

**Shell Cove
Boat Harbour Precinct**

**Concept Plan Application
and Environmental Assessment
Appendix I - Aquatic Ecology**

prepared by

LFA (Pacific) Pty Ltd

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SHELL COVE BOAT HARBOUR PROJECT

CONCEPT PLAN APPLICATION SHELL COVE BOAT HARBOUR PRECINCT SHELLHARBOUR.

AQUATIC ECOLOGY ASSESSMENT

**Report Prepared for
Australand Holdings Limited**

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Marine Pollution Research Pty Ltd

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Figure 1 Defined Shell Cove Boat Harbour Precinct (bounded by red line)

1 INTRODUCTION

Marine Pollution Research Pty Ltd (MPR) was commissioned by Australand Corporation Pty Ltd (Australand) to provide an aquatic ecological assessment to accompany the Environmental Assessment (EA) for the Concept Plan Application for the Shell Cove Boat Harbour Precinct, Shellharbour, as described in the Preliminary Environmental Assessment prepared by LFA (2007).

The proposal is for the development of various facilities and infrastructure associated with the Shell Cove Boat Harbour and will be built around the approved boat harbour following its construction. The development includes residential and commercial areas, a marina plus associated retail areas, public parklands, marine facilities associated with boat launching into the new boat harbour plus marine facilities associated with beach access. The development also includes stormwater control features incorporating constructed wetlands for stormwater polishing prior to discharge to the boat harbour.

1.1 The Study Area

In December 2005, Shellharbour Council applied to the Minister under S.96(2) for a modification of the previously approved Development Consent for the Shellharbour Marina and associated works and approval was granted in October 2006. The approved modifications:

- Altered the form of the development by an approximate 15° rotation of the Boat harbour plan form. The effect of rotation of the harbour was to reduce the disturbance of acid sulphate soil and thereby reduce the environmental impact as well as overall costs.
- Realigned and shortened of the breakwater by 50m with adoption of a berm type design for this structure.
- Made minor changes to the northern groyne plus resulted in a consequential narrowing of the entrance channel and the deletion of the southern groyne.
- Reduced the number, and changed the layout, of the marina berths.
- Deleted the Boat harbour flushing pipe system.

This final approved boat harbour forms the inner white footprint inside the proposed boat harbour precinct shown in Figure 1. The "study area" for the present assessment as described in the LFA (2007) Preliminary Environmental Assessment Report is shown in Fig 1 below and coincides with the precinct footprint.

1.2 Director General's Requirements

The assessment has been made against the Director General's Requirements (DGRs), as attached to a letter from the Department of Planning to Australand (dated 9 November 2007, Reference Number MP07 0027). Specifically, this report addresses the aquatic ecological aspects of the following DGRs:

3. Description of the existing environment (see Section 2).
5. Consideration of impacts under the EPBC Act (see Sections 2.3 and 4)
6. Assessment of potential impacts of the project plus suggestions for the draft statement of commitments with regard to environmental management, mitigation and monitoring measures (see Sections 3 to 5).
10. Assessment of the following key issues (see Section X):
 - 8.1 Outline of potential impacts on aquatic biota and habitats against Fisheries Management Act 1994 (see Section 2.3 and 3).
 - 8.2 Predictions of any impacts on aquatic environments on or adjacent to the site, in particular on offshore rocky reef areas and measures for mitigation (see Sections 2 and 3).
 - 8.3 Measures to protect and manage adjacent aquatic habitats (See Sections 4 and 5).

For the purposes of aquatic ecological assessment, the Director General's Requirements (DGRs) require consideration of 'off-shore rocky reefs', and DPI Fisheries' guidelines require consideration of possible fish passage relationships between the aquatic areas in the LFA precinct footprint, the freshwater drainages to the footprint and the connections from the footprint to the ocean. Accordingly, the study area for the aquatic ecology report includes all aquatic areas within the total area shown in Fig 1 (but not in the white area which already has Ministerial approval (see Section 1.1 above).

1.3 Relevant Field Work and Survey Methods

MPR and the author of this report have been involved with the Shell Cove boat harbour project since its inception some 16 years ago and has provided aquatic ecological assessments of the present study area for the original project EIS (LFA 1995) and the ensuing Commission of Inquiry, plus specific assessments of the boat harbour proposal under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC)

Act 1999 (MPR 2007). MPR also undertook the pilot saltmarsh construction project on Tongarra Creek plus designed and supervised the construction of the Myimbarr compensatory saltmarsh wetland, component as required as a condition of consent for the approved boat harbour works. This project includes using remaining saltmarsh plant material from Shellharbour Swamp to plant out the developing Myimbarr saltmarsh. This ongoing involvement has required MPR to make continuous assessments of remaining aquatic areas within the present study area. MPR also undertakes base-line water quality and marine ecology assessment of the waters and sub-tidal reefs offshore from the project site plus on-shore within the existing lagoon at the Boollwarroo Parade bridge.

The assessment for this project is based on the assessments made by the author of this report (Mr Paul Anink) during the repeated field visits to the site (both on-shore and off-shore) for saltmarsh, water quality and off-shore marine ecological assessments. The various reports prepared for the project over time are relied on for the presentation of relevant flora and fauna information for the site.

Specific on-shore field visits for this EA project were made on 5 December 2007 and on 23 May 2008 to re-assess the various aquatic habitats of the site. Habitat condition was assessed against the existing flora and fauna information available for the site. The latest water quality assessments were made on 24 October 2008.

