated benthic organisms (e.g. molluscs, polychaete worms and crustaceans). The displacement of this habitat and / or associated organisms is not considered to have a significant impact on marine mammals.
- **Disturbance of sediments** during piling works has the potential to cause turbidity and release contaminants into the water column. Given the sandy nature of sediments in Cattle Bay these plumes would be short lived and localised. Further, given the low concentrations of contaminants found in marine sediments here this disturbance would not result in any measurable changes to water quality which would impact marine mammals in the local area.
- **Impacts of floating plant** - Remediation and construction works will require floating plant (e.g. pile driver, crane for lifting piles and other elements into place and barges to bring piles and marine elements to the site). These are likely to be required to be anchored or moored to keep them in place. Anchoring gear has long cables necessary to achieve stability in low swell conditions. These equipment have the potential to impact on marine mammals through noise, vessel or cable strike and construction related liquids or solid material spills (discussed further in ensuing sections).
- **Construction noise** sources include 1) background vessel and equipment engine noise and 2) impact or high frequency pulse noise from use of equipment (e.g. from piling, hammering, cutting and drilling tools). These both have the potential to affect marine mammal behavior. Given the proximity of Cattle Bay to the Port of Eden, the impacts of

engine noise are likely to be low in relation to existing background noise from vessels that currently use the port. Pulse impact noises are more likely to result in startle responses with animals turning away (avoiding) the noise source. While the overall risk of construction noise directly affecting marine mammals is low, the chance of disruptive behavioural responses (e.g. animals moving away from the area) is high, particularly for cetacean pods of mothers and calves.

- **Cable strike or entanglement** is related to anchor cables that stretch and slacken in the water column. This risk is generally greater for inquisitive young cetaceans and pinnipeds (seals) than for older animals, although all animals are susceptible to slashing injuries from cable movement in the water column if they are swimming over or under the cable at the time. The risk of cable strike is greater at night when floating plant is left on site with multiple anchors / moorings. The potential risk is also related to the number of animals in the area, which in turn is related to the time of year.
- **Pollution via spillage of liquids and solids** - Hazardous substances entering the waterway have the potential to cause harm to marine mammals via ingestion and / or creating water quality impacts. Pollution is related to both vessel management (i.e. fuel, bilge and on-board fuel tank and material lifting (crane) regulation) and over water work practices on the wharf for the remediation works and on the floating pontoons for the installation of services.

MITIGATION MEASURES FOR MARINA CONSTRUCTION

- All potential construction impacts on marine mammals can be avoided by minimising construction activity in the core whale visitation season (i.e. mid-September to end November) and undertaking all work within the framework of a Marine Mammal Protection Plan (MMPP) that sets out the requirements for monitoring marine mammal proximity and protocols for ceasing and resuming works related to the proximity. Such plans are routinely used to manage potential conflicts with marine mammals (e.g. recent port construction and high tension cable laying projects in Botany Bay).
- Peak usage periods for whales, dolphins and seals identified in Section 3.3 (Cat Balou Marine Mammal Sighting Data 2012 - 2014) should be referred and avoided in planning any works.
- The overall risk of cable strike can be managed by avoiding works during the peak marine mammal visitation period and by undertaking works in the framework of a MMPP.
- The risk of overnight cable strike can be minimised by placing floating plant on a swing mooring rather than leaving plant in a fixed mooring configuration as the reliance on a single swing mooring line will minimise cable oscillation.
- The risk of fuel, transfer and construction spillages can be mitigated by implementation of a Construction Environmental Management Plan (CEMP) that addresses these issues.

OPERATIONAL IMPACTS

- **Entanglement or ingestion of rubbish** - The marina may accumulate floating rubbish brought in via wind waves and wind action. Alternatively, incorrect disposal of rubbish by marina users may occur. This rubbish can cause harm to marine mammals through entanglement or ingestion. This is listed as a Key Threatening Process (i.e. a process that

‘threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community’) under both the NSW *TSC Act* 1995 and the *EPBC Act* 1999.

- **Trapping or stranding of animals** - The marina has the potential to funnel surface breathing animals (e.g. seals, whales and to a lesser extent dolphins and turtles) into shallow waters via the main fairway along the eastern shoreline. These animals should be able to escape by swimming under the floating walkway that connects the marina arms and accordingly the potential for trapping or stranding marine mammals is considered low. A similar low risk is associated with animals approaching the bay from the west.
- **Water pollution** resulting from hydrocarbon spills, bilge and sewer pump-out and the risks associated with ablation of chemicals (mainly copper) from vessel antifouling paints has the potential to impact on the health of marine biota, including marine mammals, present in the area. Oil spills have been seen on numerous occasions to have highly adverse effects on marine birds and mammals.
- **Light pollution** - The marina will require suitable lighting for pedestrian and vessel safety. Light pollution from inshore and offshore structures can be a hazard for some aquatic animals, especially marine birds which are attracted to them. Light reflected into the water can also attract various aquatic species, particularly cephalopods that in turn can attract avian and piscine (fish) predators. Fur seals are known to feed on fish and cephalopods so may be attracted into the marina vicinity if a significant increase in food source occurs. However, the potential for an impact on marine mammals is thought to be insignificant taking into account the alternative availability of food throughout Two Fold Bay and the existing light sources associated with the nearby Eden wharf and break wall structures.
- **Noise impacts from vessels** - Marina operation will result in an increase in overall ambient engine noise. The main source of operational noise from the marina would be engine noise from vessels transiting in and out. There may be some use periods (e.g. weekend or summer months) when vessels are used more frequently than others and during these periods a higher degree of impact is likely. During the peak summer months (e.g. December – March) it is unlikely that whales will be in the area, however, resident dolphins and seals may still be present. Underwater noise can disrupt behavioural patterns of marine mammals and cause marine mammal aggregations or pods to be disrupted. Marine mammals will generally avoid vessels on the basis of noise. However, the relationship between noise and marine mammal behaviour is complex (evidenced by the bow riding behaviour of dolphins, following behaviour of marine mammals associated with fishing vessels and circling plus nudging behaviour of stationary vessels by whales (e.g. Hale 2002)). The impacts of vessel noise can also be linked to vessel interactions with marine mammals (i.e. recreational whale and dolphin watching) and there is much literature available on the potential impacts of these activities and the available protocols to minimise the risk to marine mammals from these interactions (including legislation).
- **Vessel strike** is of major concern for marine mammals. It has the potential to cause injury and / or death depending on vessel size and speed and species involved. Damaging vessel strike within the confines of the marina is unlikely due to the very low speeds that vessels would be travelling and the ability for drivers to easily see and avoid mammals that may be present. Within the marina, non-harmful interactions between boats and

inquisitive mammals (e.g. seals) may occur. However, vessel strike outside the marina confines, within Twofold Bay and the immediate coastal environment is a greater threat. Especially from faster moving vessels (e.g. deep-sea recreational fishing vessels) utilising the highly productive fishing grounds along the continental slope. Coastal upwellings in the area cause deep nutrient rich waters to be brought into the coastal waters and can trigger plankton blooms that attract assemblages of fish and krill that are exploited by marine mammals (particularly humpback whales as discussed in Section 3.2). Vessel strike from slower moving sailing vessels is considered much less likely but still has the potential to occur.

- The overall increase of high speed vessels within Twofold Bay and immediate coastal environment resulting from the proposed Cattle Bay marina (and the possibility of additional high speed vessels from the proposed Boyd town and Port of Eden marinas) increases the risk for marine mammals through behavioural disruptions from vessel noise and harassment, for injuries or death from ingesting marine debris and from vessel strike.

MITIGATION MEASURES FOR MARINA OPERATIONS

- The risk of ingestion of, or entanglement in, rubbish / debris by marine mammals can be mitigated by implementing a marina Operational Environmental Management Plan (OEMP) that includes provision for inspection and regular clearing of marine debris from the waters inside the marina and along the Cattle Bay beach-line. The regular inspection should include a periodic inspection of the seabed in the marina to clear out any accumulated rubbish that could threaten marine life. Mitigating the risk from marine debris can also be achieved by educating boaters.
- In regards to water pollution, the risk of hydrocarbon spills is negligible as the marina will not be providing fuel services or any form of mechanical servicing. Vessels that require fuel, oils or servicing will need to travel elsewhere (generally to the port facilities in Snug Cove). The marina will be operated on a zero bilge, sewage and ships liquid waste discharge policy, meaning vessels will not be allowed to discharge bilge, grey or black waters to the bay whilst in the marina. The marina will not be providing a public sewage pump out facility but will be providing a managed sewage pump-out facility via a portable collection system mounted on a trolley that can be brought to a vessel along the marina walkway and which would be taken ashore for collected sewage to be disposed at an appropriately sited connection to the council sewer (i.e. with no risk of sewage spills to the waters of Twofold Bay). The trolley transport system will have safeguards to ensure that there cannot be accidental spillages. This will ensure that there can be no risk of human pathogens reaching the waters of Twofold Bay from the marina operations.
- Common mitigation measures to protect aquatic species from light pollution are to install downwards directed lighting (with most light falling onto pontoon hard surfaces to minimise light spill into the water) supplemented with dimmer systems, or timed lights with trip mechanisms as necessary.
- Much of the noise generated within the marina would be absorbed by the surrounding structures (e.g. intertidal beach to north, rocky reefs to east and west) and a proportion of the noise transmitted south would be reflected by the wave attenuator structure back towards the shores. As a result, residual underwater noise would likely be attenuated,

reflected or refracted noise. As for the most part vessels will be stationary within the marina, the overall increase in noise from marina operations in relation to existing noise sources from the port in Snug Cove would not likely be significant and would not pose any additional risk to marine mammals. The 2011 Conservation Management Plan for Southern Right Whales has also concluded that shipping the noise risk to these whales was minor (i.e. individuals may be affected but there is no affect at the population level).

- The overall mitigation measure for excessive vessel noise and for marine animal interactions is education, with protocols and specific information on the marine animals that boaters are likely to encounter at various times of the year, and the steps that boaters should take to minimise their impact on these animals, including lower speeds and minimum off-set distances.
- Vessel strike is a world-wide problem (Marsh *et al.* 2003) and there is a clear relationship between the number of vessels within a given area and the incident of vessel strike. The 2011 Conservation Management Plan for Southern Right Whales, concluded that from an east Australian coast population perspective, vessel collision risk was moderate (i.e. population recovery could be stalled or reduced). Management of this risk requires a mix of education (i.e. passive management tools such as information packs given to boaters and signage at the marina) and active management such as daily information on known marine mammal activity (via close relationships with the existing network of whale watchers including residents, commercial fishers, mussel farmers, NPWS whale-watch and Cat Balou Cruise). As the number of recreational vessels from Twofold Bay increases there may be a future need for variable or zoned (time and place) speed limits to be enforced, particularly in relation to Southern Right Whales and Humpback Whale feeding aggregations and during peak marine mammal visitation periods.
- Local boaters need to be educated to be constantly aware of marine mammals co-existing in these waters and to adopt appropriate speeds and clearance when near.

3.6 Risk Profiles

Risk profiles were developed for all marine mammals known to or with the potential to occur in the local area, taking into account current database searches (Section 3.1), Cat Balou sightings data (Section 3.3) and the potential impacts of the proposed marina development as discussed in Section 3.5. These profiles provide the following information:

- Species
- Conservation Status
- Required Habitat / Distribution
- Likelihood of Occurrence
- Main Areas of Use (i.e. within Twofold Bay and immediate coastal environment)
- Main Period of Use
- Potential Threats
- Mitigation Available
- Overall Risk

DUGONG

| | |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Dugong, <i>Dugong dugon</i> |
| Conservation Status | Endangered, Protected (TSC Act) |
| Required Habitat / Distribution | Major concentrations occur in wide shallow protected bays, wide shallow mangrove channels and in the lee of large inshore islands. Will occupy deeper waters if food is available. Shallow waters such as tidal sandbanks and estuaries have been reported as sites for calving. Distribution extends south from warmer coastal and island waters of the Indo-West Pacific to northern NSW. |
| Likelihood of Occurrence | Low – the current record for Eden may be erroneous. |
| Main Areas of Use | N/A – not identified in Cat Balou data records. |
| Main Period of Use | N/A – not identified in Cat Balou data records. |
| Potential Threats | Removal or pollution of seagrass habitats. Collision with boats and other marine traffic. Accidental entanglement in nets, traps and other fishing gear. |
| Mitigation Available | Yes – as per Section 3.5 |
| Overall Risk | Low |

AUSTRALIAN FUR SEAL

| | |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Australian Fur Seal, <i>Arctocephalus pusillus</i> |
| Conservation Status | Vulnerable, Protected (TSC Act) Listed marine mammal (EPBC Act) |
| Required Habitat / Distribution | The Australian Fur Seal has a relatively restricted distribution in the south eastern areas of Australia (Bass Strait, parts of Tasmania and southern Victoria). They can be seen hauling out on islands off South Australia and in southern NSW, with the occasional animal appearing as far north as the mid north coast of NSW. There are no permanent local populations and breeding occurs on exposed oceanic sites in Bass Strait from October to January. Australian Fur Seals frequent coastal waters and oceans. Their preferred habitats especially for breeding is rocky islands, which include boulder or pebble beaches and gradually sloping rocky ledges. Australian Fur Seals come ashore each year and form breeding colonies. Adult males come ashore first and establish territories. Females spend the gestation period at sea, coming ashore just before giving birth between October and December. Australian Fur Seals feed on a variety of bony fishes, squid and octopus. They may use the seabed and rocky reefs of Cattle Bay for feeding on fish and cephalopods. They are voracious hunters and often take advantage of situations where fish are corralled by nets and fish farms, increasing the risks associated with these facilities. |
| Likelihood of Occurrence | High (but seasonal) |

EDEN RESORT HOLDINGS LTD**CATFOLD BAY MARINA - HYDROGRAPHIC MAPPING & MARINE MAMMAL RISK PROFILES**

| | |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Main Areas of Use | Twofold Bay, especially near to Eden – the vast majority of Catfold Bay sightings are around the Eden break wall. |
| Main Period of Use | September – November |
| Potential Threats | Entanglement in discarded or in-use fishing gear. Vessel and cable strike. Noise impacts. Light pollution impacts (through impact on food source). |
| Mitigation Available | Yes – as per Section 3.5. |
| Overall Risk | Moderate (and seasonal) |

NEW ZEALAND FUR SEAL

| | |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | New Zealand Fur Seal, <i>Arctocephalus forsteri</i> |
| Conservation Status | Vulnerable, Protected (TSC Act) Listed marine mammal (EPBC Act) |
| Required Habitat / Distribution | It occurs as an occasional non-breeding vagrant in NSW southern coastal waters up to locations north of Sydney. Its use of Twofold Bay would be similar to that of the Australian fur seal (i.e. feeding and basking). |
| Likelihood of Occurrence | Moderate (and seasonal) – While data is non-specific, Catfold Bay Cruises have indicated that most Fur Seals seen in Twofold Bay are Australian Fur Seals. |
| Main Areas of Use | Within Twofold Bay, especially near to Eden – the vast majority of Catfold Bay Fur Seal sightings are around the Eden break wall. |
| Main Period of Use | September – November |
| Potential Threats | Entanglement in discarded or in-use fishing gear. Vessel and cable strike. Noise impacts. Light pollution impacts (through impact on food source). |
| Mitigation Available | Yes – as per Section 3.5. |
| Overall Risk | Low - Moderate (and seasonal) |

COMMON DOLPHIN

| | |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Common dolphin, <i>Delphinus delphis</i> |
| Conservation Status | Protected (TSC Act) Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | Continental shelf and pelagic waters of the Atlantic and Pacific Oceans within the broad zones of the temperate and tropical latitudes. The presence of warm water influences the distribution of this species. Are known to form groups, which often number in the thousands. Main prey items include squid and small school fish. |

| | |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Like lihood of Occurrence | Moderate - High (likely to occur year-round) – many local records. |
| Main Areas of Use | Two fold Bay and immediate coastal areas. |
| Main Period of Use | A resident population is most likely to be present year-round in Two fold Bay. Cat Balou data indicates that sightings are most prevalent in September and October. |
| Potential Threats | Entanglement in discarded or in-use fishing gear. Vessel and cable strike. Noise impacts. Light pollution impacts (through impact on food source). Habitat modification. Biological pollution. |
| Mitigation Available | Yes – as per Section 3.5. |
| Overall Risk | Moderate (year-round) |

BO TTLENO SE (AND INDIAN O CEAN BO TTLENO SE) DO LPHIN

| | |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Bottlenose Dolphin, <i>Tursiops truncatus s. str.</i> Indian Ocean Bottlenose, <i>Tursiops aduncus</i> (Note no distinction within Cat Balou Records) |
| Conservation Status | Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | The Bottlenose Dolphin lives in coastal waters and oceans. Found worldwide in temperate and tropical waters. They are resident or frequent inhabitants of bays and coastal areas. In some areas populations will maintain defined home ranges within recognised coastal landforms. Others are pelagic animals, found well out to sea, often off or quite close to a continental shelf edge. This species occupies a broader range of habitats than any other marine mammal, giving it access to a huge variety of organisms including invertebrates, bottom-dwelling fish and squid, plus the full range of pelagic (oceanic) fish species. Bottlenose Dolphins are a very social species and feed together, although they are known to feed alone. They also take advantage of human-induced prey abundance and regularly approach fishing trawlers. |
| Like lihood of Occurrence | Moderate - High (year-round) – many local records. |
| Main Areas of Use | Two fold Bay and immediate coastal areas. |
| Main Period of Use | A resident population is most likely to be present year-round in Two fold Bay. Cat Balou data indicates that sightings are most prevalent in September and October. |
| Potential Threats | Entanglement in discarded or in-use fishing gear. Vessel and cable strike. Noise impacts. Light pollution impacts (through impact on food source). Habitat modification. |

| | |
|----------------------|---------------------------|
| | Biological pollution. |
| Mitigation Available | Yes – as per Section 3.5. |
| Overall Risk | Moderate (year round) |

RISSE'S DOLPHIN

| | |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Risso's Dolphin, <i>Grampus griseus</i> |
| Conservation Status | Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | Risso's Dolphins have been recorded from all Australian states except Tasmania and the Northern Territory. Inhabits tropical, subtropical, temperate and sub-antarctic waters between 60° N and 60° S. Has been sighted both inshore and well offshore, although is generally considered pelagic and oceanic. Occur mainly on steep sections of the upper continental slope usually in waters deeper than 1000 m in tropical and warm temperate latitudes. |
| Likelihood of Occurrence | Low – no local records. |
| Main Areas of Use | N/A – no local Cat Balou data exists for this species. Would be most likely to occur in offshore coastal waters outside Two Fold Bay. |
| Main Period of Use | N/A – no local data exists for this species. |
| Potential Threats | Human induced mortality (i.e. hunting). Entanglement in drift-nets set outside Australian Territorial Waters and in lost or discarded netting. Pollution (including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea) leading to bio-accumulation of toxic substances. |
| Mitigation Available | N/A – threats not applicable to current proposal. |
| Overall Risk | Low |

