Meeting dates for these groups during the project were as follows:

- Project Inception Meeting with EPA Project Team (March 2008)
- Steering Committee Meeting #1 – overview and collection of information sources (May 2008)
- Knowledge Management Committee Meeting #1 – workshop on critical services, processes and components (May 2008)
- Joint Meeting of the Steering Committee and Knowledge Management Committee – presentation of draft ECD document for comment (July 2008)
- A meeting to present the final documentation to the Steering Committee occurred in November 2008

Scientific Expert Panel Process

In light of the potential for positive alignment between significant conservation/management initiatives being developed for Moreton Bay, in parallel with the current project preparing the Ecological Character Description (ECD) for the Moreton Bay Ramsar Site, BMT WBM Pty Ltd and the Scientific Expert Panel (SEP) of the Southeast Queensland Healthy Waterways Partnership (the Partnership) were engaged by the EPA to conduct a number of meetings and workshops to discuss, collate and review the scientific understanding of Moreton Bay's ecological health/character and to identify opportunities for alignment of ecological monitoring (and associated environmental indicators for key ecological assets) in Moreton Bay. The three conservation/management initiatives included:

- the Southeast Queensland Healthy Waterways Strategy (and associated Ecosystem Health Monitoring Program [EHMP]) administered by the Partnership;
- the Ramsar Convention (and associated Ecological Character Description [ECD] in preparation by BMT WBM); and
- the draft Moreton Bay Marine Park Zoning Plan (and the associated monitoring plan currently being implemented by the EPA).

The approach adopted to collate this understanding and identify opportunities was to develop an overall Conceptual Framework (hereafter, 'the Framework') for Moreton Bay with a specific focus on the ecological assets underpinning its ecological health/character identified in the draft ECD and other relevant assessment documents. Key aspects of the Framework identified were:

- Identification of critical or key whole-of-Bay processes that affect the Bay's ecological health/character;
- Identification and agreement of the key ecological assets (eg. habitats and species) that were salient to all three conservation/management initiatives;
- Development of conceptual models for the key ecological assets (i.e. key attributes, threats and indicators of ecosystem health/character including where practicable defining limits or thresholds of acceptable change); and
- Based on the three steps above, assess the extent that key ecological assets were already being monitored and develop new or revised monitoring priorities that were relevant to the management and monitoring objectives of the EHMP, the ECD (in terms of the site's status as a Ramsar site) and the proposed Marine Park Zoning Plan.

The methodology used for developing the Conceptual Framework involved a series of (3) half-day meetings and (2) devoted full day workshops to discuss and address the key aspects of the Conceptual Framework. All meetings were organised and minuted by the Partnership's secretariat staff.

The meetings were convened by John Bennett (EPA and SEP member) and Eva Abal (SEP) as co-chairs at the offices of the Partnership. BMT WBM's role in the process was to prepare inputs for the meetings (agendas, workshop notes and presentations), present the information for discussion by the group and to document and 'write up' technical outputs in the form of conceptual models and diagrams which were distributed for comment and review by participants prior to meetings. A separate report (BMT WBM 2008b) was produced out of this process documenting the proceedings and discussions.

Meeting and workshop dates for the participants were as follows:

- July 2008 – Inception Meeting
- 17 July 2008 – 1st Workshop
- 28 July 2008 – 2nd Workshop
- 12 August 2008 – Meeting
- September 2008 – Meeting

Participants in the Meetings and Workshop (in addition to the BMT WBM study team) were as follows:

SEP Sub-Committee

John Bennett, Chair	Queensland Environmental Protection Agency
Gay Deacon	Queensland Environmental Protection Agency
Eva Abal	SEP, SEQ Partnership
Brad Zeller (Altern. Michelle Winning)	Queensland Department of Primary Industries and Fisheries
Nicole Udy	Queensland Environmental Protection Agency
Dave Rissik	Queensland Environmental Protection Agency
Thomas Schlacher	Sunshine Coast University
Rod Connolly	Griffith University
Tim Stevens	Private Capacity (now GHD Pty Ltd)
Jackie Robinson	University of Queensland

Outputs identified through this SEP review process relevant to the ECD included:

- An overview of the key ecosystem processes underpinning Bay function (and associated 'overview' conceptual model);

- Understanding of how these processes interact and create connectivity between the inshore and offshore habitats of the Bay;
- Recognition of the key threats and stressors operating within and adjacent to the Bay;
- Identification of the key habitats and species of the Bay; and
- Development of conceptual models for the key habitats and species that include:
    - identification of key indicators of habitat/species extent and condition;
    - identification of the key attributes and controls on ecosystem health and character; and
    - identification of stressors and threats (direct and indirect) to the habitats/species.

As outlined in Sections 4 and 5 of the report, from this process, a range of indicators, information gaps and monitoring priorities were identified that are directly relevant to the ECD study.

Other Expert Input and Peer Review

The study team also made contact with specific experts and organisations outside the SEP process. In this context, we recognise and appreciate the assistance of the following individuals and organisations:

- Dr Col Limpus, Queensland Environmental Protection Agency
- Dr Janet Lanyon, University of Queensland
- Dr Don Sands, formerly of the CSIRO
- Dr Ian Gynther, Queensland Environmental Protection Agency
- Dr Steve Van Dyck, Queensland Museum
- Dr Ed Meyer, formerly University of Queensland
- Dr Glen Ingram, formerly Queensland Museum
- David Geering, Queensland Wader Study Group
- Jill Denning, Queensland Wader Study Group
- John Birbeck, Caloundra City Council
- Jason Searle, Gold Coast City Council

External Peer Review of the draft ECD Report was also undertaken by Wetland International Oceania (Roger Jaensch and Warren Lee Long) under contract with BMT WBM Pty Ltd.

APPENDIX B: POLICY AND PLANNING CONTEXT

This Appendix outlines the range of statutory plans, strategies and areas and non-statutory instruments relevant to the management of the Ramsar Site.

Principal Management Plans

Marine Park (Moreton Bay) Zoning Plan

The purpose of the *Marine Parks (Moreton Bay) Zoning Plan 1997* is to provide for the ecologically sustainable use of Moreton Bay Marine Park and to protect its natural, recreational, cultural heritage and amenity values. This is similar to the objectives of the Ramsar Convention, being for the conservation and wise use of the area. The marine park zoning plan operates through the delineation of zones within the declared marine park and regulates activities within these zones through the issue of permits and/or regulatory provisions.

The 1997 zoning plan, developed under the *Marine Parks Act 2004,* expires on 1 September 2008 (EPA 2008b). A review of this plan is currently being undertaken and will consider the objectives of the *Marine Parks Act 2004.*

Table B-1 provides a summary of the zones and their purposes under the current and draft proposed zoning plan. In general, the current marine park zoning plan protects and conserves valuable intertidal and marine habitats such as mangroves, seagrass and coral communities within various protection and habitat zones. The proposed draft zoning plan is seeking to improve the level of protection afforded to a range of representative habitats within the Bay by increasing the area and number of marine national park (green) zones.

Table B-1 Current and proposed Moreton Bay Marine Parks zones and their purposes

Zones	Purpose, Prohibitions and Comments
	Marine Parks (Moreton Bay) Zoning Plan 1997
General Use Zone	o Purpose: to provide for the general use and public enjoyment of the zone in ways that are consistent with the conservation of the marine park. o These areas allow all activities, though some require a permit to occur within the marine park. o This zone constitutes the majority of the marine park.
Habitat Zone	o Purpose: to conserve significant habitats within the marine park and the cultural heritage and amenity values of the marine park, to maintain the productivity and diversity of ecological communities within the marine park, and to provide for reasonable public use and enjoyment of the zone consistent with the conservation of the marine park. o Most activities are allowed in these zones, but activities such as shipping operations and mining are prohibited.
Conservation Zone	o Purpose: to conserve the zone's cultural and natural resources and amenity values, to conserve the zone's natural condition to the greatest possible extent, to allow members of the public to enjoy the relatively undisturbed nature of the zone, and to ensure use of the zone's natural resources is ecologically sustainable. o Recreational activities are permitted but commercial trawling is prohibited.
Buffer Zone	o Purpose: to provide for the protection of the zone's biological diversity and natural condition to the greatest possible extent, while allowing the public to appreciate and enjoy the undisturbed nature of the zone and for the trolling for pelagic fish.
Protection Zones	o To provide for the permanent preservation of the zone's biological diversity and natural condition to the greatest possible extent, while allowing the public to appreciate and enjoy the undisturbed nature of the zone. o All forms of fishing and extracting are prohibited.
	Moreton Bay Marine Park Draft Zoning Plan
General Use Zone	o Purpose: the zoning applied to areas where a higher level of protection could not be achieved or was not required given the percentage of each habitat type protected in other zones. o Most activities can occur with or without a permit under an ecologically sustainable management framework.
Habitat Protection Zone	o Purpose: to provide significant habitat, especially those supporting threatened species, protect areas adjacent to land based national parks, and provide an environmental buffer against threatening processes, while allowing for prevention of substantial economic impacts from phasing out of commercial netting (e.g. allowing areas supporting low levels of trawling). o Activities which disturb the seabed are prohibited.
Conservation Park Zone	o Purpose: to broadly complement the level of protection provided to adjacent land based protected areas while supporting existing recreational use and some limited commercial fishing, to protect special and unique areas where Marine National Park Zones would have resulted in unacceptable social or economic impacts, and to allow continued entry and use of areas of high recreational value, in particular for recreational fishing. o Most forms of large scale extractive use, direct disposal, private structures and development are prohibited. o Limited recreational and commercial line fishing and crabbing may still occur.
Marine National Park Zone	o Purpose: to protect the full range of habitat types and an example of each biodiversity feature, to maintain the ecological viability and integrity of populations, species and communities, to protect species of conservation concern as well as species vulnerable habitats and lifestages, to protect the natural values of the marine environment to ensure greater resilience against future changes or threats, and to provide for adaptive management through assessment of effectiveness of zoning. o All forms of extractive use, direct disposal into the area, coastal development and most maritime infrastructure are prohibited to provide whole-of-ecosystem protection.

Source: Information on *Moreton Bay Marine Park Draft Zoning Plan* taken from EPA (2008a).

South-east Queensland Regional Coastal Management Plan

The application of the South East Queensland Regional Coastal Management Plan (SEQRCMP) (EPA 2006) extends to the coastal zone between and including Maroochy Shire to Coolangatta, and operates in conjunction with the *State Coastal Management Plan.* It aims to achieve sustainable coastal management in SEQ, and to avoid or minimise future adverse impacts on coastal resources.

Within the SEQRCMP, specific regional direction is provided on 17 State Coastal Plan policies, and in addition, includes two regionally specific policies[12] (EPA 2006). Most policies within the Plan are relevant to the Ramsar site, either providing direction on the wise use of the coastal zone for social or economic purposes, or for the conservation of sensitive areas within the coastal zone, including those in Moreton Bay. Applicable policies include:

- *Policy 2.1.10 Tourism and Recreational Activities* – Intense tourism and recreational pressures are important community and economic assets in the SEQ area. The Policy requires the avoidance or minimisation (in order of preference) of potential adverse impacts, including cumulative impacts, on protected species, particularly threatened and migratory species. Further, the Policy requires that planning for tourism and recreation in the SEQ region makes provision, where relevant, for seasonal variations in faunal activity and migrations.
- *Policy 2.8.1 Areas of state significance (natural resources)* – This Policy covers areas within the Ramsar site including significant coastal wetlands, Nature Conservation Act Protected Areas[13] and significant coastal dunes. The Policy recognises that areas of state significance (natural resources) play a critical role in maintaining a healthy functioning coast, and that they must be protected from land uses and activities that may have adverse impacts on their continued integrity and functioning (i.e. wise use).
- *Policy 2.8.2 Coastal Wetlands* –This Policy applies to the conservation and management of coastal wetlands, including land within 100m of a coastal wetland. This policy identifies areas within the Moreton Bay Ramsar site as having large and intact coastal wetland ecosystems with high ecological integrity and functioning. However, it does not cover all areas within the Ramsar site boundary. It also considers that wetlands in some areas within Moreton Bay are experiencing pressures from direct and cumulative impacts including Pumicestone Passage and parts of Bribie Island, parts of the Hays Inlet and Brisbane northern wetland complex, and part of the Carbrook wetland complex south of Beenleigh-Redland Bay Road.
- *Policy 2.8.3 Biodiversity* – This Policy focuses on areas of Coastal Biodiversity Significance including wetlands (significant and coastal) and areas of shorebird habitat. Areas within or immediately adjacent to the Ramsar site boundary are also designated as areas of terrestrial Coastal (State) Biodiversity Significance. The Policy requires future planning consider various aspects of management impacting on the conservation and wise use of the Ramsar site including:

  - to ensure development does not result in further loss, degradation or fragmentation of areas of coastal biodiversity significance and value; and

  - to identify areas that are degraded between areas of biodiversity significance and require rehabilitation to reinstate habitat values and ecological functioning.

12 Policy 2.1.15 - *Non-tidal artificial waterways* and Policy 2.4.7 - *Algal Bloom Management*.
13 As identified under the SEQRCMP.

- *Policy 2.8.4 Rehabilitation of Coastal Resources* – The SEQRCMP requires rehabilitation and enhancement of coastal resources to improve values and functioning of the coastal zone. General areas defined for priority rehabilitation and enhancement include coastal wetlands, endangered regional ecosystems and dunal systems (refer Policies 2.8.1 and 2.8.2) and shorebird nesting, roosting and feeding sites (Policy 2.8.3).

A range of other statutory plans, strategies and areas and non-statutory management plans and instruments apply in the Moreton Bay region and to areas or values within the Ramsar site.

Other Statutory Plans

Protected Areas Management Plans

There are a number of terrestrial-based protected areas within the boundaries of the Moreton Bay Ramsar site. Some of these protected areas have management plans to provide for their conservation and wise use, while others have no formal management plans or strategies currently in place.

Moreton Island National Park, Cape Moreton Conservation Park and Moreton Island Recreation Area and Management Plan

The Plan (EPA 2007) aims to maintain and manage protected areas on Moreton Island as relatively undisturbed coastal landscapes where people will continue to access and enjoy the island's regionally unique, nature-based recreational activities. It also aims to make conservation of the island's natural communities, species and cultural heritage a key focus of management on the island. The Plan has been developed to ensure that management considers international agreements including the Ramsar Convention, protected areas legislation, native title, cultural heritage, and local plans (under the jurisdiction of Brisbane City Council). While only applying to a proportion of the Moreton Bay Ramsar site, the Plan aims to maintain and manage values protected by the Ramsar Convention.

Carbrook Wetlands Conservation Park, Serpentine Creek Conservation Park

The Carbrook Wetlands Conservation Park and Serpentine Creek Conservation Park Management Plan (QPWS 1999a) identifies the wetlands systems within these parks as good examples of their type within the South East Queensland bioregion. Desired outcomes, and policies, guidelines and actions are set out in the plan to address management of the protected area including its plants and animals (including wetlands, especially Carbrook Wetland including Native Dog Creek), scenic and aesthetic, scientific and educational, and recreational values.

King Island Conservation Park

The King Island Conservation Park Management Plan (QPWS 1999b) highlights the importance of the Park as an area of extensive tidal flats, rubble banks and seagrass beds which are important to migratory wader birds as feeding grounds. The management plan aims to maintain the island in its natural condition and to allow no developed facilities. It notes that the Park will be managed in accordance with the Ramsar Convention, and consistently with the surrounding marine park zoning requirements.

Buckely's Hole Conservation Park

The Buckely's Hole Conservation Park Management Plan (Department of Environment and Heritage 1998) identifies the Park as being a place of significance for migratory birds, and as providing nature-based recreational opportunities such as bird-watching and bushwalking. The Plan aims to ensure:

- the lagoon and its surrounds are maintained for the continued use by water birds;
- threatened fauna is monitored and their requirements are included in ongoing management programs;
- nature-based recreational and educational day use opportunities are provided; and
- Aboriginal groups and the local community are provided with the opportunity to be involved in the management of the Park.

Other Protected Areas

Other *Nature Conservation Act* protected areas within the Moreton Bay Ramsar site do not currently have management plans, but are managed by QPWS in accordance with the management principles for that class of protected area under the Act:

Bribie Island Recreation Area and Bribie Island National Park - The Bribie Island Recreation Area includes the Bribie Island National Park, and is managed pursuant to the *Recreation Areas Management Act 2006* for the purposes of nature conservation and nature-based recreation. Currently there is no conservation management plan for the area.

St Helena Island National Park - Queensland's first historic national park was the St Helena Island National Park. The aim of the National Park is to preserve the ruins and artefacts on the Island from further degradation, and to provide an educational tool to accurately present the park and its history to visitors.

Southern Moreton Bay Islands National Park - This protected region has an area of more than 1500 ha, and is comprised of Willes, Cobby Cobby, Kangaroo, Woogoompah and Coomera Islands. The southern islands area is managed for conservation of the natural environment, with marine park conservation and protection zones surrounding the islands.

Environmental Values and Water Quality Objectives

Schedule 1 of the *Environmental Protection (Water) Policy 1997* identifies environmental values and water quality objectives for Moreton Bay and its coastal catchments. In particular the schedule sets quantitative objectives for key physico-chemical water quality parameters such as nutrients and sediments that, if achieved, will protect aquatic ecosystem values. A number of areas within the Bay are provided the highest level of ecosystem protection, known as High Ecological Value (or HEV) areas. These areas are to be retained in their current condition (in terms of water quality, biotic quality) to the greatest extent practicable. The environmental values and water quality objectives of the schedule must be considered in decision-making under the Environmental Protection Act in relation to regulated activities that involve discharge of contaminants to waterways as well as in other statutory plans and strategies.

South East Queensland Regional Plan

BMT WBM

The purpose of the South East Queensland Regional Plan 2005-2026 (Office of Urban Management (OUM) 2005) is to provide a sustainable growth management strategy for SEQ to the year 2026, including the protection and enhancement of the region's natural environment, biodiversity and natural resources. It is a statutory plan to which all other planning in SEQ, such as local government planning schemes, state plans and policies, must align. The Plan applies to those local government areas (LGAs) in the SEQ region and Queensland waters adjacent to these LGAs, including all of the Moreton Bay Ramsar site.

The vision of the SEQ Regional Plan includes that ecological and culturally significant landscapes are valued, celebrated and protected. The Plan's regional land use pattern identifies "areas of regionally significant conservation, natural resource, landscape, …. and recreational value", with the majority of the Ramsar site being included in the Regional Landscape and Rural Production Area.

Regional policies set out the desired regional outcomes, principles and policies to address growth management in SEQ, and guide planning and decision-making at State and local levels. Desired regional outcome 2 recognises the quality and diversity of the natural environment of SEQ, including features such as rich and diverse native flora and fauna, diverse coastline and marine waters encompassing coastal wetlands (e.g. Pumicestone Passage and Carbrook Wetlands), unique sand islands (Moreton, Stradbroke and Bribie Islands), and the dugong, turtle and fish habitats of Moreton Bay. A number of policies have been developed to implement these principles, including the protection, conservation, management, rehabilitation and/or restoration of coastal wetlands.

Fisheries Management Plans (East Coast Trawl) and (Coral Reef Fin Fish)

These fisheries management plans apply to all of Queensland's waters and provide for the use, conservation and enhancement of the community's fisheries resources by managing the east coast trawl fishery and reef line fishery in a way that seeks to apply and balance the principles of ecologically sustainable development, and promote ecologically sustainable development.

The *Fisheries Management (East Coast Trawl) Plan 1999* requires the use of bycatch reduction devices (BRDs) and turtle excluder devices (TEDs) throughout the fishery, and sets regulated periods for defined waters including within the Moreton Bay area and Ramsar site.

Fish habitat areas

Fish habitat areas are statutory areas defined under the *Fisheries Act 1994* and its regulations for the protection of important fish habitats across the State of Queensland. Several declared areas are within the Moreton Bay Ramsar site and coincide with its boundaries. Declaration of a fish habitat area provides particular powers for the chief executive administering the Fisheries Act to regulate development and activities within them.

Water Resource Plans

Water Resource Plans (WRPs), required under the *Water Act 2000*, are developed to plan the allocation and sustainable management of water to provide a balance between sustainability for river ecosystems and certainty of supply for water users, but also to ensure there is adequate provision for the natural processes that underpin river health. WRPs in the SEQ region must be consistent with the SEQ Regional Plan (see above). All WRPs include environmental outcomes (e.g. needs of specific species), river flow objectives and performance indicators for different flow levels, and monitoring and reporting requirements.

The *Water Resource (Logan Basin) Plan 2007* (Logan WRP) sets out the objectives for the Logan River and its tributaries, which feed southern Moreton Bay including the area within the Ramsar site. In particular it plans for ecological outcomes for water in particular areas within or flowing into the Ramsar site (refer Table B-2).

Table B-2 WRP ecological outcomes for areas within the Logan catchment

Estuary	Ecological Outcome
Logan and Albert Rivers estuary	To minimise changes to the delivery of fresh water, sediment, nutrients and organic matter to the estuary and southern Moreton Bay; and To minimise changes to the brackish water habitat in the estuary.
Canungra Creek, Christmas Creek, Running Creek, Palen Creek and Upper Logan River subcatchment areas, Albert River and parts of its tributaries, Burnett Creek and part of its tributaries and Teviot Brook and part of its tributaries	To minimise changes to the low flow regime of the watercourses; and To minimise changes to the medium and high flow regime important to river forming processes.
Carbrook wetlands	To minimise changes to the flooding regime.

Likewise, the *Water Resource (Moreton) Plan 2007* (Moreton WRP) sets out the objectives for the wider Moreton Bay catchment to the north of the Logan River catchment. This includes the wider Brisbane area, and the catchment of Pumicestone Passage. In particular it plans for ecological outcomes for estuaries within or flowing into the Ramsar site (refer Table B-3).

Table B-3 WRP ecological outcomes for areas within the Moreton catchment

Estuary	Ecological Outcome
Stanley River and tributaries, upstream of the impounded area of Woodford Weir	To minimise changes to flows that support river-forming processes; and To minimise changes to the low flow regime.
Boondall Wetlands	To provide freshwater flows necessary to maintain the long-term pattern of inflows to, and ecological functions of, the wetlands.
Estuarine reaches	To minimise changes to brackish water habitats.
Moreton Bay and Pumicestone Channel	To minimise changes to the natural movement and delivery of sediment, and the delivery of fresh water, natural nutrients and organic matter.

The *Water Resource (Gold Coast) Plan 2006* (Gold Coast WRP) sets out the objectives for the Coomera River and its tributaries, which feed southern Moreton Bay and the Broadwater including the area within the Ramsar site. In particular it plans for ecological outcomes for water in particular areas within or flowing into the Ramsar site (refer Table B-4).

Table B-4 WRP ecological outcomes for areas within Gold Coast river catchments

Estuary	Ecological Outcome
Coomera River Estuary	To minimise changes, as far as practicable, to freshwater flows into the Coomera River estuary and to minimise changes to the freshwater inflows to Coombabah Lake.
For Coomera River within the area known as Canungra Land Warfare Centre, including, in particular, Back Creek, and	To minimise changes to the flow regimes of the waters.

other waters of high ecological value, including, in particular, Tallebudgerra Creek and Currumbin Creek	
Moreton Bay and the Broadwater	To minimise changes, as far as practicable, to the volume and seasonality of freshwater flows into these waterways.

Local Government Planning Schemes

The Moreton Bay Ramsar site includes land and waters within the local government areas of the Gold Coast City Council, Redland City Council, Brisbane City Council, Moreton Bay Regional Council and Sunshine Coast Regional Council.

Each of these Local Governments administers a planning scheme prepared under the *Integrated Planning Act 1997* (IPA) that regulates new development in the local government area such as the change on intensification of a use of land, subdivision of land and related operational and building works.

In addition to the range of strategies and measures administered under planning schemes through IPA, local governments also administer local laws prepared under the *Local Government Act 1993* for the regulation of activities such as vegetation clearing, access restrictions, and control of domestic animals that are not administered through the development provisions of the IPA.

Local Governments play an important role in defining the pattern of urban settlement in Southeast Queensland and in the regulation of construction and operation of development that is relevant to the values of the Ramsar site.

Non-statutory plans

SEQ Healthy Waterways Strategy – Moreton Bay Action Plan

The SEQ Healthy Waterways Strategy 2007 – 2012 (SEQ HWP 2007) has been developed and is implemented by the SEQ Healthy Waterways Partnership. The Partnership is a voluntary alliance of local governments, State government agencies and community and industry representatives.

The Strategy and, in particular, the Moreton Bay Action Plan within it, covers the whole of Moreton Bay including Pumicestone Passage, the southern Broadwater, and to the mouths of all rivers, and aims to sustain and enhance the ecosystem health of the Bay. The purpose of the Plan is similar to that of the Ramsar Convention, addressing particular activities within Moreton Bay to ensure that the Bay's ecosystem health is protected and where necessary stabilised and restored, while allowing for sustainable resource use.

The Plan recognises there is an existing policy and regulatory framework in place for protecting critical habitats and species, and management of human activities to ensure their sustainability, particularly at Commonwealth and State level (i.e. *EPBC Act* and *Marine Parks Act*), and specifically in recognition of Ramsar-listed sites as areas of national environmental significance under the *EPBC Act*.

The Plan focuses on four themes:

- appropriate levels of protection of critical habitats and species;

- management of commercial and recreational activities within the Bay to minimise their impact on the Bay's ecosystems;
- improved understanding of Moreton Bay's ecosystems and the condition and trends in any changes to that ecosystem; and
- high community awareness of the values of the Bay and commitment to their long-term protection.

A series of Management Outcomes for each of the themes, Management Action Targets and a subsequent series of actions have been determined.

The Future in Balance - SEQ Catchments

Formed through the regional arrangements for natural resource management between the Australian and Queensland Governments under the National Heritage Trust, the SEQ Catchments Natural Resource Management (NRM) body administers the regional NRM plan entitled, the *Integrated Natural Resource Management Plan for South East Queensland* (also know as *The Future In Balance*) (NRM SEQ 2004). While a strategic document to guide planning and investment in NRM activities in the region, the Plan aims to incorporate and build on existing plans, influence those that are emerging, conform to Australian and Queensland guidelines, and coordinate implementation of required actions.

The Plan framework sets out targets, actions and organisations, and identifies the major natural assets of the region and threats impacting on them. The SEQC Regional Investment Strategy identifies six natural resource assets to be managed or protected, with the most relevant assets for meeting the principles in the Ramsar Convention being coastal and marine, water and biodiversity. Aspirational (30-50 years), Resource Condition (10-15 years) and Management Action (1-5 years) targets are outlined for each of the assets.

Shorebird Management Strategy – Moreton Bay

In response to the need to protect migratory shorebird species found in Moreton Bay listed under the Japan Australia Migratory Bird Agreement (JAMBA) or the China Australia Migratory Bird Agreement (CAMBA), the EPA and QPWS developed the *Shorebird Management Strategy – Moreton Bay* (EPA 2005b). Within Moreton Bay, five main approaches have been adopted for the conservation of shorebirds:

- Protecting shorebird habitat;
- Protecting shorebirds from disturbance;
- Protecting critical shorebird sites;
- Community education; and
- Research and monitoring.

In particular the actions within the Strategy for the above approaches are relevant to maintenance of the ecological character of the Ramsar site (eg. maintenance and enhancement of shorebird habitats).