1.4 Relevant Literature

Marine Pollution Research Pty Ltd (MPR 1995) undertook studies to assess the potential impacts arising from the development and use of the boat harbour and marine facilities on the marine ecological aspects (water quality and aquatic ecology) and this report was presented as Appendix 11 of the EIS (Lester Firth 1995). The report provided:

- A review of existing information on the aquatic ecology of the study area.
- Results of water quality and aquatic ecology field studies of the marine biological habitats and the likely flora and fauna of these habitats.
- Assessment of impacts of proposed construction and operational aspects on the marine biological community plus suggested mitigation.
- A comprehensive pre-construction plus during- and post-construction water quality and aquatic ecology monitoring programme.

The EIS was considered by a Commission of Inquiry (CoI). The Determining Authorities for the boat harbour construction were NSW DUAP and NSW DLWC (activities under part IV and V of the EP&A Act respectively), and the Determining Authority for the Shadforth Wetland construction was DUAP. Both Departments prepared Determining Authority Reports with resultant Conditions of Consent (CoC) that included the coastal water quality and aquatic ecology monitoring components as proposed in the EIS Appendix 11 report.

A detailed pre-construction water quality and aquatic ecology monitoring program was approved by the Shellharbour Compliance Committee with the additional concurrence of NSW Fisheries and NSW NPWS in 2003, and a pre-construction monitoring program of water quality plus aquatic ecology of locations off-shore from the South Shellharbour Beach commenced in 2004, and has been underway since.

With regard to other aquatic ecology work specific to the study area, Griffiths (1998) reported on the fish in Shellharbour Swamp (the white area in the study area) and Benkendorff (1999) reported on the intertidal molluscs residing in the on-shore rocky reefs abutting the precinct boundary.

2 EXISTING AQUATIC ECOLOGY

With respect to aquatic habitats, the area of potential impacts (study site) was determined to be the remaining brackish water component of Shellharbour Swamp plus the freshwater drainages to these areas, Shellharbour-South Beach plus the Bass Point embayment rock shore abutting the Boat harbour Precinct. Fig 2 shows the location of these main aquatic habitats. These are described as follows.

2.1 Freshwater Drainages and Brackish Wetland

With regard to actual aquatic habitats within the precinct footprint there are a series of constructed freshwater drainage ditches carrying stormwater from the surrounding lands into the remnant brackish wetland habitat within Shellharbour Swamp:

- Constructed freshwater drainage lines plus remaining in-line ponds located within the disused Golf Course area or taking street drainage from Shellharbour Village (northern drainages).
- Constructed stormwater treatment in-line ponds plus freshwater drainages to the brackish water wetland, treating and draining stormwater from the new housing estate (western drainage).
- Remnant of a constructed drainage line running from disused farm and (southern drainage).

The freshwater drainages are for the most part simply constructed steep sided ditches, often with shallow in-line stormwater treatment ponds. The main freshwater plant observed around these drainages is Cumbungi (*Typha orientalis*) plus Water Ribbon (*Triglochin procerum*). Whilst native fish have not been observed in the upper drainages or in the shallow in-line ponds, the introduced pest species, the Plague Minnow (*Gambusia holbrooki*) is known from the freshwater system, and it is likely that the freshwater drainage in-line ponds would support some native fish, principally eels. In this respect Griffiths (1998) also found three freshwater gudgeons in the lower brackish water drainages of Shellharbour Swamp (Striped and Flathead Gudgeons (*Gobiomorphus australis* and *Philypnodon grandiceps*) plus Empirefish (*Hypseleotris compressa*).

Whilst these drainages are currently connected to the brackish water lagoon in Shellharbour Swamp, the brackish water lagoon plus associated drainage lines will be progressively lost to the approved harbour construction works and the direct connection to the sea will be lost as stormwater will be diverted to the new harbour.