DUSKY DOLPHIN

| | |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Dusky Dolphin, <i>Lagenorhynchus obscurus</i> |
| Conservation Status | Migratory, Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | In Australia, Dusky Dolphins are known from only 13 reports since 1828, with two sightings in the early 1980s. They occur across southern Australia from Western Australia to Tasmania with unconfirmed sightings south of continental Australia but confirmed sightings near Kangaroo Island, South Australia, and off Tasmania. Dusky Dolphins occur mostly in temperate and sub-Antarctic waters. They are considered to primarily inhabit inshore waters but may also be pelagic at times. |
| Likelihood of Occurrence | Low – no local records. |
| Main Areas of Use | N/A – no local Cat Balou data exists for this species. |

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| | Would be most likely to occur outside Two fold Bay. |
| Main Period of Use | N/A – no local data exists for this species. |
| Potential Threats | Incidental capture in pelagic drift-net fisheries operating in the Tasman Sea and outside Australian Territorial Waters. Entanglement in lost or discarded netting. Pollution, including increasing amounts of plastic debris at sea, oil spills and dumping of industrial wastes into waterways and the sea, are leading to bio-accumulation of toxic substances in body tissues of many marine species. |
| Mitigation Available | N/A – threats not applicable to current proposal. |
| Overall Risk | Low |

SOUTHERN RIGHT WHALE

| | |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Southern Right Whale, <i>Eubalaena australis</i> |
| Conservation Status | Endangered, Protected (TSC Act) Endangered, Migratory, Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | Temperate and sub-polar waters of the Southern Hemisphere. Migrate between summer feeding grounds in Antarctica and winter breeding grounds around the coasts of southern Australia, New Zealand, South Africa and South America. They move inshore in winter for calving and mating. The major habitats are feeding areas of the Southern Ocean, mating and calving aggregation areas in the Great Australian Bight and calving areas along the coasts of Australia. Two fold Bay is considered as a BIA for East Coast Southern Right Whale population recovery (DSEPC 2011) as it is known historically to be an important calving and resting area. |
| Likelihood of Occurrence | Moderate - High (but seasonal) – a number of local records. |
| Main Areas of Use | Cat Balou records from outer areas of Two fold Bay and immediate coastal environment. Females with young travelling south may remain in shallow waters of 5 to 10 m depth. Atlas of NSW Wildlife records from within Two fold Bay. |
| Main Period of Use | Sightings common from September - November. Peak in juvenile / sub-adults in September. October and November are the highest risk months for mother / calf pods. |
| Potential Threats | Collision with boats and other marine traffic. Noise impacts from vessels. Accidental entanglement in nets, traps and other fishing gear. Marine debris, particularly plastic, which can cause suffocation, abrasion, infection or blockages when swallowed. |
| Mitigation Available | Yes – refer to Section 3.5. |
| Overall Risk | Moderate (and seasonal) |

HUMPBACK WHALE

| | |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Humpback Whale, <i>Megaptera novaeangliae</i> |
| Conservation Status | Vulnerable, Protected (TSC Act) Vulnerable, Migratory, Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | Occur in oceanic and coastal waters worldwide. Feed and grow in the Southern Ocean during the summer months followed by a northwards migration along the east Australian coast between June and October to sub-tropical waters to mate and calve. The east coast population migrates along the continental shelf north past Two Fold Bay from late autumn to winter and south past Two Fold Bay in late spring and early summer, accompanied by new born calves (principally from September through November). On the southern migration Humpbacks regularly enter Two Fold Bay or delay their migrations in coastal waters offshore of Two Fold Bay to feed on coastal krill and small teleost fish, including sardines, particularly when upwellings provide suitable feeding conditions. Silva <i>et al.</i> (2011) noted that whale concentrations tended to shift from year to year over an area up to 20 km offshore of Two Fold Bay. |
| Likelihood of Occurrence | High (but seasonal) – many local records. |
| Main Areas of Use | Cat Balou records for outer areas of Two Fold Bay and immediate coastal environment. Numerous Atlas of NSW Wildlife records for Two Fold Bay and immediate coastal waters. |
| Main Period of Use | Regularly observed in NSW waters in June and July, on northward migration and October and November, on southward migration. Local sightings common from September - November. Peak in juvenile / sub-adults in September. October and November are the highest risk months for mother / calf pods. |
| Potential Threats | Collision with boats and other marine traffic. Noise impacts from vessels. Accidental entanglement in nets, traps and other fishing gear. Marine debris, particularly plastic, which can cause suffocation, abrasion, infection or blockages when swallowed. |
| Mitigation Available | Yes – refer to Section 3.5. |
| Overall Risk | Moderate (and seasonal) |

BLUE WHALE

| | |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Blue Whale, <i>Balaenoptera musculus</i> |
| Conservation Status | Endangered, Protected (TSC Act) Endangered, Migratory, Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | Blue Whale sightings in Australian waters have been widespread, and it is likely that the whales occur right around the continent at various |

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| | times of the year. However, much of the Australian continental shelf and coastal waters have no particular significance to the whales and are used only for migration and opportunistic feeding. The only known areas of significance to Blue Whales are feeding areas around the southern continental shelf, notably the Perth Canyon, in Western Australia, and the Bonney Upwelling and adjacent upwelling areas of South Australia and Victoria. It is an oceanic species that may occur rarely in coastal waters but is not expected in Twofold Bay. |
| Like lihood of Occurrence | Low (and seasonal) – very few local records. |
| Main Areas of Use | No recent Cat Balou records from local area. Atlas of NSW Wildlife record for the mouth of the Twamba River and the entrance to Twofold Bay. Expected in deeper coastal/ oceanic waters. |
| Main Period of Use | No recent local records. |
| Potential Threats | Commercial and ‘scientific’ whaling. Acoustic pollution (vessel noise and seismic survey activity). Entanglement (in marine debris, fishing and aquaculture equipment). Physical injury and death from ship strike. Built structures that impact upon habitat availability or use (marinas, wharves, aquaculture installations, mining or drilling infrastructure). Changing water quality and pollution (e.g. runoff from land based agriculture, oil spills, outputs from aquaculture). Changes to water flow regimes causing extensive sedimentation or erosion or altered currents in near shore habitat (e.g. dredging). |
| Mitigation Available | Yes – refer to Section 3.5. A number of threats for this species are not applicable to current proposal. |
| Overall Risk | Low (and seasonal) |

KILLER WHALE

| | |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Killer Whale (Orc a), <i>Orcinus orca</i> |
| Conservation Status | Protected (TSC Act) Migratory, Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | The preferred habitat includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters. They may be more common in cold, deep waters, but off Australia, Killer Whales are most often seen along the continental slope and on the shelf, particularly near seal colonies. Killer Whales have regularly been observed within the Australian territorial waters along the ice edge in summer. Killer Whales are recorded from all states, with concentrations reported around Tasmania. Sightings are also frequent in South Australia and Victoria. |
| Like lihood of Occurrence | Low (and seasonal) – very few local records. |

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| Main Areas of Use | No recent Cat Balou records from local area. Atlas of NSW Wild life record for the mouth of the Towamba River in Two fold Bay. |
| Main Period of Use | No recent local records. |
| Potential Threats | Pollution – leading to bioaccumulation of contaminants in tissues. Targeted hunting and illegal killing. Interactions with fisheries (e.g. entanglement in drift nets set outside the Australian EEZ, and in lost or discarded netting in international waters). |
| Mitigation Available | Yes – refer to Section 3.5. A number of threats for this species are not applicable to current proposal. |
| Overall Risk | Low (and seasonal) |

BRYDE'S WHALE

| | |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Byde's Whale , <i>Balaenoptera edeni</i> |
| Conservation Status | Migratory, Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | Occur in temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40° N and 40° S, or the 20 °C isotherm. Recorded from all Australian states except the Northern Territory. The coastal form appears to be limited to the 200 m depth isobar, moving along the coast in response to availability of suitable prey. The offshore form is found in deeper water (500 m to 1000 m). |
| Likelihood of Occurrence | Low - Moderate (and seasonal) – a number of recent local records. |
| Main Areas of Use | Coastal environments outside Two fold Bay. |
| Main Period of Use | Recent Cat Balou sightings from October and November. |
| Potential Threats | Pollution, including plastic debris at sea (especially the coastal forms). Oil spills and dumping of industrial wastes leading to bio-accumulation of toxic substances in body tissues. Direct disturbance from seismic and/or defense operations. Collisions with vessels. Entanglement in fishing gear. Competition with commercial fisheries. |
| Mitigation Available | Yes – refer to Section 3.5. A number of threats for this species are not applicable to current proposal. |
| Overall Risk | Low (and seasonal) |

MINKE WHALE (AND DWARF MINKE)

| | |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Minke Whale, <i>Balaenoptera acutorostrata</i> Dwarf Minke Whale, <i>B. acutorostrata</i> subspecies |
| Conservation Status | Whales and other cetaceans (EPBC Act) |
| Required Habitat / Distribution | The Dwarf Minke whale is a form of <i>B. acutorostrata</i> found in the southern hemisphere. Minke whales feed most often in cooler waters at higher latitudes and can be found in both coastal/inshore and oceanic/offshore areas. Dwarf Minke whales have a circumpolar distribution in the Southern Hemisphere (reported as far south as 60-65° S), especially during the summer months, but are more common in temperate and warmer waters of middle and lower latitudes. They are frequently reported in areas off of Australia (such as the Great Barrier Reef), South America and South Africa. The distribution of the Antarctic and Dwarf Minke species partially overlaps, mostly in the lower latitudes of the Antarctic Minke's range (in the Southern Ocean). The Dwarf Minke form in this area is considered more "coastal" and generally present earlier in the year than the "offshore" Antarctic species. |
| Likelihood of Occurrence | Moderate (and seasonal) – A number of local sightings for Dwarf Minke's. |
| Main Areas of Use | Coastal environments outside Two Fold Bay. |
| Main Period of Use | Local Cat Balou sightings of Dwarf Minke's from July – October with the vast majority occurring in September. |
| Potential Threats | Pollution, including plastic debris at sea (especially the coastal forms). Collisions with vessels. Entanglement or incidental take in fishing gear. Noise pollution - anthropogenic noise is an increasing concern for baleen whales which use low-frequency sounds to communicate. Human interactions. Habitat disturbance. |
| Mitigation Available | Yes – refer to Section 3.5. A number of threats for this species are not applicable to current proposal. |
| Overall Risk | Low (and seasonal) |

PYGMY SPERM WHALE

| | |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Species | Pygmy Sperm Whale, <i>Kogia breviceps</i> |
| Conservation Status | Protected (TSC Act) |
| Required Habitat / Distribution | The Pygmy Sperm Whale inhabits pelagic (open-ocean) temperate to tropical waters around the world. It is considered to have a cosmopolitan, oceanic distribution. They occur in tropical and temperate oceans around the world, living mostly beyond the edge of the continental shelf. It is known from all three major ocean basins. |

| | |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Like lihood of Occurrence | Low (and seasonal) – A small number of local sightings. |
| Main Areas of Use | Atlas of NSW Wildlife records near the mouth of the Trowomba River in Twofold Bay. No recent Cat Balou records. Most likely in coastal and oceanic environments outside Twofold Bay. |
| Main Period of Use | No recent use data. |
| Potential Threats | Pollution, including plastic debris at sea (especially the coastal forms). Collisions with vessels. Entanglement or incidental take in fishing gear. Competition with fisheries. Noise pollution - anthropogenic noise is an increasing concern for baleen whales which use low-frequency sounds to communicate. Human interactions and hunting. Habitat disturbance. |
| Mitigation Available | Yes – refer to Section 3.5. A number of threats for this species are not applicable to current proposal. |
| Overall Risk | Low (and seasonal) |

4. HYDROGRAPHIC MAPPING

Refer to **Appendix 5** for full report and figures.

The main findings of the hydrographic mapping component are as follows:

- The bathymetry of Cattle Bay is generally simple with depth increasing with increasing distance offshore.
- Depth does not exceed 10 m (Chart datum) within the area shoreward of a line from Eden break wall to Cocora Point.
- In areas of rocky shoreline (points of the bays), the rock extends some distance into the subtidal zone, forming high rugosity rocky reef which generally extends a limited distance offshore. This results in some shallow rock pinnacles emerging a short distance offshore from rocky shorelines.
- The remainder of the shoreline is comprised of Cocora and Cattle Bay beaches which have reworked marine sediments in the shallow offshore sections, grading to heavily bioturbated marine sediments further offshore.

5. SEA GRASS & HABITAT MAPPING

Refer to **Appendix 5** for full report, figures and photographs.

The main findings of the seagrass and habitat mapping component are as follows:

- Four major classes of habitat were noted;
 - A) high profile rocky reef, dominated by brown macroalgae;
 - B) cobble, shell and broken stone;
 - C) seagrass - comprised of three species; and
 - D) unconsolidated sand and silt.
- Habitats show a basic zonation, with rocky reef being the dominant habitat in the shallow waters adjacent to the rocky foreshore. Cobbles and shell were primarily at the outer edge of the rocky reef, and only represented a small band of habitat. Further offshore, either sand or seagrass, or a mosaic of both.
- Much of the area identified as seagrass had a very sparse covering, especially outer areas of *Heterostera* sp.
- Habitat mapping indicates the 7m depth contour as an approximation of the outer boundary between sand and seagrass habitats; this may be due to light restrictions with an increase in depth. The inner boundary of seagrass was at approximately 1m depth.
- Diver estimations of mooring scour on a number of moorings indicate there is approx. 5 to 10m of chain (measured at 8m for 5 moorings), indicating an approximate area of 200m² per mooring of potential seagrass habitat being intermittently scoured which prevents seagrass colonisation. It is noted that removal of moorings and placement of these vessels onto berths could reduce scouring of seagrass habitat in the order of 4,000m² (assuming removal of 20 moorings).
- The report provides a risk assessment for seagrass for marina construction and operation phases.

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Appendix 1 – FM Act 1994 Searches



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FISHERIES MANAGEMENT ACT 1994 - SCHEDULE 4

SCHEDULE 4 – [Endangered species, populations](#) and ecological communities

(Section 220C)

Part 1 - [Endangered species](#)

[Fish](#)

| | |
|-----------------------------------------|----------------------------------------|
| Archaeophya adamsi Fraser, 1959 | Adam's emerald dragonfly |
| Austrocordulia leonardi | Sydney Hawk dragonfly |
| * Maccullochella ikei Rowland | eastern freshwater cod |
| * Maccullochella macquariensis (Cuvier) | trout cod |
| Macquaria australasica (Cuvier, 1830) | Macquarie perch |
| Mogurnda adspersa (Castelnau, 1878) | purple spotted gudgeon |
| Nannoperca australis Günther, 1861 | southern pygmy perch |
| * Nannoperca oxleyana Whitley | Oxleyan pygmy perch |
| Notopala sublineata (Conrad, 1850) | river snail |
| Sphyrna lewini (Griffith & Smith, 1834) | scalloped hammerhead shark |
| Thunnus maccoyii | southern bluefin tuna |

[Marine vegetation](#)

Part 2 - [Endangered populations](#)

[Fish](#)

Ambassis agassizii Steindachner, 1866, olive perchlet, western New South Wales [population](#)
 Craterocephalus amniculus (Crowley and Ivanstoffs, 1990), Darling River Hardyhead, Hunter River [population](#)

Gadopsis marmoratus, river blackfish, Snowy River [population](#)

Tandanus tandanus (Mitchell, 1838), eel tailed catfish, Murray-Darling Basin [population](#)

[Marine vegetation](#)

Posidonia australis Hook. f. (1858), seagrass, Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie [populations](#)

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)

Aquatic [ecological community](#) in the catchment of the Snowy River in NSW (as described in the final determination of the [Fisheries Scientific Committee](#) to [list](#) that aquatic [ecological community](#))

Part 4 - [Species presumed extinct](#)

[Fish](#)

| | |
|--------------------------------------|--------------------|
| Hadrachaeta aspeta Hutchings, 1977 | marine worm |
| Pristis zijsron Bleeker, 1851 | green sawfish |
| Metaprotella haswelliana Mayer, 1882 | Haswells caprellid |

[Marine vegetation](#)

| | |
|------------------------------------------------------|------------------|
| Vanvoorstia bennettiana (Harvey) Papenfuss (1956) | Bennetts seaweed |
|------------------------------------------------------|------------------|



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FISHERIES MANAGEMENT ACT 1994 - SCHEDULE 4A

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>Euastacus dharawalus</i> (Morgan, 1997) | Fitzroy Falls spiny crayfish |
| <i>Galaxias rostratus</i> | flathead galaxias |
| <i>Smeagol hilaris</i> Tillier & Ponder, 1992 | marine slug |

[Marine vegetation](#)

| | |
|--------------------------------------------|-------------------|
| <i>Nereia lophocladia</i> J. Agardh (1897) | marine brown alga |
|--------------------------------------------|-------------------|

Part 2 - Critically endangered ecological communities

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FISHERIES MANAGEMENT ACT 1994 - SCHEDULE 5

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 |
| Euastacus armatus (von Martens 1866) | Murray crayfish |
| Microorchestia bousfieldi Lowry & Peart, 2010 | Bousfields marsh-hopper |
| Sphyrna mokarran Ruppell, 1837 | great hammerhead shark |

[Marine vegetation](#)

Part 2 - Vulnerable ecological communities

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New South Wales Consolidated Acts

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FISHERIES MANAGEMENT ACT 1994 - SCHEDULE 6

SCHEDULE 6 – [Key threatening processes](#)

(Section 220C)

Degradation of native riparian vegetation along New South Wales water courses

Hook and line [fishing](#) in areas important for the survival of threatened [fish species](#)

Human-caused climate change

Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams

Introduction of [fish](#) to waters within a river catchment outside their natural range

Introduction of non-indigenous [fish](#) and [marine vegetation](#) to the coastal waters of New South Wales

Removal of large woody debris from New South Wales rivers and streams

The current shark meshing program in New South Wales waters

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Appendix 2 – TSC Act 1995 Searches

Atlas of NSW Wildlife Search Results

Search Criteria : Marine Mammals

Search Area : Within 10 km of study site

Search Date : 16 June 2014




Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.