APPENDIX C: INDIGENOUS CULTURAL HERITAGE REPORT

The full report prepared by *Converge Heritage + Community Pty Ltd* is included here. A summary of the key aspects of the report as it relates to identification of critical services related to indigenous cultural heritage is contained in Section 7.

1. Introduction

BMT WBM commissioned Converge Heritage + Community to conduct a desktop assessment of indigenous cultural values associated with the Moreton Bay Ramsar areas. This assessment forms part of an audit of existing environmental values being undertaken by BMT WBM.

Resolution IX.21 of the Ramsar Convention, entitled "Taking into account the cultural values of wetlands" was adopted at Ramsar's ninth conference. Through this resolution, Ramsar signatory governments have agreed "… that in the application of the existing criteria for identifying Wetlands of international importance, a wetland may also be considered of international importance when, in addition to relevant ecological values, it holds examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning" (paragraph 12). Further, the resolution outlines cultural characteristics as follows:

a. Sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland.

b. Sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetlands.

c. Sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples.

d. Sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland (paragraph 15).

This important change to global policy statements of the Ramsar Convention provides a strong mandate for taking into consideration the indigenous cultural values of the Moreton Bay Ramsar areas in the current audit being conducted by BMT WBM.

The scope of this assessment is limited to being desktop, and will be based only on documentation that is already in the public arena. Specifically, consultation with indigenous groups is not part of the scope. This assessment provides:

- Contextual information;
- A discussion of the relationship between indigenous groups and land;
- A summary of available information about cultural connections with Ramsar areas;
- Case studies that demonstrate that significant cultural values may be associated with Moreton Bay Ramsar areas;

- Available information on how cultural values are being sustained; and
- An assessment of the limits of acceptable change if cultural values in Ramsar areas are to be protected and managed.

2. Legislation and Professional Standards

Legislation specific to cultural heritage that is relevant to this assessment is as follows:

Aboriginal Cultural Heritage Act 2003 (ACH Act)

The paramount legislation in Queensland, with regard to Aboriginal cultural heritage, is the Aboriginal Cultural Heritage Act 2003, which states that a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage (the "cultural heritage duty of care") (Section 23[1]). The Act defines cultural heritage as a significant Aboriginal area, object, or evidence, of archaeological or historic significance, of Aboriginal occupation (Section 8). A "significant Aboriginal area" is an area of particular significance to Aboriginal people because of either or both of the following: Aboriginal tradition; the history, including the contemporary history, of any Aboriginal party for the area (Section 9).

The ACH Act states that it is an offence for a person to harm, remove or possess cultural heritage if the person "knows or ought reasonably to know that the object is Aboriginal cultural heritage" (Section 26).

Sections 34-37 of the Act provide directions on how an Aboriginal party for an area is determined. If the area is within the external boundaries of a registered native title claim, then the native title party for that area (also known as the applicant) will be the Aboriginal party. If there is currently no registered claim, but a registered claim once existed, then until a new registered claim is in place, the Aboriginal party for that area will be the native title party of the previous registered claim. Finally, if there is no registered claim and never has been one, then the Aboriginal party is a person "with particular knowledge about traditions, observances, customs or beliefs associated with the area, and has responsibility for the area under Aboriginal tradition.

The application of the ACH Act when defining Aboriginal parties is important to the Ramsar areas of Moreton Bay, some of which are within the external boundaries of registered claims, while others either have never been claimed, or once were within a registered claim that no longer exists.

The Act has established a database and register. While these sources of information are far from complete, they contain information about places, usually archaeological sites, which have been recorded during previous surveys.

In addition to the requirements of legislation, professional standards are established by Resolution IX.21 of the Ramsar Convention (discussed above), and the Burra Charter. The Burra Charter (Marquis-Kyle and Walker 1999) continues to guide cultural heritage management in Australia. First adopted in 1979 by Australia ICOMOS (International Council on Monuments and Sites), the charter was initially designed for the conservation of and management of historical heritage. However, after the addition of further guidelines that defined cultural significance and conservation policy, use of the charter was extended to indigenous studies.

The charter defines conservation as 'the processes of looking after a place so as to retain its cultural significance' (Article 1.4). A place is considered significant if it possesses aesthetic, historic, scientific or social value for past, present or future generations (Article 1.2). The definition given for each of these values is as follows (Articles 2.2 to 2.5).

Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.

Historic value encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section.

A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.

Scientific research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information.

Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group.

Article 2.6 of the Guidelines notes that other categories of cultural significance may become apparent during the course of assessment of particular sites, places or precincts. A range of cultural significance values may apply. Article 5 of the Burra Charter states that "conservation of a place should identify and take into consideration all aspects of its cultural significance without unwarranted emphasis on any one aspect at the expense of others" (Marquis-Kyle and Walker 1999).

3. Context

3.1 Environmental Context

Moreton Bay covers roughly 1 400 square kilometres between Peel and Bribie Islands and is about 50 km long and 25 km wide. Moreton and Stradbroke Islands protect the bay and the mainland shore from ocean waves, with the wave climate dominated by wind-waves rather than swell. Wind-wave direction is mainly from the southeast, northeast and southwest (Stephens 1992). In the north-east, however, swell-waves develop via the channels of the North Entrance tidal delta. The Brisbane River is the only major river that feeds into the bay. Smaller streams, including the Albert and Logan Rivers to the south and the Pine and Caboolture Rivers in the northwest, also feed into the bay.

To the west of the bay, between Redland Bay and Lytton Hill, the shoreline is rocky and dominated by Tertiary basalt. The coastline in the region is fringed by intertidal sand flats and coral reefs (Stephens 1992). The Brisbane River delta extends from Hamilton to Lytton Hill and is comprised of coastal sediments. The Redcliffe Peninsula, in contrast, consists of a series of laterised Tertiary sandstone and basalt headlands. Deception Bay is a coastal plain with estuarine mudflats and beachridges, with the sand supplied by the North Entrance marine tidal delta. Bribie Island is a barrier island comprised of Pleistocene and Holocene beachridges, whereas Moreton and North Stradbroke Islands are dune islands containing prominent bedrock headlands. These islands also consist of dunes of both Pleistocene and Holocene age.

The sedimentary environments of Moreton Bay have been formed by fluvial, tide and wave influences since the last glacial maximum (Lang *et al.*. 1998). Seismic stratigraphic surveys around the Bay have identified various sediments that have been deposited as sea levels have changed over time. The analyses of these sediments have allowed scientists to reconstruct the bay environment from the late Pleistocene through to the present day.

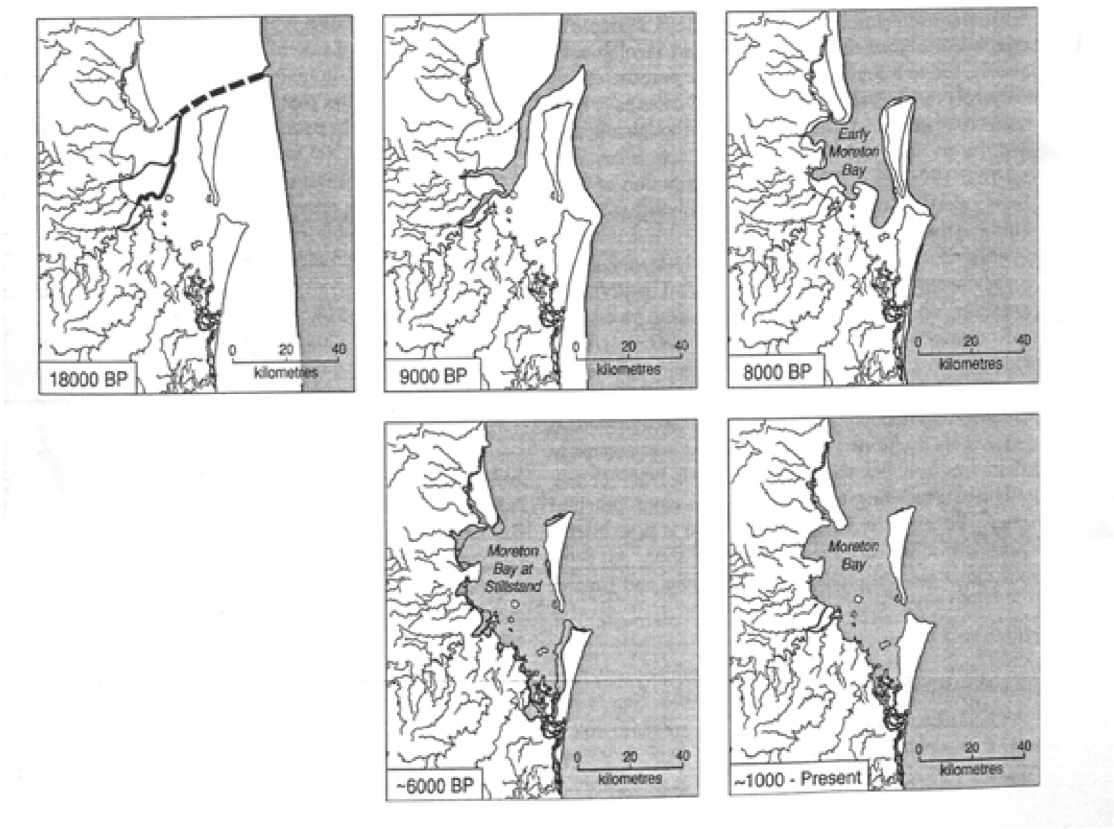

Figure 1: Development of Moreton Bay during the Holocene Period (Hall, 1999: 171).

Seismic testing has revealed that during the last Ice Age (18000 – 10000 BP) the coastline of southeast Queensland was roughly 35 kilometres or more eastwards of its present-day location (see Figure 1). People living on the southern Moreton Islands were effectively living inland on a wide coastal plain and Moreton Island was part of the mainland. Moreton and Stradbroke islands, at this time, were essentially large subcoastal sand dunes overlooking a broad coastal plain to the east and subcoastal river valley to the west (Hall 1999).

Two substantial river systems were present during this time: to the south of Russell Island the palaeo-Logan River system; and to the north a large tributary of the Brisbane River (Willmott and Stevens 1992). The landscape may have been comparable to that which can still be seen inland of the Caloundra Currimundi coastline of northern southeast Queensland. Along major rivers and creeks, open Eucalypt forest would have predominated, with sections of riparian forest present along waterways. On the flat plains, heathlands, swamps and woodland areas would have predominated.

The present day Moreton Bay gradually formed as sea levels rose after the Last Glacial Maximum (-150m at 18 000 BP). Old river systems were gradually flooded with sea water. The marine environment was probably brackish, rather that salt, because of the low tidal influence and entry of fresh water into the system. Vegetation systems along, what once had been riverine environments, gradually died back due to the gradual incursion of salty water.

From 10 000 to 6 500 years BP, as the bay continued to fill, Moreton, Stradbroke, Macleay and Karragarra became islands, and Russell became an extended peninsula into what was becoming a huge bay - not unlike Deception Bay today. The riverine environment was replaced by vegetation and fauna suited to marine conditions. Sea water purity was high, sustaining substantial coral growth around Victoria Point, Peel Island and near the northern parts of North Stradbroke. Sea levels stabilised around 6000 years ago and Moreton Bay, at this time, was more extensive than it is today.

The Moreton Bay regional environment supports an abundance of plant and animal food species. Coastal lowlands or ‘wallum’ vegetation comprises over one-third of the Moreton Region’s area. This bioprovince is defined as being an “undulating lowland belt below the 30m contour which has an assured rainfall, similar soil morphology, Lack of soil fertility and similarly structured floristic communities” (Hall 1980: 80) and encompasses beaches, low dunes, estuaries, fringing forests, dune forests and various types of Wallum forest. Coastal lowland vegetation is commonly in a state of flux as external conditions, such as climatic variation and mobile landscapes, constantly change. Such a dynamic environment creates a diversity of habitats for flora and fauna.

The coastal lowland environment sustains more than 50% of the 60-odd species of terrestrial land mammals listed for the Moreton Region (Hall 1980: 80). Wallum vegetation, in particular, supports a large and diverse range of bird species, including thousands of sea birds and wading birds, reptiles and mammals. Significantly, marine resources are plentiful in Moreton Bay. A wide range of fish species, including mullet, bream, tailor, whiting, flathead and jewfish are present, as well as other marine animals such as dugong, turtles and porpoise.

In summary, Moreton Bay has been an area of considerable change through the past 10,000 years, from part of the mainland to its present marine environment. Throughout this time, changes to the landscape wrought by fluctuating sea levels, inundation, and climate change would have been associated with accompanying changes to vegetation and animal populations.

3.2 Human Context

Humans are thought to have occupied coastal Southeast Queensland since at least the late Pleistocene (up to 20 000 years Before Present [BP]). This estimate is based on archaeological evidence from the Talgai (Morwood 1987) and Wallen Wallen Creek sites (Neal and Stock 1986). Within Moreton Bay itself, however, evidence suggests a more recent occupation of Moreton Bay, with a number of sites dated from between 2000 and 200 years BP (late Holocene) (Hall 1999). A large-scale midden complex, found on the southwest coast of Moreton Island, has been dated to around 2200 years BP and sites in Deception Bay and Sandstone Point to around 3000 years BP (Hall 1989). A comparative dense number of middens were noted along the shores of Pumicestone Passage both on Bribie Island and on the mainland, but no archaeological dating has been done

(Stockton 1974). Interestingly, to date, very few sites have been discovered in the region that date to between 2000 and 6000 years – a period when sea levels in the bay had stabilised and the environment is thought to have been very similar to that of today (Hall 1999) (Figure 2). One exception is the Brisbane Airport Site, with material dating from 1170 to 5837 years BP.

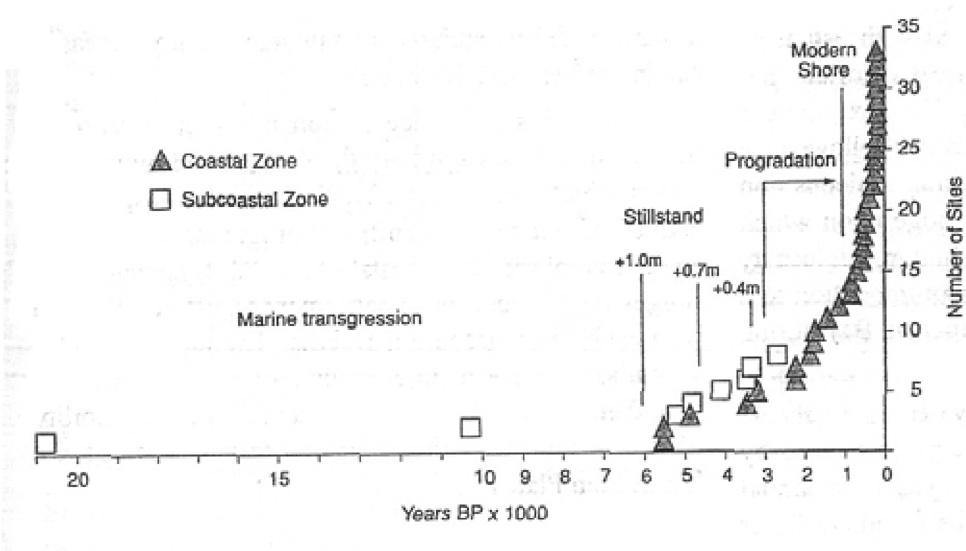

Figure 2: Moreton region sites through time by environmental zone. (Hall 1999: 173)

Evidence from these excavations and other archaeological sites discovered in Moreton Bay indicates that fishing, the collection of shellfish and the gathering of local food plants were important activities for Aboriginal peoples living in the region. As Ulm notes:

> *Over the past 40 years, archaeological investigations in southeast Queensland have focused almost exclusively on the coastal strip…. Although little of the region has been systematically surveyed, over 1,500 coastal midden sites have been documented, 62 of which have been excavated. Of these 62 sites, 27 are said to contain fish remains, although … only 21 have been radiometrically dated (Ulm 2002: 79).*

During the many millennia of occupation, it should be understood that Aboriginal lifeways would have impacted on the natural environment of Moreton Bay, e.g., for example, techniques such as fire stick land management, to keep vegetation clear and managed may have played a role in determining the mosaic of vegetation and thus by implication the spread of fauna populations. Whatever this impact, early ethnographic observations after non-indigenous occupation commenced in the 1820s present a picture of an abundance of fauna populations in a mosaic of landscapes. Examples are provided.

Fish abounded in Moreton Bay. In particular, numerous observations highlight the presence of schools of sea mullet during the late 1800s.

> *I have seen schools so vast that the bay was a solid mass of them….it is impossible for anyone to form an estimate as to the quantity, but I should say that a hundred boats might have been filled out of a wing of this seething mass (Welsby in Thomson 1967: 86).*

A suite of methods were used by Aboriginal groups to fish in Moreton Bay. Stake and brush traps were used on tidal flats. At Woody Point near Redcliffe, Flinders noted that "upon the shoal near the house, there was more than one enclosure of a semi-circular form, and the sticks and branches of which it was made were set and interwoven so close that a fish could not pass between" (Steele 1072: 19).

Nets were commonly referred to in the early records of Moreton Bay. Flinders commented on netting, and his assistant Uniacke wrote that the "nets used for fishing are made by the men from the bark of the kurrajong (hibiscus heterophyllus), a shrub which is very common in the swamps" (Steele 1972: 95). Other bark including that of the native cotton tree (*Hibiscus tiliaceous*) which went by the local name of "Talwalpin" (Watkins 1981: 44) and wattle bark, were twisted together and gum was then used to glue the resulting string to a framework made of sticks. These small "heart shaped" nets about 1.2 metres across were usually used in pairs, and were probably the most well known and consistently described nets known as "tow rows" (Colliver and Woolston 1975: 96; Petrie 1904: 73). Gaiarbau, a traditional person from the Jinibara group described his experiences of using these nets to catch mullet in Deception Bay:

> *One man kept watch in the top of a tree, probably a quarter of a mile away. He remained hidden from view behind a shield of vines and leaves cut from the adjacent scrub, for if had not been screened the mullet would have seen him and not come into shallow water. The rest of the men were placed at a distance beyond him, sitting down and waiting for his signal. As soon as he saw fish he put one hand up. Gradually he would lower it, and when he brought it right down to his side the fishermen would know that the mullet had come past his tree. Then he would raise the other hand, and slowly lower it as they got beyond this sight. The signaling was taken up by another man who was in the water fairly close to the waiting fishermen. If this man stood up, then the others knew that the school was in the deep water, and they remained sitting and let that school pass, and waited patiently until a school came along that was in the water shallow enough for their purpose. If the tree watcher sat down they would know that a school of mullet was coming into shallow water. But if he saw that the fish were in deep water he would not lower his arm below half way, so that the next man could see how the fish were traveling. The latter kept a wet sand-ball, as big as a cricket ball, in his hand. When the conditions were right, he would throw the sand-ball underhand about 10 yards out into the sea. The purpose of this was to cause the mullet to stop. He would then throw a second ball about five yards out to induce them to come in and see what caused the splash, and then he would throw a third sand-ball into water knee deep. All this time he was squatting down in the water so as not to be prominent. In the meantime the fishermen who had been alerted would all sneak up to within about 20 yards of him and quietly enter the water in a half circle, closing in to complete a full circle as soon as the fish got into water that was shallow enough. They then proceeded to catch them. Each man carried two nets, one in each hand (Gaiarbau in Winterbotham n.d.: 51-52).*

Walters makes an important observation that the various forms of fishing observed in Moreton Bay were mostly associated with mudflats, mangrove fringes, inshore sandbars and sandflats, and surf beaches (Walters 1985: 55).

Fish traps and spears were also used in Moreton Bay, with a stone walled fish trap found at Toorbul Point (Walters 1986). The following ethnographic account describes a possible method used to herd fish into the traps.

> *During the Mullet and Tailor seasons, if a shoal was close in, Mrs Birt would row out, trailing a bunch of Bribie pine, torulosa she oak and vanilla lily, this she maintained was necessary to attract the porpoises, very doubtful, but occasionally they would follow the dinghy and frighten a portion of the shoal into the trap. This exercise had to be performed on a falling tide; when it fully receded there would still be a couple of feet in the trap, with the top of the rock enclosure just awash. The fish were then easily caught with either scoop or cast nets… ("Old Salt" in Walters 1986: 44-45).*

Dolphins are also thought to have been employed to herd fish towards nets, particularly when the shore was too steep or Lacked rocks for the construction of fish traps (Hall 1999).

Large dugong herds were also common in the bay. In 1891 Campbell reported a herd spread over 5km long and 300m wide. "It was altogether the largest herd of these animals I ever saw, and I am afraid to make any computation as to the number of it" (Thomsom 1967: 105). A fixed herd of 'three or four hundred' year-round was noted by Welsby. This number greatly expanded during the winter months, when herds from the north migrated down to the bay (Welsby in Thomson 1967: 105). Seagrass beds, nourished by decaying plant matter brought down the rivers during late summer, were abundant during winter and attracted large herds. Groups of Aboriginal men netted the dugong on the shallow flats adjacent to bay islands, or set up nets overnight in channels near seagrass beds (Draper 1978). Although fish were easier to catch, the dugong provided a much larger quantity of meat.

> *Should any of the tribes on the sea coast have been so fortunate as to catch a sea-hog – called youngun – which sometimes is of the size of a young bullock, intelligence of the event is immediately sent along the coast to invite the neighbouring tribes to the banquet; this lasts, between incessant eating and sleeping when quite gorged, two or three days, until the whole animal is consumed…. (Eipper 1841 in Steele 1972: 284).*

In 1853 Stobart described the capture of a dugong, and the ceremony associated with this event.

> *They had just caught a junger (a French Dugong), a species of sea calf which abounds here and which they reckon a great delicacy and affords a great feast for them…. There is a sort of ceremony takes place … when it is brought on shore…. The women and the younger boys and children are not allowed to be present nor the women even to see the animal at all, though they have portions … sent to them. They pitched the head unskinned on the fire, those who assisted at the killing of it have the first slices and the rest seemed more as guests (Stobart in Love 1985:59-60).*

A model of Aboriginal subsistence and settlement by Draper (1978) highlights the seasonal nature of Aboriginal traditional activities in Moreton Bay before the vast impact of non-indigenous settlement.

The model was developed using biogeographical and documentary data and is supported by more recent archaeological research. Winter in Moreton Bay was a time of abundant marine and littoral resources, when dugong, shellfish and fish were plentiful (Draper 1978). Historical and ethnographic evidence suggests that, during this season, Aboriginal peoples concentrated on fishing and collecting shellfish. For people living on large bay islands, such as Moreton, the fishing season started in April when fish began to migrate into the bay. Groups of men mounted co-operative ventures using hand nets and large quantities of mullet, bream and tailor were caught. Staple foods during this season included fish and fern roots, with the diet supplemented with shellfish and other food species. Large numbers of dugong also migrated into Moreton Bay during winter and were an important food resource for Aboriginal groups. Plant foods were harvested from nearby wallum vegetation beyond the coastal dunes. “Midyim” berries, in particular, were plentiful growing in sandhill areas.

Huts were set up along the coast to cater for the concentration and movements of fish (Draper 1978). The following account discusses the presence of these huts in Moreton Bay and the general subsistence and settlement patterns followed by Aboriginal groups.

> *We were informed that these people had several such villages on the island; and that they resorted to one or to another, according to the weather, the season of the year, and the contiguity of food. At present they are near the opening between Moreton and Stradbroke Islands, depending chiefly on the shoals of mullet for food. A few weeks ago, they went further into the interior, collecting honey. At some seasons they resort to places producing wild fruits; and in wet weather, to elevated situations, contiguous to those parts of the coast, abounding with oysters. In these last situations, their huts are said to be large enough for a man to stand up in (Backhouse in Steele 1975: 228).*

Such an abundant supply of food during the winter months provided an opportunity for groups to meet and perform ceremonies. Such large-scale gatherings were an important aspect of Aboriginal culture in southeast Queensland (Sullivan 1977). The winter mullet runs in particular enabled groups to meet and participate in social and ceremonial activities. Bora grounds were often the meeting place used by groups for such gatherings. As with the bunya nut festivals, bora ceremonies lasted for several weeks and involved the gathering of a number of Aboriginal groups, many of who travelled great distances to meet with their neighbours (Petrie, 1904).

In contrast to the abundant food supply, and subsequent large-scale ceremonial gatherings, that took place during the winter months, early summer was both a less productive and less social time of year because of the threat of fire and the hot dry conditions (Draper 1978). During these months, food and freshwater was more abundant along the coast, rather than in inland areas. Fern roots were a staple food during this period and were found in fresh water swamp areas. Bevelled-edged pounders are commonly found in archaeological sites in Moreton Bay, providing evidence for the processing of such roots. Following the summer storms (October to December) more resources became available and several bird species came into season. Swans were caught easily and duck species were plentiful. Stobart recounted, as he sailed in Pumicestone Passage, that “we came upon a flock of some hundred Black swans…. The ducks here too were in great abundance” (Stobart in Love 1985: 63-64). Flying foxes also gathered in large numbers. St. Helena Island was known to be a roosting place. Stobart reported see “an immense flight of them in the air above the trees” (Stobart in Love 1985: 63).

New growth stimulated by the rains attracted larger macropods. Late summer was therefore a time for hunting. Animals were hunted using spears or herded into nets. Snakes, lizards, tortoises, goannas and grubs were also sought after (Hall 1980).

In summary, environmental, ethnographic and archaeological evidence indicates that Moreton Bay, its surrounding islands and mainland formed an extensive, resource-rich and significant landscape in which Aboriginal groups have lived for the past 6,000 years. Before this time, Aboriginal populations would have coped with changes in sea levels and climate, resulting in changes and fluctuations in landscape, flora and faunal populations. The ethnographic sources also provide a basis for comparison with current flora and fauna populations and may be of value in demonstrating changes to the environment of Moreton Bay after non-indigenous settlement.

3.3 A Cultural Landscape

While environmental, ethnographic and archaeological evidence may indicate the richness of the Moreton Bay environment during the past 6,000 or so years that would have been an important and sustaining resource for Aboriginal groups, these observations only give partial insights into the relationship between those Aboriginal groups and the land in which they lived and indeed continue to live. Often, the ethnographic reports provide a commentary on what the observer has found interesting, thus emphasizing a perspective that tends to focus on resources, rather than placingon the public record an understanding of the complex cultural and social network that existed, and continues to exist amongst Aboriginal people of Southeast Queensland.