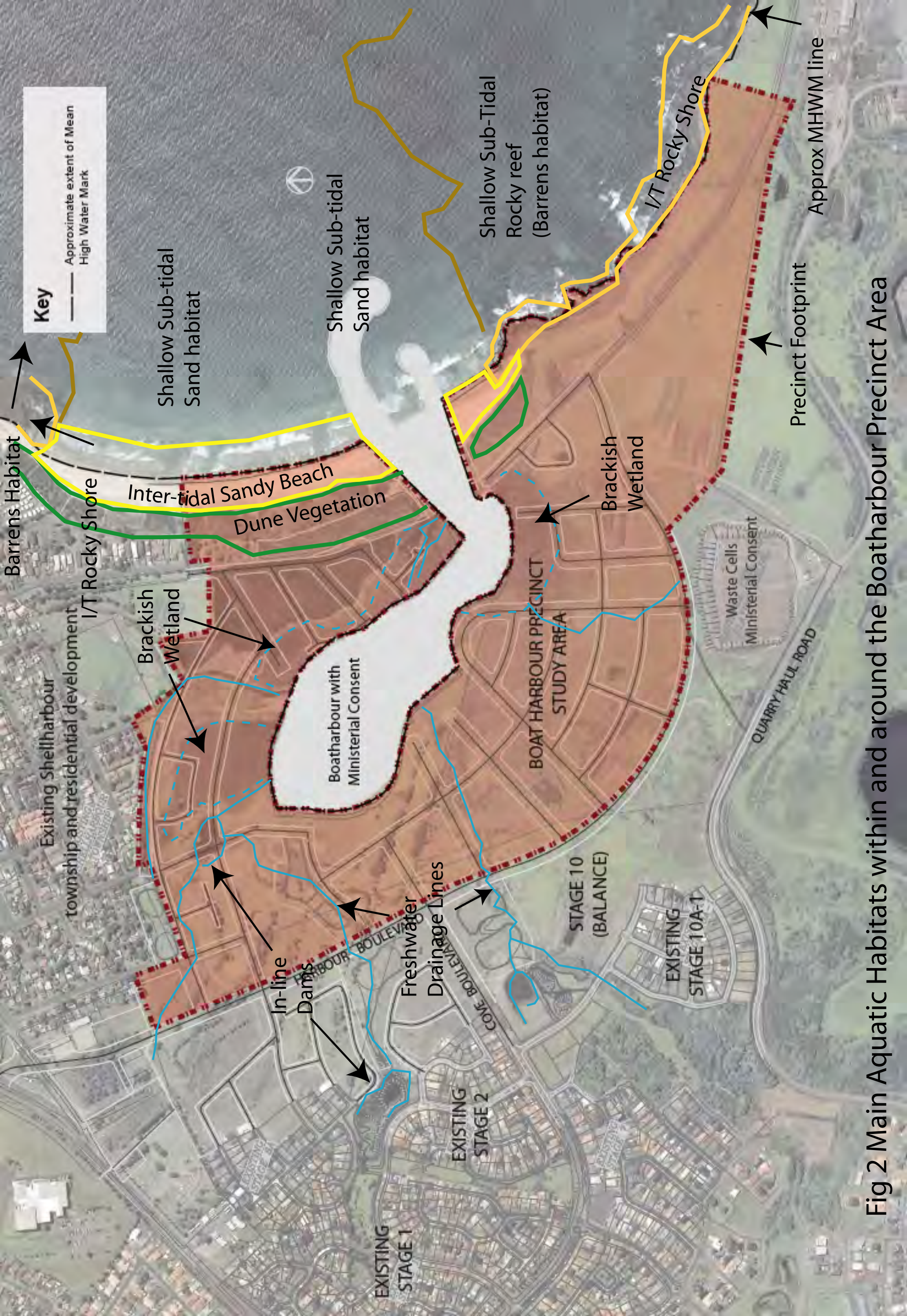


Fig 2 Main Aquatic Habitats within and around the Boatharbour Precinct Area

Whilst a portion of the precinct footprint has areas within the nominated intertidal zone (as indicated by the nominal mean high water mark (MHW) line on Fig 2) there is little or no actual tidal water inundation reaching the precinct area by virtue of the more or less permanent sand berm across the mouth of the outer lagoon. When the mouth is nominally open (as it was at the time of the field survey in January 2008), the drainage lines within the wetland drain out but, as the opening is generally perched well above the beach, there is only a very small tidal prism, with consequent little actual water movement between the sea and the lagoon and there is consequently insufficient tidal saline water to fill and overtop the drains.

This is the dominant hydraulic mechanism which has resulted in the Shellharbour Swamp altering over time from an intermittent saltmarsh habitat to a Sea Rush dominated wet brackish swamp. That is, the remaining upper brackish water wetland elements within the precinct footprint (see Fig 2) are almost all monospecific Sea Rush (*Juncus kraussii*) habitat with some minor freshwater and brackish water sedge or herb elements interspersed throughout, e.g., Jointed Twig-rush *Baumea articulata*, Streaked Arrowgrass (*Triglochin striatum*), Swamp Weed (*Selliera radicans*) and Knobby Club-rush (*Isolepis nodosa*). This habitat holds stormwater runoff following catchment storms and there is generally a salinity gradation between the upper remnant wetland elements (which tend to be almost freshwater) to brackish water in the lower swamp areas fringing the intertidal drainage lines (all within the approved harbour works area to be excavated).

As with the upper freshwater drainages, the remnant upper brackish water wetlands support a diversity of freshwater invertebrate species (when water is available) and could provide suitable intermittent feeding habitat for a number of freshwater and brackish water fish species; although the only fish actually observed within this habitat is the Plague Minnow.

2.2 Intertidal and Sub-tidal Habitats

The remaining (nominally) intertidal habitats within the precinct footprint include the beach dune habitat, the intertidal rocky shore habitat and the beach sand habitats, all along the eastern side of the precinct and separated from the proposed construction works by the existing coast road (Boollwarroo Parade), which currently links Shellharbour to Bass Point.

The dune habitat is described in the companion flora and fauna report to this report (Kevin Mills and Associates 2008). It comprises a generally re-constructed dune habitat and there are continuing dune rehabilitation works. The dune habitat includes Coastal Banksia woodland and Spinifex grassland on the frontal dunes (Kevin Mills and Associates 2008).

The remaining 'true' intertidal and sub-tidal marine habitats are as follows:

- Intertidal Beach Sands
- Intertidal Rocky Shores
- Sub-tidal Sandy Bottoms
- Shallow and Intermediate depth Sub-tidal Rocky Reefs (to about 14 m depth)

There are also Deep Sub-tidal Rocky Reefs (from 16 to at least 26 m depth) located outside the study area as depicted in Fig 2.

Whilst none of these habitats are directly impacted by proposed construction works within the Boat harbour Precinct area, the proposed precinct works include rehabilitation works for the terrestrial habitat components (the dune habitats and the riparian habitats between the rocky shore and the existing or proposed coast roads. Some of these rehabilitation works are underway along the foreshore south of the existing lagoon mouth.

2.2.1 Intertidal habitats

MPR (1995) compared the intertidal beach fauna of South Shellharbour beach with that of North Shellharbour Beach and found that Shellharbour-South Beach supported a more diverse and abundant benthic population than Shellharbour-North Beach. Comparison of regional beach intertidal fauna species lists indicated that the beach intertidal fauna assemblage at Shellharbour South beach was similar to that reported from ocean beaches for the Illawarra between Garie Beach and Seven Mile Beach (Dexter 1983 - Garie and Seven Mile Beaches; Outteridge 1992 - Bellambi, Corrimal, Fairy Meadow, Fishermans, Port Kembla and Perkins Beaches; MPR 1992 - Scarborough/Wombarra Beach).

Intertidal rocky shores support their own distinctive flora and fauna and are utilised by other animals for food and shelter. Rock pools are utilised by fish as nurseries and rocky shores are used by several shore birds for feeding and roosting (notably sooty oyster catchers - see Kevin Mills & Associates 2008).