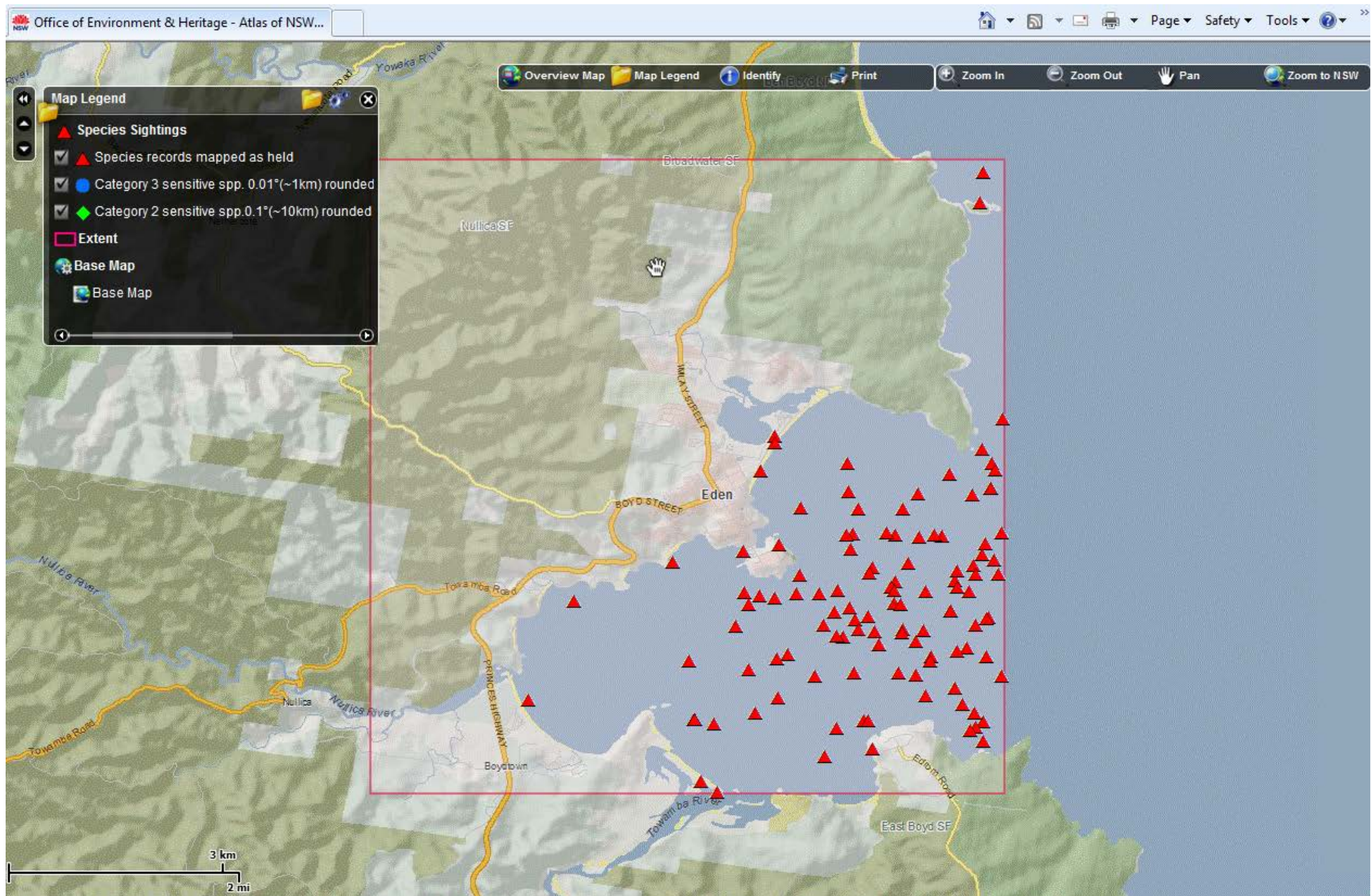
Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°).

Copyright the State of NSW through the Office of Environment and Heritage.

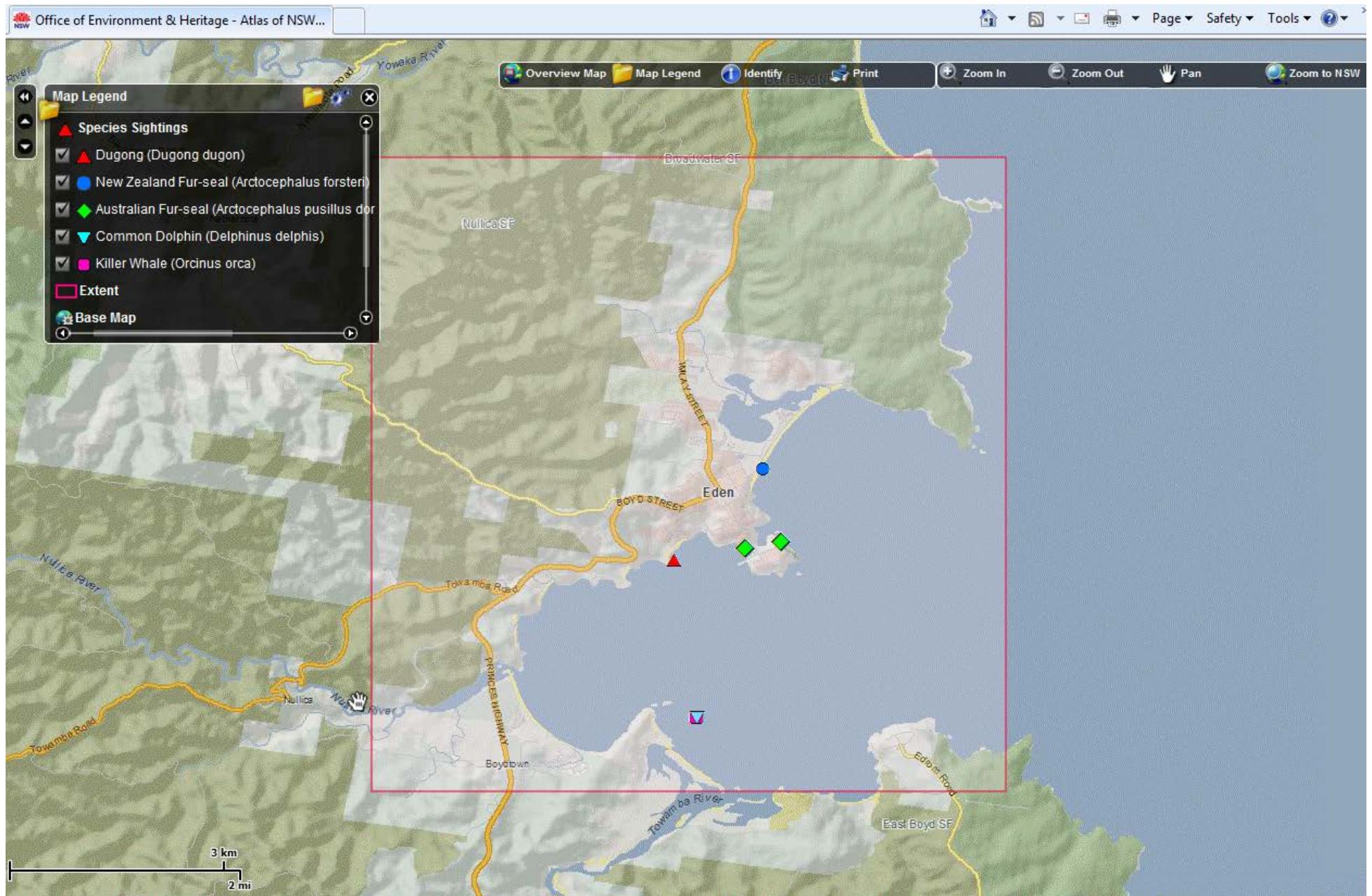
Search criteria : Public Report of all Valid Records of in selected area [North: -37.01 West: 149.85 East: 149.95 South: -37.11] returned a total of 121 records of 10 species.

Report generated on 16/06/2014 1:00 PM

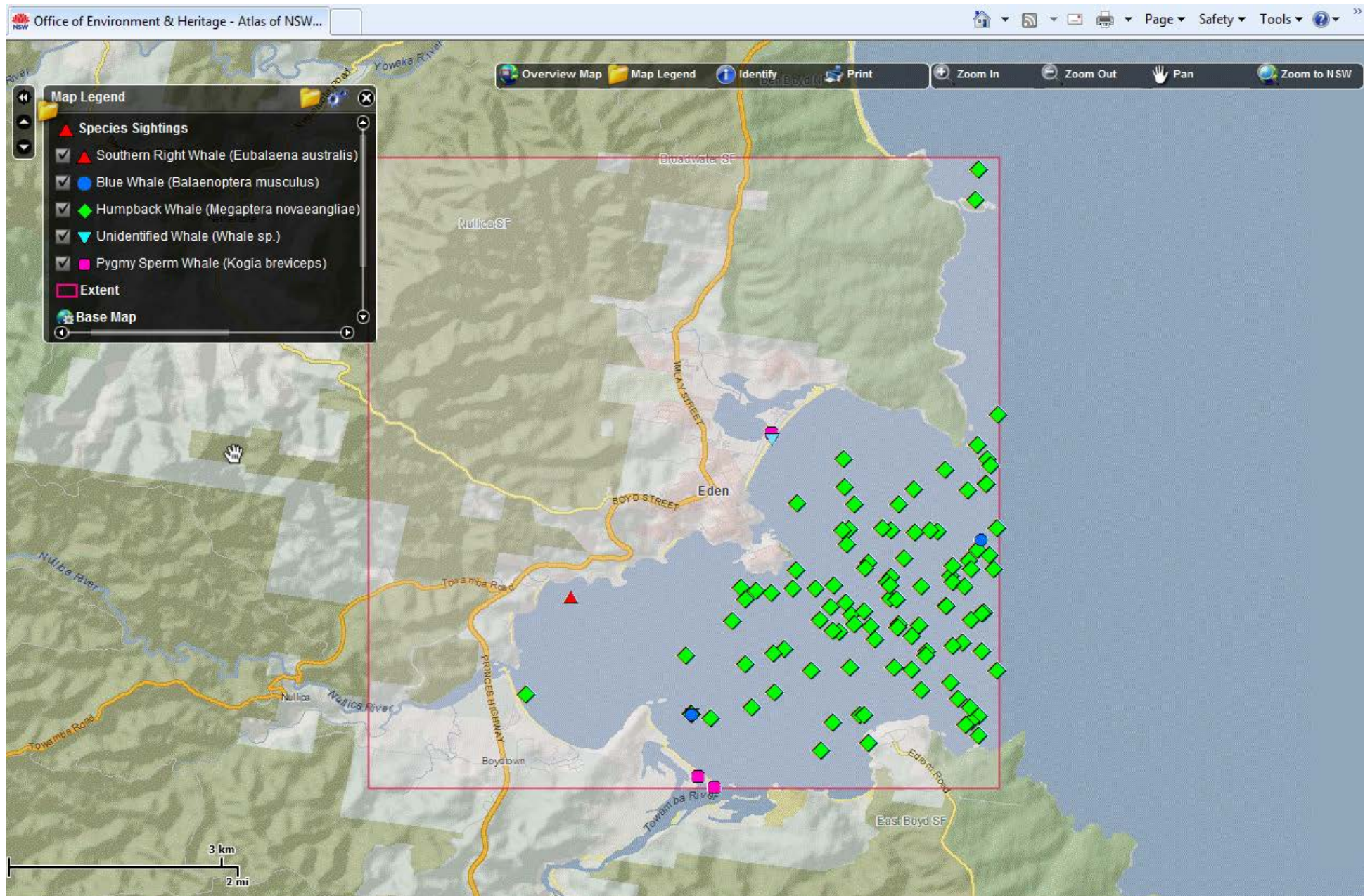
| Kingdom | Class | Family | Species Code | Scientific Name | Exotic | Common Name | NSW status | Comm. status | Records | Info |
|----------|----------|-----------------|--------------|-----------------------------------------|--------|----------------------|------------|--------------|---------|---------------------------------------------------------------------------------------|
| Animalia | Mammalia | Dugongidae | 1558 | <i>Dugong dugon</i> | | Dugong | E1,P | | 1 |  |
| Animalia | Mammalia | Otariidae | 1543 | <i>Arctocephalus forsteri</i> | | New Zealand Fur-seal | V,P | | 1 | |
| Animalia | Mammalia | Otariidae | 1882 | <i>Arctocephalus pusillus doriferus</i> | | Australian Fur-seal | V,P | | 2 | |
| Animalia | Mammalia | Balaenidae | 1561 | <i>Eubalaena australis</i> | | Southern Right Whale | E1,P | E | 1 |  |
| Animalia | Mammalia | Balaenopteridae | 1567 | <i>Balaenoptera musculus</i> | | Blue Whale | E1,P | E | 3 | |
| Animalia | Mammalia | Balaenopteridae | 1575 | <i>Megaptera novaeangliae</i> | | Humpback Whale | V,P | V | 105 |  |
| Animalia | Mammalia | Balaenopteridae | 9041 | <i>Whale sp.</i> | | Unidentified Whale | P | | 2 | |
| Animalia | Mammalia | Kogiidae | 1581 | <i>Kogia breviceps</i> | | Pygmy Sperm Whale | P | | 3 | |
| Animalia | Mammalia | Delphinidae | 1616 | <i>Delphinus delphis</i> | | Common Dolphin | P | | 1 | |
| Animalia | Mammalia | Delphinidae | 1600 | <i>Orcinus orca</i> | | Killer Whale | P | | 2 | |



Atlas of NSW Wildlife records of all marine mammal sightings within 10 km of the study site.



Atlas of NSW Wildlife records of dugongs, seals, dolphins and killer whales within 10 km of the study site.



Atlas of NSW Wildlife records of whales within 10 km of the study site.

Appendix 3 – EPBC Act 1999 Searches



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.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 16/06/14 13:47:24

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

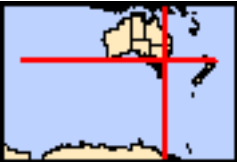
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 10.0Km



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](#).

| | |
|-----------------------------------------------------------|------|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance: | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Areas: | None |
| Listed Threatened Ecological Communities: | 3 |
| Listed Threatened Species: | 53 |
| Listed Migratory Species: | 43 |

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.

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.

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.

| | |
|----------------------------------------------------|------|
| Commonwealth Land: | 1 |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 70 |
| Whales and Other Cetaceans: | 12 |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Commonwealth Reserves Marine | None |

Extra Information

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

| | |
|--------------------------------------------------|----|
| Place on the RNE: | 12 |
| State and Territory Reserves: | 4 |
| Regional Forest Agreements: | 1 |
| Invasive Species: | 41 |
| Nationally Important Wetlands: | 1 |
| Key Ecological Features (Marine) | 1 |

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [\[Resource Information \]](#)

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.

| Name | Status | Type of Presence |
|------------------------------------------------------------------------------------|-----------------------|---------------------------------------|
| Littoral Rainforest and Coastal Vine Thickets of Eastern Australia | Critically Endangered | Community likely to occur within area |
| Lowland Grassy Woodland in the South East Corner Bioregion | Critically Endangered | Community likely to occur within area |
| Subtropical and Temperate Coastal Saltmarsh | Vulnerable | Community likely to occur within area |

Listed Threatened Species [\[Resource Information \]](#)

| Name | Status | Type of Presence |
|------------------------------------------------------------------------------------|------------|--------------------------------------------------------------------|
| Birds | | |
| Anthochaera phrygia Regent Honeyeater [82338] | Endangered | Species or species habitat known to occur within area |
| Botaurus poiciloptilus Australasian Bittern [1001] | Endangered | Species or species habitat known to occur within area |
| Dasyornis brachypterus Eastern Bristlebird [533] | Endangered | Species or species habitat likely to occur within area |
| Diomedea epomophora epomophora Southern Royal Albatross [25996] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea epomophora sanfordi Northern Royal Albatross [82331] | Endangered | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans antipodensis Antipodean Albatross [82269] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans exulans Tristan Albatross [82337] | Endangered | Species or species |

| Name | Status | Type of Presence |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------|
| Diomedea exulans gibsoni Gibson's Albatross [82271] | Vulnerable | habitat may occur within area |
| Diomedea exulans (sensu lato) Wandering Albatross [1073] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438] | Vulnerable | Species or species habitat likely to occur within area |
| Halobaena caerulea Blue Petrel [1059] | Vulnerable | Species or species habitat may occur within area |
| Lathamus discolor Swift Parrot [744] | Endangered | Species or species habitat likely to occur within area |
| Macronectes giganteus Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Neophema chrysogaster Orange-bellied Parrot [747] | Critically Endangered | Species or species habitat may occur within area |
| Pterodroma leucoptera leucoptera Gould's Petrel [26033] | Endangered | Species or species habitat may occur within area |
| Rostratula australis Australian Painted Snipe [77037] | Endangered | Species or species habitat may occur within area |
| Sternula nereis nereis Australian Fairy Tern [82950] | Vulnerable | Species or species habitat likely to occur within area |
| Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche cauta salvini Salvin's Albatross [82343] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche cauta steadi White-capped Albatross [82344] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche eremita Chatham Albatross [64457] | Endangered | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche melanophris Black-browed Albatross [66472] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche melanophris impavida Campbell Albatross [82449] | Vulnerable | Species or species habitat may occur within |

| Name | Status | Type of Presence area |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------|
| Fish | | |
| Epinephelus daemeli Black Rockcod, Black Cod, Saddled Rockcod [68449] | Vulnerable | Species or species habitat may occur within area |
| Prototroctes maraena Australian Grayling [26179] | Vulnerable | Species or species habitat known to occur within area |
| Frogs | | |
| Heleioporus australiacus Giant Burrowing Frog [1973] | Vulnerable | Species or species habitat likely to occur within area |
| Litoria aurea Green and Golden Bell Frog [1870] | Vulnerable | Species or species habitat may occur within area |
| Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733] | Vulnerable | Species or species habitat may occur within area |
| Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942] | Vulnerable | Species or species habitat likely to occur within area |
| Mammals | | |
| Balaenoptera musculus Blue Whale [36] | Endangered | Species or species habitat likely to occur within area |
| Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184] | Endangered | Species or species habitat known to occur within area |
| Eubalaena australis Southern Right Whale [40] | Endangered | Breeding likely to occur within area |
| Isoodon obesulus obesulus Southern Brown Bandicoot (Eastern) [68050] | Endangered | Species or species habitat known to occur within area |
| Megaptera novaeangliae Humpback Whale [38] | Vulnerable | Congregation or aggregation known to occur within area |
| Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104] | Vulnerable | Species or species habitat likely to occur within area |
| Potorous longipes Long-footed Potoroo [217] | Endangered | Species or species habitat likely to occur within area |
| Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645] | Vulnerable | Species or species habitat may occur within area |
| Pseudomys fumeus Konoom, Smoky Mouse [88] | Endangered | Species or species habitat may occur within area |
| Pseudomys novaehollandiae New Holland Mouse, Pookila [96] | Vulnerable | Species or species habitat likely to occur within area |
| Pteropus poliocephalus Grey-headed Flying-fox [186] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Plants | | |