Approximately one third of Queensland's Aboriginal and Torres Strait Islander population lives in Southeast Queensland (South East Queensland Regional Plan 2005). Many of these people have moved to the region. As contemporary residents, these people are often referred to as "historically associated", and may be regarded as stakeholders in the region similar to the non-indigenous population. In contrast, those Aboriginal people who are descendants of ancestors who lived in Southeast Queensland before non-indigenous settlement identify as Traditional Owners. Each of these groups is an important stakeholder in the community of Southeast Queensland, but Traditional Owners have additional and different aspirations to non-indigenous and historically associated indigenous stakeholders. Through their lineage, Traditional Owners inherit responsibilities under traditional law and custom to manage their land (often referred to as country), as well as a connection to country that is a cultural and spiritual relationship. This is best summed up in the words of Southeast Queensland's Traditional Owners:

> *As the current Aboriginal Traditional Owners in South East Queensland we have inherited a responsibility to look after our country. This responsibility has been handed to us by our ancestors, whose spirits continue to guide our decisions. We in turn have a responsibility to manage our country to the best of our abilities and to teach our youth the values and skills and provide them with the knowledge that they will need to manage our country with and after us….*
>
> *Cultural resources are all the tangible and intangible things in our land and sea country that are essential to our wellbeing: land, water, plants and animals (biodiversity), coastal and marine things, the air (atmosphere), and community. As Aboriginal people, we have such a deep and integral connection and set of relationships with these 'natural' elements that we consider them as cultural entities., Our identity as well as our cultural, spiritual and material*

> *wellbeing is entwined with the country and its health; without strong and healthy country, our people cannot be strong and healthy (SEQTOLSMA 2008: 8)*

In the absence of consultation as part of this brief, two important points should be made. Firstly, the statements of SEQTOLSMA would suggest that those Traditional Owners relevant to the Ramsar areas of Moreton Bay will have strong views on what will be considered their country or cultural resource, and will wish to take part in management decisions. Secondly, a further consideration is that the Traditional Owners relevant to Ramsar areas may have valuable historical knowledge of what these areas were like in the past, and what management strategies would be preferred. These points are best demonstrated through some case studies that are provided below.

Case Study 1 – Blue Lake, North Stradbroke Island

In 2007, consideration was given by the Queensland Government to the potential to harvest fresh water from aquifers on North Stradbroke Island for the water grid being developed across Southeast Queensland. Consultation was commenced with the Minjerribah Moorgumpin Elders in Council, the Aboriginal Cultural Heritage Body for North Stradbroke Island. During initial consultation, the Elders expressed deep concern about the project, as it potentially could impact directly on water levels in Blue Lake, a natural freshwater lake on the island. The Elders were particularly worried about such impacts because of the high levels of cultural significance associated with the lake. What constitutes the lake's cultural significance cannot be reported here, without consultation with and the permission of the Elders. Suffice to say that the Elders were extremely relieved when the project was abandoned because of general public concern.

This case study illuminates Traditional Owners' responsibilities and connection with country. Other people in the North Stradbroke community were concerned about the environmental impact of water harvesting on Blue Lake, a known and much appreciated natural part of the island. But the Traditional Owners' concerns were amplified by their cultural connection to the lake which is a significant Aboriginal area in the meaning of the ACH Act.

Case Study 2 – Traditional Hunting Guidelines

An excellent example of on-going traditional responsibilities and customs working today is provided by the Quandamooka people.

> *The Quandamooka people of the Moreton Bay area are continuing their ages old traditional hunting, which provides an important part of their diet. Working with the Queensland Environmental Protection Agency (EPA), the Quandamooka people have developed Traditional Hunting Guidelines to ensure that hunting practices are sustainable. With the new zoning plan in Moreton Bay Marine Park the Quandamooka people are looking to progress the Traditional Hunting Guidelines into a Traditional Use of Marine Resources Agreement (TUMRA) which will be the new best practice. Quandamooka people have demonstrated their commitment to making the Agreement work through six years of sound management since the establishment of the traditional Hunting Guidelines (SEQTOLSMA 2008: 13).*

Case Study 3 – Native Title's Rights and Interests

Whether or not native title is relevant from the perspective of land tenure in the Ramsar areas of Southeast Queensland is not a discussion for this assessment. Rather, the point being made is that the rights and interests detailed in the various native title claims in the Moreton Bay area give an indication of Traditional Owners' perspectives about their traditional responsibilities and rights. While the native title process may result in these claimed rights and interests only being relevant where native title has not been extinguished, from the Traditional Owners' perspectives, it is likely that they would prefer these rights and interests to be relevant in all of their country.

Consistent in the native title rights and interests claimed in all of the claim applications that cover parts of the Ramsar areas are the following themes:

- Access to enter and remain on lands and waters;
- Use and enjoy land and waters, including traditional hunting and gathering;
- Protection and management of the resources of lands and waters;
- Capacity to exercise customary rights and discharge traditional responsibilities;
- Recognition as Traditional Owners

The themes enunciated by the claimed rights and interests show that there is no differentiation between land and water – both are country – and all country requires protection and management.

Case Study 4 – SEQTOLSMA

The Moreton Bay region is home for a number of Traditional Owner groups. These are as follows:

Moreton Bay Region and Ramsar Areas	
North of the Pine River, Deception Bay, Pumicestone Passage and Bribie Island and the Sunshine Coast	Kabi Kabi (sometimes called Gubbi Gubbi) families
Between the Pine and Logan Rivers and over Brisbane, with the exception of the coastal strip around Cleveland and Mt Cotton	Jagera and Turrbal families
Moreton and North Stradbroke Islands, many of the island of southern Moreton Bay, the coastal strip around Cleveland and Mt Cotton, and the sea between	Quandamooka (Ngugi, Noonucle, Gorenpul) families
Southern end of Moreton Bay, including islands and coastal strip	Yugambeh (eight groups) and Ngarang-Wal/Kombumeri families.

Table 1: Traditional Groups of Moreton Bay

Other Traditional Owner groups include the Jinibara and Mulinjarlie families, but these groups are sub-coastal and may not necessarily have Ramsar areas in their traditional countries.

In 2005, representatives of all but two of these groups commenced negotiations about forming a body "to establish more comprehensive and meaningful Traditional Owner involvement and ownership in improving the condition of the region's natural resources", and "to promote more comprehensive and effective engagement of Traditional Owners in cultural (natural) resource management" (SEQTOLSMA 2008, p. iv). The outcome is the development of an on-going body of Traditional Owner representatives who have now developed a plan, called OUR PLAN, for the future (SEQTOLSMA 2008). Actions relevant to Ramsar areas that have been nominated by OUR PLAN include: the development of a Memorandum of Agreement with SEQ Catchments; developing alliances and partnerships at all levels of government and with the wider community; and becoming fully engaged in planning, decision-making and delivery of on-ground works (SEQTOLSMA 2008: 26).

The foundation of SEQTOLSMA is an important initiative that has the capacity to provide a central body with which consultation and management planning can be developed. SEQTOLSMA does not reduce the responsibilities of Traditional Owners, and recognizes that within the organization, certain Traditional Owners speak for parts (their country) of Southeast Queensland. In regard to the Ramsar areas of Moreton Bay, no one Traditional Owner will speak for them all; rather specific areas will be associated with certain groups, as shown in Table 1. In large part, this arrangement also reflects the requirements of the ACH Act in regard to cultural heritage decision-making by Aboriginal Parties.

Taking these arrangements into account, SEQTOLSMA offers an opportunity for the development of overarching management planning for Ramsar areas, with the additional capacity for relevant Traditional Owners to have input into those areas that are within their countries.

4. Summary

Aboriginal people have lived in Southeast Queensland and the Moreton region for many millennia. While traditional customs such as hunting and fire stick management would have impacted to some extent on the environment of the area, groups and families were supported by a rich variety of resources. The traditional perspective of and relationship with the region is much more than acknowledgement of rich resources, and is a spiritual and social linkage that is important to the wellbeing of Traditional Owners. Ethnographic sources emphasize the richness of available resource, but do not usually give insight into the cultural connection between Traditional Owners and the country that contained these resources.

Traditional Owners have a responsibility to manage their country. Although the brief to this assessment precluded consultation with Traditional Owners, the case studies provided above underline that the Traditional Owners of Southeast Queensland are continuing their traditional responsibilities. In the absence of guidance from Traditional Owners on this matter, it is reasonable to predict the following:

- Each of the Ramsar areas will hold significant cultural values to the relevant Traditional Owner group/s. These values may include physical and non-physical cultural heritage areas and objects, oral knowledge, such as stories, animals and plants, and the natural environment itself;
- The values of each of the Ramsar areas may be different to the others, e.g., the environmental, spiritual and cultural nature of Pumicestone Passage may have been different to those of North Stradbroke Island, and thus require differences in traditional management.

- Traditional Owners are already taking an active role in managing Ramsar areas as part of their management of the wider Moreton Bay area, and that they will wish to increase this role if offered the opportunity.
- The Traditional Owners have already formed an encompassing organization (SEQTOLSMA) which may prove to be a vehicle through which consultation and planning for the future could be organized. Only through consultation with the individual Traditional Owner groups could this be ascertained.

5. Sustaining Cultural Values

This assessment has demonstrated that there has been little to no assessment to date that is available in the public record about the cultural values of Ramsar area in Moreton Bay. Although this lack of information gives little insight into how cultural values are being sustained, hints are provided by initiatives detailed in case studies above.

6. Limits of Acceptable Change

Limits of acceptable change can only be measured through consultation with Traditional Owners. Limits of acceptable change will only become apparent, if indeed they do, after a detailed understanding about cultural values and how they are being sustained is achieved.

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APPENDIX D: LIST OF KEY SPECIES AND COMMUNITIES

Group	Species/Communities	Justification
Seagrass	*Halophila ovalis; H. decipiens; H. spinolsa; Halodule uninervis; Syringodium isoetifolium; Cymodocea serrulata; Zostera capricorni*	Ecosystem services
Mangroves	*Aegiceras corniculatum; Avicennia marina; Bruguiera gymnorhiza; Ceriops australis; Excoecaria agallocha; Lumnitzera racemosa; Rhizophora stylosa*	Ecosystem services
Saltmarsh	Numerous species	Ecosystem services
Freshwater emergent macrophytes	Numerous species	Ecosystem services
Ramsar habitat type	Unforested peatland (Type U); Forested peatlands (Type Xp); Permanent freshwater lakes (Type O).	Uncommon habitat types in bioregion
swamp daisy	*Olearia hygrophila*	Threatened
swamp orchids	*Phaius australis, P. bernaysii* and *P. tancarvilleae*	Threatened
knotweed	*Persicaria elatior*	Threatened
Marine turtles	*Chelonia mydas; Caretta caretta*	Threatened
dugong	*Dugong dugon*	Threatened
Wallum specialist fish species	*Nannoperca oxleyana; Pseudomugil mellis*	Threatened
Frog species	*Adelotus brevis, Crinia tinnula, Litoria cooloolensis, Litoria freycineti, Litoria olongburensis*	Threatened
Mangrove specialist species	*Xeromys myoides; Acrodipsas illidgei*	Threatened
Avifauna	*Botaurus poiciloptilus, Esacus*	Threatened

	neglectus, Rostratula australis, Sterna albifrons	
Vertebrates	Refer to Tables 9-1 to 9-6.	Species present

Table D-1 Shorebirds

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB	MB Status
Scolopacidae	*Actitis hypoleucos*	common sandpiper	C	M	1	1	INBM
Scolopacidae	*Arenaria interpres*	ruddy turnstone	C	M	1	1	INBM
Scolopacidae	*Calidris acuminata*	sharp-tailed sandpiper	C	M	1	1	INBM
Scolopacidae	*Calidris alba*	Sanderling	C	M	1	1	INBM
Scolopacidae	*Calidris canutus*	red knot	C	M	1	1	INBM
Scolopacidae	*Calidris ferruginea*	curlew sandpiper	C	M	1	1	INBM
Scolopacidae	*Calidris melanotos*	pectoral sandpiper	C	M	1	1	INBM
Scolopacidae	*Calidris ruficollis*	red-necked stint	C	M	1	1	INBM
Scolopacidae	*Calidris subminuta*	long-toed stint	C	M	1	1	INBM, V
Scolopacidae	*Calidris tenuirostris*	great knot	C	M	1	1	INBM
Scolopacidae	*Gallinago hardwickii*	Latham's snipe	C	M	1	1	INBM
Scolopacidae	*Heteroscelus brevipes*	grey-tailed tattler	C	M	1	1	INBM
Scolopacidae	*Heteroscelus incanus*	wandering tattler	C	M	1	1	INBM
Scolopacidae	*Limicola falcinellus*	broad-billed sandpiper	C	M	1	1	INBM
Scolopacidae	*Limnodromus semipalmatus*	Asian dowitcher	C	M	1	1	INBM
Scolopacidae	*Limosa lapponica*	bar-tailed godwit	C	M	1	1	INBM
Scolopacidae	*Limosa limosa*	black-tailed godwit	C	M	1	1	INBM
Scolopacidae	*Numenius madagascariensis*	eastern curlew	R	M	1	1	INBM
Scolopacidae	*Numenius minutus*	little curlew	C	M	1	1	INBM
Scolopacidae	*Numenius phaeopus*	whimbrel	C	M	1	1	INBM
Scolopacidae	*Phalaropus lobatus*	red-necked phalarope	C	M	1	1	INBM, V
Scolopacidae	*Philomachus pugnax*	ruff	C	M	1	1	INBM, V
Scolopacidae	*Tringa flavipes*	lesser yellowlegs	C	M	1	1	INBM, V
Scolopacidae	*Tringa glareola*	wood sandpiper	C	M	1	1	INBM
Scolopacidae	*Tringa nebularia*	common greenshank	C	M	1	1	INBM
Scolopacidae	*Tringa stagnatilis*	marsh sandpiper	C	M	1	1	INBM
Scolopacidae	*Xenus cinereus*	terek sandpiper	C	M	1	1	INBM
Rostratulidae	*Rostratula australis*	Australian painted snipe	V	V,M	1	1	PBR
Jacanidae	*Irediparra gallinacea*	comb-crested jacana	C	M	1	1	BR
Burhinidae	*Burhinus grallarius*	bush stone-curlew	C		1	1	BR
Burhinidae	*Esacus neglectus*	beach stone-curlew	V		1	1	BR
Haematopodidae	*Haematopus fuliginosus*	sooty oystercatcher	R		1	1	BR
Haematopodidae	*Haematopus longirostris*	pied oystercatcher	C		1	1	BR
Recurvirostridae	*Cladorhynchus leucocephalus*	banded stilt	C	M	1		ANBR,V
Recurvirostridae	*Himantopus himantopus*	black-winged stilt	C	M	1	1	BR
Recurvirostridae	*Recurvirostra novaehollandiae*	red-necked avocet	C	M	1	1	BR
Charadriidae	*Charadrius bicinctus*	double-banded plover	C	M	1	1	INBM
Charadriidae	*Charadrius leschenaultii*	greater sand plover	C	M	1	1	INBM
Charadriidae	*Charadrius mongolus*	lesser sand plover	C	M	1	1	INBM
Charadriidae	*Charadrius ruficapillus*	red-capped plover	C		1	1	BR
Charadriidae	*Charadrius veredus*	oriental plover	C	M	1	1	INBM
Charadriidae	*Elseyornis melanops*	black-fronted dotterel	C		1	1	BR
Charadriidae	*Erythrogonys cinctus*	red-kneed dotterel	C		1	1	BR

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB	MB Status
Charadriidae	*Pluvialis fulva*	Pacific golden plover	C	M	1	1	INBM
Charadriidae	*Pluvialis squatarola*	grey plover	C	M	1	1	INBM
Charadriidae	*Thinornis rubricollis*	hooded plover	C		1		ANBR,V
Charadriidae	*Vanellus miles*	masked lapwing	C		1	1	BR
Charadriidae	*Vanellus tricolor*	banded lapwing	C		1	1	BR
Glareolidae	*Glareola maldivarum*	oriental pratincole	C	M	1	1	INBM,V
Glareolidae	*Stiltia isabella*	Australian pratincole	C	M	1	1	ANBR,V
Species Richness					**50**	**48**	

INBM	Interntaional non-breeding migrant
BR	Breeding resident
ANBR	Australian non-breeding resident
PBR	Possible breeding resident (though no breeding records to date)

Table D-2 Waterbirds

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Anseranatidae	*Anseranas semipalmata*	magpie goose	C	M	1	1
Anatidae	*Anas castanea*	chestnut teal	C	M	1	1
Anatidae	*Anas gracilis*	grey teal	C	M	1	1
Anatidae	*Anas rhynchotis*	Australasian shoveler	C	M	1	
Anatidae	*Anas superciliosa*	Pacific black duck	C	M	1	1
Anatidae	*Aythya australis*	hardhead	C	M	1	1
Anatidae	*Biziura lobata*	musk duck	C	M	1	1
Anatidae	*Chenonetta jubata*	Australian wood duck	C	M	1	1
Anatidae	*Cygnus atratus*	black swan	C	M	1	1
Anatidae	*Dendrocygna arcuata*	wandering whistling-duck	C	M	1	1
Anatidae	*Dendrocygna eytoni*	plumed whistling-duck	C	M	1	1
Anatidae	*Malacorhynchus membranaceus*	pink-eared duck	C	M	1	
Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose	R	M	1	1
Anatidae	*Nettapus pulchellus*	green pygmy-goose	C	M	1	
Anatidae	*Oxyura australis*	blue-billed duck	C	M	1	1
Anatidae	*Stictonetta naevosa*	freckled duck	R	M	1	1
Anatidae	*Tadorna radjah*	radjah shelduck	R	M	1	
Anatidae	*Tadorna tadornoides*	Australian shelduck	C	M	1	
Podicipedidae	*Podiceps cristatus*	great crested grebe	C		1	1
Podicipedidae	*Poliocephalus poliocephalus*	hoary-headed grebe	C		1	1
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe	C		1	1
Anhingidae	*Anhinga melanogaster*	darter	C		1	1
Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant	C		1	1
Phalacrocoracidae	*Phalacrocorax melanoleucos*	little pied cormorant	C		1	1
Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant	C		1	1
Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant	C		1	1
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican	C		1	1
Ardeidae	*Ardea alba*	great egret	C	M	1	1
Ardeidae	*Ardea ibis*	cattle egret	C		1	1
Ardeidae	*Ardea intermedia*	intermediate egret	C		1	1
Ardeidae	*Ardea pacifica*	white-necked heron	C		1	1
Ardeidae	*Ardea sumatrana*	great-billed heron	C		1	
Ardeidae	*Botaurus poiciloptilus*	Australasian bittern	C		1	1
Ardeidae	*Egretta garzetta*	little egret	C		1	1
Ardeidae	*Egretta novaehollandiae*	white-faced heron	C		1	1
Ardeidae	*Ixobrychus flavicollis*	black bittern	C		1	1
Ardeidae	*Ixobrychus minutus*	little bittern	C		1	1
Ardeidae	*Nycticorax caledonicus*	nankeen night heron	C		1	1
Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill	C		1	1
Threskiornithidae	*Platalea regia*	royal spoonbill	C		1	1
Threskiornithidae	*Plegadis falcinellus*	glossy ibis	C		1	1
Threskiornithidae	*Threskiornis molucca*	Australian white ibis	C		1	1
Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis	C		1	1
Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork	R		1	1
Gruidae	*Grus rubicunda*	brolga	C	M	1	1
Rallidae	*Amaurornis olivaceus*	bush-hen	C		1	1
Rallidae	*Fulica atra*	Eurasian coot	C		1	1
Rallidae	*Gallinula tenebrosa*	dusky moorhen	C		1	1
Rallidae	*Gallinula ventralis*	black-tailed native-hen	C		1	
Rallidae	*Gallirallus philippensis*	buff-banded rail	C		1	1
Rallidae	*Porphyrio porphyrio*	purple swamphen	C		1	1
Rallidae	*Porzana fluminea*	Australian spotted crake	C		1	1

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Rallidae	*Porzana pusilla*	Baillon's crake	C		1	1
Rallidae	*Porzana tabuensis*	spotless crake	C		1	
Rallidae	*Rallus pectoralis*	Lewin's rail	R		1	1
Scolopacidae	*Gallinago hardwickii*	Latham's snipe	C	M	1	1
Rostratulidae	*Rostratula australis*	australian painted snipe	V	V,M	1	1
Jacanidae	*Irediparra gallinacea*	comb-crested jacana	C		1	1
Recurvirostridae	*Cladorhynchus leucocephalus*	banded stilt	C	M	1	
Recurvirostridae	*Himantopus himantopus*	black-winged stilt	C	M	1	1
Recurvirostridae	*Recurvirostra novaehollandiae*	red-necked avocet	C	M	1	1
Charadriidae	*Elseyornis melanops*	black-fronted dotterel	C	M	1	1
Charadriidae	*Erythrogonys cinctus*	red-kneed dotterel	C	M	1	1
Charadriidae	*Vanellus miles*	masked lapwing	C		1	1
Laridae	*Chlidonias hybridus*	whiskered tern	C		1	1
Laridae	*Chlidonias leucopterus*	white-winged black tern	C	M	1	1
Species Richness					**66**	**57**

Table D-3 Mammals

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Ornithorhynchidae	*Ornithorhynchus anatinus*	platypus	C		1	
Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna	C		1	1
Dasyuridae	*Antechinus flavipes*	yellow-footed antechinus	C		1	1
Dasyuridae	*Antechinus subtropicus*		C		1	
Dasyuridae	*Dasyurus hallucatus*	northern quoll	C		1	
Dasyuridae	*Dasyurus maculatus*	spotted-tailed quoll (southern subspecies)	V	E	1	
Dasyuridae	*Phascogale tapoatafa*	brush-tailed phascogale	C		1	1
Dasyuridae	*Planigale maculata*	common planigale	C		1	1
Dasyuridae	*Sminthopsis murina*	common dunnart	C		1	1
Peramelidae	*Isoodon macrourus*	northern brown bandicoot	C		1	1
Peramelidae	*Perameles nasuta*	long-nosed bandicoot	C		1	1
Phascolarctidae	*Phascolarctos cinereus*	koala (SEQ bioregion)	V		1	1
Vombatidae	*Vombatus ursinus*	common wombat	R		1	
Burramyidae	*Cercartetus nanus*	eastern pygmy-possum	C		1	
Petauridae	*Petaurus australis*	yellow-bellied glider	C		1	
Petauridae	*Petaurus breviceps*	sugar glider	C		1	1
Petauridae	*Petaurus norfolcensis*	squirrel glider	C		1	1
Pseudocheiridae	*Petauroides volans*	greater glider	C		1	
Pseudocheiridae	*Pseudocheirus peregrinus*	common ringtail possum	C		1	1
Acrobatidae	*Acrobates pygmaeus*	feathertail glider	C		1	1
Phalangeridae	*Trichosurus caninus*	short-eared possum	C		1	
Phalangeridae	*Trichosurus vulpecula*	common brushtail possum	C		1	1
Potoroidae	*Aepyprymnus rufescens*	rufous bettong	C		1	
Potoroidae	*Potorous tridactylus*	long-nosed potoroo	V	V	1	
Macropodidae	*Macropus agilis*	agile wallaby	C		1	1
Macropodidae	*Macropus dorsalis*	black-striped wallaby	C		1	
Macropodidae	*Macropus giganteus*	eastern grey kangaroo	C		1	1
Macropodidae	*Macropus parryi*	whiptail wallaby	C		1	
Macropodidae	*Macropus robustus*	common wallaroo	C		1	
Macropodidae	*Macropus rufogriseus*	red-necked wallaby	C		1	1
Macropodidae	*Petrogale herberti*	Herbert's rock-wallaby	C		1	
Macropodidae	*Petrogale penicillata*	brush-tailed rock-wallaby	V	V	1	
Macropodidae	*Thylogale stigmatica*	red-legged pademelon	C		1	
Macropodidae	*Thylogale thetis*	red-necked pademelon	C		1	
Macropodidae	*Wallabia bicolor*	swamp wallaby	C		1	1
Pteropodidae	*Nyctimene robinsoni*	eastern tube-nosed bat	C		1	
Pteropodidae	*Pteropus alecto*	black flying-fox	C		1	1
Pteropodidae	*Pteropus poliocephalus*	grey-headed flying-fox	C	V	1	1
Pteropodidae	*Pteropus scapulatus*	little red flying-fox	C		1	1
Pteropodidae	*Syconycteris australis*	eastern blossom bat	C		1	1
Megadermatidae	*Macroderma gigas*	ghost bat	V		1	
Rhinolophidae	*Rhinolophus megaphyllus*	eastern horseshoe-bat	C		1	
Rhinolophidae	*Rhinolophus philippinensis*	greater large-eared horseshoe bat	E	E	1	
Hipposideridae	*Hipposideros semoni*	Semon`s leaf-nosed bat	E	E	1	
Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat	C		1	1
Emballonuridae	*Taphozous georgianus*	common sheathtail bat	C		1	
Molossidae	*Mormopterus beccarii*	Beccari's freetail bat	C		1	1
Molossidae	*Mormopterus norfolkensis*	east coast freetail bat	C		1	1
Molossidae	*Mormopterus planiceps*	southern freetail bat	C		1	
Molossidae	*Mormopterus sp. 2*	eastern freetail bat	C		1	1

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Molossidae	*Nyctinomus australis*	white-striped freetail bat	C		1	1
Vespertilionidae	*Chalinolobus dwyeri*	large-eared pied bat	R	V	1	
Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat	C		1	1
Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat	C		1	1
Vespertilionidae	*Chalinolobus nigrogriseus*	hoary wattled bat	C		1	1
Vespertilionidae	*Chalinolobus picatus*	little pied bat	R		1	
Vespertilionidae	*Falsistrellus tasmaniensis*	eastern false pipistrelle	C		1	
Vespertilionidae	*Kerivoula papuensis*	golden-tipped bat	R		1	
Vespertilionidae	*Miniopterus australis*	little bent-wing bat	C		1	1
Vespertilionidae	*Miniopterus schreibersii*	eastern bent-wing bat	C	CD	1	1
Vespertilionidae	*Myotis macropus*	large-footed myotis	C		1	1
Vespertilionidae	*Nyctophilus bifax*	northern long-eared bat	C		1	1
Vespertilionidae	*Nyctophilus geoffroyi*	lesser long-eared bat	C		1	
Vespertilionidae	*Nyctophilus gouldi*	Gould's long-eared bat	C		1	1
Vespertilionidae	*Nyctophilus timoriensis*	eastern long-eared bat	V	V	1	
Vespertilionidae	*Pipistrellus adamsi*	Cape York pipistrelle	C		1	
Vespertilionidae	*Scoteanax rueppellii*	greater broad-nosed bat	C		1	1
Vespertilionidae	*Scotorepens balstoni*	inland broad-nosed bat	C		1	
Vespertilionidae	*Scotorepens greyii*	little broad-nosed bat	C		1	
Vespertilionidae	*Scotorepens orion*	south-eastern broad-nosed bat	C		1	1
Vespertilionidae	*Scotorepens sanborni*	northern broad-nosed bat	C		1	
Vespertilionidae	*Scotorepens sp. (Parnaby)*	central-eastern broad-nosed bat	C		1	1
Vespertilionidae	*Vespadelus darlingtoni*	large forest bat	C		1	
Vespertilionidae	*Vespadelus pumilus*	eastern forest bat	C		1	
Vespertilionidae	*Vespadelus regulus*	souther forest bat	C		1	
Vespertilionidae	*Vespadelus troughtoni*	eastern cave bat	C		1	1
Vespertilionidae	*Vespadelus vulturnus*	little forest bat	C		1	
Muridae	*Hydromys chrysogaster*	water rat	C		1	1
Muridae	*Melomys burtoni*	grassland melomys	C		1	1
Muridae	*Melomys cervinipes*	fawn-footed melomys	C		1	1
Muridae	*Pseudomys delicatulus*	delicate mouse	C		1	1
Muridae	*Pseudomys gracilicaudatus*	eastern chestnut mouse	C		1	
Muridae	*Pseudomys novaehollandiae*	New Holland mouse	C		1	
Muridae	*Pseudomys oralis*	Hastings River mouse	V	E	1	
Muridae	*Pseudomys patrius*	eastern pebble-mound mouse	C		1	
Muridae	*Rattus fuscipes*	bush rat	C		1	1
Muridae	*Rattus lutreolus*	swamp rat	C		1	1
Muridae	*Rattus sordidus*	canefield rat	C		1	
Muridae	*Rattus tunneyi*	pale field-rat	C		1	
Muridae	*Xeromys myoides*	false water-rat	V	V	1	1
Canidae	*Canis lupus dingo*	dingo			1	
Species Richness					**91**	**45**