MPR (1995) compared rocky shore assemblages at the northern and southern ends of Shellharbour-South and Shellharbour-North Beaches. Observations of these habitats in January 2008 indicate that the basic zone descriptions supplied by MPR (1995) are still applicable. Four basic shore zones or bands were noted, differentiated by visually dominant organisms and to a lesser extent by height above sea level:

- The upper zone was generally broad and characterised by several species of littorinid snails, mainly *Nodilittorina unifasciata*, *Bembicium nanum* and *N. pyramidalis* plus the nerite snail, *Nerita atramentosa*.
- At the bottom of the littorinid zone there was a patchy mid-shore zone of barnacles and molluscs (mainly grazing patelloid gastropods and the carnivorous gastropod *Morula marginalba*).
- At the lower end of the shore there was a patchy, but more or less distinct band, characterised by tube worms (*Galeolaria caespitose*) and termed the Galeolaria zone. This band comprised patches of tube worms, barnacles, tufted algae and various grazing animals, mainly gastropods. At sites SS and BN, cunjevoi (*Pyura stolonifera*) was also present. At site SS cover of cunjevoi varied from 25 to 100 %. At site BN cunjevoi cover varied between 2 and 80 %.
- At the lowest extent of the intertidal there is a zone of tufted and fringing algae with patches of cunjevoi. This band is located in the swash zone of the prevailing surf.

The assemblages of common biota recorded from the Shellharbour rocky reef study were similar to those reported from other regional studies; Coalcliff to Clifton (The Ecology Lab 2004), Scarborough/Wombarra rock platforms (Carolan et al in 1991), Bellambi Point/Red Point (Water Board 1991), Gerringong/Gerroa (MPR 1991) and CSIRO south coast study (Owen 1973).

However, Bendenkorf (1999) found that the actual species diversity of intertidal rocky reef mollusc fauna at South Shellharbour was much greater than other reefs in the region. Based on intensive studies over 4 years, Bendenkorf identified 159 species from 13 natural reefs, 8 built sea-pools and one intertidal channel in the Wollongong region. The fauna comprised 33 common species, 21 uncommon species and 105 rare species. Based on 15 separate surveys over the four-year study period. Bendenkorf found just over 130 of these species on South Shellharbour reefs. This compares with total species counts in the range 30 species (at Scarborough) to some 90 species (at Bellambi). The overall richness of the mollusc fauna at South Shellharbour reefs was attributed to geographical features, with the greatest diversity found on gently sloping reefs with a high degree of habitat complexity, and which were comparatively sheltered from ocean wave influence.

2.2.2 Sub-tidal habitats

There have been several studies of the sub-littoral soft bottom fauna in the region; MPR (1992) undertook a survey of shallow sub-littoral beach fauna off Scarborough/Wombarra Beach, Water Board (1991) surveyed the embayment off Perkins Beach (Windang), Ecology Lab (1993b) surveyed shallow and deep water soft bottom benthos off Bass Point and MPR (1995) compared shallow sandy seabed benthic assemblages off Shellharbour -South and Shellharbour-North Beaches. MPR (1995) found that Shellharbour-South Beach supported a marginally more diverse and a more abundant benthic population than Shellharbour-North Beach and that the benthic assemblages off Shellharbour South beach were similar to those reported from other exposed coastal beach benthic communities but with greater diversity and abundance at Shellharbour South; probably attributable to the relatively greater degree of shelter from wave action afforded by Bass Point.

Shallow rocky reefs are extensive in the region and in the study area and are mostly extensions of the rocky shorelines, particularly the rocky headlands. Shallow sub-tidal rocky reefs support their own distinctive flora and fauna and are utilised by other animals for food and shelter. The reefs are utilised by fish as nurseries, for shelter and feeding and by a number of fishing birds (notably cormorants, terns and penguins) plus pelagic fish species, squid and cuttle fish which hunt over the reefs. The shallow rocky reefs of the immediate study area are also utilised recreationally by surfers and by line and rod fishers and for spearfishing competitions.

Near-shore subtidal, fringing reef has been described in terms of particular habitats, generally associated with the dominance of particular types of algae (Underwood et al. 1991, Andrew and O'Neill 2000). Most of the common near-shore, subtidal reef habitats described by Andrew and O'Neill (2000) were represented within the shallow water rocky reef assemblages studied regionally; MPR 1990 - Gerringong/Gerroa, SPCC 1983, 1986 - Five Islands, EPA 1992 - Five Islands plus Bass Point, MPR 1995 - Shellharbour-South Beach and The Ecology Lab 2004 - Coalcliff to Clifton.

MPR (1995) compared shallow rocky reef habitats at the two ends of Shellharbour South beach with other rocky reefs in the area and concluded that most of the shallow sub-tidal rocky shores in the study area were characterised by very narrow and patchy fringing algae/Pyura habitats and large Barrens habitat with patches of other habitat plus sand channels. The two Shellharbour South reefs are described as follows:

- Shellharbour-South Beach south end reef was almost totally a 'barrens habitat' beyond the thin Fringing algae/Pyura swash zone, with small patches of kelp *Ecklonia radiata*, bubble weed *Phyllospora comosa*

and *Caulerpa remotifolia* throughout the distribution. Sand channels were numerous and most supported colonies of the large sand tube worm (*Diopatra dentata*). There were large numbers of sea urchins (*Heliocidaris* spp., mainly *Heliocidaris erythrogramma*) in the shallow swash zone (above the transects) and purple sea urchins (*Centrostephanus rodgersii*) plus *Heliocidaris tuberculata* were found throughout the deeper barrens habitat. Prime cover was almost entirely encrusting coralline algae with the main grazers (aside from the sea urchins) being grazing gastropods (*Cellana tramoserica* and *Australium tentiforme*).