| Name | Status | Type of Presence |
|--------------------------------------------------------------------------------------------|------------|--------------------------------------------------------|
| Cryptostylis hunteriana Leafless Tongue-orchid [19533] | Vulnerable | Species or species habitat known to occur within area |
| Genoplesium rhyoliticum Pambula Midge-orchid [55116] | Endangered | Species or species habitat likely to occur within area |
| Leionema ralstonii [64926] | Vulnerable | Species or species habitat likely to occur within area |
| Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood [21618] | Endangered | Species or species habitat likely to occur within area |

| Reptiles | | |
|---------------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------------|
| Caretta caretta Loggerhead Turtle [1763] | Endangered | Breeding likely to occur within area |
| Chelonia mydas Green Turtle [1765] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat known to occur within area |
| Eretmochelys imbricata Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Sharks | | |
| Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751] | Critically Endangered | Species or species habitat likely to occur within area |
| Carcharodon carcharias Great White Shark [64470] | Vulnerable | Species or species habitat known to occur within area |
| Rhincodon typus Whale Shark [66680] | Vulnerable | Species or species habitat may occur within area |

| Listed Migratory Species [Resource Information] | | |
|--------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------|
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. | | |
| Name | Threatened | Type of Presence |
| Migratory Marine Birds | | |
| Apus pacificus Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Diomedea antipodensis Antipodean Albatross [64458] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea dabbenena Tristan Albatross [66471] | Endangered* | Species or species habitat may occur within area |
| Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans (sensu lato) Wandering Albatross [1073] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea gibsoni Gibson's Albatross [64466] | Vulnerable* | Foraging, feeding or |

| Name | Threatened | Type of Presence |
|------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------|
| | | related behaviour likely to occur within area |
| Diomedea sanfordi Northern Royal Albatross [64456] | Endangered* | Foraging, feeding or related behaviour likely to occur within area |
| Macronectes giganteus Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043] | | Foraging, feeding or related behaviour likely to occur within area |
| Sterna albifrons Little Tern [813] | | Species or species habitat may occur within area |
| Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche eremita Chatham Albatross [64457] | Endangered | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche impavida Campbell Albatross [64459] | Vulnerable* | Species or species habitat may occur within area |
| Thalassarche melanophris Black-browed Albatross [66472] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche salvini Salvin's Albatross [64463] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche steadi White-capped Albatross [64462] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Migratory Marine Species | | |
| Balaenoptera edeni Bryde's Whale [35] | | Species or species habitat may occur within area |
| Balaenoptera musculus Blue Whale [36] | Endangered | Species or species habitat likely to occur within area |
| Caperea marginata Pygmy Right Whale [39] | | Species or species habitat may occur within area |
| Carcharodon carcharias Great White Shark [64470] | Vulnerable | Species or species habitat known to occur within area |
| Caretta caretta Loggerhead Turtle [1763] | Endangered | Breeding likely to occur within area |
| Chelonia mydas Green Turtle [1765] | Vulnerable | Foraging, feeding or related behaviour known |

| Name | Threatened | Type of Presence |
|------------------------------------------------------------------------------------------|------------|--------------------------------------------------------------|
| | | to occur within area |
| Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat known to occur within area |
| Eretmochelys imbricata Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Eubalaena australis Southern Right Whale [40] | Endangered | Breeding likely to occur within area |
| Lagenorhynchus obscurus Dusky Dolphin [43] | | Species or species habitat may occur within area |
| Lamna nasus Porbeagle, Mackerel Shark [83288] | | Species or species habitat likely to occur within area |
| Megaptera novaeangliae Humpback Whale [38] | Vulnerable | Congregation or aggregation known to occur within area |
| Orcinus orca Killer Whale, Orca [46] | | Species or species habitat may occur within area |
| Rhincodon typus Whale Shark [66680] | Vulnerable | Species or species habitat may occur within area |
| Migratory Terrestrial Species | | |
| Haliaeetus leucogaster White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Hirundapus caudacutus White-throated Needletail [682] | | Species or species habitat known to occur within area |
| Merops ornatus Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Monarcha melanopsis Black-faced Monarch [609] | | Species or species habitat known to occur within area |
| Myiagra cyanoleuca Satin Flycatcher [612] | | Species or species habitat known to occur within area |
| Rhipidura rufifrons Rufous Fantail [592] | | Species or species habitat known to occur within area |
| Migratory Wetlands Species | | |
| Ardea alba Great Egret, White Egret [59541] | | Species or species habitat known to occur within area |
| Ardea ibis Cattle Egret [59542] | | Species or species habitat likely to occur within area |
| Gallinago hardwickii Latham's Snipe, Japanese Snipe [863] | | Foraging, feeding or related behaviour may occur within area |
| Numenius minutus Little Curlew, Little Whimbrel [848] | | Foraging, feeding or related behaviour likely |

| Name | Threatened | Type of Presence |
|-----------------------------------------------------------------------------|-------------|--------------------------------------------------|
| Rostratula benghalensis (sensu lato) Painted Snipe [889] | Endangered* | Species or species habitat may occur within area |

Other Matters Protected by the EPBC Act

| | |
|-------------------|------------------------------------------|
| Commonwealth Land | [Resource Information] |
|-------------------|------------------------------------------|

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

| Name |
|---------------------|
| Commonwealth Land - |

| | |
|-----------------------|------------------------------------------|
| Listed Marine Species | [Resource Information] |
|-----------------------|------------------------------------------|

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|----------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------|
| Birds | | |
| Apus pacificus Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardea alba Great Egret, White Egret [59541] | | Species or species habitat known to occur within area |
| Ardea ibis Cattle Egret [59542] | | Species or species habitat likely to occur within area |
| Catharacta skua Great Skua [59472] | | Species or species habitat may occur within area |
| Diomedea antipodensis Antipodean Albatross [64458] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea dabbenena Tristan Albatross [66471] | Endangered* | Species or species habitat may occur within area |
| Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans (sensu lato) Wandering Albatross [1073] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea gibsoni Gibson's Albatross [64466] | Vulnerable* | Foraging, feeding or related behaviour likely |

| Name | Threatened | Type of Presence |
|------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------|
| | | to occur within area |
| Diomedea sanfordi Northern Royal Albatross [64456] | Endangered* | Foraging, feeding or related behaviour likely to occur within area |
| Gallinago hardwickii Latham's Snipe, Japanese Snipe [863] | | Foraging, feeding or related behaviour may occur within area |
| Gallinago megala Swinhoe's Snipe [864] | | Foraging, feeding or related behaviour likely to occur within area |
| Gallinago stenura Pin-tailed Snipe [841] | | Foraging, feeding or related behaviour likely to occur within area |
| Haliaeetus leucogaster White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Halobaena caerulea Blue Petrel [1059] | Vulnerable | Species or species habitat may occur within area |
| Hirundapus caudacutus White-throated Needletail [682] | | Species or species habitat known to occur within area |
| Lathamus discolor Swift Parrot [744] | Endangered | Species or species habitat likely to occur within area |
| Macronectes giganteus Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Merops ornatus Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Monarcha melanopsis Black-faced Monarch [609] | | Species or species habitat known to occur within area |
| Myiagra cyanoleuca Satin Flycatcher [612] | | Species or species habitat known to occur within area |
| Neophema chrysogaster Orange-bellied Parrot [747] | Critically Endangered | Species or species habitat may occur within area |
| Numenius minutus Little Curlew, Little Whimbrel [848] | | Foraging, feeding or related behaviour likely to occur within area |
| Pandion haliaetus Osprey [952] | | Species or species habitat known to occur within area |
| Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043] | | Foraging, feeding or related behaviour likely to occur within area |
| Rhipidura rufifrons Rufous Fantail [592] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
|---------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------|
| Rostratula benghalensis (sensu lato) Painted Snipe [889] | Endangered* | Species or species habitat may occur within area |
| Sterna albifrons Little Tern [813] | | Species or species habitat may occur within area |
| Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
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| Thalassarche impavida Campbell Albatross [64459] | Vulnerable* | Species or species habitat may occur within area |
| Thalassarche melanophris Black-browed Albatross [66472] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche salvini Salvin's Albatross [64463] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche steadi White-capped Albatross [64462] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726] | | Species or species habitat known to occur within area |
| Fish | | |
| Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227] | | Species or species habitat may occur within area |
| Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233] | | Species or species habitat may occur within area |
| Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235] | | Species or species habitat may occur within area |
| Hippocampus minotaur Bullneck Seahorse [66705] | | Species or species habitat may occur within area |
| Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240] | | Species or species habitat may occur within area |
| Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242] | | Species or species habitat may occur within area |
| Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243] | | Species or species habitat may occur within area |
| Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245] | | Species or species habitat may occur within area |

| Name | Threatened | Type of Presence |
|-----------------------------------------------------------------------------------------------------------------------|------------|--------------------------------------------------|
| Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246] | | Species or species habitat may occur within area |
| Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247] | | Species or species habitat may occur within area |
| Leptoichthys fistularius Brushtail Pipefish [66248] | | Species or species habitat may occur within area |
| Lissocampus runa Javelin Pipefish [66251] | | Species or species habitat may occur within area |
| Maroubra perserrata Sawtooth Pipefish [66252] | | Species or species habitat may occur within area |
| Mitotichthys semistriatus Halfbanded Pipefish [66261] | | Species or species habitat may occur within area |
| Mitotichthys tuckeri Tucker's Pipefish [66262] | | Species or species habitat may occur within area |
| Notiocampus ruber Red Pipefish [66265] | | Species or species habitat may occur within area |
| Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268] | | Species or species habitat may occur within area |
| Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274] | | Species or species habitat may occur within area |
| Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275] | | Species or species habitat may occur within area |
| Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276] | | Species or species habitat may occur within area |
| Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277] | | Species or species habitat may occur within area |
| Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278] | | Species or species habitat may occur within area |
| Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279] | | Species or species habitat may occur within area |
| Urocampus carinirostris Hairy Pipefish [66282] | | Species or species habitat may occur within area |
| Vanacampus margaritifer Mother-of-pearl Pipefish [66283] | | Species or species habitat may occur within area |
| Vanacampus phillipi Port Phillip Pipefish [66284] | | Species or species habitat may occur within area |

| Name | Threatened | Type of Presence |
|-------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------|
| Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285] | | Species or species habitat may occur within area |
| Mammals | | |
| Arctocephalus forsteri New Zealand Fur-seal [20] | | Species or species habitat may occur within area |
| Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21] | | Species or species habitat may occur within area |
| Reptiles | | |
| Caretta caretta Loggerhead Turtle [1763] | Endangered | Breeding likely to occur within area |
| Chelonia mydas Green Turtle [1765] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat known to occur within area |
| Eretmochelys imbricata Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Whales and other Cetaceans | | [Resource Information] |
| Name | Status | Type of Presence |
| Mammals | | |
| Balaenoptera acutorostrata Minke Whale [33] | | Species or species habitat may occur within area |
| Balaenoptera edeni Bryde's Whale [35] | | Species or species habitat may occur within area |
| Balaenoptera musculus Blue Whale [36] | Endangered | Species or species habitat likely to occur within area |
| Caperea marginata Pygmy Right Whale [39] | | Species or species habitat may occur within area |
| Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60] | | Species or species habitat may occur within area |
| Eubalaena australis Southern Right Whale [40] | Endangered | Breeding likely to occur within area |
| Grampus griseus Risso's Dolphin, Grampus [64] | | Species or species habitat may occur within area |
| Lagenorhynchus obscurus Dusky Dolphin [43] | | Species or species habitat may occur within area |
| Megaptera novaeangliae Humpback Whale [38] | Vulnerable | Congregation or aggregation known to occur within area |
| Orcinus orca Killer Whale, Orca [46] | | Species or species habitat may occur within area |

| Name | Status | Type of Presence |
|---------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------|
| Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418] | | Species or species habitat likely to occur within area |
| Tursiops truncatus s. str. Bottlenose Dolphin [68417] | | Species or species habitat may occur within area |

Extra Information

| | |
|-------------------|------------------------------------------|
| Places on the RNE | [Resource Information] |
|-------------------|------------------------------------------|

Note that not all Indigenous sites may be listed.

| Name | State | Status |
|------------------------------------------------|-------|------------------|
| Natural | | |
| Yowaka Reserve Proposal | NSW | Indicative Place |
| Bell Bird Creek Nature Reserve | NSW | Registered |
| Ben Boyd National Park | NSW | Registered |
| Boyds Tower Fish Fossils | NSW | Registered |
| Eden Geological Site | NSW | Registered |
| Historic | | |
| East Boyd Bay Area | NSW | Indicative Place |
| Post Office (former) | NSW | Indicative Place |
| Boydton Group | NSW | Registered |
| Church Ruins | NSW | Registered |
| Eden Courthouse | NSW | Registered |
| Edrom Lodge | NSW | Registered |
| Sea Horse Inn | NSW | Registered |

| | |
|------------------------------|------------------------------------------|
| State and Territory Reserves | [Resource Information] |
|------------------------------|------------------------------------------|

| Name | State |
|-----------------|-------|
| Bell Bird Creek | NSW |
| Ben Boyd | NSW |
| Eagles Claw | NSW |
| Unnamed FMZ2 | NSW |

| | |
|----------------------------|------------------------------------------|
| Regional Forest Agreements | [Resource Information] |
|----------------------------|------------------------------------------|

Note that all areas with completed RFAs have been included.

| Name | State |
|--------------------------|-----------------|
| Eden RFA | New South Wales |

| | |
|------------------|------------------------------------------|
| Invasive Species | [Resource Information] |
|------------------|------------------------------------------|

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status | Type of Presence |
|------------------------------------------------------------------------|--------|--------------------------------------------------------|
| Birds | | |
| Acridotheres tristis Common Myna, Indian Myna [387] | | Species or species habitat likely to occur within area |
| Alauda arvensis Skylark [656] | | Species or species habitat likely to occur within area |
| Anas platyrhynchos Mallard [974] | | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|--------------------------------------------------------------------------------|--------|--------------------------------------------------------|
| Carduelis carduelis European Goldfinch [403] | | Species or species habitat likely to occur within area |
| Carduelis chloris European Greenfinch [404] | | Species or species habitat likely to occur within area |
| Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803] | | Species or species habitat likely to occur within area |
| Passer domesticus House Sparrow [405] | | Species or species habitat likely to occur within area |
| Streptopelia chinensis Spotted Turtle-Dove [780] | | Species or species habitat likely to occur within area |
| Sturnus vulgaris Common Starling [389] | | Species or species habitat likely to occur within area |
| Turdus merula Common Blackbird, Eurasian Blackbird [596] | | Species or species habitat likely to occur within area |
| Mammals | | |
| Bos taurus Domestic Cattle [16] | | Species or species habitat likely to occur within area |
| Canis lupus familiaris Domestic Dog [82654] | | Species or species habitat likely to occur within area |
| Felis catus Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Feral deer Feral deer species in Australia [85733] | | Species or species habitat likely to occur within area |
| Lepus capensis Brown Hare [127] | | Species or species habitat likely to occur within area |
| Mus musculus House Mouse [120] | | Species or species habitat likely to occur within area |
| Oryctolagus cuniculus Rabbit, European Rabbit [128] | | Species or species habitat likely to occur within area |
| Rattus norvegicus Brown Rat, Norway Rat [83] | | Species or species habitat likely to occur within area |
| Rattus rattus Black Rat, Ship Rat [84] | | Species or species habitat likely to occur within area |
| Sus scrofa Pig [6] | | Species or species habitat likely to occur within area |
| Vulpes vulpes Red Fox, Fox [18] | | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------|
| Plants | | |
| Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643] | | Species or species habitat likely to occur within area |
| Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425] | | Species or species habitat likely to occur within area |
| Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473] | | Species or species habitat likely to occur within area |
| Asparagus plumosus Climbing Asparagus-fern [48993] | | Species or species habitat likely to occur within area |
| Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255] | | Species or species habitat likely to occur within area |
| Chrysanthemoides monilifera subsp. monilifera Boneseed [16905] | | Species or species habitat likely to occur within area |
| Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332] | | Species or species habitat likely to occur within area |
| Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934] | | Species or species habitat likely to occur within area |
| Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126] | | Species or species habitat likely to occur within area |
| Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] | | Species or species habitat likely to occur within area |
| Nassella neesiana Chilean Needle grass [67699] | | Species or species habitat likely to occur within area |
| Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884] | | Species or species habitat likely to occur within area |
| Opuntia spp. Prickly Pears [82753] | | Species or species habitat likely to occur within area |
| Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780] | | Species or species habitat may occur within area |
| Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747] | | Species or species habitat likely to occur within area |
| Rubus fruticosus aggregate Blackberry, European Blackberry [68406] | | Species or species habitat likely to occur within area |
| Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497] | | Species or species habitat likely to occur within area |
| Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665] | | Species or species habitat likely to occur |

| Name | Status | Type of Presence |
|-----------------------------------------------------------|--------|--------------------------------------------------------|
| Senecio madagascariensis | | within area |
| Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624] | | Species or species habitat likely to occur within area |
| Ulex europaeus | | |
| Gorse, Furze [7693] | | Species or species habitat likely to occur within area |

| Nationally Important Wetlands | | [Resource Information] |
|-------------------------------|--|--------------------------|
| Name | | State |
| Twofold Bay | | NSW |

| Key Ecological Features (Marine) | [Resource Information] |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area. | |

| Name | Region |
|------------------------|------------|
| Upwelling East of Eden | South-east |

Coordinates

-37.07122 149.90181

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 following provisions of the EPBC Act have been mapped:

- migratory and
- marine

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.