Table D-4 Reptiles

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Chelidae	*Chelodina expansa*	broad-shelled river turtle	C		1	
Chelidae	*Chelodina longicollis*	eastern snake-necked turtle	C		1	1
Chelidae	*Elseya dentata*	northern snapping turtle	C		1	
Chelidae	*Elseya latisternum*	saw-shelled turtle	C		1	1
Chelidae	*Elusor macrurus*	Mary River turtle	E	E	1	
Chelidae	*Emydura macquarii krefftii*	Krefft's river turtle	C		1	
Chelidae	*Emydura macquarii macquarii*	Murray turtle	C		1	
Chelidae	*Emydura macquarii nigra*	Fraser Island short-neck turtle	C		1	
Chelidae	*Emydura macquarii signata*	Brisbane short-necked turtle	C		1	1
Gekkonidae	*Diplodactylus steindachneri*	Steindachner's gecko	C		1	
Gekkonidae	*Diplodactylus vittatus*	wood gecko	C		1	1
Gekkonidae	*Gehyra australis*	northern dtella	C		1	
Gekkonidae	*Gehyra dubia*		C		1	1
Gekkonidae	*Gehyra variegata*	tree dtella	C		1	
Gekkonidae	*Heteronotia binoei*	Bynoe's gecko	C		1	1
Gekkonidae	*Nephrurus milii*		C		1	
Gekkonidae	*Oedura lesueurii*	Lesueur's velvet gecko	C		1	
Gekkonidae	*Oedura monilis*		C		1	
Gekkonidae	*Oedura ocellata*		C		1	
Gekkonidae	*Oedura rhombifer*	zig-zag gecko	C		1	
Gekkonidae	*Oedura robusta*	robust velvet gecko	C		1	1
Gekkonidae	*Oedura tryoni*	southern spotted velvet gecko	C		1	
Gekkonidae	*Phyllurus caudiannulatus*	ringed thin-tailed gecko	R		1	
Gekkonidae	*Saltuarius cornutus*	northern leaf-tailed gecko	C		1	
Gekkonidae	*Saltuarius salebrosus*	rough-throated leaf-tailed gecko	C		1	
Gekkonidae	*Strophurus elderi*	jewelled gecko	C		1	
Gekkonidae	*Strophurus taenicauda*	golden-tailed gecko	R		1	
Gekkonidae	*Strophurus williamsi*	soft-spined gecko	C		1	
Gekkonidae	*Underwoodisaurus milii*				1	
Pygopodidae	*Delma inornata*		C		1	
Pygopodidae	*Delma plebeia*	common delma	C		1	
Pygopodidae	*Delma tincta*		C		1	
Pygopodidae	*Delma torquata*	collared delma	V	V	1	
Pygopodidae	*Lialis burtonis*	Burton's legless lizard	C		1	1
Pygopodidae	*Paradelma orientalis*	brigalow scaly-foot	V	V	1	
Pygopodidae	*Pygopus lepidopodus*	common scaly-foot	C		1	1
Pygopodidae	*Pygopus schraderi*		C		1	
Agamidae	*Amphibolurus muricatus*	jacky lizard	C		1	
Agamidae	*Amphibolurus nobbi*		C		1	
Agamidae	*Chlamydosaurus kingii*	frilled lizard	C		1	1
Agamidae	*Diporiphora australis*		C		1	1
Agamidae	*Diporiphora bilineata*	two-lined dragon	C		1	
Agamidae	*Hypsilurus spinipes*	southern angle-headed dragon	C		1	
Agamidae	*Physignathus lesueurii*	eastern water dragon	C		1	1
Agamidae	*Pogona barbata*	bearded dragon	C		1	1
Varanidae	*Varanus gouldii*	sand monitor	C		1	1

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Varanidae	*Varanus tristis*	black-tailed monitor	C		1	
Varanidae	*Varanus varius*	lace monitor	C		1	1
Scincidae	*Anomalopus leuckartii*		C		1	
Scincidae	*Anomalopus verreauxii*		C		1	1
Scincidae	*Calyptotis lepidorostrum*		C		1	
Scincidae	*Calyptotis scutirostrum*		C		1	1
Scincidae	*Calyptotis temporalis*		C		1	
Scincidae	*Carlia amax*		C		1	
Scincidae	*Carlia foliorum*		C		1	1
Scincidae	*Carlia munda*		C		1	
Scincidae	*Carlia pectoralis*		C		1	
Scincidae	*Carlia schmeltzii*		C		1	
Scincidae	*Carlia tetradactyla*		C		1	
Scincidae	*Carlia vivax*		C		1	1
Scincidae	*Cautula zia*		R		1	
Scincidae	*Coeranoscincus reticulatus*	three-toed snake-tooth skink	R	V	1	
Scincidae	*Coggeria naufragus*	satinay sand skink	C		1	
Scincidae	*Cryptoblepharus plagiocephalus*		C		1	
Scincidae	*Cryptoblepharus virgatus*		C		1	1
Scincidae	*Ctenotus arcanus*		C		1	1
Scincidae	*Ctenotus eurydice*		C		1	
Scincidae	*Ctenotus robustus*		C		1	1
Scincidae	*Ctenotus taeniolatus*	copper-tailed skink	C		1	1
Scincidae	*Cyclodomorphus gerrardii*	pink-tongued lizard	C		1	1
Scincidae	*Egernia cunninghami*	Cunningham's skink	C		1	
Scincidae	*Egernia frerei*	major skink	C		1	1
Scincidae	*Egernia major*	land mullet	C		1	1
Scincidae	*Egernia mcpheei*		C		1	
Scincidae	*Egernia modesta*		C		1	
Scincidae	*Egernia rugosa*	yakka skink	V	V	1	
Scincidae	*Egernia striolata*	tree skink	C		1	1
Scincidae	*Egernia whitii*	White's skink	C		1	
Scincidae	*Eremiascincus fasciolatus*	narrow-banded sand swimmer	C		1	
Scincidae	*Eremiascincus richardsonii*	broad-banded sand swimmer	C		1	
Scincidae	*Eroticoscincus graciloides*		R		1	
Scincidae	*Eulamprus brachysoma*		C		1	
Scincidae	*Eulamprus martini*		C		1	1
Scincidae	*Eulamprus murrayi*		C		1	
Scincidae	*Eulamprus quoyii*	eastern water skink	C		1	
Scincidae	*Eulamprus tenuis*		C		1	1
Scincidae	*Eulamprus tryoni*		C		1	
Scincidae	*Hemisphaeriodon gerrardii*				1	
Scincidae	*Lampropholis adonis*		C		1	
Scincidae	*Lampropholis amicula*		C		1	1
Scincidae	*Lampropholis colossus*		R		1	
Scincidae	*Lampropholis couperi*		C		1	
Scincidae	*Lampropholis delicata*		C		1	1
Scincidae	*Lampropholis guichenoti*		C		1	1
Scincidae	*Lerista fragilis*		C		1	
Scincidae	*Lerista punctatovittata*		C		1	
Scincidae	*Menetia greyii*		C		1	
Scincidae	*Menetia timlowi*		C		1	

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Scincidae	*Morethia boulengeri*		C		1	
Scincidae	*Morethia taeniopleura*	fire-tailed skink	C		1	1
Scincidae	*Nangura spinosa*	Nangur skink	R		1	
Scincidae	*Ophioscincus cooloolensis*		R		1	
Scincidae	*Ophioscincus ophioscincus*		C		1	
Scincidae	*Ophioscincus truncatus*		R		1	1
Scincidae	*Saiphos equalis*		C		1	1
Scincidae	*Saproscincus rosei*		R		1	
Scincidae	*Saproscincus spectabilis*		R		1	
Scincidae	*Tiliqua scincoides*	eastern blue-tongued lizard	C		1	1
Typhlopidae	*Ramphotyphlops affinis*		C		1	
Typhlopidae	*Ramphotyphlops ligatus*		C		1	1
Typhlopidae	*Ramphotyphlops nigrescens*		C		1	
Typhlopidae	*Ramphotyphlops proximus*		C		1	1
Typhlopidae	*Ramphotyphlops silvia*		R		1	
Typhlopidae	*Ramphotyphlops unguirostris*		C		1	
Typhlopidae	*Ramphotyphlops wiedii*		C		1	1
Boidae	*Antaresia maculosus*		C		1	
Boidae	*Aspidites melanocephalus*	black-headed python	C		1	
Boidae	*Morelia spilota*	carpet python	C		1	1
Colubridae	*Boiga irregularis*	brown tree snake	C		1	1
Colubridae	*Dendrelaphis punctulata*	common tree snake	C		1	1
Colubridae	*Tropidonophis mairii*	freshwater snake	C		1	1
Elapidae	*Acanthophis antarcticus*	common death adder	R		1	1
Elapidae	*Brachyurophis australis*	coral snake	C		1	
Elapidae	*Cacophis harriettae*	white-crowned snake	C		1	1
Elapidae	*Cacophis krefftii*	dwarf crowned snake	C		1	1
Elapidae	*Cacophis squamulosus*	golden crowned snake	C		1	
Elapidae	*Cryptophis boschmai*	Carpentaria whip snake	C		1	
Elapidae	*Cryptophis nigrescens*	eastern small-eyed snake	C		1	1
Elapidae	*Cryptophis nigrostriatus*	black-striped snake	C		1	
Elapidae	*Demansia psammophis*	yellow-faced whip snake	C		1	1
Elapidae	*Demansia torquata*	collared whip snake	C		1	
Elapidae	*Demansia vestigiata*	black whip snake	C		1	
Elapidae	*Denisonia devisi*	De Vis' Banded Snake	C		1	
Elapidae	*Furina diadema*	red-naped snake	C		1	
Elapidae	*Furina dunmalli*	Dunmall's snake	V	V	1	
Elapidae	*Furina ornata*	orange-naped snake	C		1	
Elapidae	*Hemiaspis damelii*	grey snake	E		1	
Elapidae	*Hemiaspis signata*	black-bellied swamp snake	C		1	1
Elapidae	*Hoplocephalus bitorquatus*	pale-headed snake	C		1	
Elapidae	*Hoplocephalus stephensii*	Stephens' banded snake	R		1	
Elapidae	*Notechis scutatus*	eastern tiger snake	C		1	
Elapidae	*Oxyuranus scutellatus*	taipan	C		1	
Elapidae	*Pseudechis australis*	king brown snake	C		1	
Elapidae	*Pseudechis guttatus*	spotted black snake	C		1	
Elapidae	*Pseudechis porphyriacus*	red-bellied black snake	C		1	1
Elapidae	*Pseudonaja nuchalis*	western brown snake	C		1	
Elapidae	*Pseudonaja textilis*	eastern brown snake	C		1	1
Elapidae	*Simoselaps warro*	robust burrowing	R		1	

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
		snake				
Elapidae	*Suta suta*	Myall Snake	C		1	
Elapidae	*Tropidechis carinatus*	rough-scaled snake	C		1	
Elapidae	*Vermicella annulata*	bandy-bandy	C		1	1
Species Richness					**151**	**52**

Table D-5 Frogs

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Myobatrachidae	*Adelotus brevis*	tusked frog	V		1	1
Myobatrachidae	*Assa darlingtoni*	pouched frog	R		1	
Myobatrachidae	*Crinia deserticola*	chirping froglet	C		1	
Myobatrachidae	*Crinia parinsignifera*	beeping froglet	C		1	1
Myobatrachidae	*Crinia signifera*	clicking froglet	C		1	1
Myobatrachidae	*Crinia tinnula*	wallum froglet	V		1	1
Myobatrachidae	*Lechriodus fletcheri*	black soled frog	R		1	
Myobatrachidae	*Limnodynastes dumerilii*	grey bellied pobblebonk	C		1	
Myobatrachidae	*Limnodynastes fletcheri*	barking frog	C		1	
Myobatrachidae	*Limnodynastes peronii*	striped marshfrog	C		1	1
Myobatrachidae	*Limnodynastes salmini*	salmon striped frog	C		1	
Myobatrachidae	*Limnodynastes tasmaniensis*	spotted grassfrog	C		1	1
Myobatrachidae	*Limnodynastes terraereginae*	scarlet sided pobblebonk	C		1	
Myobatrachidae	*Mixophyes fasciolatus*	great barred frog	C		1	
Myobatrachidae	*Mixophyes fleayi*	Fleay's barred frog	E	E	1	
Myobatrachidae	*Mixophyes iteratus*	giant barred frog	E	E	1	
Myobatrachidae	*Opisthodon ornatus*	ornate burrowing frog	C		1	1
Myobatrachidae	*Philoria kundagungun*	mountain frog	R		1	
Myobatrachidae	*Philoria loveridgeri*	Loveridege's Frog	R		1	
Myobatrachidae	*Pseudophryne coriacea*	red backed broodfrog	C		1	1
Myobatrachidae	*Pseudophryne major*	great brown broodfrog	C		1	1
Myobatrachidae	*Pseudophryne raveni*	copper backed broodfrog	C		1	1
Myobatrachidae	*Taudactylus pleione*	Kroombit tinkerfrog	E	V	1	
Myobatrachidae	*Uperoleia fusca*	dusky gungan	C		1	1
Myobatrachidae	*Uperoleia laevigata*	eastern gungan	C		1	1
Myobatrachidae	*Uperoleia rugosa*	chubby gungan	C		1	1
Hylidae	*Cyclorana alboguttata*	greenstripe frog	C		1	
Hylidae	*Cyclorana brevipes*	superb collared frog	C		1	
Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog	C		1	
Hylidae	*Litoria bicolor*	northern sedgefrog	C		1	
Hylidae	*Litoria brevipalmata*	green thighed frog	R		1	
Hylidae	*Litoria caerulea*	common green treefrog	C		1	1
Hylidae	*Litoria chloris*	orange eyed treefrog	C		1	
Hylidae	*Litoria cooloolensis*	Cooloola sedgefrog	R		1	1
Hylidae	*Litoria dentata*	bleating treefrog	C		1	1
Hylidae	*Litoria fallax*	eastern sedgefrog	C		1	1
Hylidae	*Litoria freycineti*	wallum rocketfrog	V		1	1
Hylidae	*Litoria gracilenta*	graceful treefrog	C		1	1
Hylidae	*Litoria inermis*	bumpy rocketfrog	C		1	
Hylidae	*Litoria latopalmata*	broad palmed rocketfrog	C		1	1
Hylidae	*Litoria nasuta*	striped rocketfrog	C		1	1
Hylidae	*Litoria olongburensis*	wallum sedgefrog	V	V	1	1
Hylidae	*Litoria pearsoniana*	cascade treefrog	E		1	
Hylidae	*Litoria peronii*	emerald spotted treefrog	C		1	1

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Hylidae	*Litoria rothii*	northern laughing treefrog	C		1	
Hylidae	*Litoria rubella*	ruddy treefrog	C		1	1
Hylidae	*Litoria tyleri*	southern laughing treefrog	C		1	1
Hylidae	*Litoria verreauxii*	whistling treefrog	C		1	
Hylidae	*Litoria wilcoxii*	stony creek frog	C		1	1
Species Richness					**49**	**26**

Table D-6 Birds

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Casuariidae	*Dromaius novaehollandiae*	emu	C		1	1
Megapodiidae	*Alectura lathami*	Australian brush-turkey	C		1	1
Phasianidae	*Coturnix chinensis*	king quail	C		1	1
Phasianidae	*Coturnix pectoralis*	stubble quail	C		1	1
Phasianidae	*Coturnix ypsilophora*	brown quail	C		1	1
Anseranatidae	*Anseranas semipalmata*	magpie goose	C		1	1
Anatidae	*Anas castanea*	chestnut teal	C		1	1
Anatidae	*Anas gracilis*	grey teal	C		1	1
Anatidae	*Anas rhynchotis*	Australasian shoveler	C		1	
Anatidae	*Anas superciliosa*	Pacific black duck	C		1	1
Anatidae	*Aythya australis*	hardhead	C		1	1
Anatidae	*Biziura lobata*	musk duck	C		1	1
Anatidae	*Chenonetta jubata*	Australian wood duck	C		1	1
Anatidae	*Cygnus atratus*	black swan	C		1	1
Anatidae	*Dendrocygna arcuata*	wandering whistling-duck	C		1	1
Anatidae	*Dendrocygna eytoni*	plumed whistling-duck	C		1	1
Anatidae	*Malacorhynchus membranaceus*	pink-eared duck	C		1	
Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose	R		1	1
Anatidae	*Nettapus pulchellus*	green pygmy-goose	C		1	
Anatidae	*Oxyura australis*	blue-billed duck	C		1	1
Anatidae	*Stictonetta naevosa*	freckled duck	R		1	1
Anatidae	*Tadorna radjah*	radjah shelduck	R		1	
Anatidae	*Tadorna tadornoides*	Australian shelduck	C		1	
Podicipedidae	*Podiceps cristatus*	great crested grebe	C		1	1
Podicipedidae	*Poliocephalus poliocephalus*	hoary-headed grebe	C		1	1
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe	C		1	1
Sulidae	*Morus serrator*	Australasian gannet	C		1	1
Sulidae	*Sula dactylatra*	masked booby	C		1	1
Sulidae	*Sula leucogaster*	brown booby	C		1	1
Anhingidae	*Anhinga melanogaster*	darter	C		1	1
Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant	C		1	1
Phalacrocoracidae	*Phalacrocorax melanoleucos*	little pied cormorant	C		1	1
Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant	C		1	1
Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant	C		1	1
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican	C		1	1
Fregatidae	*Fregata ariel*	lesser frigatebird	C		1	1
Fregatidae	*Fregata minor*	great frigatebird	C		1	1
Ardeidae	*Ardea alba*	great egret	C		1	1
Ardeidae	*Ardea ibis*	cattle egret	C		1	1
Ardeidae	*Ardea intermedia*	intermediate egret	C		1	1
Ardeidae	*Ardea pacifica*	white-necked heron	C		1	1
Ardeidae	*Ardea sumatrana*	great-billed heron	C		1	
Ardeidae	*Botaurus poiciloptilus*	Australasian bittern	C		1	1
Ardeidae	*Butorides striatus*	striated heron	C		1	1
Ardeidae	*Egretta garzetta*	little egret	C		1	1
Ardeidae	*Egretta novaehollandiae*	white-faced heron	C		1	1
Ardeidae	*Egretta sacra*	eastern reef egret	C		1	1
Ardeidae	*Ixobrychus flavicollis*	black bittern	C		1	1
Ardeidae	*Ixobrychus minutus*	little bittern	C		1	1
Ardeidae	*Nycticorax caledonicus*	nankeen night heron	C		1	1
Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill	C		1	1
Threskiornithidae	*Platalea regia*	royal spoonbill	C		1	1

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Threskiornithidae	*Plegadis falcinellus*	glossy ibis	C		1	1
Threskiornithidae	*Threskiornis molucca*	Australian white ibis	C		1	1
Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis	C		1	1
Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork	R		1	1
Accipitridae	*Accipiter cirrhocephalus*	collared sparrowhawk	C		1	1
Accipitridae	*Accipiter fasciatus*	brown goshawk	C		1	1
Accipitridae	*Accipiter novaehollandiae*	grey goshawk	R		1	1
Accipitridae	*Aquila audax*	wedge-tailed eagle	C		1	1
Accipitridae	*Aviceda subcristata*	Pacific baza	C		1	1
Accipitridae	*Circus approximans*	swamp harrier	C		1	1
Accipitridae	*Circus assimilis*	spotted harrier	C		1	1
Accipitridae	*Elanus axillaris*	black-shouldered kite	C		1	1
Accipitridae	*Elanus scriptus*	letter-winged kite	C		1	
Accipitridae	*Erythrotriorchis radiatus*	red goshawk	E	V	1	
Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle	C		1	1
Accipitridae	*Haliastur indus*	brahminy kite	C		1	1
Accipitridae	*Haliastur sphenurus*	whistling kite	C		1	1
Accipitridae	*Hamirostra melanosternon*	black-breasted buzzard	C		1	
Accipitridae	*Hieraaetus morphnoides*	little eagle	C		1	1
Accipitridae	*Lophoictinia isura*	square-tailed kite	R		1	1
Accipitridae	*Milvus migrans*	black kite	C		1	
Accipitridae	*Pandion haliaetus*	osprey	C		1	1
Falconidae	*Falco berigora*	brown falcon	C		1	1
Falconidae	*Falco cenchroides*	nankeen kestrel	C		1	1
Falconidae	*Falco hypoleucos*	grey falcon	R		1	
Falconidae	*Falco longipennis*	Australian hobby	C		1	1
Falconidae	*Falco peregrinus*	peregrine falcon	C		1	1
Falconidae	*Falco subniger*	black falcon	C		1	
Gruidae	*Grus rubicunda*	brolga	C		1	1
Rallidae	*Amaurornis olivaceus*	bush-hen	C		1	1
Rallidae	*Fulica atra*	Eurasian coot	C		1	1
Rallidae	*Gallinula tenebrosa*	dusky moorhen	C		1	1
Rallidae	*Gallinula ventralis*	black-tailed native-hen	C		1	
Rallidae	*Gallirallus philippensis*	buff-banded rail	C		1	1
Rallidae	*Porphyrio porphyrio*	purple swamphen	C		1	1
Rallidae	*Porzana fluminea*	Australian spotted crake	C		1	1
Rallidae	*Porzana pusilla*	Baillon's crake	C		1	1
Rallidae	*Porzana tabuensis*	spotless crake	C		1	
Rallidae	*Rallus pectoralis*	Lewin's rail	R		1	1
Otididae	*Ardeotis australis*	Australian bustard	C		1	
Turnicidae	*Turnix maculosa*	red-backed button-quail	C		1	1
Turnicidae	*Turnix melanogaster*	black-breasted button-quail	V	V	1	1
Turnicidae	*Turnix pyrrhothorax*	red-chested button-quail	C		1	1
Turnicidae	*Turnix varia*	painted button-quail	C		1	1
Turnicidae	*Turnix velox*	little button-quail	C		1	1
Scolopacidae	*Actitis hypoleucos*	common sandpiper	C		1	1
Scolopacidae	*Arenaria interpres*	ruddy turnstone	C		1	1
Scolopacidae	*Calidris acuminata*	sharp-tailed sandpiper	C		1	1
Scolopacidae	*Calidris alba*	sanderling	C		1	1
Scolopacidae	*Calidris canutus*	red knot	C		1	1
Scolopacidae	*Calidris ferruginea*	curlew sandpiper	C		1	1
Scolopacidae	*Calidris melanotos*	pectoral sandpiper	C		1	1
Scolopacidae	*Calidris ruficollis*	red-necked stint	C		1	1
Scolopacidae	*Calidris subminuta*	long-toed stint	C		1	1

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Scolopacidae	*Calidris tenuirostris*	great knot	C		1	1
Scolopacidae	*Gallinago hardwickii*	Latham's snipe	C		1	1
Scolopacidae	*Heteroscelus brevipes*	grey-tailed tattler	C		1	1
Scolopacidae	*Heteroscelus incanus*	wandering tattler	C		1	1
Scolopacidae	*Limicola falcinellus*	broad-billed sandpiper	C		1	1
Scolopacidae	*Limnodromus semipalmatus*	Asian dowitcher	C		1	1
Scolopacidae	*Limosa lapponica*	bar-tailed godwit	C		1	1
Scolopacidae	*Limosa limosa*	black-tailed godwit	C		1	1
Scolopacidae	*Numenius madagascariensis*	eastern curlew	R		1	1
Scolopacidae	*Numenius minutus*	little curlew	C		1	1
Scolopacidae	*Numenius phaeopus*	whimbrel	C		1	1
Scolopacidae	*Phalaropus lobatus*	red-necked phalarope	C		1	1
Scolopacidae	*Philomachus pugnax*	ruff	C		1	1
Scolopacidae	*Tringa flavipes*	lesser yellowlegs	C		1	1
Scolopacidae	*Tringa glareola*	wood sandpiper	C		1	1
Scolopacidae	*Tringa nebularia*	common greenshank	C		1	1
Scolopacidae	*Tringa stagnatilis*	marsh sandpiper	C		1	1
Scolopacidae	*Xenus cinereus*	terek sandpiper	C		1	1
Rostratulidae	*Rostratula benghalensis*	painted snipe	V	V	1	1
Jacanidae	*Irediparra gallinacea*	comb-crested jacana	C		1	1
Burhinidae	*Burhinus grallarius*	bush stone-curlew	C		1	1
Burhinidae	*Esacus neglectus*	beach stone-curlew	V		1	1
Haematopodidae	*Haematopus fuliginosus*	sooty oystercatcher	R		1	1
Haematopodidae	*Haematopus longirostris*	pied oystercatcher	C		1	1
Recurvirostridae	*Cladorhynchus leucocephalus*	banded stilt	C		1	
Recurvirostridae	*Himantopus himantopus*	black-winged stilt	C		1	1
Recurvirostridae	*Recurvirostra novaehollandiae*	red-necked avocet	C		1	1
Charadriidae	*Charadrius bicinctus*	double-banded plover	C		1	1
Charadriidae	*Charadrius leschenaultii*	greater sand plover	C		1	1
Charadriidae	*Charadrius mongolus*	lesser sand plover	C		1	1
Charadriidae	*Charadrius ruficapillus*	red-capped plover	C		1	1
Charadriidae	*Charadrius veredus*	oriental plover	C		1	
Charadriidae	*Elseyornis melanops*	black-fronted dotterel	C		1	1
Charadriidae	*Erythrogonys cinctus*	red-kneed dotterel	C		1	1
Charadriidae	*Pluvialis fulva*	Pacific golden plover	C		1	1
Charadriidae	*Pluvialis squatarola*	grey plover	C		1	1
Charadriidae	*Thinornis rubricollis*	hooded plover	C		1	
Charadriidae	*Vanellus miles*	masked lapwing	C		1	1
Charadriidae	*Vanellus tricolor*	banded lapwing	C		1	1
Glareolidae	*Glareola maldivarum*	oriental pratincole	C		1	
Glareolidae	*Stiltia isabella*	Australian pratincole	C		1	1
Laridae	*Chlidonias hybridus*	whiskered tern	C		1	1
Laridae	*Chlidonias leucopterus*	white-winged black tern	C		1	1
Laridae	*Larus novaehollandiae*	silver gull	C		1	1
Laridae	*Stercorarius parasiticus*	Arctic jaeger	C		1	1
Laridae	*Stercorarius pomarinus*	pomarine jaeger	C		1	
Laridae	*Sterna albifrons*	little tern	E		1	1
Laridae	*Sterna bengalensis*	lesser crested tern	C		1	1
Laridae	*Sterna bergii*	crested tern	C		1	1
Laridae	*Sterna caspia*	Caspian tern	C		1	1
Laridae	*Sterna hirundo*	common tern	C		1	1
Laridae	*Sterna nilotica*	gull-billed tern	C		1	1
Columbidae	*Chalcophaps indica*	emerald dove	C		1	1
Columbidae	*Columba leucomela*	white-headed pigeon	C		1	1