- Shellharbour-South Beach north end (SN) supported a larger expanse of fringing habitat in the shallows than the previous two sites with barrens habitat at the deeper end. *Pyura* habitat was patchy and confined to the shallows. Patches of *Phyllospora* and *Ecklonia* habitat were scattered throughout the barrens habitat. There were proportionally more abalone noted on this site, all very small and none of legal harvesting size. Boulder fields at this site supported a diverse cryptic fauna of brittle stars, small abalone, chitons, anemones and polychaete worms.

The Ecology Lab (2004) recorded a number of fish species normally associated with shallow in-shore rocky reefs including; *Achoerodus viridis* (blue groper), *Eubalichthys bucephalus* (reef leatherjacket), *Crinodus lophodon* (rock cale), *Parma microlepis* (white-ear parma), *Parma unifasciata* (girdled parma) and *Pempheris multiradiata* (common bullseye). Two species typical of sandy habitats were also observed; *Sillago ciliata* (sand whiting) and *Urolophus* sp., (stingaree) and four species were non-specific to sand or reef; *Pagrus auratus* (snapper), *Dasyatis brevicaudata* (smooth stingray), *Trachurus novaezelandiae* (yellowtail) and *Myliobatis australis* (eagle ray).

2.3 Threatened Aquatic Species

With reference to possible threatened aquatic species in the defined study area, a combined search was made of the NSW DECC/DPI Bionet database plus the Commonwealth EPBC on-line search tool. One freshwater fish (the Australian Grayling) is listed as Vulnerable under the EPBC Act and is protected under the FMA. The search also yielded 30 other fish and shark species, all listed under the EPBC Act, which could occur in the sub-tidal waters off-shore from the study area. The impact of the boat harbour proposal has been separately assessed in regard to these species (MPR 2007), and a referral report submitted under the EPBC Act to DEWHA. On 30 January 2008 DEWHA advised that “the proposed action is not a controlled action and, as such, does not require assessment and approval by the

Minister for the Environment, Heritage and the Arts before it can proceed”. The approved action was described as follows: “to develop an in-shore boat harbour and associated shore-based land development located near Shellharbour, NSW”.

With regard to the one aquatic species that could potentially occur in the present development footprint, the MPR (2007) report concluded:

- The Australian Grayling *Prototroctes maraena* is a species of brackish to freshwater habitats and is unlikely to occur in the waters of the study area. It was not recorded in the extensive studies of the marine and brackish water habitats of Shellharbour Swamp as reported by Griffiths (1998).

Of the original 31 species identified in the MPR (2007) report, 25 fish species were sea horses and pipefish. In late 2001 Syngnathid and Solenostomid fish species (sea horses and pipe fish) were included in the list of marine species under Part 13 of the EPBC Act. As a result of this listing, it is an offence to kill, injure, take or trade Syngnathids and Solenostomids in or from a Commonwealth area.

For the most part the 25 species occur on sub-tidal rocky reefs and seagrass beds (Kuitert 2000). Whilst most are unlikely to occur on the mobile marine sands off Shellharbour South Beach, there is suitable habitat for some species within the existing rocky reef habitats at either end of the beach. Further, whilst there are seagrasses in the lagoon and drain waters of Shellharbour Swamp, the waters are brackish to fresh and most of the submerged plant life in the drainage is *Ruppia sp.*, a seagrass-like plant which is intolerant of full saline waters. Accordingly, it is expected that the submerged plants in the lagoon and drainage lines would be unlikely to support Syngnathids or Solenostomids. This conclusion is borne out by the field fish sampling results. The original EIS fieldwork did not find any of these species and the more extensive surveys undertaken by Griffith in Shellharbour Swamp (Griffith 1998) did not yield any Syngnathids or Solenostomids.

With regard to species listed as critically endangered, endangered or vulnerable under the EPBC Act, and under the FMA which could potentially occur in waters or habitats immediately adjacent to the defined study area, it is concluded that the Black Rock Cod (listed as Vulnerable under the FMA) could be expected to occur as a transient juvenile in intertidal rock pools of the area.

In this regard, MPR (2007) concluded:

- Black Rock Cod *Epinephelus daemelli* is described as a common but

very secretive NSW coastal and estuarine rocky reef species (Kuitert 1997) and is reported as a juvenile from coastal intertidal rock pools in the locality (Griffiths 2003). There is suitable rocky reef habitat for adult Black Rock Cod around Bass Point but not in the inshore shallow rocky reefs at either end of Shellharbour South Beach.

In summary, it is concluded that the aquatic habitats within the defined study area do not support aquatic species listed as critically endangered, endangered or vulnerable under the EPBC Act, and under the FMA. It is also concluded that Black Rock Cod (listed as Vulnerable under the FMA) could be expected to occur as a transient juvenile in intertidal rock pools immediately adjacent to the defined study area.

3 POTENTIAL CONSTRUCTION AND OPERATIONAL IMPACTS

With regards to the total Shell Cove project, the construction of the Shell Cove project has been given a staged approval, with construction of the marine works to be generally undertaken prior to the precinct construction works under consideration in this report. Accordingly, the description of the present aquatic ecology of the site is pertinent for the approved first stage marine works and the condition of the aquatic habitats on the site plus offshore from the site for the purposes of the present assessment will be that which is achieved after the first stage marine works are completed.

3.1 Works to be Undertaken under Existing Approvals

Development consent for the project was originally granted on 26 November 1996, by the Minister of Urban Affairs and Planning, under Part 4 of the *Environmental Planning and Assessment Act, 1979*. The form of the development and of the Conditions of Consent have subsequently been modified several times between 26 November 1996 and 31 October 2006.