Acknowledgements

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

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-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](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- Other groups and individuals

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

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix 4 – Cat Balou Raw Data

| Date | | 11/07/2014 | 8/07/2014 | 3/07/2014 | 14/05/2014 | 13/05/2014 | 12/05/2014 | 24/11/2013 | 23/11/2013 | 20/11/2013 | 19/11/2013 |
|--------------------|-------------------------|------------|-----------|-----------|------------|------------|------------|------------|------------|------------|------------|
| Species | Whale (unidentified) | | | | | 1 | | 1 | | | |
| | Humpback | 1 | 1 | 1 | 1 | | 1 | | 1 | 1 | 1 |
| | Dwarf minke | | | 1 | | | | | | | |
| | Southern right whale | | | | | | | | | | |
| | Common dolphins | | 1 | 1 | | | | 1 | 1 | 1 | |
| | Bottlenose dolphins | | | | | | | | | | |
| | Dolphins (unidentified) | 1 | | | | | | | | | |
| | Australian Fur Seal | 1 | | | | | | 1 | 1 | 1 | 1 |
| | Orca | | | | | | | | | | |
| | Bryde's whale | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Whale demographics | Juvenile (From 1/10/12) | | 1 | 1 | 1 | 1 | 1 | | | | |
| | Sub-adult | | | | | | | | 1 | | |
| | Adult | 1 | | | | | | | | 1 | |
| | Mother & Calf | | | | | | | | | 1 | 1 |
| | Mother, calf & escort | | | | | | | 1 | | | |
| | Not specified | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Whale counts | Number of Individuals | | 1 | 2 | | 1 | 1 | 3 | 2 | 6 | 4 |
| | Number of Groups | several | 1 | 2 | | | | | | 2 | 2 |
| | Not specified | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | Aslings Beach | | | | | | | | | | |
| | Calle Calle Bay | | | | | | | | | | |
| | Coastal (East) | 1 | | | | | | | | | 1 |
| | Coastal (North) | | | | | | | | | 1 | |
| | Coastal (South) | | | | | | | | | | |
| | Eden Breakwall | | | | | | | | | | |
| | Eden Wharf | | | | 1 | | | | | | |

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| Date | | 2/11/2012 | 1/11/2012 | 31/10/2012 | 30/10/2012 | 29/10/2012 | 28/10/2012 | 27/10/2012 | 26/10/2012 | 25/10/2012 | 24/10/2012 |
|-------------------|-----------------------|-----------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|
| Whale locations | Heads of Twofold Bay | | | 1 | | | | | | | |
| | Honeysuckle Bay | | | | | | | | | | |
| | North Head | | | | | | | | | | |
| | South Head | | 1 | | 1 | | | | | | |
| | The Lookout | | 1 | | | 1 | | 1 | 1 | 1 | |
| | Twofold Bay | 1 | 1 | | 1 | 1 | 1 | 1 | | 1 | 1 |
| | Whale Spit | | | | | | | | | | |
| | Not specified | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Whale behaviour | Active | | | | | | | | | | |
| | Breaching | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Tail slapping | 1 | 1 | 1 | | 1 | | 1 | | 1 | 1 |
| | Blow | | | | | | | | | | |
| | Travelling | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Dolphin counts | Number of Individuals | | | | | | | | | | |
| | Number of Groups | 1 | 1 | 3 | 1 | | 4 | | 1 | 1 | 3 |
| | Not specified | | | | | 1 | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Dolphin locations | Aslings Beach | | | | | | | | | | |
| | Calle Calle Bay | | | | | | | | | | |
| | Coastal (East) | 1 | | | | | | | | | |
| | Coastal (North) | | | | | | | | | | |
| | Coastal (South) | | | 1 | | | 1 | | 1 | | |
| | Eden Breakwall | | | | | | | | | | |
| | Eden Wharf | | | | | | | | | | |
| | Heads of Twofold Bay | | | | 1 | | | | | | |
| | Honeysuckle Bay | | | | | | | | | | |
| | North Head | | | | | | 1 | | | | |

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| Date | | 5/08/2012 | 17/07/2012 | 4/07/2012 | 1/07/2012 |
|--------------------|-------------------------|-----------|------------|-----------|-----------|
| Species | Whale (unidentified) | | | | |
| | Humpback | | | | 1 |
| | Dwarf minke | | | | |
| | Southern right whale | 1 | 1 | 1 | |
| | Common dolphins | | | | |
| | Bottle nose dolphins | | | | 1 |
| | Dolphins (unidentified) | | | | |
| | Australian Fur Seal | | 1 | 1 | 1 |
| | Orca | | | | |
| | Bryde's whale | | | | |
| | | | | | |
| | | | | | |
| Whale demographics | Juvenile (From 1/10/12) | | | | |
| | Sub-adult | | | 1 | |
| | Adult | | | | 1 |
| | Mother & Calf | 1 | | | |
| | Mother, calf & escort | | | | |
| | Not specified | | 1 | | |
| | | | | | |
| | | | | | |
| Whale counts | Number of Individuals | 2 | 2 | 1 | 4 |
| | Number of Groups | 1 | 1 | 1 | 1 |
| | Not specified | | | | |
| | | | | | |
| | | | | | |
| | Aslings Beach | | 1 | | |
| | Calle Calle Bay | 1 | | | |
| | Coastal (East) | | | | |
| | Coastal (North) | | | | |
| | Coastal (South) | | | | |
| | Eden Breakwall | | | | |
| | Eden Wharf | | | | |

| Date | | 5/08/2012 | 17/07/2012 | 4/07/2012 | 1/07/2012 |
|-------------------|-----------------------|-----------|------------|-----------|-----------|
| Whale locations | Heads of Twofold Bay | | | | |
| | Honeysuckle Bay | | | 1 | |
| | North Head | | | | |
| | South Head | | | | |
| | The Lookout | 1 | | | |
| | Twofold Bay | | | | 1 |
| | Whale Spit | | | | |
| | Not specified | | | | |
| | | | | | |
| | | | | | |
| Whale behaviour | Active | | | | |
| | Breaching | | | | |
| | Tail slapping | | | | |
| | Blow | | | | |
| | Travelling | | | | |
| | | | | | |
| | | | | | |
| Dolphin counts | Number of Individuals | | | | lots |
| | Number of Groups | | | | 1 |
| | Not specified | | | | |
| | | | | | |
| | | | | | |
| Dolphin locations | Aslings Beach | | | | |
| | Calle Calle Bay | | | | |
| | Coastal (East) | | | | |
| | Coastal (North) | | | | |
| | Coastal (South) | | | | |
| | Eden Breakwall | | | | |
| | Eden Wharf | | | | |
| | Heads of Twofold Bay | | | | |
| | Honeysuckle Bay | | | | 1 |
| | North Head | | | | |
| | | | | | |

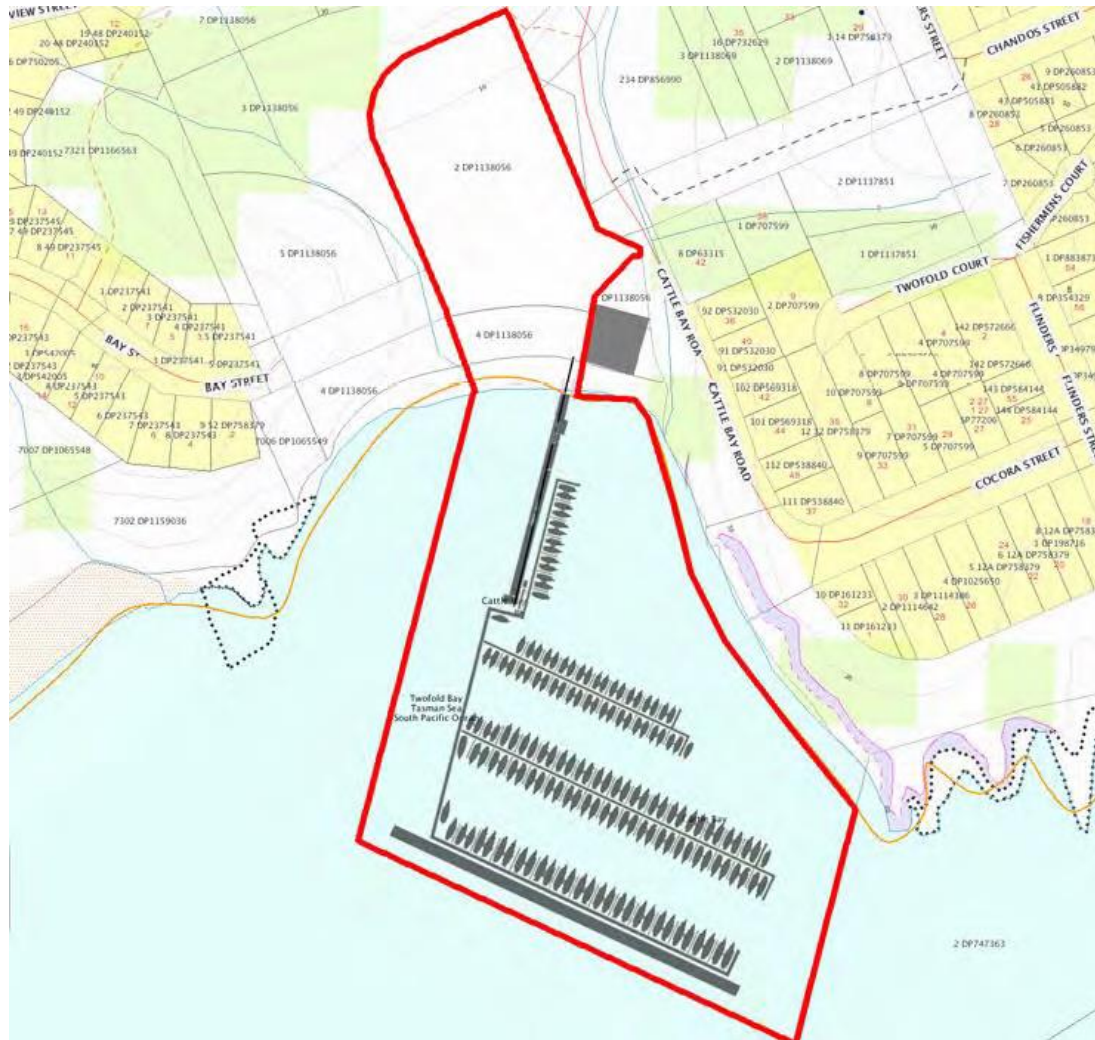
| Date | | 5/08/2012 | 17/07/2012 | 4/07/2012 | 1/07/2012 |
|----------------|-----------------------|-----------|------------|-----------|-----------|
| | South Head | | | | |
| | The Lookout | | | | |
| | Two fold Bay | | | | |
| | Whale Spit | | | | |
| | Not specified | | | | |
| | | | | | |
| | | | | | |
| Seal counts | Number of Individuals | | | 2 | a couple |
| | Number of Groups | | | 1 | 1 |
| | Not specified | | 1 | | |
| | | | | | |
| | | | | | |
| Seal locations | Aslings Beach | | | | |
| | Calle Calle Bay | | | | |
| | Coastal (East) | | | | |
| | Coastal (North) | | | | |
| | Coastal (South) | | | | |
| | Eden Breakwall | | | 1 | |
| | Eden Wharf | | | | |
| | Heads of Two fold Bay | | | | |
| | Honeysuckle Bay | | | | |
| | North Head | | | | |
| | South Head | | | | |
| | The Lookout | | | | |
| | Two fold Bay | | | | |
| | Whale Spit | | | | |
| | Not specified | | 1 | | 1 |
| | | | | | |
| | | | | | |
| Orca counts | Number of Individuals | | | | |
| | Number of Groups | | | | |
| | Not specified | | | | |

| Date | | 5/08/2012 | 17/07/2012 | 4/07/2012 | 1/07/2012 |
|-----------------|-----------------------|-----------|------------|-----------|-----------|
| | | | | | |
| | | | | | |
| Ore a locations | Aslings Beach | | | | |
| | Calle Calle Bay | | | | |
| | Coastal (East) | | | | |
| | Coastal (North) | | | | |
| | Coastal (South) | | | | |
| | Eden Breakwall | | | | |
| | Eden Wharf | | | | |
| | Heads of Two fold Bay | | | | |
| | Honeysuckle Bay | | | | |
| | Leather jacket | | | | |
| | North Head | | | | |
| | South Head | | | | |
| | The Lookout | | | | |
| | The Pinnacles | | | | |
| | Two fold Bay | | | | |
| | Whale Spit | | | | |
| | Not specified | | | | |
| | | | | | |



Appendix 5 – Hydrographic & Habitat Mapping Report (Marine Solutions)

BATHYMETRY AND SEAGRASS SURVEY AT THE SITE OF A PROPOSED MARINA, CATTLE BAY, EDEN



Report to

Ocean Environmental

July 2014



www.marinesolutions.net.au

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3 Executive Summary

This report outlines the techniques and findings of a field survey conducted in early July 2014 to develop a bathymetric and habitat map of Cattle Bay, Eden, with particular regard to the seagrass communities. This survey was targeted to address condition 4(a) of the Bega Valley Shire Council conditions issued by letter on the 9th August 2013. The ecological assessment undertaken included surveys of the inshore and offshore limits of seagrass that would be affected by the development. In addition, video footage and still photos were taken at the site to document the current status of the area.

The bathymetry of the area is generally simple, with depth increasing with increasing distance from the shoreline. The majority of Cattle Bay is covered by marine sediments, with the exclusion of sections of rocky foreshore which extend to the subtidal in a highly rugose manner.

Three species of seagrass were noted during the survey, and their approximate distribution mapped throughout the bay. On the inner margin, seagrasses were found to colonise sediments to the head of Cattle Bay, and to the edge of the rocky reef where suitable substrates were located. The outer edge of the seagrass community was not clearly defined, however as a proxy, sparse seagrass was found at least to the 7m depth contour. The sparse nature of the seagrass meant it was nonsensical to infer an outer edge of the seagrass, but rather more logical to provide an indication of suitable seagrass habitat extending beyond the survey area.

Suggestions are made to mitigate against possible impacts on the existing seagrass beds, however it is a possibility that the development of a marina may reduce seabed disturbance by reducing demand for swing moorings which scour the seabed; re-berthing of vessels in a marina will potentially reduce seabed scouring and thereby allow an increased area of habitat to be colonised by seagrasses over time.

4 Study Site

Eden is a small coastal town on the shores of Twofold Bay, South Coast of New South Wales (Figure 1). The region is known for its fishing and coastal trading and so not surprisingly has a strong maritime heritage including recreational and commercial boating.

From a maritime perspective, Eden provides the most southerly all-weather anchorage on the New South Wales coast, thus often acts as the departure point for vessels heading across or through Bass Strait. Similarly, it is often the first point of call for vessels heading north from Victoria or Tasmania.

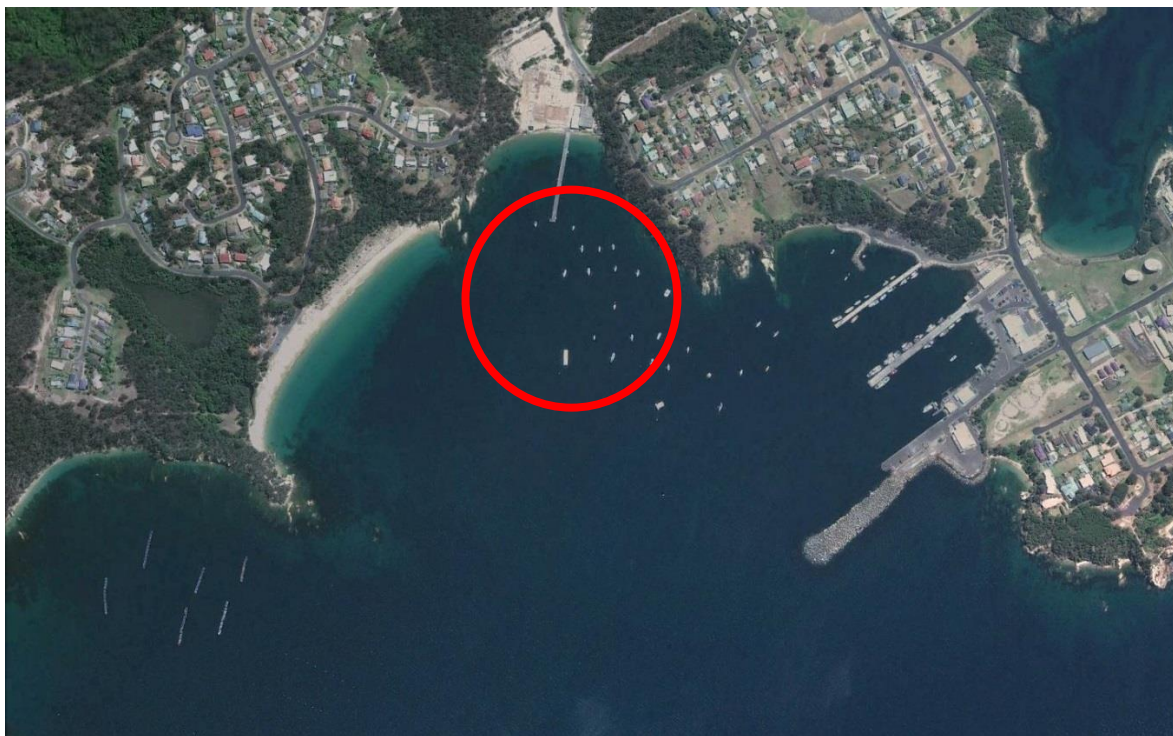


Figure 1 Aerial View of the port of Eden, showing Cattle Bay highlighted in red

The marine ecology of the area is dominated by offshore influences, however anecdotal evidence and local expertise indicate that during high rainfall events the Kiah Inlet and Nullica River combine to provide significant fresh water inputs which can reduce the in-water visibility and provide a source of sediments to the bay.

To conduct the field based investigations at Cattle Bay, a multidisciplinary approach was utilised which required bathymetric mapping, towed video and diver investigation.

5 Bathymetry

Methods

A process of bathymetric mapping was undertaken in order to identify any marine features or significant habitat boundaries in the immediate vicinity of the proposed development. The bathymetry of the proposed development area was generated by mounting a Garmin GPS map551 S with a 600W RMS sounder onto a vessel and driving a series of pre-determined grids over the area of interest. At intervals of 2 seconds, the GPS location and the depth were concurrently recorded, along with any user defined waypoints which were required. Therefore, this method logs 1800 records hour⁻¹, and in the course of a day, a considerable area was covered.

Positions were logged by a Garmin GPS map 551S and depths were measured to the nearest tenth of a metre. The depth information string was post-processed to tidally correct for chart datum using tidal predictions for Eden, and barometric pressure using observations from local weather stations. The data was interpolated using GIS program Surfer 11.0, and land shape files were constructed using georeferenced photo imagery.

This information is displayed in a variety of output formats which can be modified as required, but include chart datum and AHD maps and .dxf files for integration into CAD programs.

Results

The bathymetry of Cattle Bay is generally simple with depth increasing with increasing distance offshore. Depth does not exceed 10m (Chart datum) within the area shoreward of a line from Eden breakwater to Cocora Point (**Error! Reference source not found.**).

In areas of rocky shoreline (points of the bays), the rock extends some distance into the subtidal zone, forming high rugosity rocky reef which generally extends a limited distance offshore. This results in some shallow rock pinnacles emerging a short distance offshore from rocky shorelines. These pinnacles may not be accurately represented as they are small and isolated, and thus may not have been accurately captured by the mapping

The remainder of the shoreline is comprised of Cocora and Cattle Bay beaches which have reworked marine sediments in the shallow offshore sections, grading to heavily bioturbated marine sediments further offshore. This means the animals living in the sediments (infauna) are burrowing and disturbing the sediments rather than wave or current action moving the sediments on the bottom. In general this is considered a depositional environment with low water movement at the seabed.