Family	Scientific Name	Common Name	NCA	EPBCA	SEQ	MB
Columbidae	*Columba livia*	rock dove				
Columbidae	*Geopelia cuneata*	diamond dove	C		1	
Columbidae	*Geopelia humeralis*	bar-shouldered dove	C		1	1
Columbidae	*Geopelia striata*	peaceful dove	C		1	1
Columbidae	*Geophaps scripta scripta*	squatter pigeon	V	V	1	
Columbidae	*Leucosarcia melanoleuca*	wonga pigeon	C		1	1
Columbidae	*Lopholaimus antarcticus*	topknot pigeon	C		1	1
Columbidae	*Macropygia amboinensis*	brown cuckoo-dove	C		1	1
Columbidae	*Ocyphaps lophotes*	crested pigeon	C		1	1
Columbidae	*Phaps chalcoptera*	common bronzewing	C		1	1
Columbidae	*Phaps elegans*	brush bronzewing	C		1	
Columbidae	*Ptilinopus magnificus*	wompoo fruit-dove	C		1	1
Columbidae	*Ptilinopus regina*	rose-crowned fruit-dove	C		1	1
Columbidae	*Ptilinopus superbus*	superb fruit-dove	C		1	1
Columbidae	*Streptopelia chinensis*	spotted turtle-dove				
Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo	C		1	1
Cacatuidae	*Cacatua leadbeateri*	Major Mitchell's cockatoo	V		1	
Cacatuidae	*Cacatua roseicapilla*	galah	C		1	1
Cacatuidae	*Cacatua sanguinea*	little corella	C		1	1
Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo	C		1	1
Cacatuidae	*Calyptorhynchus funereus*	yellow-tailed black-cockatoo	C		1	1
Cacatuidae	*Calyptorhynchus lathami*	glossy black-cockatoo	V		1	1
Cacatuidae	*Nymphicus hollandicus*	cockatiel	C		1	
Psittacidae	*Alisterus scapularis*	Australian king-parrot	C		1	1
Psittacidae	*Aprosmictus erythropterus*	red-winged parrot	C		1	
Psittacidae	*Barnardius zonarius*	Australian ringneck	C		1	
Psittacidae	*Barnardius zonarius barnardi*	mallee ringneck	C		1	
Psittacidae	*Cacatua tenuirostris*	long-billed corella	C		1	
Psittacidae	*Cyclopsitta diophthalma coxeni*	Coxen's fig-parrot	E	E	1	
Psittacidae	*Glossopsitta concinna*	musk lorikeet	C		1	1
Psittacidae	*Glossopsitta porphyrocephala*	purple-crowned lorikeet	C		1	
Psittacidae	*Glossopsitta pusilla*	little lorikeet	C		1	1
Psittacidae	*Lathamus discolor*	swift parrot	E	E	1	
Psittacidae	*Melopsittacus undulatus*	budgerigar	C		1	
Psittacidae	*Neophema pulchella*	turquoise parrot	R		1	
Psittacidae	*Neophema splendida*	scarlet-chested parrot	C		1	
Psittacidae	*Northiella haematogaster*	blue bonnet	C		1	
Psittacidae	*Pezoporus wallicus wallicus*	ground parrot	V		1	
Psittacidae	*Platycercus adscitus*	pale-headed rosella	C		1	1
Psittacidae	*Platycercus elegans*	crimson rosella	C		1	1
Psittacidae	*Platycercus eximius*	eastern rosella	C		1	
Psittacidae	*Psephotus haematonotus*	red-rumped parrot	C		1	1
Psittacidae	*Psitteuteles versicolor*	varied lorikeet	C		1	
Psittacidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet	C		1	1
Psittacidae	*Trichoglossus haematodus*	rainbow lorikeet	C		1	1
Cuculidae	*Cacomantis flabelliformis*	fan-tailed cuckoo	C		1	1
Cuculidae	*Cacomantis variolosus*	brush cuckoo	C		1	1
Cuculidae	*Chrysococcyx basalis*	Horsfield's bronze-cuckoo	C		1	1
Cuculidae	*Chrysococcyx lucidus*	shining bronze-cuckoo	C		1	1
Cuculidae	*Chrysococcyx minutillus*	little bronze-cuckoo	C		1	1
Cuculidae	*Chrysococcyx osculans*	black-eared cuckoo	C		1	1
Cuculidae	*Chrysococcyx russatus*	Gould's bronze-cuckoo	C		1	1
Cuculidae	*Cuculus pallidus*	pallid cuckoo	C		1	1

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Cuculidae	*Cuculus saturatus*	oriental cuckoo	C		1	1
Cuculidae	*Eudynamys scolopacea*	common koel	C		1	1
Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo	C		1	1
Centropodidae	*Centropus phasianinus*	pheasant coucal	C		1	1
Strigidae	*Ninox connivens*	barking owl	C		1	1
Strigidae	*Ninox novaeseelandiae*	southern boobook	C		1	1
Strigidae	*Ninox rufa queenslandica*	rufous owl (sth. subsp.)	V		1	
Strigidae	*Ninox strenua*	powerful owl	V		1	1
Tytonidae	*Tyto alba*	barn owl	C		1	1
Tytonidae	*Tyto capensis*	grass owl	C		1	1
Tytonidae	*Tyto novaehollandiae*	masked owl	C		1	
Tytonidae	*Tyto tenebricosa*	sooty owl	R		1	
Podargidae	*Podargus ocellatus plumiferus*	plumed frogmouth	V		1	
Podargidae	*Podargus strigoides*	tawny frogmouth	C		1	1
Caprimulgidae	*Caprimulgus macrurus*	large-tailed nightjar	C		1	
Caprimulgidae	*Eurostopodus argus*	spotted nightjar	C		1	
Caprimulgidae	*Eurostopodus mystacalis*	white-throated nightjar	C		1	1
Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar	C		1	1
Apodidae	*Apus affinis*	house swift	C		1	
Apodidae	*Apus pacificus*	fork-tailed swift	C		1	1
Apodidae	*Collocalia esculenta*	glossy swiftlet	C		1	
Apodidae	*Collocalia spodiopygius*	white-rumped swiftlet	R		1	
Apodidae	*Collocalia vanikorensis*	uniform swiftlet	C		1	
Apodidae	*Hirundapus caudacutus*	white-throated needletail	C		1	1
Alcedinidae	*Alcedo azurea*	azure kingfisher	C		1	1
Halcyonidae	*Dacelo leachii*	blue-winged kookaburra	C		1	
Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra	C		1	1
Halcyonidae	*Todiramphus chloris*	collared kingfisher	C		1	1
Halcyonidae	*Todiramphus macleayii*	forest kingfisher	C		1	1
Halcyonidae	*Todiramphus pyrrhopygia*	red-backed kingfisher	C		1	
Halcyonidae	*Todiramphus sanctus*	sacred kingfisher	C		1	1
Meropidae	*Merops ornatus*	rainbow bee-eater	C		1	1
Coraciidae	*Eurystomus orientalis*	dollarbird	C		1	1
Pittidae	*Pitta versicolor*	noisy pitta	C		1	1
Menuridae	*Menura alberti*	Albert's lyrebird	R		1	
Menuridae	*Menura novaehollandiae*	superb lyrebird	R		1	
Atrichornithidae	*Atrichornis rufescens*	rufous scrub-bird	V		1	
Climacteridae	*Climacteris affinis*	white-browed treecreeper	C		1	
Climacteridae	*Climacteris erythrops*	red-browed treecreeper	R		1	
Climacteridae	*Climacteris picumnus*	brown treecreeper	C		1	
Climacteridae	*Cormobates leucophaeus*	white-throated treecreeper	C		1	1
Maluridae	*Malurus cyaneus*	superb fairy-wren	C		1	1
Maluridae	*Malurus lamberti*	variegated fairy-wren	C		1	1
Maluridae	*Malurus melanocephalus*	red-backed fairy-wren	C		1	1
Maluridae	*Stipiturus malachurus*	southern emu-wren	V		1	
Pardalotidae	*Acanthiza apicalis*	inland thornbill	C		1	
Pardalotidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill	C		1	1
Pardalotidae	*Acanthiza lineata*	striated thornbill	C		1	1
Pardalotidae	*Acanthiza nana*	yellow thornbill	C		1	1
Pardalotidae	*Acanthiza pusilla*	brown thornbill	C		1	1
Pardalotidae	*Acanthiza reguloides*	buff-rumped thornbill	C		1	1
Pardalotidae	*Chthonicola sagittata*	speckled warbler	C		1	1
Pardalotidae	*Dasyornis brachypterus*	eastern bristlebird	E	E	1	
Pardalotidae	*Gerygone fusca*	western gerygone	C		1	

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Pardalotidae	*Gerygone levigaster*	mangrove gerygone	C		1	1
Pardalotidae	*Gerygone mouki*	brown gerygone	C		1	1
Pardalotidae	*Gerygone olivacea*	white-throated gerygone	C		1	1
Pardalotidae	*Gerygone palpebrosa*	fairy gerygone	C		1	
Pardalotidae	*Hylacola pyrrhopygia*	chestnut-rumped heathwren	C		1	
Pardalotidae	*Pardalotus punctatus*	spotted pardalote	C		1	1
Pardalotidae	*Pardalotus rubricatus*	red-browed pardalote	C		1	
Pardalotidae	*Pardalotus striatus*	striated pardalote	C		1	1
Pardalotidae	*Sericornis citreogularis*	yellow-throated scrubwren	C		1	1
Pardalotidae	*Sericornis frontalis*	white-browed scrubwren	C		1	1
Pardalotidae	*Sericornis magnirostris*	large-billed scrubwren	C		1	1
Pardalotidae	*Smicrornis brevirostris*	weebill	C		1	1
Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater	C		1	1
Meliphagidae	*Acanthorhynchus tenuirostris*	eastern spinebill	C		1	1
Meliphagidae	*Anthochaera carunculata*	red wattlebird	C		1	1
Meliphagidae	*Anthochaera chrysoptera*	little wattlebird	C		1	1
Meliphagidae	*Certhionyx niger*	black honeyeater	C		1	
Meliphagidae	*Conopophila rufogularis*	rufous-throated honeyeater	C		1	
Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater	C		1	1
Meliphagidae	*Epthianura albifrons*	white-fronted chat	C		1	
Meliphagidae	*Grantiella picta*	painted honeyeater	R		1	
Meliphagidae	*Lichenostomus chrysops*	yellow-faced honeyeater	C		1	1
Meliphagidae	*Lichenostomus fasciogularis*	mangrove honeyeater	C		1	1
Meliphagidae	*Lichenostomus fuscus*	fuscous honeyeater	C		1	1
Meliphagidae	*Lichenostomus leucotis*	white-eared honeyeater	C		1	
Meliphagidae	*Lichenostomus melanops*	yellow-tufted honeyeater	C		1	
Meliphagidae	*Lichenostomus penicillatus*	white-plumed honeyeater	C		1	
Meliphagidae	*Lichenostomus versicolor*	varied honeyeater	C		1	
Meliphagidae	*Lichenostomus virescens*	singing honeyeater	C		1	
Meliphagidae	*Lichmera indistincta*	brown honeyeater	C		1	1
Meliphagidae	*Manorina flavigula*	yellow-throated miner	C		1	
Meliphagidae	*Manorina melanocephala*	noisy miner	C		1	1
Meliphagidae	*Manorina melanophrys*	bell miner	C		1	
Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater	C		1	1
Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater	C		1	1
Meliphagidae	*Melithreptus brevirostris*	brown-headed honeyeater	C		1	
Meliphagidae	*Melithreptus gularis*	black-chinned honeyeater	R		1	1
Meliphagidae	*Melithreptus lunatus*	white-naped honeyeater	C		1	1
Meliphagidae	*Myzomela obscura*	dusky honeyeater	C		1	
Meliphagidae	*Myzomela sanguinolenta*	scarlet honeyeater	C		1	1
Meliphagidae	*Philemon buceroides*	helmeted friarbird	C		1	
Meliphagidae	*Philemon citreogularis*	little friarbird	C		1	1
Meliphagidae	*Philemon corniculatus*	noisy friarbird	C		1	1
Meliphagidae	*Phylidonyris albifrons*	white-fronted honeyeater	C		1	
Meliphagidae	*Phylidonyris nigra*	white-cheeked honeyeater	C		1	1
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland honeyeater	C		1	1
Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater	C		1	1
Meliphagidae	*Ramsayornis fasciatus*	bar-breasted honeyeater	C		1	
Meliphagidae	*Xanthomyza phrygia*	regent honeyeater	E	E	1	
Petroicidae	*Eopsaltria australis*	eastern yellow robin	C		1	1
Petroicidae	*Melanodryas cucullata*	hooded robin	C		1	
Petroicidae	*Microeca fascinans*	jacky winter	C		1	1
Petroicidae	*Petroica goodenovii*	red-capped robin	C		1	1

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Petroicidae	*Petroica multicolor*	scarlet robin	C		1	
Petroicidae	*Petroica phoenicea*	flame robin	C		1	1
Petroicidae	*Petroica rosea*	rose robin	C		1	1
Petroicidae	*Tregellasia capito*	pale-yellow robin	C		1	
Orthonychidae	*Orthonyx temminckii*	logrunner	C		1	
Pomatostomidae	*Pomatostomus halli*	Hall's babbler	C		1	
Pomatostomidae	*Pomatostomus superciliosus*	white-browed babbler	C		1	
Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler	C		1	
Cinclosomatidae	*Cinclosoma punctatum*	spotted quail-thrush	C		1	1
Cinclosomatidae	*Psophodes olivaceus*	eastern whipbird	C		1	1
Neosittidae	*Daphoenositta chrysoptera*	varied sittella	C		1	1
Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush	C		1	1
Pachycephalidae	*Colluricincla megarhyncha*	little shrike-thrush	C		1	1
Pachycephalidae	*Falcunculus frontatus*	crested shrike-tit	C		1	
Pachycephalidae	*Oreoica gutturalis*	crested bellbird	C		1	
Pachycephalidae	*Pachycephala olivacea*	olive whistler	R		1	
Pachycephalidae	*Pachycephala pectoralis*	golden whistler	C		1	1
Pachycephalidae	*Pachycephala rufiventris*	rufous whistler	C		1	1
Dicruridae	*Dicrurus bracteatus*	spangled drongo	C		1	1
Dicruridae	*Grallina cyanoleuca*	magpie-lark	C		1	1
Dicruridae	*Monarcha leucotis*	white-eared monarch	C		1	1
Dicruridae	*Monarcha melanopsis*	black-faced monarch	C		1	1
Dicruridae	*Monarcha trivirgatus*	spectacled monarch	C		1	1
Dicruridae	*Myiagra alecto*	shining flycatcher	C		1	1
Dicruridae	*Myiagra cyanoleuca*	satin flycatcher	C		1	1
Dicruridae	*Myiagra inquieta*	restless flycatcher	C		1	1
Dicruridae	*Myiagra rubecula*	leaden flycatcher	C		1	1
Dicruridae	*Rhipidura fuliginosa*	grey fantail	C		1	1
Dicruridae	*Rhipidura leucophrys*	willie wagtail	C		1	1
Dicruridae	*Rhipidura rufifrons*	rufous fantail	C		1	1
Campephagidae	*Coracina lineata*	barred cuckoo-shrike	C		1	
Campephagidae	*Coracina maxima*	ground cuckoo-shrike	C		1	
Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike	C		1	1
Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike	C		1	1
Campephagidae	*Coracina tenuirostris*	cicadabird	C		1	1
Campephagidae	*Lalage leucomela*	varied triller	C		1	1
Campephagidae	*Lalage sueurii*	white-winged triller	C		1	1
Oriolidae	*Oriolus sagittatus*	olive-backed oriole	C		1	1
Oriolidae	*Sphecotheres viridis*	figbird	C		1	1
Artamidae	*Artamus cinereus*	black-faced woodswallow	C		1	
Artamidae	*Artamus cyanopterus*	dusky woodswallow	C		1	1
Artamidae	*Artamus leucorynchus*	white-breasted woodswallow	C		1	1
Artamidae	*Artamus minor*	little woodswallow	C		1	1
Artamidae	*Artamus personatus*	masked woodswallow	C		1	1
Artamidae	*Artamus superciliosus*	white-browed woodswallow	C		1	
Artamidae	*Cracticus nigrogularis*	pied butcherbird	C		1	1
Artamidae	*Cracticus torquatus*	grey butcherbird	C		1	1
Artamidae	*Gymnorhina tibicen*	Australian magpie	C		1	1
Artamidae	*Strepera graculina*	pied currawong	C		1	1
Paradisaeidae	*Ptiloris paradiseus*	paradise riflebird	C		1	
Corvidae	*Corvus bennetti*	little crow	C		1	
Corvidae	*Corvus coronoides*	Australian raven	C		1	1
Corvidae	*Corvus orru*	Torresian crow	C		1	1

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Corcoracidae	*Corcorax melanorhamphos*	white-winged chough	C		1	
Corcoracidae	*Struthidea cinerea*	apostlebird	C		1	
Ptilonorhynchidae	*Ailuroedus crassirostris*	green catbird	C		1	
Ptilonorhynchidae	*Ailuroedus melanotis*	spotted catbird	C		1	
Ptilonorhynchidae	*Chlamydera maculata*	spotted bowerbird	C		1	
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	satin bowerbird	C		1	1
Ptilonorhynchidae	*Sericulus chrysocephalus*	regent bowerbird	C		1	
Alaudidae	*Mirafra javanica*	singing bushlark	C		1	1
Motacillidae	*Anthus novaeseelandiae*	Richard's pipit	C		1	1
Passeridae	*Lonchura castaneothorax*	chestnut-breasted mannikin	C		1	1
Passeridae	*Neochmia modesta*	plum-headed finch	C		1	
Passeridae	*Neochmia temporalis*	red-browed finch	C		1	1
Passeridae	*Stagonopleura guttata*	diamond firetail	C		1	
Passeridae	*Taeniopygia bichenovii*	double-barred finch	C		1	1
Passeridae	*Taeniopygia guttata*	zebra finch	C		1	
Nectariniidae	*Nectarinia jugularis*	yellow-bellied sunbird	C		1	
Dicaeidae	*Dicaeum hirundinaceum*	mistletoebird	C		1	1
Hirundinidae	*Cheramoeca leucosternus*	white-backed swallow	C		1	1
Hirundinidae	*Hirundo ariel*	fairy martin	C		1	1
Hirundinidae	*Hirundo neoxena*	welcome swallow	C		1	1
Hirundinidae	*Hirundo nigricans*	tree martin	C		1	1
Hirundinidae	*Hirundo rustica*	barn swallow	C		1	
Sylviidae	*Acrocephalus stentoreus*	clamorous reed-warbler	C		1	1
Sylviidae	*Cincloramphus cruralis*	brown songlark	C		1	
Sylviidae	*Cincloramphus mathewsi*	rufous songlark	C		1	
Sylviidae	*Cisticola exilis*	golden-headed cisticola	C		1	1
Sylviidae	*Cisticola juncidis laveryi*	zitting cisticola	C		1	
Sylviidae	*Megalurus gramineus*	little grassbird	C		1	1
Sylviidae	*Megalurus timoriensis*	tawny grassbird	C		1	1
Zosteropidae	*Zosterops lateralis*	silvereye	C		1	1
Muscicapidae	*Zoothera heinei*	russet-tailed thrush	C		1	
Muscicapidae	*Zoothera lunulata*	Bassian thrush	C		1	
Species Richness					**403**	**290**

APPENDIX E: CURRICULAR VITAE OF AUTHORS

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Catchment and examines the risks and adaptation options for responding to expected increases in saltwater intrusion and flooding as a result of sea level rise and increased intensity of cyclones.

Moreton Bay Ecological Character Description (2008 – on-going). Project Manager for a major study of the wetlands of Moreton Bay including an ECD report, a report on the assessment and effectiveness of management actions, a report on management goals and environmental indicators and a review and refinement of the Moreton Bay Ramsar boundary and Ramsar Information Sheet. Extensive liaison and consultation with the scientists of the Moreton Bay Partnership Scientific Expert Panel to develop a Whole-of-Bay Conceptual Model.

Cooktown Long Term Dredging and Dredge Spoil Management Strategy (2007 – on-going). Project Manager for preparation of a long term strategy for Queensland Transport. Led a team of coastal engineers and scientists to assess the impacts from dredging and material placement from maintenance dredging of the Endeavour River.

Northshore Hamilton Land Use Master Plan (2008). Led and project managed inputs in the fields of ecology and coastal planning for the project being undertaken for the Urban Land Development Authority. Project undertaken in partnership with lead consultant Hassel for the proposed community in Hamilton, Queensland.

Policy Review for Artificial Waterways - Queensland EPA (2008). Project Manager and leader of a team of water quality scientists and ecologists to prepare a policy analysis and options paper for the Queensland EPA on the issue of artificial lake and waterway development in Queensland. Policy advice used in formulation of policy positions under the Queensland State Coastal Management Plan.

SUN LNG Plant EIS, Gladstone Qld (2007-2008). Project Manager for BMT WBM input into the EIS in the fields of ecology, water quality, coastal planning and coastal management. Project undertaken in partnership with lead EIS consultant RLMS for the proposed LNG Plant in Gladstone, Queensland.

Currawinya Lakes Ecological Character Description (2007 – 2008). Project Manager and Lead Author in the preparation of the ECD for the Currawinya Lakes Ramsar Site in Western Queensland. Managed a small team of ecologists and hydrologists in preparation of the resource assessment, Ramsar Information Sheet, and revised mapping boundaries.

Marine Extraction Material Allocation Process (2007). Represented several firms through the preparation of application and assessment reports for allocations of sand resources from Moreton Bay.

New Parallel Runway Project EIS (2005 – 2007). Co-ordinator for all consultant contracts related to land and marine impact issues associated with the Environmental Impact Statement (EIS) process. Project managed the dredge management strategy for the project involving a multi-disciplinary team of consultants and experts as well as the wetland mitigation and offset strategy for the project, approved by the Australian Government.

Development of Water Quality Objectives under the EPP Water (2004 – 2005). Leader of the project management team that delivered environmental values and water quality objectives for Southeast Queensland, Mary River and Douglas Shire under Schedule 1 of the Environmental Protection Policy (EPP) Water. Delivery of a consultation and engagement programme with key stakeholders and project management Government approval process.

Operational policy reform – Queensland Parks and Wildlife Service (2002). Project manager for review and development of a range of operational policies related to the management of the Queensland protected area and State Forest estate. Established systems for internal review, evaluation and quality assurance for policy development between the Service's central and regional offices.

Development and Implementation of Queensland coastal legislation reform (2000-2003). Project manager for major reform to the State's coastal planning and assessment legislation. Project manager for implementation of the amendment process including negotiation with key Government and non-Government stakeholders, training and information delivery, development of new systems and procedures and preparation of operational policy and guidelines.

Development of the Queensland Coastal Policy (State Coastal Management Plan) (2000-2002). Lead role within the project team that developed the 2001 State Coastal Plan and first generation regional coastal management plans under the Queensland Coastal Protection and Management Act 1995. Development of key policies related to coastal development, natural resources, cultural resources and coastal processes and management.

Publications and Presentations

Fisk, GW. (2008) 'National Coastal Policy – Issues for Consideration'. Presented at the National Coast to Coast Conference 2008. Darwin Northern Territory.

Fisk, GW. (2004) 'Integrated Coastal Zone Management – the Queensland Experience". Presented at the Coastal Zone Asia Pacific Conference 2004. Brisbane, Queensland.

Contributing author on Queensland State of the Environment Reports (1999) and (2003).

Fisk, GW. (2002) 'Regulation of development on Queensland's coast under the Coastal Protection and Management Act'. Presented at the Coast to Coast 2002 Conference. Tweed Heads, New South Wales.

"Perceptions of the Performance of State Coastal Zone Management Programs in the United States. II. State and Regional Analysis" Robert W. Knecht, Biliana Cicin-Sain, Co-authors. *Coastal Management* Volume 25, No. 3, 1997: pp. 325 - 343.

"Growth in Capacity for Integrated Coastal Management Since UNCED: An International Perspective" Professors Biliana Cicin-Sain and Robert Knecht, Co-Authors, *Ocean and Coastal Management* Volume 26, 1996.

"Perceptions of the Performance of State Coastal Zone Management Programs in the United States" Professors Robert Knecht and Biliana Cicin-Sain, Co-authors. *Coastal Management* Volume 24, No. 2, 1996: pp. 141-164.

"Policy Issues in the Development of Marine Biotechnology: A Global Perspective" Co-author with Cicin-Sain, Knecht, and Bouman *Ocean Yearbook 12*, 1996.

Book Reviews on the Wollongong Papers on Maritime Policy Numbers 1 and 2 in Ocean and Coastal Management Volume 24, 1996.

"Impacts of Expansion at Port Everglades: A Case Study of Environmental Mitigation", in <u>Urban Growth and Sustainable Habitats: Case Studies of Policy</u>

Conflicts in South Florida's Coastal Environment. D. Suman, M. Shivlani, M. Villanueva eds. 1995: pp. 9-30.

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Project Experience

Port and Dredging Related Assessments

Toondah Harbour Ecotoxicological Assessments (2006). Project manager for a project assessing potential ecotoxicological impacts associated with the disposal of dredge spoil disposal within a marine park.

Dalrymple Bay Coal Terminal Expansion Study (2005-2006). Principal ecologist for a MCU application examining impacts of port expansion on marine water quality, ecological communities and fisheries values.

Brisbane Airport Expansion EIS (2005-2006). Principal ecologist for a major EIS examining the impacts of sand extraction in northern Moreton Bay, and reclamation of estuarine and terrestrial habitat near the existing airport.

Toondah Harbour Sediment Quality Assessments (2005). Scientist for a project assessing the physio-chemical proporties of sediments to be removed from a boat harbour.

Abbot Point Expansion EIS (2005-2006). Principal ecologist for a major EIS examining impacts of dredging of berth pockets, and on-land works within the existing port facility.

Port of Brisbane Seawall Alliance (2004). Senior scientist for environmental assessments for the construction of the Port of Brisbane expansion project.

Anoxic Sediment Management in Lake Macquarie - Review of Environmental Factors (2004). Principal ecologist for a REF examining impacts of anoxic sediment removal at three sites within Lake Macquarie, Newcastle.

Swan Bay Dredging Review of Environmental Factors (2004). Principal ecologist for a REF examining impacts of dredging and rock wall construction at Swan Bay and Swansea Channel, Lake Macquarie.

Port of Dhamra Initial Risk Identification (2004). Project manager for a study examining the potential risks and impacts of a major port project in a highly sensitive environment on the Orissa Coast, India. Particular focus of the study was on impact of port activities on the largest sea turtle rookery in the world.

Sand Extraction Study Phase 2 – Marine Benthos (2003-2004). Project manager for a research project examining the effects of dredging on marine fauna communities in Moreton Bay.

Port of Hay Point Spoil Ground Assessments (2004). Project manager on an investigation of environmental attributes and constraints to spoil dumping at the Port of Hay Point.

Port of Bing Bong Dredge Feasibility Assessments (2003). Marine biologist on a project examining the costs and benefits of dredge management options at the Port of Bing Bong, Northern Territory.

Port of Weipa Impact Review (2003). Project Manager of a study examining the potential impacts of sediment movement on biological communities at the Port of Weipa.

Port of Mackay Sampling and Analysis Plan (2002). Project Manager for the development of a SAP for the monitoring of dredge spoil.