Condition 15 of the approval requires that Environmental Management Plans (EMPs) be prepared for each of four elements of the project. These elements are: the Boat harbour, Shadforth Wetland System, the acoustic barriers adjacent to the Quarry Haul Road and relocation of landfill from Shellharbour Swamp. This condition also lists a number of individual management plans and programs that must be prepared as part of each EMP.

The Minister for Land and Water Conservation granted original concurrence for the project under Section 41 of the *Coastal Protection Act 1979* on 19 March 1998, subject to a set of Conditions of Concurrence. Concurrence for the modified development was granted on 18 September 2007 with an additional five Conditions of Concurrence. Condition 3 of the 1998 conditions requires that an EMP be prepared for the boat harbour entrance works and beaches and lists a number of individual management plans and programs that must be prepared as part of this EMP. The 2007 conditions include further requirements for the individual plans relevant to the operation of the boat harbour.

Thus, as part of the staged approvals and with respect to aquatic ecological impacts, the project has required the construction plus approval of a compensatory integrated wetland plus lagoon to include both saltmarsh and freshwater wetland components as compensation for the removal of the existing Shellharbour Swamp wetland (part of which falls in the lands under consideration for the present EA). This integrated wetland system was required to be approved prior to marine works commencing. This step has been achieved with the construction and approval of the Myimbarr Wetland complex in the headwaters of Tongarra

Creek. Accordingly, when the approved marine works commence the remaining wetland plus the intertidal drainage lines and the remaining lagoon elements will be excised.

The staged approval also required removal of the existing landfill located landward of Boollwarroo Parade (and north of the lagoon road bridge). This included some areas of shallow water habitat plus some small drainage lines leading to the lagoon. This part of the project has been completed and thus some additional area of aquatic habitat as assessed above has already been excised.

The staged marine approvals also require the removal and treatment of acid sulfate soils (ASS) and the provision of a suitable land platform for the construction works to be assessed in this EA (i.e., construction of hotel, shopping centre, residential development, marina support facilities and dry boat storage facilities around the marina). Patterson Britton and Partners (2007a) state that the land platform will be constructed by filling over the existing surface using conventional earthmoving plant. Where ASS exists beneath the land platform it will be capped in situ and surcharged with soil stockpiles to speed consolidation, except in areas of low finished level where it will be 'chased out' and disposed of as per the boat harbour excavation. Accordingly, any remaining aquatic habitat in the precinct areas west of Boollwarroo Parade will be excised under the approved marine works, as extensive earth works will have been undertaken to provide suitable building platforms.

Finally, the approved works include provisions for the maintenance and rehabilitation of the dune areas east of Boollwarroo Parade and north of the lagoon road bridge plus beach nourishment works. The dune rehabilitation works are currently underway and will be advanced as part of the approved boat harbour construction works.

Once the marine works commence, a portion of the intertidal beach plus a small portion of the adjacent intertidal rock shore (all located within the present EA area) will be lost to construction of the harbour entrance works (dredged channel and breakwaters).

In summary, all the actual remaining aquatic habitats within the defined EA area west of Boollwarroo Parade plus the Shellharbour lagoon east of the road bridge and some portions of the beach and rocky intertidal shore within the defined EA area east of Boollwarroo Parade will generally be excised under existing construction approvals prior to building works for the current EA commence.

With regard to the defined EA area under consideration, the beach section east of the rehabilitated sand dunes and north of the approved entrance works plus the intertidal rocky reef south of the approved harbour entrance works will be the only aquatic habitats remaining from those described in Section 2 above.

3.2 Existing Construction and Operation Controls for Approved Works

With regard to the possible condition of these remaining aquatic habitats plus that of the aquatic habitats offshore from the EA area, the approval process for the marine works required both construction and operational environmental management plans (CEMP and OEMP) which would ensure that there would be no significant impact on the remaining habitats and on the rehabilitated dune and foreshore habitats.

3.2.1 Construction EMP

The construction aspects of the project have been addressed in the original EIS, and a Construction Environmental Management Plan (CEMP) has been prepared (Patterson Britton and Partners 2007a) for the approved marine works to address the requirements of Condition 15 of the Development Consent Conditions (as modified) and the requirements of Condition 3 of the Development Concurrence Conditions:

- Amongst other aspects, the CEMP provides details of the staged development up to the completion of the harbour works including the provision of all the prepared precinct areas to be considered in the present EA.
- The CEMP also provides details of the staged stormwater diversions plus treatment works and of staged construction water management, treatment and disposal.
- Finally, the CEMP provided details of aquatic and water quality monitoring requirements to establish that the adjacent aquatic habitats have been protected as required under the conditions of consent.

It is concluded that application of the approved CEMP would provide sufficient protection during construction of the separately approved boat harbour works to the remaining and adjacent aquatic habitats such that they would be in a similar state to that existing at present.

3.2.2 Operation EMP

The operational aspects of the project have been addressed in the original EIS, and an Operation Environmental Management Plan (OEMP) has been prepared (Patterson Britton and Partners 2007b) for the approved marine works and for the proposed precinct works to address the requirements of Condition 15(d) of the Development Consent Conditions (as modified), Condition 3 of the 1998 Conditions of Concurrence and the 2007 Conditions of Concurrence.

The objectives of the OEMP are stated as follows:

- Avoid environmental impacts from the operation of the boat harbour where possible;
- minimise impacts that are unavoidable;
- ensure that the works are carried out in accordance with appropriate environmental statutory requirements;
- ensure that the Marina Operator prepares a Marina Plan of Management (MPM) for their operation of the marina, which, as a minimum, should address all issues raised within this OEMP and the Conceptual Marina Plan of Management;
- ensure that operation of the marina is conducted in accordance with the MPM and principles outlined in this OEMP and that any corrective actions are performed in a timely and appropriate manner; and
- respond to changes in environmental conditions through review of the monitoring and control programs.