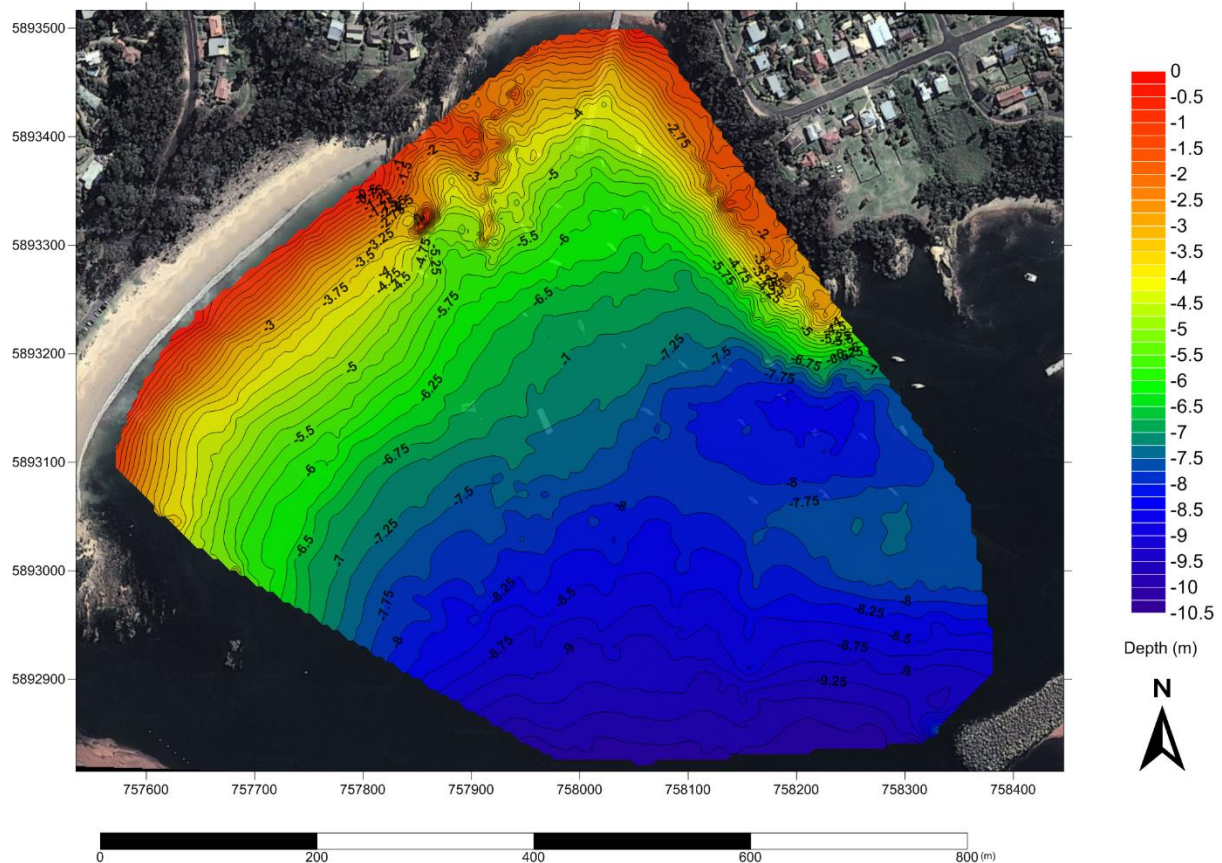


Figure 2 Plan view bathymetry of Cattle Bay and surrounds, Eden

The bathymetry of the area should not be used for navigational purposes as the contour lines are interpolated between actual sampling points. The spacing of the sampling points was variable, however nowhere within the surveyed area was further than 30m from a survey point. The individual survey points can be seen in Figure 3 below.

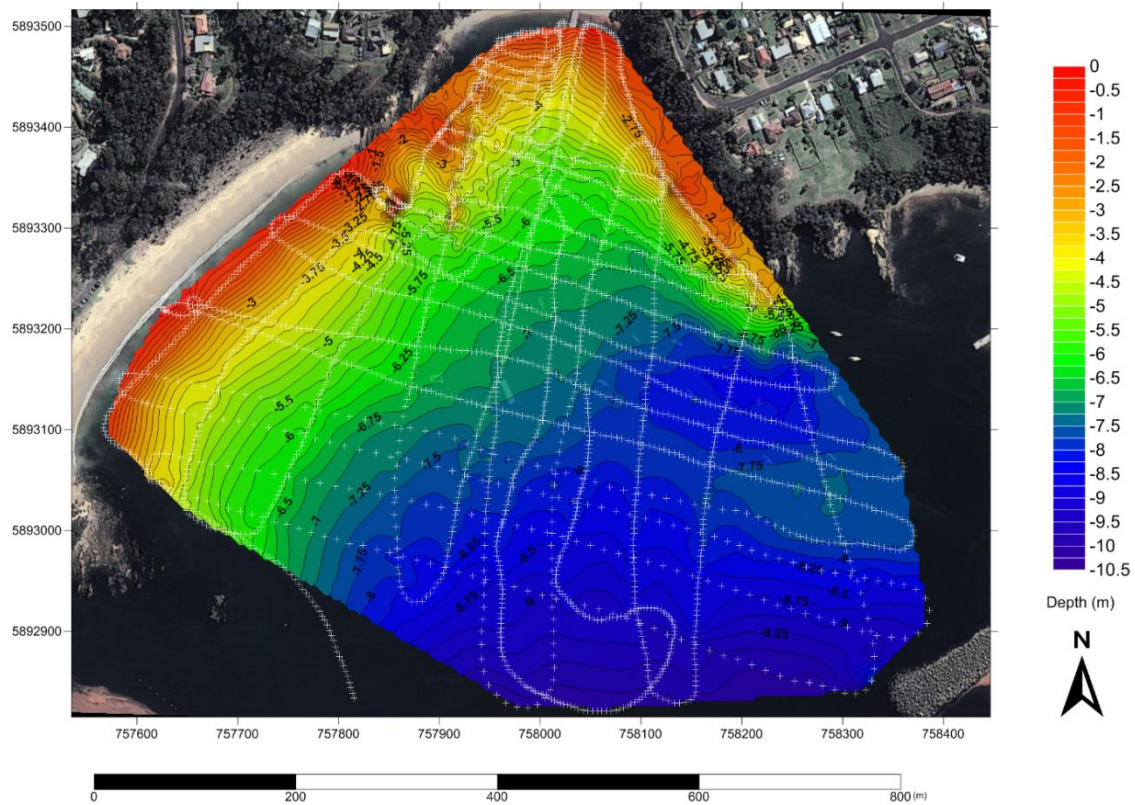


Figure 3 Bathymetry overlaid with sampling points used for output generation.

The admiralty charts of the area (Figure 4) show a small pinnacle rising to 2.2m chart datum, however this was not evident in mapping conducted during this survey

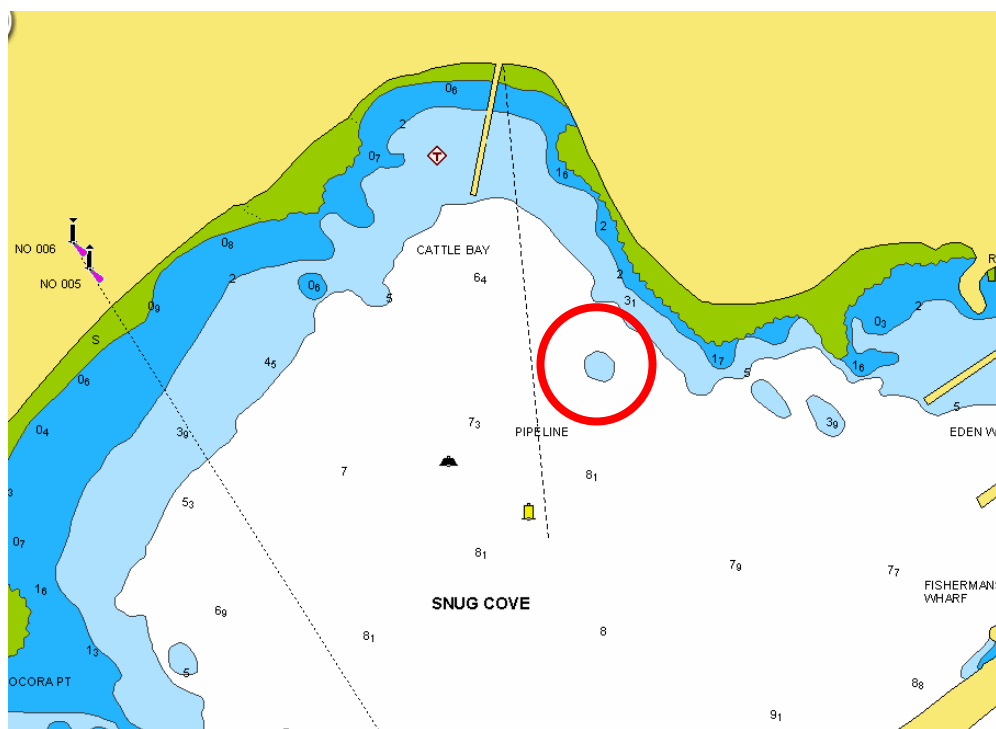
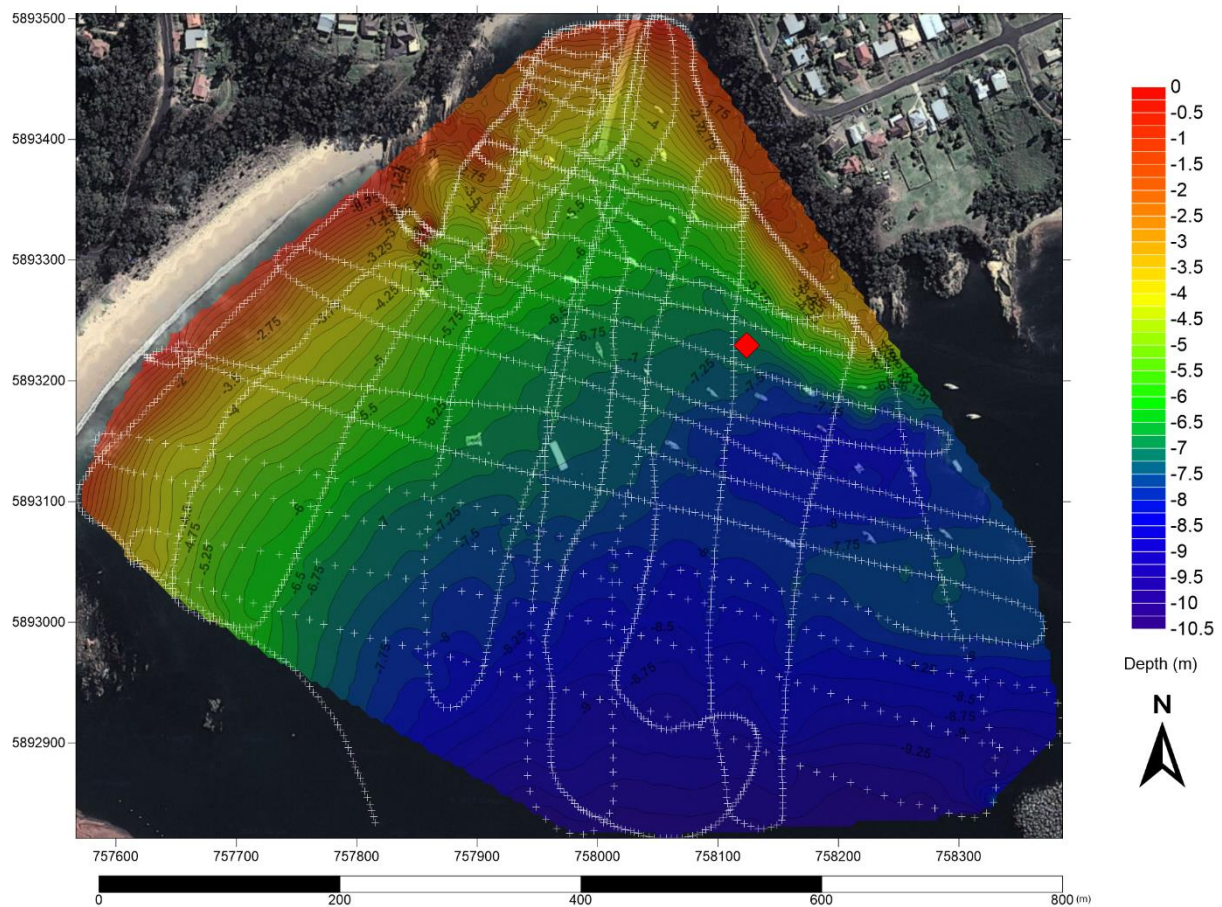


Figure 4 Digitised admiralty chart of Cattle Bay, 2.2m CD area marked in red

By overlaying the location of the shallow area, as taken from the chart, on the survey point locations it is clear that the survey did not cross the shallowest section as marked on the charts, however passed some 10m to the side of the location in question. The only inference that can be made from this is that the area marked 2.2m CD must be a pinnacle of rock which rises sharply from the seabed, and does not have a large footprint. Thus, if it is required to be removed, there will be relatively small amounts of material to dispose of.



Given the shallow section identified in the charts, but not by singlebeam survey, is within the proposed marina footprint (Figure 5), it may be required to target this small area with sidescan survey, or alternatively with a targeted diver identification during construction so it can be reduced to the required depth at Chart Datum.

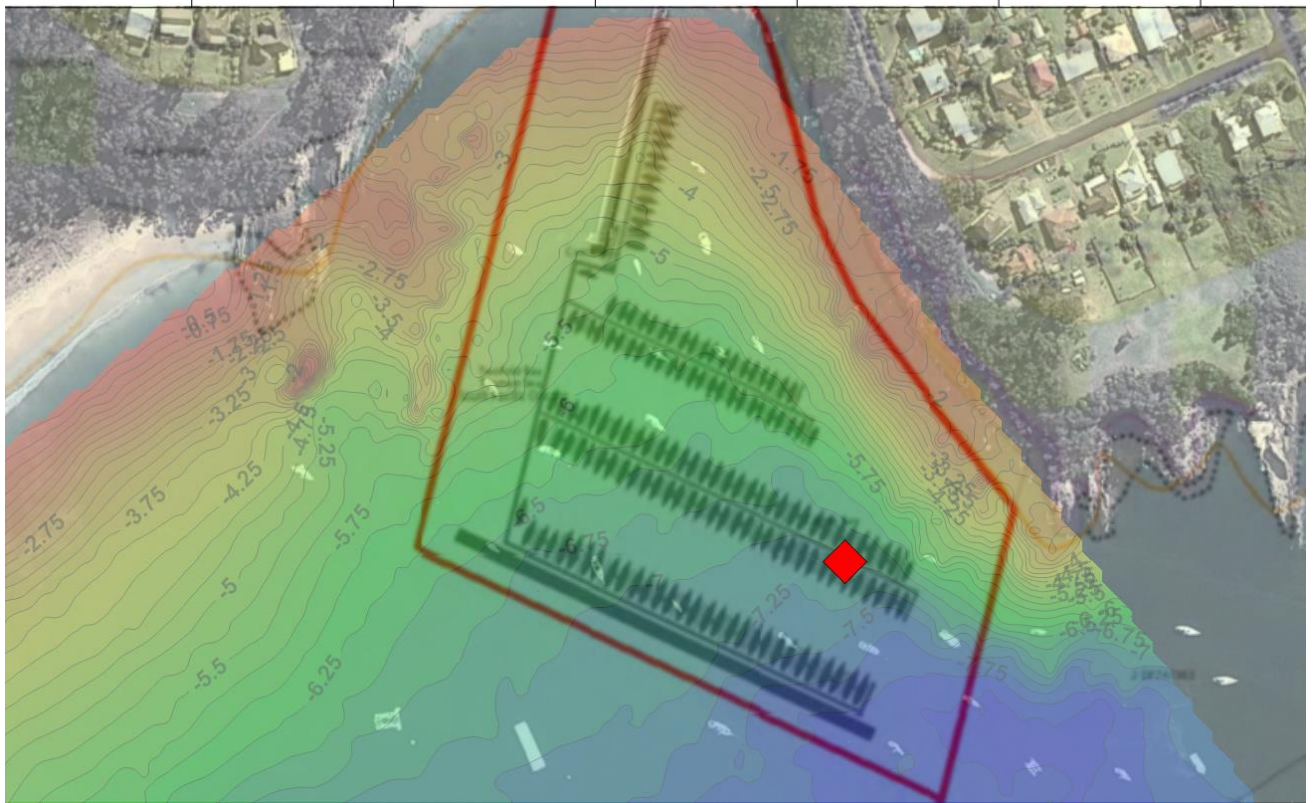


Figure 5 Proposed development overlaid on the shallow pinnacle as identified in the admiralty charts

The bathymetry is provided in Appendix 3 as relative to Chart Datum (CD), Relative to Australian Height Datum (AHD) and as a .dxf file. Close up maps of Bathymetry and Habitat Mapping are available in Appendix 4.

6 Habitat Mapping

Methods

To determine the extent of seagrass communities and other habitats on the seabed surrounding the proposed development area, a process of habitat classification was conducted using a number of diver-swum and towed video transect surveys to provide information about the location and frequency of these potentially sensitive habitats.

Towed video transects were undertaken in order to cover a large area of potential seagrass habitat rapidly, whereas diver based investigations provided more accurate identification of seagrass species and general habitats. Transect positions were recorded using a Garmin GPS 72. The video record of the towed transects is available in Appendix 1.

Towed video surveys were conducted along four transects in the vicinity of the proposed development, ranging from <1m to 9m water depth. Video footage was taken on a Scielex single CCD underwater video camera housed in a towing frame and recording to an Archos viewable portable hard drive, and serviced by external lights. An external GPS antenna and overlay box provides position, speed and direction overlay on the camera imagery and subsequent recordings. The towed camera was deployed from a drifting vessel and lowered to the bottom until an image was registered topside, and real time visual habitat classification could be conducted. The direction and speed of vessel drift was controlled by utilising local currents, wind and the vessels motor to cover predetermined lines of interest, or features arising from the bathymetry or camera imagery.

Subsequent to the towed video work being completed, diver investigations were undertaken, allowing detailed inspection of mooring scour, seagrass speciation and marine habitats.

Divers used a Sony NEX 5 in an Aquapazza underwater housing to film video footage one metre above the bottom and take high resolutions still photos.

Results

Habitat mapping was conducted throughout the proposed development footprint and surrounds (Figure 9). Utilising towed video, drop video and diver investigations four major

classes of habitat were identified, and their approximate distribution mapped, with particular note taken of the inner and outer edge of the seagrass where it was present.