Harrington Waters Impact Assessment Study – Supplementary Report (2002). Aquatic ecologist responsible for additional reporting for a Supplementary IAS report for a dredging proposal at Harrington, central NSW.

Port of Bundaberg Dredge Material Placement Monitoring (1997-2002). Benthic ecologist for field investigations monitoring impacts of dredging and material placement on seagrass and soft sediment macroinvertebrate communities. Responsible for the field work, identification of macroinvertebrate samples and reporting.

Hay Point Services – Trestle Contaminants Investigation (2002). Scientist examining the effects of abrasive grit on metal concentrations in sediments and biota.

Port of Hay Dredge Monitoring (2001-2003). Project Manager for monitoring impacts of dredged material placement on soft sediment macroinvertebrate communities and sediments. Responsible for the monitoring design and reporting.

Bundaberg Port Deepening EIS (2000-2001). Marine ecologist examining the estuarine benthic macroinvertebrates from dredged material placement areas at Weipa, North Queensland.

Port of Mackay Long Term Dredge Spoil Management Strategy (2000-2001). Project Manager for the development of a Long Term Dredge Spoil Management Strategy.

Weipa Dredge Monitoring (1999-2000). Aquatic ecologist examining the estuarine benthic macroinvertebrates from dredged material placement areas at Weipa, North Queensland.

Assessment of Impacts Associated With Potential Ocean Disposal of Dredged Material (2000). Project Manager co-ordinating elutriate tests and reporting of potential water quality impacts associated with dredged material at the Port of Mackay.

Port of Brisbane Reclamation Impact Assessment Study (1999-2000). Marine ecologist examining the characteristics of macrobenthic communities at and adjacent to proposed reclamation works at Fisherman Islands, Brisbane.

Port of Bundaberg Long Term Dredge Spoil Management Strategy (1999). Marne Ecologist for the development of a Long Term Dredge Spoil Management Strategy.

Assessment of the Impacts of Dredging and Material Placement at Coffs Harbour (1999). Aquatic ecologist examining the potential impacts of dredging and material placement at Muttonbird Island, Coffs Harbour.

Karumba Dredge Monitoring (1998-1999). Benthic ecologist for field investigations monitoring impacts of dredging and material placement on soft sediment macroinvertebrate communities. Responsible for the monitoring design, field work, identification of macroinvertebrate samples and reporting.

Impacts of Superbund Construction on the Ecology of Fisherman Islands (1998). Ecologist examining the potential impacts of port related works on the mangrove and seagrass communities, fisheries and sediment distributions at Fisherman Islands, Brisbane.

Boathaven Bay Marina Development Impact Assessment Study (1998). Benthic ecologist for field investigations of potential impacts of a proposed marina development in Boathaven Bay, Airlie Beach, as part of an environmental impact assessment. Responsible for survey design, field investigations of coral, soft sediment macroinvertebrate communities and fish, identification of macroinvertebrate samples and reporting.

Mourilyan Harbour Bed-Levelling Impact Assessment (1998). Benthic ecologist for field investigations of potential impacts of bed-levelling activities within Mourilyan Harbour. Involved survey design, identification of macroinvertebrate samples and reporting.

Port of Weipa Dredge Material Disposal Area Options (1997-1998). Benthic ecologist undertaking identification of soft sediment macroinvertebrate samples for a project examining potential dredge material placement areas.

Removal of Tony's Bar Impact Assessment Study (1997). Benthic ecologist for field investigations of potential impacts of bar removal in the Tweed River as part of an environmental impact assessment. Responsible for survey design, field investigations of hard-bottom and soft sediment macroinvertebrate communities, identification of macroinvertebrate samples and reporting.

Estuary Environment Impact Assessments and Monitoring (Non-dredging)

Laguna Whitsundays Resort Environmental Assessments and Approvals (2005-2006). Senior scientist for a planning study examining the construction of a golf course and its potential impacts of marine communities and habitats.

Noosa North Shore Assessment of 4WD impacts on beach fauna (2005-2006). Project manager for a beach macroinvertebrate monitoring project.

Ninds Creek STP monitoring (2004-2005). Senior scientist for a sewage discharge-monitoring project in North Queensland. Study components included assessments of water quality, sediment quality and sewage mapping using $\delta^{15}N$ isotope analysis, and provision of recommendations on discharge criteria.

Coomera River Environmental Assessment (2004-2005). Senior scientist examining variations in estuarine macroinvertebrates in the Coomera River, and possible linkages to habitat degradation.

Cruise Terminal Assessments for Gold Coast Broadwater (2003). Senior scientist for a risk assessment examining the feasibility of developing a cruise ship terminal in Gold Coast Broadwater.

Management Advice for Sewage Spill into a Ramsar listed Wetland (2003). Project manager for an investigation into the impact of a sewage spill into a sensitive estuarine environment.

Sunaqua Sea Cage EIS (2002-2003). Ecologist for a proposed aquaculture development in eastern Moreton Bay. Responsible for reporting on macroinvertebrate impacts, focussing on nutrient enrichment impacts.

Swansea Channel Management Options Assessment (2002). Senior ecologist for aquatic vegetation mapping and conservation value assessment at Swansea Channel, Lake Macquarie.

Hexham Swamp Macroinvertebrate Monitoring Technical Advisor (2002). Provision of technical advice to Hunter Catchment Management Trust for the selection of tenders for a biological monitoring program examining impacts of floodgate removal on a brackish/freshwater wetland environment.

Upstart Bay Aquaculture Facility – Statistical Advisor (2001). Provision of statistical assessments and advice for a water quality monitoring program for waste water discharges into Upstart Bay, north Queensland.

Maryborough Co-generation Thermal Modelling (2000). Senior ecologist for assessments of the impacts of thermal discharges from a sugar refinery on aquatic communities. Responsible for survey design and reporting.

Byron Bay Sewage Treatment Plant Environment Assessments (1999-2000). Senior ecologist for environmental 'health' assessments of three estuaries in the northern rivers region, and environmental impacts of two outfalls.

Rocky Point Prawn Farm - Impact Assessment Study (1999). Ecologist examining the existing environment (biota, habitats, environmental zonings), potential impacts and environmental management of impacts for the upgrade and expansion of the Rocky Point Prawn farm, with a particular focus on waste water discharge impacts into Moreton Bay Marine Park.

Eenie Creek Impact Assessment Study (1999). Aquatic ecologist examining the existing environment and potential impacts of a retail development at Eenie Creek, Noosa.

Historical Trends in Gold Coast Water Quality (1997-1999). Ecologist examining historical changes in mangrove and seagrasses within Gold Coast City waterways, and the potential influence of water quality degradation on these changes.

Karuah River Water Quality and Oyster Health Monitoring (1998). Biologist in a baseline data collation study of the water quality and environmental health aspects of oysters in Port Stephens, prior to the construction of a bridge across the Karuah River.

Caboolture River Sewage Monitoring (1997). Benthic ecologist for field investigations to design a survey design to monitor impacts of sewage discharge on soft sediment macroinvertebrate communities.

Environmental Impact Statement - 509 Tingal Road, Wynnum (1998). Aquatic biologist examining the existing (marine biological) environment, potential impacts and mitigation strategies associated with a proposed urban development near mangrove communities in Brisbane.

Ukerebagh Passage Tidal Flap Gates EIS (1997). Aquatic biologist examining the aspects of the existing (marine biological) environment, potential impacts and mitigation strategies for the installation of tidal flap gates at Ukerebagh Passage, Tweed River.

Brisbane Airport Rail-link - Ecological Assessment (1997-1998). Aquatic biologist examining the existing (marine biological) environment and potential impacts along a number of train line routes.

Response to Australian Heritage Commission Proposed Listing of Balaclava Island and the Narrows Area (1997). Aquatic biologist examining the biological criteria used to proposed AHC listing of the Narrows area.

Estuary Management Studies

Woronora River Estuary Processes Study (2005) Principal ecologist examining ecological patterns and processes relevant to the management of Woronora River estuary, Sydney. Included estuarine vegetation mapping and macroinvertebrate surveys.

Richmond River Estuary Processes Study (2005) Principal ecologist examining patterns and processes relevant to the management of Richmond River estuary, northern NSW.

Nambucca River Estuary Management Plan and Study (2005) Aquatic ecologist responsible for the development of management strategies for the Nambucca River estuary, northern NSW.

Wooli Wooli River Estuary Processes Study (2004-2005) Principal ecologist examining patterns and processes relevant to the management Wooli Wooli River estuary, northern NSW.

Botany Bay Conceptual Environmental Understanding Study (2003). Marine ecologist on a study examining the interactions between hydraulics, water quality and ecological/fisheries patterns and processes at Botany Bay.

Gold Coast Harbour Environmental Monitoring (2003-2004). Project manager for a monitoring program examining the benthic macroinvertebrate and seagrass communities of the Broadwater, Gold Coast.

Gold Coast Harbour Environmental Baseline Data Collation Study (2002). Marine biologist for a data compilation study examining the natural, social and economic environment of the Gold Coast Harbour precinct.

Burrill Lake Estuary Processes Study (2001). Project manager and marine ecologist undertaking the estuary processes study.

Maroochy River Mouth Remediation Environmental Assessments (2001). Marine ecologist examining the environmental attributes of the Maroochy River mouth, and possible impacts associated with dredging and sediment relocation to remediate erosion problems in the study area.

Gold Coast Harbour Environmental Baseline Study (2001). Marine ecologist for the development of an environmental baseline for future planning and management of Gold Coast Harbour.

Pittwater Estuary Processes Study and Management Plan (2001). Marine Ecologist examining the processes influencing the ecological communities of Pittwater, Sydney.

Burrill Lake Causeway Assessments (2000-2001). Marine ecologist examining the impacts of the causeway on the ecology of Burrill Lake, NSW south coast.

Gunnamatta Bay Estuary Processes Study and Management Plan (2000-2001). Marine Ecologist examining the processes influencing the ecological communities of Gunnamatta Bay, Port Hacking.

Evans River Estuary Plan (2000). Ecologist for the development of a management plan for the Evans River estuary.

Gymea Bay Estuary Processes Study and Management Plan (2000-2001). Marine Ecologist examining the processes influencing the ecol0gical communities of Gymea Bay, Port Hacking.

Fennell and Edmunds Bays Remediation Strategies (2000). Aquatic ecologist for assessments of estuarine communities and habitats in and adjacent to Fennell and Edmunds Bays, Lake Macquarie. Responsible for survey design, statistical analyses and reporting.

Narrabeen Lagoon Estuary Processes Study (2000). Aquatic ecologist examining the estuarine benthic macroinvertebrates and fish communities in Narrabeen Lagoon, Sydney.

Wonboyn Estuary - Estuary Processes Study, and Estuary Management Study and Plan (2000). Ecologist examining the extent and types of ecological communities in the Wonboyn estuary, and the effects of estuary processes on the ecology of the area.

Nambucca Estuary - Estuary Processes Study (1999-2000). Ecologist examining the extent and types of ecological communities in the Nambucca estuary, and the effects of estuary processes on the ecology of the area. The results of the project provide input into the Nambucca Estuary Management Plan.

Batemans Bay/Clyde River Estuary - Estuary Processes Study (1999). Project Manager, responsible for undertaking assessments of the extent and types of ecological communities in the Batemans Bay/Clyde River estuary, the status of information on the health and condition of estuarine environments, and the effects of physical and biological processes on the ecology of the area. The results of the project provide input into the Batemans Bay/Clyde River Estuary Management Plan.

Historical Trends in Water Quality of Gold Coast Waterways (1997-2000). Aquatic ecologist examining changes in marine vegetation communities within Gold Coast waterways, and possible linkages to water quality.

Aquatic and Riparian Environmental Assessment of Gold Coast Waterways (1997-2000). Aquatic ecologist examining the condition and conservation values of aquatic communities within Gold Coast waterways.

State of Environment Assessments

State of the Catchment Report - Lake Samsonvale Catchment (2001). Environmental scientist examining pressures and condition of land and water resources in the Lake Samsonvale catchment.

State of the Environment Report - Caboolture Shire (2000). Project Manager for the 1999-2000 SoE report. Involved the identification of key indicators, and reporting on the condition, pressures and responses related to key themes.

State of the Rivers and Estuaries Report - NSW South Coast (1999). Project Manager for the ‘Estuaries’ chapter of the SoRE report.

State of the Rivers and Estuaries Report - NSW South Coast (1999). Project Manager responsible for the compilation and editing of the overall SoRE report written by DLWC.

Freshwater Ecology - Non-mining Assessments

Robina Lakes Fisheries Assessments (2005-2006). Project Manager for an investigation (legal case) of fisheries values of a proposed development in the Gold Coast hinterland.

The Edge Noosa – Aquatic Ecology and Fisheries Assessments (2005-2006). Project manager for a study examining the fish assemblages and platypus of a golf course development on Kin Kin Creek near Noosa. Targeted field surveys focussed on threatened fish species, namely Oxleyan Pygmy Perch and Honey Blue-eye, and platypus.

Caboolture-Landsborough Rail Upgrade (2005-2006). Senior aquatic ecologist for a planning study examining potential impacts of rail infrastructure of aquatic ecosystems and their values. Targeted field surveys focussed on threatened fish species, namely Oxleyan Pygmy Perch and Honey Blue-eye.

Bruce Highway Upgrade – Caboolture Morayfield (2006). Senior aquatic ecologist for a planning study examining potential impacts of road infrastructure options on aquatic ecosystems and their values.

Bruce Highway Upgrade – Cooroy to Curragh (2005). Senior aquatic ecologist for a planning study examining potential impacts of road infrastructure options on aquatic ecosystems and their values.

Burnett River Dam Baseline Monitoring Study (2003). Project manager for a multidisciplinary study examining the water quality, macrophytes, macroinvertebrates, fish and platypus assemblages of a future dam development on the Burnett River near Gayndah.

Eidsvold Weir Fish Monitoring Study (2003). Project manager for a multidisciplinary study examining the water quality, fish and platypus assemblages of a future weir development on the Burnett River near Eidsvold.

Pinjara Hills Ecological Assessments (2002). Expert witness in a court case assessing the potential impacts of a proposed development on a stream at Kenmore.

Noosa Hill Freshwater Habitat Management Plan (2002). Project Manager a Plan to develop and maintain a freshwater habitat feature in a new development.

Eprapah Creek Macroinvertebrate Monitoring (2001). Project Manager for monitoring surveys of the freshwater and estuarine reaches of Eprapah Creek, for input into a Management Plan for the catchment and waterway. Responsible for fieldwork and reporting.

Tingalpa Creek Macroinvertebrate Monitoring (2001). Project Manager for monitoring surveys of the freshwater and estuarine reaches of Tingalpa Creek, for input into a Stormwater Management Plan for the catchment and waterway. Responsible for fieldwork and reporting.

Environmental Assessments for Scrubby Creek Stormwater Management Plan (2000). Project Manager for an assessment of environment conditions and pressures on ecosystems in the upper Scrubby Creek catchment. Responsible for project management, reporting and development of management strategies.

Kooloonbung Wetland Monitoring (1999). Aquatic ecologist for monitoring the impacts of a dump site of Kooloonbung Wetland, located near Port Macquarie. Responsible for fieldwork, identification of freshwater macroinvertebrate and fish samples and reporting.

Aquatic and Riparian Fauna Surveys of Brisbane Koala Bushlands (1998). Aquatic biologist undertaking field surveys of the fish and other aquatic fauna of creek systems within Brisbane Koala Bushlands (Brisbane City Council).

Caboolture Atlas of Natural Assets - Fauna Species of Conservation Significance (1998). Aquatic ecologist for a review of fish fauna of conservation significance within the Caboolture Shire. Responsible for defining, reporting and mapping aquatic fauna species of conservation value.

Burnett River Catchment Aquatic and Terrestrial Flora/Fauna Data Review (1998). Aquatic biologist responsible for reviewing information on the aquatic fauna of the Burnett River system, and in evaluating and defining a methodology to identify areas of high conservation value within the catchment.

Central Burnett River: Hydrological and Fisheries Issues Associated with Dam & Weir Construction (1998). Aquatic biologist examining the fisheries of the Central Burnett River area, general aspects of their life-cycle, potential impacts of dam/weir construction and available mitigation strategies.

Kedron Brook Water Quality Assessments (1998-1999). Aquatic ecologist for investigations of the 'environmental health' of Kedron Brook. Responsible for field work, identification of freshwater macroinvertebrate samples and reporting.

Coomera Woods Retail Development EIS (1997). Aquatic biologist undertaking field surveys of the fish communities of creek systems within a proposed retail development on the Gold Coast, as part of an environmental impact assessment.

Fish Surveys of Gold Coast City Waterways (1999). Aquatic biologist undertaking field surveys and reporting of the fish and other aquatic fauna of 35 sites at creek systems within Gold Coast City Council.

Gowrie Creek Sewage Monitoring Design (1997). Benthic ecologist for field investigations to design a monitoring program examining the impacts of sewage discharge on macroinvertebrate communities in a highly polluted stream.

Woodford Sewage Monitoring Design (1997). Benthic ecologist for field investigations in a study to design a monitoring program of sewage discharge impacts on soft sediment macroinvertebrate communities.

Reef Ecology

Inventory and Assessment of Intertidal Rocky Shores of South-East Queensland (1998-1999). Project Manager and author of a study which defined and mapped all intertidal rocky shores within south-east Queensland. The project identified rocky shores of outstanding conservation value, with information adopted in the south-east Queensland Coastal Management Plan.

Influence of Benthic Community Structure on Reef Fishes on Moreton Island Reefs (1995-present). Scientist on a research project (with S.A. Banks, QPWS) examining the characteristics of the benthic communities at the coastal reefs off Moreton Island, and their relationship with reef fish community structure.

Influence of Habitat Availability on the Population Ecology of Anemonefishes (1993-1996). Ph.D. research program examining the population ecology of anemonefishes. This research has resulted in several refereed publications (four published, two in preparation), conference presentations and a thesis (see publication list below).

Benthic Community Structure of Northern NSW Coastal Reefs (1994-1998). Marine ecologist/author on a research project examining the characteristics of the coastal reef communities of the Tweed Coast, Byron Bay and South West Rocks (N.NSW). Results published in Harriott *et al.* (1999).

Benthic Community Ecology on Eastern Australian Sub-Tropical Rocky Reefs (1993-1996). Field assistant on a range of research projects undertaken by V. Harriott, P. Harrison and S. Banks (SCU) examining the benthic communities of Flinders Reef, Gneering Shoals, Solitary Islands and South West Rocks.

Macroalgae of Moreton Bay Database (1997). Aquatic biologist undertaking investigations on the distribution of macroalgae in Moreton Bay, and its potential use as a indicator of water quality.

General Environmental Assessments

Commonwealth Threat Abatement Plan for Marine Debris (2004-ongoing) Scientist for the development of a national plan for mitigating impacts of marine debris on listed marine species.

State of the Catchment Report - Lake Samsonvale Catchment (2001). Environmental scientist examining pressures and condition of land and water resources in the Lake Samsonvale catchment.

State of the Environment Report - Caboolture Shire (2000). Project Manager for the 1999-2000 SoE report. Involved the identification of key indicators, and reporting on the condition, pressures and responses related to key themes.

State of the Rivers and Estuaries Report - NSW South Coast (1999). Project Manager for the 'Estuaries' chapter of the SoRE report.

State of the Rivers and Estuaries Report - NSW South Coast (1999). Project Manager responsible for the compilation and editing of the overall SoRE report written by DLWC.

Freshwater Ecology – Mining

Moranbah North Mine – Assessment of Aquatic Ecosystems within a Subsidence Area (2006). Project manager for an investigation of the ecosystem health and management of a subsided river bed environment on the Isaac River, central Queensland.

Yarraman Lakes Water Quality Monitoring (2005-2006). Senior scientist examining potential impacts of mine discharges on water quality on North Stradbroke Island.

Gregory-Crinum Mine Environmental Investigations (2004-2005). Project manager for an investigation of the ecosystem health and management of waterbodies at Gregory Crinum Mine.

Kounpee Trench Recharge Risk Assessment (2004-2005). Project manager of a risk assessment examining the potential impacts of artificial recharge of a disturbed lake on North Stradbroke Island.

Kogan Power Station Baseline Water Quality Monitoring Program (2004-2005). Project manager for the development pf a sampling and analysis plan to develop a baseline water quality database for the Kogan Creek power station, Chinchilla.

Lenton Mine EMOS (2004) Development of the Water Quality component for the proposed Lenton Mine Environmental Management Overview Strategy.

Olive Downs Mine EMOS (2004) Development of the Water Quality component for the proposed Olive Downs Mine Environmental Management Overview Strategy.

Sanoma Mine EIS (2004) Senior author for the Water Quality investigations for the Sanoma Mine EIS.

North Curragh Aquatic Ecosystem Baseline Surveys (2004) Project manager for baseline aquatic ecosystem surveys for the proposed North Curragh Mine.

Vermont Mine EIS (2004) Senior author for the Aquatic Ecology investigations for the Vermont Mine EIS.

Strathmore Creek Aquatic Ecosystem Health Assessment (2003). Aquatic ecologist examining the potential impacts of groundwater seepage from a mine on aquatic ecosystems.

Collinsville Coal Environmental Evaluation (2002). Project manager for a study determining the impacts of coal mining on a stream at Collinsville Mine.

Moorvale Coal Project - Aquatic Biology Monitoring Sampling and Analysis Plan (2002). Project manager for the development of a SAP for monitoring impacts of a new coal development.

Assessment of the Impacts of Coal Mining and other Land Uses on the Ecosystem Health of the Fitzroy River (2002-ongoing). Project Manager for an ACARP-funded research project examining the ecosystem health of the Fitzroy River system using fish and macroinvertebrates indicators.

Moorvale Coal Project EIS (2001). Aquatic ecologist examining the potential impacts on stream communities of a proposed mining development near Coppabella, Bowen Basin.

Significant Species Management Plan Monitoring Reports – Oxleyan Pygmy Perch (2001-ongoing). Project Manager for monitoring investigations associated with the Oxleyan Pygmy Perch Management Plan at North Stradbroke Island.

Moranbah North Mine Aquatic Fauna Assessments (2001). Project Manager for baseline monitoring of aquatic fauna communities adjacent to Moranbah North Mine, Bowen Basin. Responsible for sampling of freshwater macroinvertebrate and fish and reporting.

Goonyella Riverside Mine Aquatic Fauna Assessments (2001). Project Manager for baseline monitoring of aquatic fauna communities adjacent to Goonyella Riverside Mine, Bowen Basin. Responsible for sampling of freshwater macroinvertebrate and fish and reporting.

Herring-Enterprise Aquatic Fauna and Water Quality Assessments (2001-2002). Project Manager for baseline monitoring of aquatic fauna in wetlands and lagoons in the Herring-Enterprise Mine lease, North Stradbroke Island. Surveys were directed towards describing spatial and temporal variations in benthic macroinvertebrate, nekton, plankton and fish communities. Responsible for field work, identification of freshwater macroinvertebrate and fish samples and reporting.

Development of Water Quality Triggers – Little Canalpin Creek (2000). Project Manager for the development of trigger levels developed for the purpose of water quality monitoring at Little Canalpin Creek, North Stradbroke Island.

Analysis of the Ionic Composition of Waters from North Stradbroke Island Freshwater Waterbodies (2000). Undertook detailed statistical analysis of long-term water quality data sets to determine any differences in the ionic composition of waterbodies on North Stradbroke Island.

Ibis Lagoon Flooding Incident (2000). Project manager and aquatic ecologist for a study examining the potential and known impacts of raised water levels, associated with sand mining operations, on the water quality and ecology of Ibis lagoon, North Stradbroke Island.

Significant Species Management Plan – Oxleyan Pygmy Perch (2000). Project Manager for the development of a management plan to mitigate possible impacts of sand mining operations on a local population of Oxleyan Pygmy Perch at North Stradbroke Island.

Ibis Mine Aquatic Fauna Surveys (1999-2000). Project Manager for baseline monitoring of aquatic fauna in wetlands and lagoons in the Ibis Mine lease, North Stradbroke Island. Surveys were directed towards describing spatial and temporal variations in benthic macroinvertebrate, nekton, plankton and fish communities. Responsible for field work, identification of freshwater macroinvertebrate and fish samples and reporting.

Goulbourn River Impact Assessments (1997). Aquatic ecologist for investigations of the fish, macroinvertebrate and aquatic flora of Goulburn River, as part of impact assessment studies of mine expansion at Ulan (NSW). Responsible for survey design, field work, identification of freshwater macroinvertebrate and fish samples and reporting.

Aquatic and Water Quality Surveys of the Yarraman Mine Site, North Stradbroke Island (1997). Aquatic biologist for field investigations of the water quality and fish, macroinvertebrate and aquatic flora communities of the freshwater lakes of North Stradbroke Island, southern Queensland.

Aquatic and Terrestrial Fauna Surveys of the Theodore Coal Projects Sites (1996). Aquatic biologist for field investigations of the fish and other aquatic fauna communities of the Dawson River, central Queensland.

Refereed Publications

Cullen E. L., Morgan, C. D., Richardson, D.L. and Tiedt, B. (2003). Integrated Approach to Assessing Mine-Related Impacts on the Sustainable Management of Water Resources Case Study – Three Mile Creek, Collinsville (Northern Bowen Basin, Queensland). *Water In Mining Conference, 13-15th October 2003*, Brisbane.

Richardson, D.L. (1999). Correlates of environmental variables with patterns in the distribution and abundance of two anemonefishes (Pomacentridae: *Amphiprion*) on an eastern Australian sub-tropical reef system. *Environmental Biology of Fishes*. **55**: 255-263.

Harriott, V.J., Banks, S.A., Mau, R.L., Richardson, D.L., and Roberts, L.G. (1999). The ecological and conservation significance of the subtidal rocky reef coral communities in northern N.S.W., Australia. *Marine and Freshwater Research.* **50**: 299-306.

Richardson, D.L. (1998). Descriptions of the juvenile colour patterns of three anemonefish species (Pomacentridae: *Amphiprion*) from New South Wales and Lord Howe-Norfolk Island region. *Proceedings of the Linnean Society of N.S.W.* **120**: 81-86.

Richardson, D.L., Harriott, V.J. and Harrison, P.L. (1997) Distribution and abundance of giant sea-anemones (Actiniaria) in sub-tropical eastern Australian waters. *Marine and Freshwater Research*, **48**: 59-66.

Richardson, D.L., Harrison, P.L. and Harriott, V.J. (1997) Timing of spawning and fecundity of a tropical and sub-tropical anemonefish (Pomacentridae: *Amphiprion*) at a high latitude reef on the east coast of Australia. *Marine Ecology Progress Series*, **156**: 175-181.

Theses & Non-Refereed Publications and Presentations

Richardson, D.L. (1999). Environmental Values of Waterways: A Broad-Scale Waterway Habitat Classification Method used in the Burnett Catchment. *Proceedings of the Workshop on the Conservation Status and Sustainability of Waterways*. 7th December 1998, Water Resource Environmental Planning, Brisbane.

Richardson, D. L. (1996) Aspects of the Ecology of Anemonefishes (Pomacentridae: *Amphiprion*) and Giant Anemones (Actiniaria) within Sub-tropical Eastern Australian Waters. Ph.D. thesis, Centre for Coastal Management, Southern Cross University Lismore. 250 pp.