3.2.3 Relevance of existing CEMP and OEMP to present Proposal

The OEMP integrates the various environmental management commitments, conditions and statutory requirements that cover the boat harbour operation. The OEMP includes management strategies with agreed performance criteria for specified acceptable levels of environmental harm. In addition, and in accord with the Conditions of Consent clause 15(d)(ii), the 1998 Conditions of Concurrence clause 3(iii) and the 2007 Condition of Consent relating to water quality monitoring, the Water Quality Management Plan required by the Conditions of Consent and the Marine Environment Management Plan required by the Conditions of Concurrence have been combined in this plan as they have significant overlap in scope and the issues involved in each are strongly interrelated.

Specifically for construction related water quality management in the CEMP, terrestrial aspects (such as stormwater management) of the Water Quality Management Plan required by the Conditions of Consent have been combined with the required Erosion and Sediment Control Plan in a 'Terrestrial Water Quality and Sediment Control Plan' as they have significant overlap in scope. Marine aspects (such as downstream impacts) of the required Water Quality Management Plan have been combined with the Marine Environment Management Plan required by the Conditions of Concurrence in a 'Marine Water Quality and Environment Management Plan' as they have significant overlap in scope.

Accordingly, the combined CEMP plus the OEMP provide an integrated and staged construction and operational framework for the control and management of stormwater and waste waters into, through and out of the EA study area during harbour and precinct preparation works and for post construction operation of the completed boat harbour. Thus the staged stormwater diversions plus construction runoff management controls will be in place prior to and potentially during the construction of infrastructure and buildings under consideration in this EA. That is, there will be existing construction safeguards in place at the commencement of building works within the precincts which ensure that catchment stormwater plus construction related runoff from the precinct perimeters is controlled to a satisfactory level so as to protect the adjacent aquatic habitats plus the habitats and biota of the adjacent waters.

Note that the integrated CEMP plus OEMP include consideration of the construction recommendations with regard to fish passage as outlined in DPI guidelines (NSW Fisheries 1999 and DPI Fisheries 2003).

Following staged development, the catchment of the former swamp will discharge into the boat harbour. As noted in the OEMP, pollutants typically of concern in stormwater from urban catchments include nutrients (principally nitrogen and phosphorus), suspended solids and gross pollutants. The proposed combined CEMP and OEMP will achieve overall water quality control for the proposed drainage system in the residential and commercial developments surrounding the boat harbour via a system of detention basins and riparian corridors. Water quality treatment measures incorporated into the drainage system include wetlands, bio-retention swales, bio-retention basins, and gross pollutant traps. These measures have been designed with the objective of reducing the nutrient, suspended solid and gross pollutant load to the receiving waters post development as compared to the existing case. It is noted in the OEMP that a quantity of suspended sediment will reach the boat harbour and will beneficially interact with dissolved copper in harbour waters while still meeting the stormwater quality objectives.

Finally, the CEMP document is constructed as a 'framework' EMP which provides information on environmental issues, mitigation measures, monitoring, compliance standards, corrective actions, reporting and auditing proceedings relating to the construction of the Boat harbour. Accordingly the document requires relevant contractors for both the Boat harbour and Marina construction to prepare detailed Site Environmental Management Plans (SEMP) for individual activities related to their Contract scope of works.

4 ASSESSMENT UNDER PART 3A of EP&A ACT

With regard to assessment of environmental impact under Part 3A of the NSW EP&A Act, the DGRs specify use of the *Guidelines for Threatened Species Assessment* (DECC/DPI 1995). These guideline provide six objectives in regard to conserving species or ecological communities listed as critically endangered, endangered or vulnerable:

- Maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation).
- Conserve biological diversity and promote ecologically sustainable development.
- Protect areas of high conservation value (including areas of critical habitat).
- Prevent the extinction of threatened species.
- Protect the long-term viability of local populations of a species, population or ecological community.
- Protect aspects of the environment that are matters of national environmental significance (NES), where NES are those matters listed under the Environment Protection & Biodiversity Conversation Act 1999.

Where there is a potential to impact on threatened species, this should be addressed through, firstly, avoiding the impact; this may mean making some changes to the proposed development. If total avoidance is not possible, then some form of minimisation may be able to be achieved and mitigation may be required. Finally, if neither avoidance nor mitigation is possible, then some form of offset or compensation will be required. This could entail the rehabilitation of similar habitat nearby.

Listed threatened and protected species are found in the waters and habitats of the coastal area east of the proposed works and, with regard to the construction and use of the infrastructure plus buildings to be built within the Precinct area, the main potential for impact is via water and waste runoff to the adjacent waters. Specific avoidance of impacts on threatened aquatic species has been achieved by imposing strict construction and operation conditions on any works to be undertaken during the boat harbour construction, and these conditions have been incorporated into two 'framework' documents, the CEMP and the OEMP.

It is concluded that provided construction and operation of all works to be approved under the present EA is undertaken with appropriate environmental safeguards there would be no significant impact on threatened aquatic species.

The environmental safeguards to be adopted before, during and post the boat harbour marine works construction are proposed are summarised in Table 1.

Table 1 – Proposed Environmental Safeguards during Construction

Issue	Construction Activity Within EA area ¹		
	Before BH Start	During BH Construction	Post BH Completion
Compensatory Wetland (Myimbarr) established	yes	yes	yes
On-going offshore marine water quality & biological monitoring by Australand (or Council)	yes	yes	yes
Shellharbour Swamp monitoring and surface water quality ²	yes	yes	no
Near Shore Marine water quality monitoring (i.e. turbidity and visual inspection of beach)	no	yes	yes
Progressive catchment based water quality measures (wetland ponds, bio-swales, natural creeks, etc)	yes	yes	yes
Best Practice on-site sediment control measures as per Blue Book, independent of CEMP	yes	yes	yes
Notes.	1. Excludes separate approved boat harbour construction 2. Monitoring only during site disturbance. Monitoring stops when site is stabilised.		