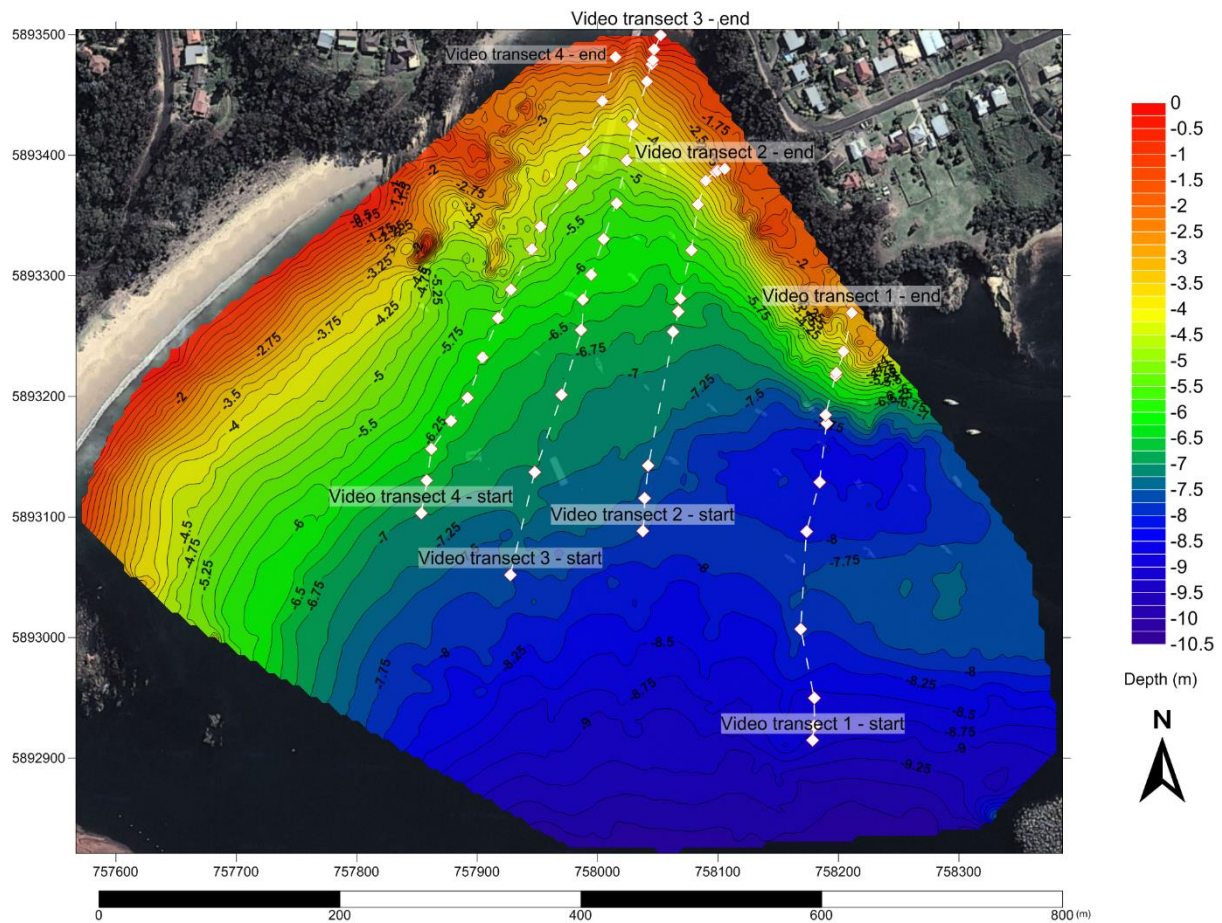


Figure 6 Towed video tracks

The four major classes of habitat noted were A) high profile rocky reef, dominated by brown macroalgae; B) Cobble, shell and broken stone; C) Seagrasses, comprised of three species, *Heterozostera sp.*, *Posidonia sp.* and *Halophila sp.* (shown in Figure 8); and D) unconsolidated sand and silt. Examples of all these habitats are shown in Figure 7, below.

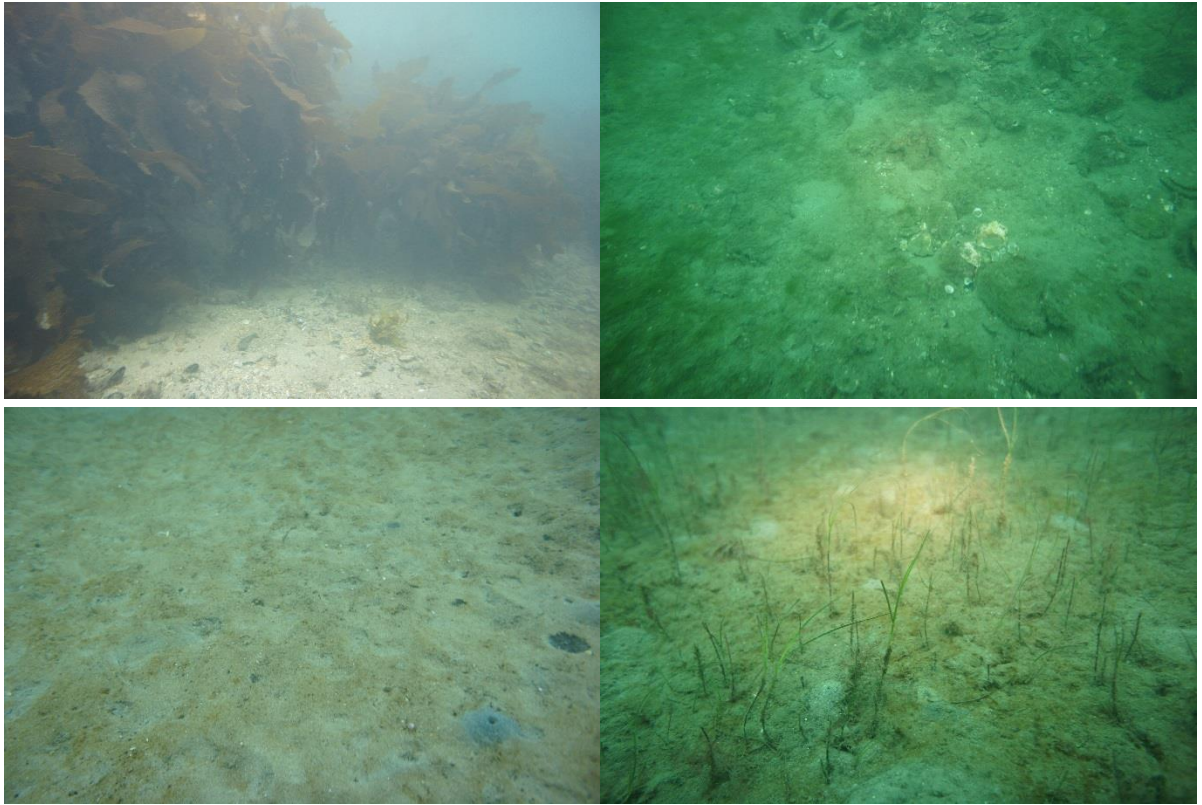


Figure 7 Four major habitats. Clockwise from top left: A) Rocky Reef; B) Cobble and Shell; C) Seagrass and D) Sand and Silt

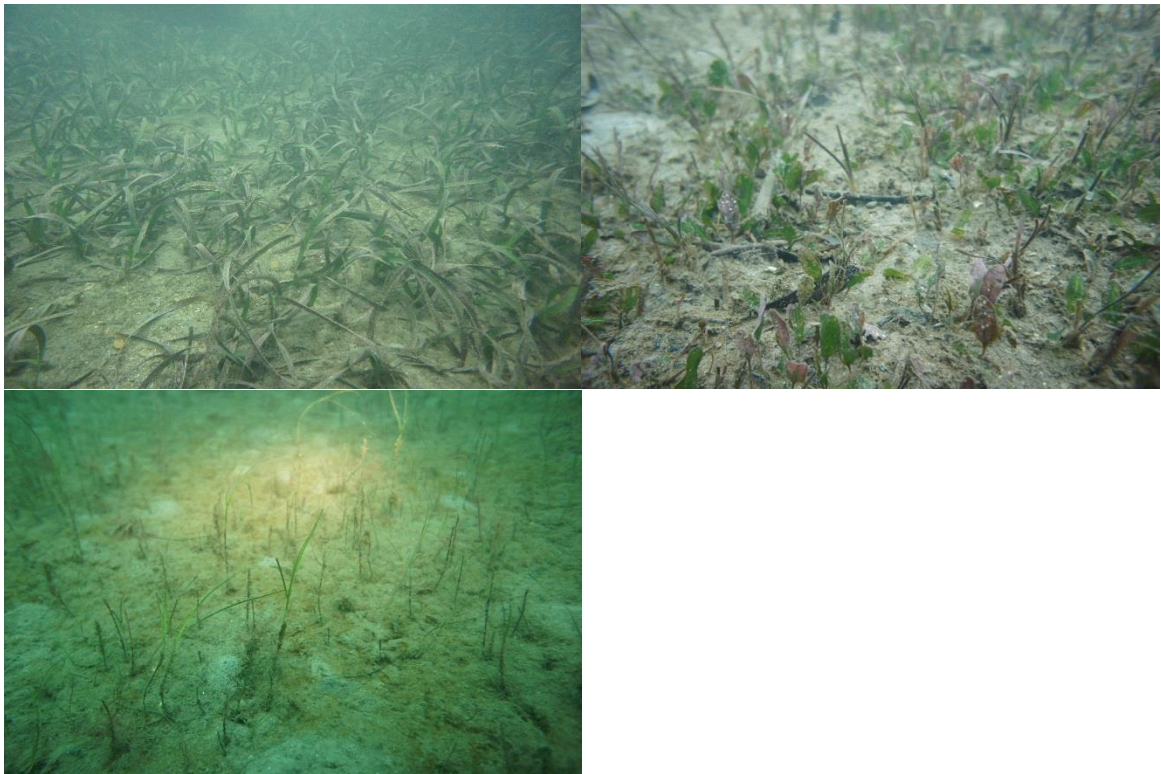


Figure 8 Three species of seagrasses were noted. Clockwise from top left: A) Posidonia; B) Halophila and C) Heterozostera

When plotted, the habitats show a basic zonation, with rocky reef being the dominant habitat in the shallow waters adjacent to the rocky foreshore. Cobbles and shell were primarily at the outer edge of the rocky reef, and only represented a small band of habitat. Further offshore, either sand or seagrass, or a mosaic of both were present.

Much of the area identified as seagrass had a very sparse covering of seagrass indicating it is suitable seagrass habitat, but at this time was not supporting dense seagrass beds.

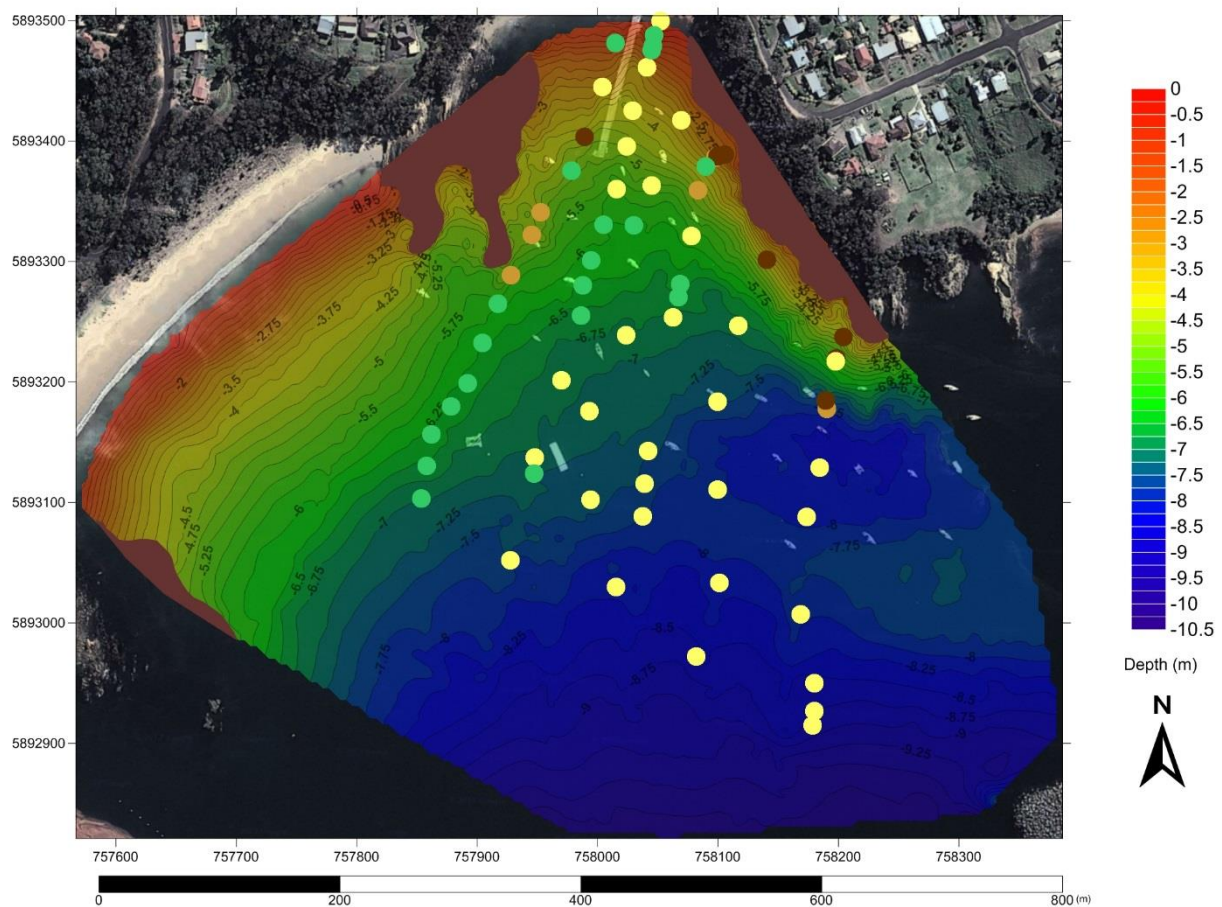


Figure 9 Habitat Sampling Points. Green – Seagrass, Dark Brown – Reef, Yellow – Sand, Light Brown – Cobbles

The habitat mapping conducted indicates the 7m depth contour as an approximation of the outer boundary between sand and seagrass habitats; this may be due to light restrictions with an increase in depth. The inner boundary of seagrasses was at approximately 1m depth at the head of Cattle Bay.

The seagrass species also exhibited some level of zonation, with *Halophila* sp. being present in mixed seagrass patches close inshore at the head of Cattle Bay. This survey confirmed the location and extent of *Posidonia* sp. patches identified in previous surveys (i.e. Marine Pollution Research 2013), along the eastern shore of Cattle Bay, just offshore of the rocky reef edge. *Heterozostera* sp. occurred throughout the bay, although no dense beds were noted. The *Heterozostera* sp. distribution throughout the bay was a mosaic of sparse seagrass with unvegetated sand patches.

A large scale image of the habitat mapping and general locations of the individual seagrass species is available in Figure 10.

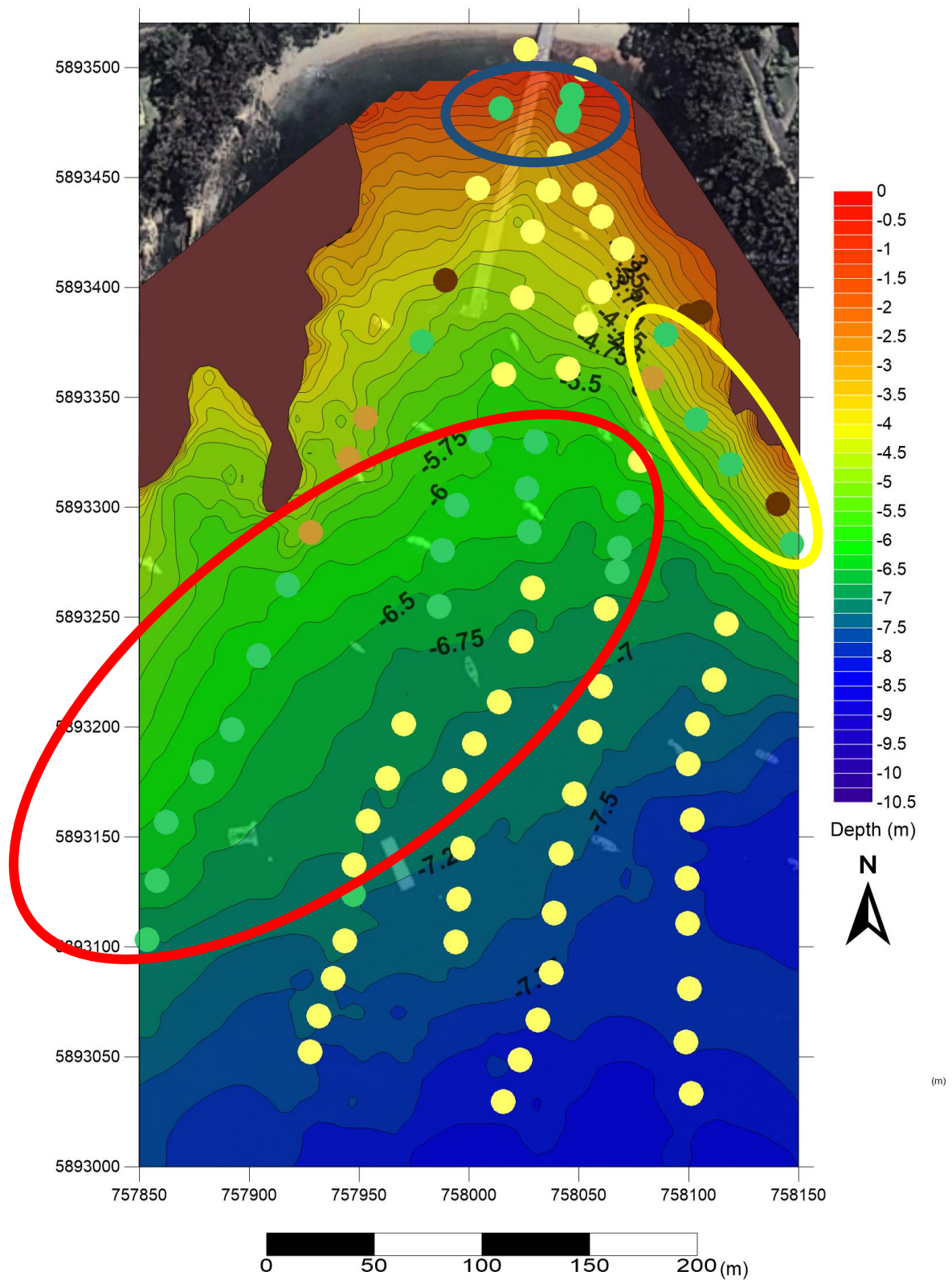


Figure 10 The Patchy nature of seagrass is evident – Red oval denotes *Heterozostera sp.*; Blue oval – *Halophila*; Yellow- *Posidonia*

7 Seagrasses

Seagrasses are subtidal and intertidal plants found mainly in shallow waters of protected estuaries and bays and are important contributors to coastal productivity and biodiversity. Seagrasses play an important role in nutrient cycling through the uptake of nutrients and can substantially alter the oxygen concentrations in sediments by releasing oxygen through their rhizomes (roots). Due to their extensive rhizome structure, seagrasses are particularly important in maintaining sediment stability. Given the importance of seagrass beds in coastal ecosystems they have been extensively studied in some Australian regions, with descriptions of the spatial or temporal patterns of seagrass growth parameters such as changes in biomass, shoot or epiphyte characteristics (Bulthuis and Woelkerling 1983; McKenzie 1994; Lanyon and Marsh 1995; Kendrick and Burt 1997).