Richardson, D. L. (1995) Biogeography of host sea-anemones and anemonefishes in the eastern Australian sub-tropics. *Australian Coral Reef Society Annual Conference*, 15-16th July 1995, Lismore NSW (*Awarded Best Poster*).

Richardson, D. L. (1995) Factors influencing the distribution and abundance of anemonefishes at North Solitary Island, northern NSW. *Australian Coral Reef Society Annual Conference*, 15-16th July 1995, Lismore NSW.

Richardson, D. L. (1991) Some Aspects of Food and Feeding in the Sydney Rock Oyster *Saccostrea commercialis* (Iredale & Roughley) in Port Stephens, N.S.W. Honours Thesis, Centre for Coastal Management, University of New England 117 pp.

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Threatened Species Habitat Assessment – Howard's Tree Farm, Wooyung (2001)
Conservation Management Plan for Glossy Black-Cockatoos-Progress Hill, Noosa (2001)
Rare & Threatened Flora & Fauna Assessment–Gregory to Blackwater Dragline Relocation Route (2000)
Grass Owl Surveys & Assessment of Coastal Habitats of the Harrington District, New South Wales (1999).
Conservation Management of Microbat Roosts and Maternity Sites at Moura Mine (1999). -
Wallum Froglet Survey and Habitat Assessment of Crowdy Bay National Park and Harrington (1999) -
Harrington Waters Estate - Wallum Froglet Habitat Assessment (1999)
Shorebird High Tide Roost Assessment - Sovereign Islands (1999)
Rare and Threatened Vertebrate Fauna Surveys of Moura Mine (1999)
An Appraisal of Little Tern occurrence at Woogoompah Island - Opportunities and Recommendations (1998)

Natural Resource Inventories & Conservation Planning Studies

Ecological Character Description of the Currawinya Lakes National Park Ramsar Site (2008 -)
Threatened Species and Biodiversity Action Plan – BMA Saraji (2006).
Threatened Species and Biodiversity Action Plan – BMA Peak Downs (2006).
Review of Habitat Values for Biodiversity & Species of Conservation Significance – BMA Poitrel Leases (2006).
An Audit & Regional Overview of Biodiversity Values for BMA Coal Operations within Central Queensland (2006).
Review of Habitat Values for Biodiversity & Species of Conservation Significance – BMA Terang Leases (2005).
Review of Habitat Values for Biodiversity & Species of Conservation Significance – BMA Blackwater Mine (2005).
Review of Habitat Values for Biodiversity & Species of Conservation Significance – BMA Saraji Mine (2005).
Review of Habitat Values for Biodiversity & Species of Conservation Significance – Gregory Crinum Mine (2005).
Review of Habitat Values for Biodiversity &Species of Conservation Significance – Peak Downs Mine (2005).
Review of Habitat Values for Biodiversity a Species of Conservation Significance – South Walker Mine (2005).
Review of Habitat Values for Biodiversity a Species of Conservation Significance – Goonyella Riverside & Broadmeadows Mines (2005)
Review of Habitat Values for Biodiversity and Species of Conservation Significance – Hay Point Facility (2005)
Biodiversity and Threatened Species Action Plan – BMA Norwich Park Mine (2005)
Coomera River Catchment Environmental Inventory – Avifauna (2003-2004)
Mapping of Ecological Habitats and Inventory for Botany Bay - Planning NSW (2003)
Caboolture Common Classification System Application – Stage 2 (2002)
Moreton Bay Sand Extraction Study (2001)
An Investigation of EPBC and NCA Act implications of the Proposed Coomera Town Centre LAP (2002)
Caboolture Shire Environmental Planning Study – Nature Conservation Studies (2001)
Lake Samsonvale ICMS – State of the Catchment Report (2001)
Tamborine Mountain Escarpment Flora and Fauna Study (2000)
An Assessment of Fauna Habitat Values of the Port of Brisbane Corporation Land Portfolio (2000)
North East Wetlands Fauna Survey (1999)
Ecological Background Studies for Tallows, Belongil and Jerusalem Creeks (1999)
Brisbane Entertainment Centre Precinct Fauna and Flora Assessment (1999)
Burnett River Catchment Fauna and Flora Overview (1998)
Habitat Inventory of Rocky Reefs of South-east Queensland (1999)
Aquatic and Riparian Environmental Assessments - Gold Coast (1998)

Impact Assessment Statements, Review of Environmental Factors, Environment Management Plans

Vertebrate Fauna Habitat Values – Sunshine Motorway Upgrade – Mooloolah River to Eenie Creek (2008 -)
Gladstone Area Water Board Fitzroy Gladstone Pipeline EIS – Terrestrial Fauna (2008)
EPBC Referral - Terrestrial Fauna - 84 Eagleby Road, Eagleby. Eagleby (2007).
Terrestrial Vertebrate Fauna Issues - Pacific Paradise Bypass and Maroochydore Road Upgrade (2007 -).
REF and EPBC Referral - Ipswich Motorway Northern Options - Terrestrial Fauna (2007).
United Collieries Warkworth Longwall Panels 10 & 11 Expansion EIS - Flora and Fauna, (2007)
Ipswich Motorway Northern Option Feasibility Study - Vertebrate Fauna Issues Report (2007).
Caloundra South CAMCOSS Re-alignment EIS & EPBC Referral - Terrestrial Fauna (2007).
Design Issues related to Terrestrial Vertebrate Fauna - Glasshouse Mountains Road Upgrade (2007)
GAWB Rockhampton to Gladstone Pipeline REF and EPBC Referral - Terrestrial Fauna (2007).
Brisbane Airport Parallel Runway EIS – Terrestrial Vertebrate Fauna (2005-06).
REF and EPBC Referral - Brisbane Airport Parallel Runway Project - Terrestrial Fauna (2007).
Flora & Fauna Baseline Surveys for the BMA Isaac River IAS (2006)
Wonbindi Coal Project Flora and Fauna EMP (2006)
Fauna, Flora and Vegetation Assessment for South Walker Mine SAA4 IAS (2006)
Dawson North Expansion EIS and EPBC Referral – Vertebrate Fauna and Ecology Sections (2005).
An Investigation of Flora, Fauna and Biodiversity Values associated with Brigalow Remnants along the Proposed Heyford Back Access Road – BMA Peak Downs Mine (2005).
Ecological Assessments – Ipswich Motorway Northern Options (2005)
Wildlife Management Issues associated with Fresh Air Rises and Intakes-Cannington Mine (2004)
Bruce Highway (Cooroy to Curra) Strategic Planning Study Stage 2 - Ecological Issues and Constraints (2004)
Moura North EMOS – Flora and Fauna (2003-04)
Theodore Coal Project (Stage 2) EIS – Nature Conservation (2003-04).

Vermont Coal Project IAS and EIS – Nature Conservation (2003)
Mt. Birnie to Boulia Telstra Cable Alignment – Ecological Assessments (2003)
Theodore Mine EPBC Act Assessments (2003)
Caboolture to Landsborough Rail Duplication (2002-2003)
Fauna and Flora Management Plan-Manning River Dredging for the Harrington Waters Estate (2002)
Jacaranda Pit IAS – Terrestrial Vertebrate Fauna Assessments - Saraji Mine (2002)
Fauna and Fauna Habitat Assessment – Ramp 4 Underground Project, Goonyella Riverside Mine (2002)
Coledale Beach Hazards Study-Ecology Section (2002)
Bruce Highway Upgrade (Uhlmann to Buchanans Road)-Flora and Fauna Pre-construction REF (2002)
Moreton Bay Sand Extraction-Ecology Section (2002)
Moorvale Coal Project IAS (2001)
Review of Flora and Fauna EIS Issues – Pacific Beach Development, Tugun (2001)
Environmental Assessments of Four Mile Beach, Port Douglas (2001)
Fauna and Flora Habitat Assessment for the Peak Downs Highway Diversion at Coppabella (2000)
Port of Brisbane Expansion IAS (2000)
Caboolture to Maroochydore Corridor Study - IAS and Land Use Transport Strategy (1999)
Eenie Creek Flora and Fauna Impact Assessment (1999)
Terrestrial and Aquatic and Terrestrial Vertebrate Fauna Survey - Saraji Mine IAS (1999)
Hexham Swamp/Ironbark Creek EIS (1998)
Port of Airlie Marina IAS (1998)

Extractive Industry

Brigalow and SEVT RE and Regrowth Community Assessments - Anglo Dawson Mine (2008)
Rehabilitation Monitoring Program 2008 – Anglo Dawson Mine (2008)
Surveys of Biodiversity and Rare and Threatened Fauna and Flora – BMA Poitrel Mine (2007).
South Marshmead Biodiversity Inventory, Blackwater (2007).
Autumn Fauna Baseline Survey – United Collieries, Warkworth (2007)
Koala Surveys and Habitat Assessment for BMA Peak Downs (2006).
Summer Fauna Baseline Survey – United Collieries, Warkworth (2006).
2006 Fauna Survey of Post-Mining Landscapes of Peak Downs Mine (2006)
Summer Season Fauna Baseline Survey – BMA Goonyella Riverside & Broadmeadows Mines (2006).
2006 Vertebrate Fauna Survey of Selected Remnant Regional Ecosystems – BMA Saraji (2006).
Winter Season Fauna Baseline Inventory - BMA Saraji (2006).
Winter Season Fauna Survey - BMA Peak Downs (2006).
Flora and Fauna Baseline Survey and Biodiversity Action Plan – United Collieries, Warkworth (2005).
2005 Vegetation, Fauna and Soils Monitoring Program for Post-mining Rehabilitation – Moura Mine (2005).
Autumn Season Vertebrate Fauna Surveys of Remnant Habitats of Norwich Park Mine 2005
Vertebrate Fauna Surveys of Remnant Habitats associated with One Mile Dam & Surrounds – Saraji Mine (2005)
Peak Downs Mine Flora and Fauna Surveys – Summer 2005
Abbott Point Wetlands Flora and Fauna Surveys – Dry Season (2004)
Target Species Investigations and Replicate Baseline Surveys of Cannington Mine Leases–Summer 2004
Flora and Fauna Assessment of Oaky Creek Mine Proposed Lease Extension (2004)
Blackwater Mine –Regional Ecosystem and Fauna Habitat Assessment (2004)
Norwich Park Mine – Baseline Flora and Fauna Habitat Assessment (2004)
Review of Fauna Habitat Values of Mine Rehabilitation in the Ramp 6E/7 area, Moura Mine (2004)
Flora and Fauna Assessment of the Moranbah North Mine – Summer 2002 and 2004 (2004)
Flora and Fauna Assessment – Collinsville Coal Project (2003-04)
Moranbah North Mine Isaac River Subsidence – Review of Ecological Impacts (2003)
Phase Two Vertebrate Fauna Monitoring & Data Integration Report – Cannington Mine & Surrounds (2003)
Vertebrate Diversity & Target Species Surveys of Wetland & Riparian Habitats - Saraji Mine (2003)
Theodore Mine EPBC Act Assessments (2003)
Threatened Species and Wetland Surveys – Saraji Mine (2003)
Terrestrial Vertebrate Fauna Monitoring Program (Phase 2)–Moura Mine (2002)
Flora and Fauna Assessment of the Moranbah North Coal Lease (2002)
Dry Season Aquatic & Terrestrial Vertebrate Fauna Surveys – Cannington Mine (2002)
Jacaranda Pit IAS – Terrestrial Vertebrate Fauna Assessments - Saraji Mine (2002)
Vertebrate Biodiversity & Flora Assessments, Remnant Habitats-Goonyella Riverside underground project (2002)
Design and Field Trials for Bat Gates for Disused Mine Tunnels, Moura Mine (2001)
Moorvale Coal Project IAS – Terrestrial Ecology Section (2001)
Fauna Habitat Assessment of Disused Voids and Low Wall Landscapes of Blackwater Mine (2001)
Ravensworth Mine Baseline Terrestrial Fauna Assessment (2001)
Summer 2001 Aquatic and Terrestrial Fauna Surveys of South Blackwater Mine (2001)
Terrestrial Vertebrate Fauna Monitoring Program (Phase 1)–Moura Mine (2001)
Summer 2001 Vertebrate Fauna Survey and Data Integraton Report for Curragh Mine, Blackwater (2001)
Rare & Threatened Flora & Fauna Assessments – Oakey Creek to Blackwater Dragline Relocation Route (2000)
Wet and Dry Season Vertebrate Fauna Surveys of Blackwater Mine (2000)
Flora and Fauna Surveys – Southern Exploration Lease, Coppabella Mine (2000)

An Investigation of the Flora and Fauna Values for the Dragline Relocation Route between Goonyella Riverside and South Walker Mines (2000)
Wet Season Aquatic and Terrestrial Fauna Survey- Goonyella Riverside Mine (2000)
A Terrestrial and Aquatic Fauna Study of Curragh Mine (2000)
Summer Season Terrestrial Vertebrate Fauna Survey of the Moorvale EPC, Nebo District (2000)
Conservation Management of Microbat Roosts and Maternity Sites at Moura Mine (1999)
Rare and Threatened Vertebrate Fauna Surveys of Moura Mine (1999)
Assessment of Fauna Habitat Enhancement Initiatives at Peak Downs Mine (1999)
Terrestrial Flora and Fauna Assessment of Coppabella Mine Site (1999)
Wet Season Survey of Terrestrial and Aquatic Fauna of Saraji Mine (1999)
An Assessment of Terrestrial Fauna Habitat Values and Management Practices at Moura Mine (1999)
Terrestrial Flora and Fauna Assessment of Moorvale Mine Site (1999)
An Investigation of the Terrestrial Vertebrate Fauna Values of Holts Hill, Clagiraba (1999)
Wet Season Aquatic and Terrestrial Survey of Blackwater Mine (1999)
Port of Airlie Extractive Industry IAS (1998).

Urban Development

Terrestrial Fauna & Fauna Habitat Values Assessment-Tinnanbar EcoVillage Site (2007 -).
Ecological Design Considerations for Bioremediation Wetlands – Neumann Developments Chevallum (2007).
Fauna & Fauna Habitat Values Assessment – 55 Alligator Creek Road, Townsville (2007 -).
Fauna & Fauna Habitat Values Assessment – Lot 207 K124620 & part of Lot 1 on EP2169, Townsville (2007 -).
Fauna and Fauna Habitat Values Assessment – Svensson Rd, Mt. Low (2007 -).
Assessment of Fauna & Fauna Habitat Values - Turtle Cove, Captain Cook Highway, Wangetti (2007 -)
Biodiversity & Threatened Species Assessments – 1105-1030 Currumbin Creek Road, Currumbin Valley (2006).
Fauna and Fauna Habitat Values Assessment – Juniper Lands adjacent to the Mooloolah River (2005)
Survey of Vertebrate Fauna Diversity & Species of Conservation Significance – 293 Compton Rd, Kuraby (2005)
Fauna and Fauna Habitat Assessment Report for 19 First Ave, Woorim (2005)
Fauna Assessment Report for 438 Old Cleveland Road East, Birkdale (2005)
Review of Fauna and Fauna Habitat Values – Hoffmann land at Old Hollett Road, Noosaville (2005).
Fauna Habitat Values Assessment – 105 Mt Petrie Road, Belmont (2005).
Ecological Assessment Report – 30 & 38 Sheaffe Street, Bracken Ridge (2004)
Pre-clearing and Clearing Surveys – Kelvin Grove Campus, Queensland University of Technology (2004)
Ecological Assessment Report – 35 Arenga Street, Manly (2004)
Fauna Habitat Values Investigation - 720-744 New Cleveland Road, Gumdale (2004)
Fauna and Fauna Habitat Values Assessment – 2 Inala Avenue, Durack (2004)
Habitat Values Assessment – 784/808 Blunder Road & 32 Peacock Street, Durack (2004)
Habitat Values Assessment – 73 Landis Street, McDowall (2004)
Fauna and Fauna Habitat Values Assessment – 100 Brookside Street, Doolandella (2004)
Threatened Species and Biodiversity Assessment – Maree Street, Caloundra (2004)
Re-evaluation of Fauna Habitat Values - 102-122 Cloverdale Road, Doolandella (2004)
Fauna and Fauna Habitat Values Assessment, 972-1010 Blunder Road, Doolandella (2004)
Flora and Fauna Assessment Report - 678 Manly Road, Wakerley (2004)
Fauna and Fauna Habitat Values Assessment – 744 New Cleveland Road, Wakerley (2004)
Habitat Values Assessment – University of Queensland land at Salisbury Street, Redland Bay (2003)
Fauna and Fauna Habitat Values – Lacey & Telegraph Roads, Bracken Ridge (2003)
Revision of Aspects of Ecological Assessments of the Noosa Shire Business Centre (2002)
Fauna Assessment – Tilley and New Cleveland Roads, Wakerley (2002)
Fauna and Fauna Habitat Values - 35 Crossacres St, Doolandella (2002)
Coastal and Ecological Studies for the Armada Development-Bayview Street, Holywell (2002)
Royal Queensland Golf Club Brisbane City Plan Designated Wetland Assessment (2002)
Fauna and Flora Values Assessment – Noosa Springs Resort (2002)
Mt Cotton Winery Amphitheatre Site -Flora and Fauna Report (2002)
Fauna Assessment - Tilley and New Cleveland Roads, Wakerley (2002)
Fauna and Fauna Habitat Values - 256-260 Lacey Road & 107-113 Telegraph Road, Bald Hills (2002)
Wetland Reconstruction Design and Management Criteria for Fauna-Grindle Road, Rocklea (2002)
Fauna Habitat Values Investigation for 102-122 Cloverdale Road, Doolandella (2002)
Fauna & Wetland Values Assessment – Grindle Road, Rocklea (2002)
An Investigation of Potential Riparian Habitat & Fauna Movement Values – Springfield Lakes (2001)
Fauna Habitat Values Investigation for the Broad Lakes Development Site, Merrimac (2001)
Flora and Fauna EIS Studies - Ardgour Pastoral Co., Nerang-Broadbeach Road, Nerang (2001)
Rothwell Environmental Studies - Flora & Fauna Report (1999)
Terrestrial Fauna Assessment of 202A Lacey Road, Bald Hills (1999)
Proposed Sporting Clay Shooting Ground - Woongoolba - Flora and Fauna Assessment (1998)
Emerald Lakes Golf Course Redevelopment - Flora and Fauna Issues (1998)
470 Seventeen Mile Rocks Road - Flora and Fauna Assessment (1998)

Expert Witness

Extensive experience as an expert witness for appeals to the Planning and Environment Court and compensation claims before the Land Court. Participation in over 90 matters since 1998. A full listing can be provided on request.

Third Party Review

Draft BHP Billiton Biodiversity Policy – Review of Fauna Issues (2007).
Review of Threatened Fauna Issues associated with Pelican Links, Caloundra - RFI response (2005).
Shorebird Management Plan-Manning River Dredging for the Harrington Waters Estate (2002)
Naturelink Cableway EIS Review (2000)
Threatened Species Assessment - Harrington Waters Estate, NSW (1999).

Research

Australian Coal Association Research Program (2006-2008) – *Assessment of Seasonal Habitat Characteristics as Predictors of Habitat Suitability for the Threatened Ornamental Snake.*

ACARP (2005-2008) – *Artificial Structures to Enhance Vertebrate Fauna Habitat Values and Accelerate Fauna Colonisation within Mine Rehabilitation of the Bowen Basin, Central Queensland – Microbats.*

Publications

Geering, A., Agnew, L., and Harding, S. (2007). *Shorebirds of Australia*. CSIRO Publishing, Collingwood.

Agnew, L.R., Veary, A.T. and Richardson, D.L. (2003). *Determination of Criteria for Mining Lease Relinquishment within central Queensland using Terrestrial Vertebrate Fauna as Indicators of Rehabilitation Success.* Project C10033. Australian Coal Association Research Program, Brisbane.

Debus, S.J.S., Agnew, L.R., and Schulz, M. 2001. Surveys for Eastern Grass Owl *Tyto Capensis* in Coastal New South Wales. Australian Bird Watcher 19(3), 55-60.

Agnew, L.R and Stewart, D. 1998. Birds of Moreton Bay. In; Ryan, M. (ed.). *Wild Guide to Moreton Bay-Wildlife and Habitats of a Beautiful Australian Coast - Noosa to the Tweed*, Queensland Museum. pp 319-353.

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Tennyson Riverside Development Marine Plant Monitoring (2008 – ongoing). Field survey and associated reporting for a monitoring programme to examine ecological responses of mangrove communities to disturbance activities.

Whyte Island Ecological Survey and Impact Assessment (2008). Field survey to map marine plant species and identify potential impacts and management issues associated with development of a sand-offloading facility.

Goonyella Riverside Mine Aquatic and Riparian Ecosystem Monitoring (2008 – ongoing). Flora component of an aquatic and riparian monitoring study to investigate ecological impacts following saline water discharge, including input into the preparation of a remediation plan.

National Coastal Vulnerability Assessment, Kakadu, Northern Territory (2008 – ongoing). Ecological input for a major study to assess vulnerability as a result of climate change in the South Alligator River, Kakadu National Park.

Brisbane Desalination Plant Siting Study (2008). Input into the environmental component, including identification of ecological values of potential desalination plant wastewater outfall sites and a review to assess expected tolerances of sensitive ecological receptors.

Angle-stemmed Myrtle Survey (2008). Targeted field survey for the Endangered flora species *Gossia gonoclada* within the Pacific Motorway Transit Project (Section B).

OZ Minerals Pipeline Environmental Audit (2008). An environmental audit of noxious plants and landform condition along an underground pipeline from OZ Minerals Century Mine to Karumba port.

Refereed Publications

Ward, M. and Johnson S.D. 2005. Pollen limitation and demographic structure in small fragmented populations of *Brunsvigia radulosa* (Amaryllidaceae). *Oikos* 108:253-262.

Ward, M., Dick C.W., Gribel, R., and Lowe, A.J. 2005. To self or not to self… A review of outcrossing and pollen-mediated gene flow in neotropical trees. *Heredity* 95:246-254.

Lowe, A.J., Boshier, D., Ward, M., Bacles, C.F.E. and Navarro, C. 2005. Genetic resource impacts of habitat loss and degradation; reconciling empirical evidence and predicted theory for neotropical trees. *Heredity* 95:255-273.

Theses and Non-refereed Publications and Presentations

Carlson, C.A., Bower, J.P. and Ward, M. 2003. An evaluation and analysis of nutritional data collected from Eucalyptus clone banks. Technical Report, Forestry Plant Propagation Working Group.

Ward, M. 2003. The effects of habitat fragmentation on the reproduction and population demographics of *Brunsvigia radulosa* (Amaryllidaceae). Honours Thesis, University of Natal, South Africa.

Ward, M. 2007. Is bigger always better? Reproductive Allee effects in invasive Asclepiads. Oral Presentation, 9th International Conference on the Ecology and Management of Alien Plant Invasions.

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government liaison, and awareness and training in environmental law for villagers from communities within Milne Bay.

August 2002 – October 2005: WBM Oceanics Australia
Senior Environmental Scientist (Environmental Law) with the environmental planning and ecology section, providing services in the areas of environmental law/policy, environmental management (planning and systems), and marine biology and ecology.

December 2000 – January 2002: WBM Oceanics Australia
Undergraduate Environmental Scientist with the marine ecology section, providing services in the areas of environmental law, marine biology and ecology.

April 2000-Dec 2000: KBR (previously Kinhill Pty Ltd)
Undergraduate Environmental Scientist in the environment and planning group responsible for carrying out data collection and assessment, report writing, collation of projects, and research of both legal and scientific information.

April 1999 – March 2000: Hyder Environmental
Undergraduate Environmental Scientist in the environment and planning group providing a wide range of services, including carrying out data collection and assessment, research and report writing.

PROJECT EXPERIENCE

Environmental Planning, Law and Policy

Kakadu National Coastal Vulnerability Assessment (2008 – Ongoing)
Project Manger for an assessment of climate change impacts on river system dynamics in the Kakadu National Park and implications for government planning, management and policy responses.

Moreton Bay Ecological Character Description (2008 – Ongoing). Team member providing advice on policy and legislation for input into a major study of the wetlands of Moreton Bay including an ECD report, and a report on the assessment and effectiveness of management actions. Lead author of a report on management goals and environmental indicators. The project also involved a review and refinement of the Moreton Bay Ramsar boundary and Ramsar Information Sheet. Extensive liaison and consultation with the scientists of the Moreton Bay Partnership Scientific Expert Panel to develop a Whole-of-Bay Conceptual Model.

Currawinya Lakes Ecological Character Description (2007 – 2008). Team member providing advice on cultural issues associated with the preparation of the ECD for the Currawinya Lakes Ramsar Site in Western Queensland. The project involved a team of ecologists and hydrologists in preparation of the resource assessment, Ramsar Information Sheet, and revised mapping boundaries.

Cardwell Shoreline Erosion Management Plan (2007- 2008)
Provision of advice on ecological and environmental planning and legislative aspects for the development of a Shoreline Erosion Management Plan (SEMP) for the area of beach adjacent to Cardwell township. The SEMP assessed beach protection options for the beach, detailing; the existing condition, likely future erosive processes, and priorities for works or strategies required to protect the shoreline giving regard to risk, cost/benefit and ecological and legislative constraints. It also considered the constraints of potential sand source areas

Port of Abbot Point Vegetation Clearing Approvals (2007 – 2008)
Project manager of review of botanical surveys from Port of Abbot Point Expansion EIS, and provision of advice regarding possible areas to be remapped (incorrect RE mapping) and areas to be cleared on strategic and non-strategic port land.

Ramsar Snapshot (2007)
Project manager of an initial review (Snapshot) of the health and management of Australia Ramsar estate for the Australian Government Department of the Environment and Water Resources. This involved analysis of the level of information on the current state of Ramsar sites (e.g. currency of each site's Ramsar Information Sheet, site maps and management plans), the financial investment in Australia's Ramsar estate, assessment of major threats and management issues facing the sites, and anticipated key pressures in the future.

Coomera Marina Development (2007)
Provision of advice regarding referral under the *EPBC Act* and declaration of the project as being of state significance under the *State Development and Public Works Organisation Act 1971* (Qld).

Maroochydore Structure Plan Advice (2007)
Project manager for a review of the hydrological, ecological and water quality aspects of the Maroochydore Structure Plan Advice, considered from the perspective of the clients (Lend Lease) and proposed future developments.

Sunshine Plaza Master Plan Advice (2007)
Project manager for provision of advice on the proposed amendment of the Sunshine Plaza Master Plan. Advice provided included potential studies that may be required prior to submission of development applications in accordance with the proposed amended Master Plan.

Woorim Shoreline Erosion Management Plan (2006-2007)
Provision of advice on ecological and environmental planning and legislative aspects for the development of a Shoreline Erosion Management Plan (SEMP) for Woorim Beach. The SEMP assessed beach protection options for the beach, detailing; the existing condition, likely future erosive processes, and priorities for works or strategies required to protect the shoreline giving regard to risk, cost/benefit and ecological and legislative constraints.

Cairns Shoreline Erosion Management Plan (2005 - 2006)
Provision of advice for the development of a shoreline erosion management plan to protect and enhance the coastal values within the Cairns Council area whilst protecting existing infrastructure. The plan took into account information from past studies in the area, the *Coastal Protection and Management Act 1995*, the State and Regional Coastal Management Plan, other relevant regulatory requirements, environmental (ecological, social, cultural, economic) values, and community attitudes and concerns.