Based on a consideration of the present aquatic ecology of the site, as presented in Section 2 above, and the consideration of the aquatic ecology of the site as it will be prior to the commencement of construction works for the particular elements subject to approval under this EA (as presented in Section 3 above), it is concluded that there will be remaining significant aquatic habitat on the subject land prior to commencement of construction, comprising the intertidal rocky shore lands south of the harbour entrance breakwater. There will also be important sandy beach habitat north of the harbour entrance and there will be important aquatic habitat adjacent to the precinct boundary, in the form of sub-tidal sandy and rock reef habitats plus the habitat of the coastal water column itself.

It is considered that provided all construction works plus operation of facilities post construction are undertaken to conform with the proposed environmental safeguards and where applicable the OEMP environmental safeguards, particularly with regard to potential water runoff, the project can provide the “maintain” part of the DECC/DPI objective.

With regard to any works adjacent to the remaining intertidal rocky reef south of the harbour entrance it is recommended that any environmental safeguard for those works provide the highest levels of construction related protection so as to ensure no impact from waste or construction water or spill runoff onto the adjacent rocky reef. Further the controls should ensure that there is no significant increase in trampling or disturbance of the adjacent intertidal rocky reefs arising from construction related activities. This includes potential increased foot traffic by virtue of cordoning off the work areas and concentrating public access onto parts of the reef.

Overall, the works already approved under the original EIS and under approved modifications since are considered to provide an “improve” portion for the “maintain or improve” requirement of the DECC/DPI guidelines. These works include:

- Replacement of the degraded Shellharbour wetland with the integrated fresh and salt water Myimbarr wetland.
- The net increase in intertidal plus shallow subtidal rocky reef afforded by the placement of rock to build the harbour entrance.
- Removal of the landfill site, which had unacceptable leachate quality.
- Removal of ASS, which was leaching low pH waters out of surface sediments and into the existing lagoon drains.
- The combined construction and operation environmental safeguards built into the project for protection and enhancement of water quality particularly with regard to improved stormwater controls from existing and proposed urbanisation.

In summary, the potential for impact on aquatic habitats and biota from works to be approved under this EA is linked to the prevention of construction and operation related runoff of polluted waters onto adjacent habitats, plus prevention of polluted runoff being carried onto adjacent habitats via runoff into adjacent waters. This can be achieved by implementation of the recommended safeguards, in accordance with Table 1 above, and continuing from the existing framework provided by the CEMP and OEMP already in place for the approved marine works. In this way the objectives of the DECC/DPI guidelines with regard to the protection of aquatic habitats and biota would be met, and the overall project can provide a ‘maintain AND improve’ outcome for remaining aquatic habitats and biota.

5 CONCLUSIONS WITH REGARD TO DGRs

With regard to the Director General's requirements (DGRs) for the protection of aquatic habitats and biota the following conclusions are made:

The existing aquatic environment that will exist when the proposed works are to be undertaken has been described in Sections 2 and 3 above. Overall it is concluded that:

- The avoidance of aquatic impact for the total project within the presently degraded Shellharbour Swamp has been offset by the provision of higher value integrated wetlands at Myimbarr and the impacts on adjacent aquatic habitats has been either avoided by the implementation of strict construction and operation safeguards to prevent water quality degradation over adjacent aquatic habitats, or offset by the provision of additional rocky reef habitat in the form of rock breakwalls. Avoidance of impact on the high conservation value natural intertidal rocky reefs has been achieved by re-designing the original breakwater to avoid any direct loss to construction.
- Consideration of impacts under the EPBC Act and consideration of matters of National Environmental Significance have been addressed in Section 2.4 and Section 4 and it is concluded that provided the framework of safeguards already in place for approved works is implemented for the present EA works there would be no significant impact on threatened aquatic species. This conclusion is confirmed by the decision of DEWHA that "the proposed action is not a controlled action and, as such, does not require assessment and approval by the Minister for the Environment, Heritage and the Arts before it can proceed".

The identified key issues of potential for impact, prediction of impacts on aquatic environments including adjacent habitats plus measures for mitigation, protection and management have been considered in Sections 3 and 4 above. Based on the assessment of potential impact provided in Sections 3 and 4, the following recommendations were made for protection of aquatic environments, habitats and biota:

- 1 Construction and operation of all works to be approved under the present EA should be undertaken in accordance with the proposed environmental safeguards nominated in Table 1 above.
- 2 All works to be undertaken under the existing EA should be done under the framework of a specific Environmental Management Plan (EMP).

- 3 With regard to any works adjacent to the remaining intertidal rocky reef south of the harbour entrance, it is recommended that any EMP for those works provide the highest levels of construction related protection so as to ensure no impact from waste or construction water or spill runoff onto the adjacent rocky reef. Further the EMP should ensure that there is no significant increase in trampling or disturbance of the adjacent intertidal rocky reefs arising from construction related activities. This includes potential increased foot traffic by virtue of cordoning off the work areas and concentrating public access onto parts of the reef.
- 4 With regard to environmental management for aquatic impact, the works to be approved under this EA should be included into the overall integrated water quality and waste management strategy incorporated as per Table 1 above. This would include utilisation of the existing integrated water quality and aquatic ecology monitoring program, where appropriate.
- 5 EMPs for any construction elements with the potential for direct runoff or disturbance to existing natural aquatic habitats (such as those adjacent to the intertidal rocky reef or beach habitats) should consider the need for any additional and specific localised monitoring requirements. This consideration would need to be on a case-by-case basis, having regard to the potential for damage or runoff and the level of safeguards, which can be implemented.

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