A range of factors have been linked to seagrass decline, however, the most common direct cause of decline is the reduction of light availability (Jordan *et al* 2002; Burdick and Short 1999; Shafer 2002), with increased nutrient levels and turbidity from a range of point and diffuse sources the key causes of such reductions. High levels of nutrients often result in increased epiphytic algal growth that can smother and shade seagrass blades, while higher turbidity reduces the amount of light reaching the beds, with deeper parts of the bed most vulnerable to light reductions. Decreased light availability can also occur due to increases in phytoplankton that cause a dramatic reduction in light penetration for a limited time (Walker and McComb 1992). As seagrass density strongly influences both the community structure and abundance of fishes (Jordan *et al* 2002) and invertebrates (Edgar *et al* 1995), decreases in seagrass density can result in considerable loss of benthic diversity and productivity.

Growth in seagrasses is known to vary spatially and temporally, however a lack of research means it is often difficult to determine if fluctuations in seagrass beds reflects human impacts or natural variability (Jordan *et al* 2002). Previous studies conducted by the Tasmanian Aquaculture and Fisheries Institute (TAFI) found natural fluctuations in the size of seagrass beds, the density and length of seagrass stems and the amount of epiphytic growth varied temporally in response to some unknown variable. Additionally the scarring of seagrass beds by direct contact from boat hulls, propellers and prop wash have all been linked to detrimental effects upon seagrass (Sargent *et al* 1995).

The major effect upon seagrass within the proposed development area is the scouring effect upon the seagrass created by swing moorings, with each of these moorings scouring a circle of the bottom, thus precluding seagrass growth within the scour zone. A single swing mooring with an 8m length of bottom chain will periodically change direction with alterations in prevailing wind and sea conditions, over time scouring an area of approximately 200m².

Both the extent and quality of seagrass habitats have been identified as suitable monitoring parameters (Ward *et al* 1999). These require different sampling techniques, with seagrass quality assessed at a small scale by sampling floral and faunal abundance and species composition, and the extent often determined through remote sensing techniques to estimate the area of beds. It is important that baseline studies are conducted to determine the spatial and temporal variation and interaction so that changes through time can be assessed by sampling at the appropriate scale.

The possible effects of any marine development upon seagrass communities can be categorised into:

- Construction
- Light reduction
- Propeller and wave scarring
- Other effects including leaching

Construction

The construction period of a marina is potentially a period of risk for seagrass surrounding the proposed development. Direct contact with existing seagrass can cause direct damage and mortality. Furthermore, the potential disturbance of sediment caused by construction activities may increase turbidity thereby reducing light availability, or cause smothering of seagrass blades.

As only long term reductions in light have the potential to significantly impact seagrass communities this is not considered a high risk during the construction phase.

It is not anticipated that the construction phase of the marina will have a major impact upon the seagrass beds surrounding the proposed development or further out in the bay.

Light Reduction

The amount of available light is one of the most important factors affecting the survival, growth and distribution of seagrasses (Shafer 2002), therefore the development of structures which shade substrates supporting existing seagrasses should be carefully planned and considered.

In the instance of marina developments, light reduction through shading has the potential to have an impact on an area of seabed and therefore seagrasses. Of the structures built above seagrass beds, floating structures are likely to result in greater reduction of seagrass density than fixed marinas of comparable size and construction (Shafer 2002). Given the importance of light to successful maintenance of seagrass beds it is prudent to take measures to maximize the light available under the marina, and therefore useful to seagrasses.

The proposed marina orientation is toward solar north, thus allowing maximum direct light penetration under the longest arm of the marina. Refracted light will continue to reach the seabed under the berthing arms where the vessel orientations are also close to solar noon.

Reduction of available light under the marina footprint is not considered to constitute a major risk to seagrass communities.

Propeller & Wave Scarring

The effect of vessels, in particular power driven vessels, actively driving through seagrass beds and causing scars is well documented (Burfeind and Stunz 2004, Sargent *et al.* 1995). In addition, the effect of pressure waves generated by the forward motion of vessels and their propellers is also documented (Michlet – www.Michletpro 8.07).

In this case the likelihood of propeller scarring is negligible because of the depth at the marina. By ensuring depth at the marina is sufficient to eliminate the risk of grounding at low tides, the risk of propeller scarring and pressure wave scarring will be minimized. Furthermore, the effects of pressure waves upon the seagrass are likely to be negligible in this instance as the vessels will be traveling slowly or at rest when adjacent to the marina. In addition, NSW Maritime bylaws have a 10 knot speed limit within 30m of moorings so any

vessel being navigated in this area would be doing so at low speed, thereby further reducing any pressure wave effect from vessels above the seagrass.

Other Effects Including Leaching

Contemporary marina construction materials and techniques have moved beyond the historical methods which occasionally resulted in leaching of CCA and other toxicants into the marine environment.

Provided the marina is constructed using accepted modern techniques and materials, leaching of harmful substances from the construction material is not a high consideration in this development, and is not foreseen to adversely impact the adjacent seagrass.

8 Comments and Recommendations

Within the scope of the survey conducted, the bathymetry appears suitable to house vessels of varying drafts. This is further evidenced by the large number of moorings currently located within the development footprint.

Of note in relation to seagrass colonisation was the large area of seabed which is scoured by swing moorings. Site investigations recorded in excess of 35 moorings within the development footprint and surrounds. It is unknown whether the proposed marina will facilitate removal or relocation of the moorings within the footprint, however given the moorings are currently afforded some level of protection by the breakwater it is unlikely they will be relocated further offshore, but rather removed and the vessels relocated into the marina.

Diver estimations on a number of moorings indicate there is approximately 5 - 10m of chain, (measured at 8m for 5 moorings), indicating an approximate area of 200m² per mooring of potential seagrass habitat being intermittently scoured which prevents seagrass colonisation. Assuming 20 moorings are removed and the vessels housed within the new marina complex, this is a total of 4000m² which will avoid scouring.

Other marina developments (Rippleside Village, Vic; Margate Marina, Tas; St Helens, Tas) all have seagrass which has colonised in and around marina arms where the habitat is suitable. There appears no impediment to seagrass colonisation around this development once the construction phase has completed. It should be noted, however, that the seagrass recorded during this survey period was generally sparse, and no dense beds other than the *Posidonia* patches on the eastern shore of the bay were observed.

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Ward T.J., Vanderklift M.A., Nicholls A.O., Kenchington R.A. (1999) Selecting marine reserves using habitats and species assemblages as surrogates for biological diversity. *Ecological Applications* 9:691–698.

10 Appendix

Appendix 1: Towed video record



Appendix 2: Photographic record of investigation

The proposed marina location from the head of Cattle Bay.



Note the high rugosity rocky reef adjacent to the rocky shoreline, emergent at low tide. It was not possible to map this close to the shore.

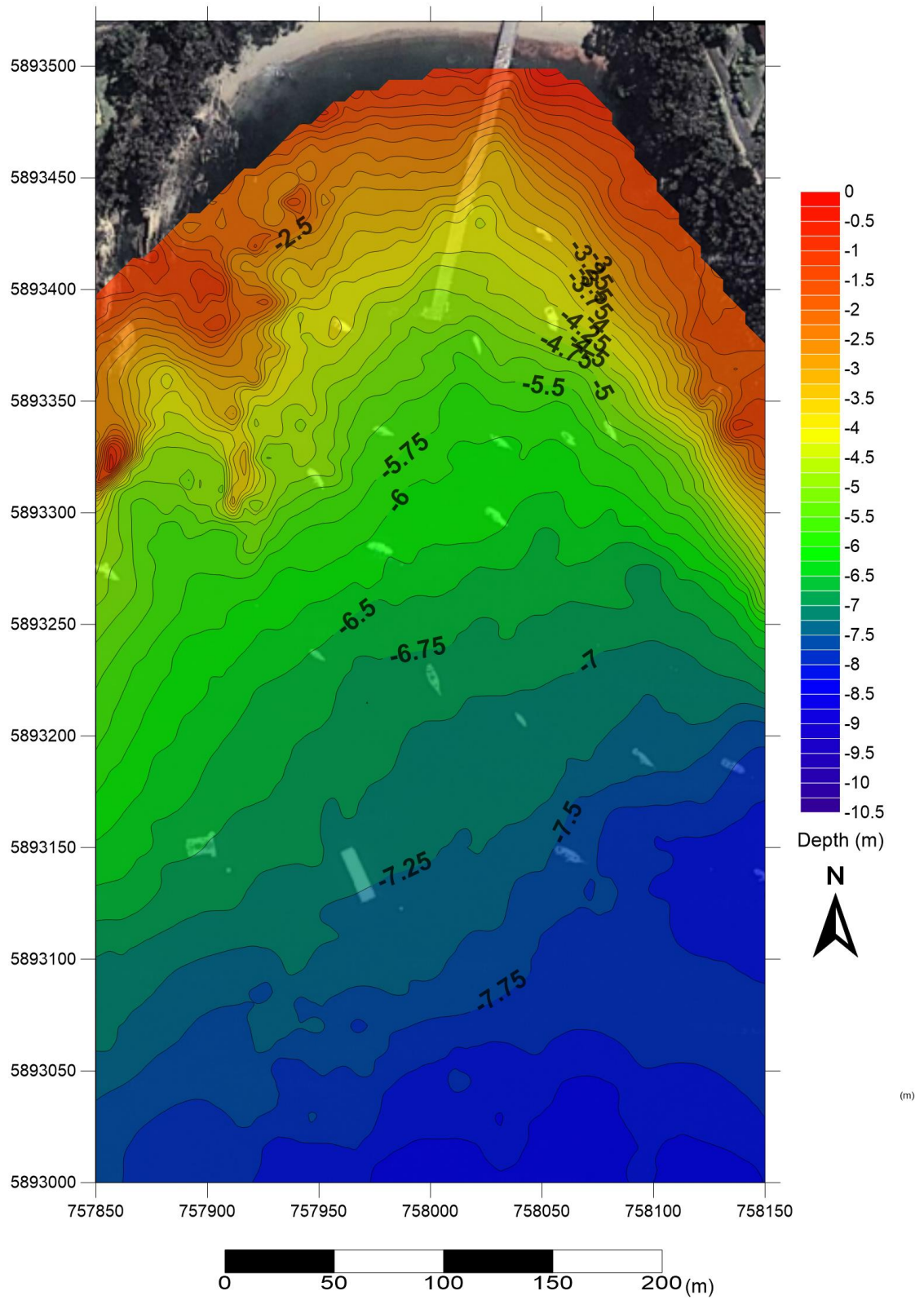


| | |
|-----------------------------------------------------------|-------------------------------------------------------------------------------------|
| <p>Mooring chain and seabed scour on an inner mooring</p> |  |
| <p>Mooring chain scour</p> |  |

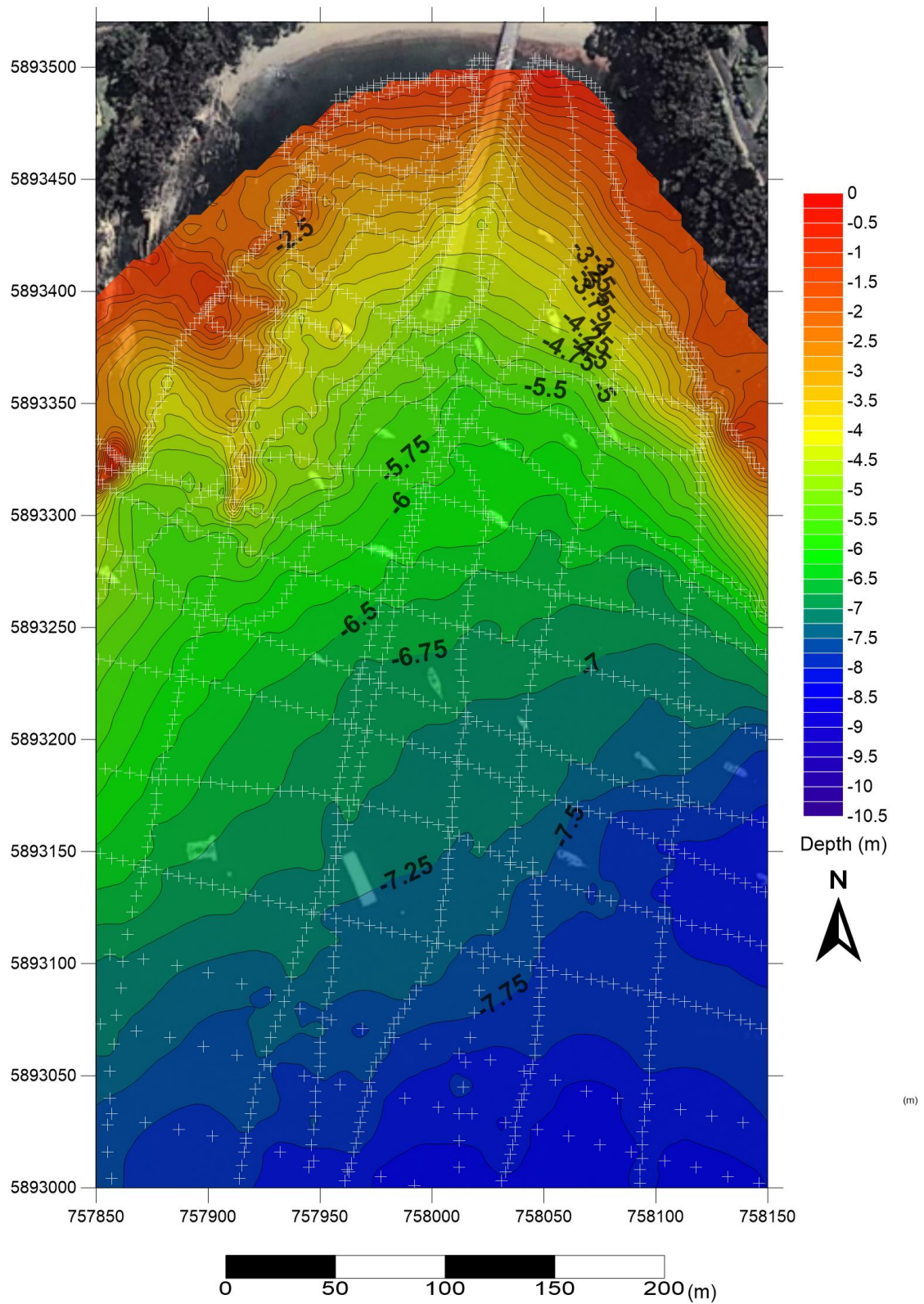
Appendix 3 Files of CD, AHD and DXF mapping

Appendix 4 Close up maps of Bathymetry, Survey Points and Habitats

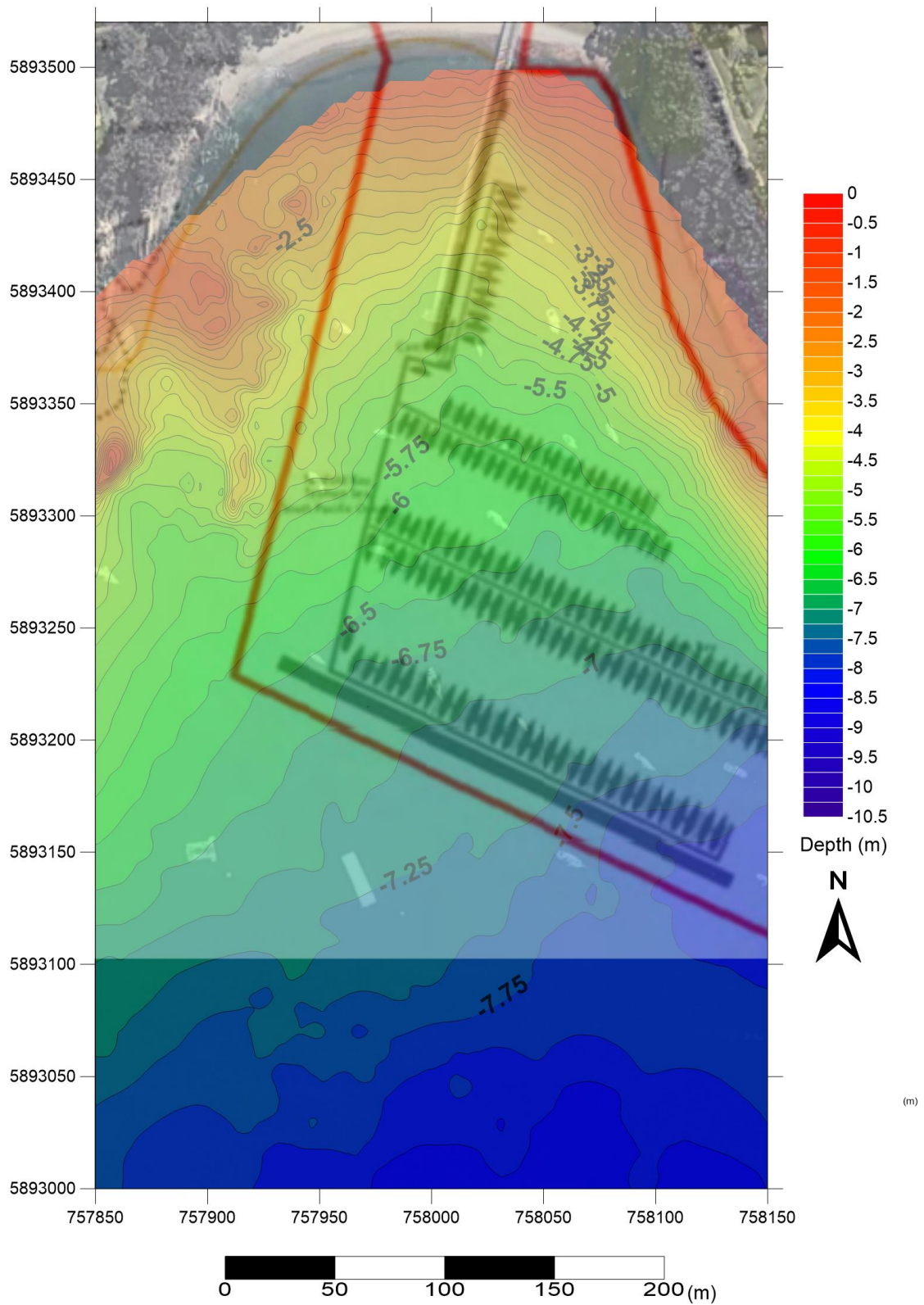
Bathymetry



Survey Points



Marina Overlay



Cattle Bay Habitats