Cairns Shoreline Erosion Management Plan Terms of Reference (2005)
Drafting of the terms of reference for the Cairns City Council's tender for the proposed Cairns Shoreline Erosion Management Plan. The drafting of the ToR required an understanding of the current erosion issues, potential management measures, community concerns, and applicable legislation and policy (State and Regional Coastal Management Plans).

Maroochy Shoreline Erosion Management Plan (2004 – 2007)
Development of a shoreline erosion management plan to protect and enhance the coastal values within the Maroochy Shire (study area - Mooloolaba to Mudjimba) whilst protecting existing infrastructure. The plan took into account information from past studies in the area, the *Coastal Protection and Management Act 1995*, the State and Regional Coastal Management Plan, other relevant regulatory requirements, environmental (ecological, social, cultural, economic) values, and community attitudes and concerns. Generic erosion protection options were assessed for suitability against policy and financial criteria, and the most appropriate management measure recommended for each beach unit.

Gippsland Lakes RT-4 Project (2005)
Compilation and assessment of relevant international, national, state, regional and local legislation and policy applicable to the use of natural or constructed wetlands adjacent to, and adjoining, the Gippsland Lakes, as a nutrient trap for improvement of water quality in the Gippsland Lakes (including the Gippsland Lakes Ramsar site). The review provided the client with an understanding of the complexity of the legislation applicable to the Gippsland Lakes wetlands.

Dredge Management Plan Development for Sand Extraction (2004-2005)
Development of a dredge management plan for sand extraction operations of two companies within Moreton Bay, to ensure operations comply with requirements under the *Coastal Protection and Management Act 1995* and the *State Coastal Management Plan.*

Marine Debris Threat Abatement Plan (2004 – 2005)
The development of a draft threat abatement plan under the requirements of the *EPBC Act,* for the designated key threatening process of *Injury and Fatality to Vertebrate Marine Life Caused by Ingestion of, or Entanglement in, Harmful Marine Debris.* The information gathering stage involved extensive stakeholder consultation (including national workshops) from industry, government, NGOs and volunteer groups throughout Australia.

Maroochy Canal Approvals (2004)
Application for Maroochy Shire Council's canal maintenance dredging development approval, including ERA19 and tidal works approval. Liaison was required with EPA (Coastal section in Brisbane), EPA Maroochydore, and the Maroochy Shire Council. The application was written to apply to all canals in the Maroochy Shire to ensure the Shire-wide maintenance program can continue unhindered in the future.

Maroochy Retaining Wall Approval (2004)
Application for development approval for a retaining wall adjacent to Cotton Tree Park, Cotton Tree, including tidal works approval.

Aquafarms Pearl Aquaculture Facility *EPBC* Preliminary Information Advice (2004)
Advice on preliminary information prepared by client under the requirements of the *EPBC Act* and the reconstruction of that material to satisfy DEH needs and requirements under the Act. Additional information requests from DEH fulfilled where required.

Russell Island Marine Survey and Marine Parks Re-Zoning Comments (2004)
Assessment of the marine environment adjacent to the client's property, and letter of comment prepared for submission to Marine Parks (QWPS) for the proposed rezoning of the area under the *Marine Parks (Moreton Bay) Zoning Plan 1997.*

Environmental Offsets and Management Plans (2004)
The project consisted of two parts: **1.**The drafting of guidelines to be posted as a public document on the Department of Environment and Heritage (DEH) website outlining the requirements for the development of environmental management plans required by conditions of approval under the *Environment Protection and Biodiversity Conservation Act 1999*. The guidelines are to be used by proponents, DEH officers and consultants. **2**. A comprehensive review of the use of offsets policy in Australia, at State and Commonwealth level. Consultation of government agencies was undertaken to ensure offset policies implemented in a non-formal manner were included in the review.

Golf Links Development EPBC Act Referral Advice (2004)
Advice provided on the need for referral of the project under the *EPBC Act.* Discussions with DEH regarding aspects of the project which were of particular concern, and scoping of studies to fill information gaps.

Implementation of the Geelong Stormwater Management Plan (2003-2004)
This project won the Water Quality section of the 2005 Victorian Coastal Awards for Excellence. It involved development of material to be used for community education with respect to stormwater management in residential, commercial and industrial programs run by the City of Greater Geelong, and performance of assessments of industrial businesses in Geelong for their management of stormwater onsite, and their potential impact to water quality in Corio Bay.

Norwich Park Mine *EPBC* Referral (2003 –2004)
Preparation of referral forms based on prior work undertaken by WBM terrestrial ecologists for referral of an extension of the Norwich Park Mine under the *EPBC Act 1999.*

Duranbah Beach Dune Management Plan (2002-2004)
Preparation of a plan of management for Duranbah Beach and dunes on the boundary of the Queensland New South Wales border. The project involved community and state agency consultation (NSW) to identify issues and management options, and to balance long-term intensive utilisation and conservation of the beach and dune system, to operate within an integrated planning framework.

Coomera Dredging Approvals Advice (2003)
Interpretation of legislation and regulations, and liaison with Queensland state agencies to determine the approvals required and processes to be followed for deepening of a channel in an area in, or in close proximity to, Marine Parks, Fish Habitat Areas and Ramsar sites.

Wonboyn Estuary Management Study and Plan (2002 - 2003)
Preparation of an Estuary Management Study outlining management objectives derived from results of a community and stakeholder survey, and the management options to satisfy these objectives. Following approval of the Study, the Estuary Management Plan was prepared. The Plan outlined management actions to be undertaken satisfy management options and objectives from the Management Study.

Maroochy River Entrance Dredging and Beach Nourishment Approvals (2002)
Interpretation of legislation, regulations and coastal policy, and liaison with Queensland state agencies to determine the approvals required and processes to be followed for a beach nourishment project, requiring groyne construction and dredging of sand in an area in, or in close proximity to Fish Habitat Areas.

Environmental Management

BMT WBM Environmental Management System (2007-Ongoing)
Scoping and development of an environmental management system with the aim of becoming ISO 14001 compliant and accredited by mid-2008.

Environmental Management Plan for Settlers Cove Jetty (2006 –2008)
Development of an Environmental Management Plan for the jetty at Settlers Cove high density residential development at Noosa with the main issues being ecological management and restoration, marine plant protection and marine and on-site water quality management.

Implementation of the Geelong Stormwater Management Plan (2003-2004)
This project won the Water Quality section of the 2005 Victorian Coastal Awards for Excellence. It involved development of material to be used for community education with respect to stormwater management in residential, commercial and industrial programs run by the City of Greater Geelong, and performance of assessments of industrial businesses in Geelong for their management of stormwater onsite, and their potential impact to water quality in Corio Bay.

Department of Main Roads, North-Coast Hinterland District (Gympie) (1999)
Involved in the assessment of an environmental awareness training program developed for Main Roads at Gympie.

Public Infrastructure

Fitzroy to Gladstone EIS (2007 – Ongoing)
Project Manager of the terrestrial and aquatic ecology components of an Environmental Impact Assessment of the Gladstone-Fitzroy Pipeline, proposed for the transfer of water from the Fitzroy River to storage at Aldoga to supply existing and potentially new industrial customers in the Gladstone area. The pipeline is the first pipeline located within the Stanwell to Gladstone Infrastructure Corridor (SGIC) and is proposed to be constructed within this corridor for the majority of its length.

Secondment to SRWP Alliance for the North Stradbroke Island Borefield and Pipeline EIS (2007)
Senior Environmental Scientist seconded to develop the EIS for the borefield and pipeline on North Stradbroke Island. Concurrent groundwater modelling assessments prepared by the Queensland government, together with inputs from the current study, indicated that groundwater draw-down represented a major risk to the environment. The project was suspended on this basis.

North Stradbroke Island Borefield and Pipeline Initial Advice Statement and Terms of Reference (2007)
Preparation of an Initial Advice Statement (IAS) pursuant to section 26(1)(a) of the Queensland *State Development and Public Works Organisation Act 1971* and the proposed borefield and pipeline on North Stradbroke Island subsequently declared a significant project for which an EIS was required. Preparation of a draft terms of reference followed, and the Environmental Impact Assessment commenced.

North Stradbroke Island Borefield and Pipeline *EPBC* Referral (2007)
Provision of advice to Redland Shire Council and the Coordinator-General's Department regarding the requirement under State legislation to construct and have operational a new borefield at North Stradbroke Island (NSI) to pump groundwater via a pipeline into the SEQ regional water grid by 31 December 2008. Referral of the proposed borefield and pipeline on North Stradbroke Island to the Australian Government Department of the Environment and Water Resources was required under the *Environment Protection and Biodiversity Conservation Act 1999* for the project's potential to impact on matters of national environmental significance (NES). As a controversial and political project, extensive preparation and liaison with Commonwealth, State and local level government was required.

Main Roads Gateway Upgrade Project (2003)
Project management of a project requiring the provision of a report on the impacts and mitigation measures of the Gateway Upgrade Project on a matter of national environmental significance (Ramsar site) under the *EPBC Act 1999.*

Port and Related Dredging Assessments

Port of Cooktown Maintenance Dredging (2007-Ongoing)
Development of the ecological and legislative/planning aspects of a long term dredging strategy, including the investigation of alternative sites and the impacts at/near the current site, for the long-term maintenance dredging of the Port of Cooktown and shipping channels.

Port of Abbot Point Vegetation Clearing Approvals (2007 – 2008)
Project manager of review of botanical surveys from Port of Abbot Point Expansion EIS, and provision of advice regarding possible areas to be remapped (incorrect RE mapping) and areas to be cleared on strategic and non-strategic port land.

Port of Botany Expansion Tender (2006-2007)
Project Manager for the marine and terrestrial ecology and turbidity management components of a tender for the expansion of port facilities at the Port of Botany, Sydney, following a successful Expression of Interest. BMT WBM was part of the Leighton Contractors – Van Oord Joint Venture tender.

Port of Abbot Point Expansion -Environmental Impact Assessment (2005 – 2006)
Preparation of the Initial Advice Statement and Terms of Reference for the EIA. Following public consultation and review by Qld Government authorities, BMT WBM began consultancy services for the EIS. On approval of the ToR, information collation, field work for data collection and drafting of the EIS will commence.

Bing Bong Maintenance Dredging Assessment (2003)
Research and preparation of a report detailing presence/absence and density of previous seagrass communities within the barge channel and surrounding area in the Gulf or Carpentaria, and assessment of possible dredge spoil dumping sites and the likely impact of dumping on seagrass.

Coomera Dredging Approvals Advice (2003)
Interpretation of legislation and regulations, and liaison with Queensland state agencies to determine the approvals required and processes to be followed for deepening of a channel in an area in, or in close proximity to, Marine Parks, Fish Habitat Areas and Ramsar sites.

Twofold Bay Naval Facility – Environmental Monitoring (2002 – 2003)
Quarterly field assessments to determine impacts during the construction of the Twofold Bay Naval Facility on the sensitive communities within the bay. This involves assessment of seagrass, rocky reefs, intertidal areas and fish stocks, as well as inspection of the wharf pylons and areas nearby for introduced species.

Turbidity Monitoring of Maintenance Dredging Karumba (2002)
Analysis of results and compilation of report following turbidity monitoring during the 2002 maintenance dredging of the channel entrance to the Port of Karumba.

Port Curtis Baseline Water Quality Sampling Program (2002)
Compilation of results of ongoing water quality monitoring program.

Mackay Port Long Term Dredge Spoil Management Strategy (2000-2001)
Research and preparation of legal (relevant legislation) and environmental issues for the Mackay Port long term dredge spoil management strategy.

Bundaberg Port Authority (2000)
Research and preparation of legal aspects, such as licensing and relevant legislation, of an IAS for the extension of the Bundaberg Port involving capital dredging and sea dumping of dredge material.

Private Development Assessments (including resource extraction assessments)

Sunshine Plaza Redevelopment (2006 – Ongoing)
Project manager for provision of advice on hydrology, aquatic ecology, water quality and stormwater management components of two development applications and information requests associated with the redevelopment of Sunshine Plaza (Stage 3) and Lot 38, respectively.

Riverside Resource Allocation (2007)
Project manager for the preparation of a resource allocation application and supporting material to extract sand from the Spitfire permit area (northern Moreton Bay) for the period 1 February 2008 to 31 January 2014.

Maroochydore Structure Plan Advice (2007)
Project manager for a review of the hydrological, ecological and water quality aspects of the Maroochydore Structure Plan Advice, considered from the perspective of the clients (Lend Lease) and proposed future developments.

Coomera Marina Development (2007)
Project management of coastal process and hydrological aspects of a proposed marina and boat building development of State significance. Provision of advice regarding referral under the *EPBC Act* and declaration of the project as being of state significance under the *State Development and Public Works Organisation Act 1971* (Qld).

Environmental Management Plan for Settlers Cove Jetty (2006 – 2008)
Development of an Environmental Management Plan for the jetty at Settlers Cove high density residential development at Noosa with the main issues being ecological management and restoration, marine plant protection and marine and on-site water quality management.

Readymix Integrated Environmental Management System (2005)
Development of an integrated environmental management system (IEMS), designed to integrate the requirements of Readymix's national Safety Health and Environment Management System (SHE) and the requirements of the licence (registration certificate) issued by the EPA (Qld) to conduct environmentally relevant activities (ERAs). The IEMS is compliant with the requirements for the contents of an IEMS pursuant to s313 *Environmental Protection Act 1994* (Qld).

Coomera Dredging Approvals Advice (2003)
Interpretation of legislation and regulations, and liaison with Queensland state agencies to determine the approvals required and processes to be followed for deepening of a channel in an area in, or in close proximity to, Marine Parks, Fish Habitat Areas and Ramsar sites.

Golf Links Development EPBC Act Referral Advice (2004)
Advice provided on the need for referral of the project under the *EPBC Act.* Discussions with DEH regarding aspects of the project which were of particular concern, and scoping of studies to fill information gaps.

Norwich Park Mine *EPBC* Referral (2003 –2004)
Preparation of referral forms based on prior work undertaken by WBM terrestrial ecologists for referral of an extension of the Norwich Park Mine under the *EPBC Act 1999.*

Environmental / Ecological Studies, Monitoring and Reviews

Noosa North Shore Vehicle Impact Study (2005 – 2006)
Development of a survey program to determine the impact of long-term usage of 4WDs on sandy beaches, in particular on benthic macrofauna. Other aspects of the project include information collation regarding previous studies in the area, and consultation with the Noosa North Shore working group, local Universities and other environmental consultants.

Gippsland Lakes RT-4 Project (2005)
Compilation and assessment of relevant international, national, state, regional and local legislation and policy applicable to the use of natural or constructed wetlands adjacent to, and adjoining, the Gippsland Lakes, as a nutrient trap for improvement of water quality in the Gippsland Lakes (including the Gippsland Lakes Ramsar site). The review provided the client with an understanding of the complexity of the legislation applicable to the Gippsland Lakes wetlands.

Ninds Creek STP Environmental Monitoring (2004 – 2005)
Project management (part of project) of the environmental monitoring of Ninds Creek, including data collection and analysis of water quality (for reactive P, faecal coliforms, COD and BOD), sediment quality, and isotope analysis of the marine red algae, *Catenella nipae*, to identify the presence of sewage-derived nitrogen.

Main Roads Gateway Upgrade Project (2003)
Project management of a project requiring the provision of a report on the impacts and mitigation measures of the Gateway Upgrade Project on a matter of national environmental significance (Ramsar site) under the *EPBC Act 1999.*

Gold Coast Harbour Marine Surveys (2003 –2004)
Field surveys, data collation and preparation of a report detailing the 'health' of the Gold Coast Harbour in relation to seagrass and benthic macrofaunal communities. As project manager, the project also involves coordination and liaison with the Gold Coast City Council

Botany Bay Habitat Inventory (2003)
Collation of spatial data from numerous government agencies and community groups for inclusion in a habitat inventory, with the view to creating an integrated planning assessment framework for Botany Bay. The project required extensive consultation with various agencies and groups, and negotiating in relation to data/information required.

Bing Bong Maintenance Dredging Assessment (2003)
Research and preparation of a report detailing presence/absence and density of previous seagrass communities within the barge channel and surrounding area in the Gulf or Carpentaria, and assessment of possible dredge spoil dumping sites and the likely impact of dumping on seagrass.

Twofold Bay Naval Facility – Environmental Monitoring (2002 – 2003)
Quarterly field assessments to determine impacts during the construction of the Twofold Bay Naval Facility on the sensitive communities within the bay. This involves assessment of seagrass, rocky reefs, intertidal areas and fish stocks, as well as inspection of the wharf pylons and areas nearby for introduced species.

Waste Management Facilities Literature Review and Generic Assessment (2002-2003)
Research and preparation of a report detailing the actual and potential impacts that different types of waste management facilities may have on water quality and catchment health. On the basis of the information collated in the literature review, a generic assessment was made of catchment effects for each facility type.

Mackay Port Long Term Dredge Spoil Management Strategy (2000-2001)
Research and preparation of legal (relevant legislation) and environmental issues for the Mackay Port long term dredge spoil management strategy.

Bundaberg Port Authority (2000)
Research and preparation of legal aspects, such as licensing and relevant legislation, of an IAS for the extension of the Bundaberg Port involving capital dredging and sea dumping of dredge material.

Urangan Boat Harbour (2000)
Data collection of water velocity data in and around the Urangan Harbour for a study investigating possible dredging and dumping strategies, and follow-up research for community consultation.

Department of Main Roads, Nerang District (1999)
Preparation of system of responsibility for the Senior Environmental Officer in the Nerang District of the Department of Main Roads

Caboolture Northern Bypass (Department of Main Roads) (1999)
Assistance in the development of an EMP for the Caboolture Northern Bypass which crossed environmentally sensitive areas.

Carole Park (1999)
Assistance in the preparation of licensing applications for the Carole Park project which involves the development of an energy park for food and beverage manufacturing.

Luggage Point Success Determination Monitoring Year 2 (2002)
Water quality sampling to aid in determination of the success of a mangrove rehabilitation project.

Turbidity Monitoring of Maintenance Dredging Karumba (2002
Analysis of results and compilation of report following turbidity monitoring during the 2002 maintenance dredging of the channel entrance to the Port of Karumba.

Port Curtis Baseline Water Quality Sampling Program (2002)
Compilation of results of ongoing water quality monitoring program.

Gunnamatta Bay Estuary Process Study (2001)
Assistance with writing of report for the Gunnamatta Bay Process Study.

Gymea Bay Estuary Process Study (2001)
Assistance with writing of report for the Gymea Bay Process Study.

Nathan Dam (2000)
Assistance in macroinvertebrate and water quality data collection, and data analysis to establish baseline conditions for the proposed Nathan Dam near Taroom (Qld).

CSR (2000)
Water quality sampling and analysis as part of a long term monitoring program for CSR.

PRESENTATIONS

The Implementation of Sustainable Development Principles – Queensland and Australia, University of Queensland, 2005

Environmental Impact Assessment, University of Queensland, 2005

Is the Legal Framework Achieving Sustainable Development? University of Queensland, 2005

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Project Experience

Water Quality and Estuary Management

Maroochy Estuary Sustainable Loads Study (2003-2004) – Project manager and modelling supervisor of a model based project to develop sustainable or target loads for the estuary.

Sandgate Estuary Water Quality Modelling Study (2003) – Project manager and modelling supervisor of a project that simulated water quality dynamics in Cabbage Tree Creek, a tributary of Moreton Bay, aimed at studying the effects of an existing 27ML/day wastewater outfall, and determining the quality improvements required to achieve defined water quality objectives for the estuary.

Batemans Bay Effluent Transport Study (2003) – Project Manager of a study investigating sewage effluent transport processes in the Batemans Bay area on the South Coast of New South Wales.

Lake Illawarra Estuary Processes Study, Management Study and Management Plan (2001-2002) – Project Manager of a study to develop an Estuary Processes Study, Management Study and Management Plan for the waterways and catchment of Lake Illawarra.

Wonboyn Lake and River Estuary Processes Study, Management Study and Management Plan (2000-2001) – Project Manager of an Estuary Processes Study, Management Study and Management Plan of the Wonboyn Lake and River on the Far South Coast of New South Wales.

Maroochy Estuary Eutrophication Modelling (2001-2002) – Project manager of a study to develop and calibrate MIKE11 EU models of the Maroochy Estuary, and to subsequently use these models to assess a range of future land use and wastewater discharge scenarios.

Batemans Bay and Clyde River Estuary Processes Study (2000) – Project Manager of an Estuary Processes Study of the Clyde River and Batemans Bay area in the South Coast of New South Wales.

Nambucca River Estuary Processes Study (1999-2000) – Project Manager of an Estuary Processes Study of the Nambucca River on the North Coast of New South Wales.

Samut Prakarn Wastewater Outfall Water Quality Study (1999) - Project Manager of a major water quality modelling study aimed at the determination of the water quality impacts on the Upper Gulf of Thailand of a large wastewater outfall (*ultimate capacity* $20m^3/s$) treating domestic and industrial waste from much of south-eastern Bangkok.

Brisbane River and Moreton Bay Wastewater Management Study (1994 - 2006) - A range of key roles in the study including the following:

- Study Team Member in Aquatic Ecosystem and Water Quality Management Scoping Studies
- Project Manager of Stage 1 Conceptual Model Study
- Project Manager of Stage 2 Hydrodynamics (HD) and Non Point Source Loading (PL2) tasks
- Member of the Scientific Advisory Group (SAG), Modelling Advisory Group (MAG), Stage 2 Round 2 Core Group (S2R2)
- Project manager of receiving water quality modelling conducted by DEH personnel
- Project Manager of Stage 3 Catchment Non Point Source Data Collection Scoping Study

- Project Manager of all Stage 4 Catchment and Receiving Water Quality Modelling Studies (total budget in excess of $500,000)

Development of an Action Plan to Improve the Water Quality of the Central Basin of Thailand (1995-1997) - Project Manager of the water quality modelling component of a major multi-national study aimed at the development of relevant action plans to manage and improve the water quality of some 700km of major rivers in the Central Basin of Thailand, including the Chao Phraya River flowing through Bangkok.

Preliminary Conceptual Model Study, Task G4, Stage 1 of the Brisbane River and Moreton Bay Wastewater Management Study (1996) - Project Manager of a study to investigate key water quality variables and ecological processes affecting water quality within the Brisbane River and Moreton Bay region. The main product of the study was a spreadsheet based conceptual model of water quality in the study area, calibrated in a general manner to ambient water quality levels.

Trinity Inlet Advection-Dispersion and Water Quality Model Study (1996) - Project Manager of a MIKE11 Advection-Dispersion and Water Quality model study of trinity Inlet. The study involved a Rhodamine WT dye release, other data collection, model calibration and various scenario assessments.

Buran Darat Development, Sentosa Island - Singapore (1994-1995) - Project Manager of a study that evaluated water quality, hydraulic, coastal engineering and construction aspects of a proposed waterway development. Provision of design and operational advice.

Stour Estuary Water Quality Modelling (1993) - Project Engineer of a study that developed, calibrated and validated a 1-D water quality model of the Stour Estuary in Kent. This model included the simulation of tidal flow, saline intrusion, nutrient, sediment and algal dynamics.

Hawkesbury Nepean Blue Green Algal Modelling (1993) - Project Engineer responsible for the development of algorithms to simulate the growth dynamics of blue-green algae, and the inclusion of these algorithms in the HR Wallingford 1-D Water Quality model, SALMON-Q. Testing of these algorithms for Sydney Water on the Hawkesbury-Nepean system

Avon River Barrage Blue Green Algal Assessments (1993) - Project Engineer responsible for assessment of the potential for blue-green algal blooms behind proposed Avon River Barrage.

Benthic Respiration Study, Kent Stour Estuary (1993) - Project Manager of a Benthic Respiration study of the Kent Stour Estuary.

Combined Sewer Overflows Assessments - Proposed Tees Barrage (1993) - Project Engineer responsible for water quality assessments of the effects of combined sewer overflows downstream of the proposed Tees Tidal Barrage on water quality.

Water quality studies for proposed Maleny development (1991) - Project Engineer responsible for water quality assessments associated with a proposed residential development at Maleny.

Water quality modelling of the Clarence River, NSW (1990) - Project Engineer responsible for a study aimed at the determination of acceptable discharge periods for a proposed aquaculture project on the Clarence River, NSW.

Water quality modelling of the Tweed River (1990) - Project Engineer involved in a study to evaluate the impacts of various entrance/dredging works on the hydraulics, water quality and ecology of the Tweed River, NSW.

Banora Point STP Outfall Study, Tweed Heads (1989) - Project Manager and modeller of a study aimed at evaluating the impacts of sewage effluent discharge strategies/qualities from the Banora Point STP on water quality in the Tweed River.

Gladstone tradewaste outfall study (1989) - Project Engineer on a multi disciplinary study investigating the potential water quality and environmental impacts of a proposed tradewaste outfall into Port Curtis.

Water quality implications of urban area development at Narangba - Brisbane - Project Engineer responsible for water quality impact assessments associated with a proposed urban development at Narangba in Brisbane.

Urban lake water quality study - Forest Lake, Brisbane - Project Engineer undertaking initial water quality management studies associated with the Forest Lake development.

Stormwater Management, Water Sensitive Urban Design (WSUD) and Integrated Water Cycle Management (IWCM)

Pimpama Coomera Water Futures Rainwater Tank Optimisation Study (2004-2005) - Project manager and modelling supervisor of a study that assessed the benefits of various rainwater tank configurations on stormwater and water supply elements of the proposed 150,000 person Pimpama Coomera Water Futures area in Gold Coast City.

Yarrabilba WSUD and IWCM study (2004) – Project manager and modelling supervisor of a study that assessed and scoped WSUD and IWCM elements of the proposed 50,000 person Yarrabilba master planned community in Beaudesert Shire.

Pimpama Coomera Water Futures WSUD Study (2003-2004) - Project manager and modelling supervisor of a study that assessed WSUD and lot scale IWCM elements of the proposed 150,000 person Pimpama Coomera Water Futures area in Gold Coast City.

Victorian WSUD Technical Manual (2003-2004) – Member of joint WBM/Ecological Engineering and Parsons Brinckerhoff team developing a WSUD Technical Manual for Melbourne Water.

Brisbane WSUD Technical Manual (2004-2005) – Member of joint WBM/Ecological Engineering and Bligh Tanner team developing a WSUD Technical Manual for Brisbane City Council.

NSW Managing Urban Stormwater (2003-2004) – Member of joint WBM/Ecological Engineering and Parsons Brinckerhoff team rewriting the NSW Managing Urban Stormwater (MUS) series of documents for the NSW DEC.

Lensworth Lake Doonella (Noosa) Development – Project manager of a team of engineers and ecologists developing a WSUD/IWCM strategy for the Lensworth Lake Doonella development at Noosa.

Lower Hunter and Central Coast and Western Sydney WSUD Capacity Building Programs (2000-2003) – Technical advisor on the subject of WSUD to both these capacity building programs.

Australian Runoff Quality WSUD Chapter (2003-2006) – Key member of team of authors tasked by Engineers Australia with preparing the WSUD chapter of Australian Runoff Quality.

Road Runoff Characterisation Study (2002) – Project Manager of a study team assessing the qualities of runoff from varying road surfaces in South East Queensland, and assessing the potential magnitudes of these loads in comparison to other sources of runoff in local urban areas.

Varsity Lakes Stormwater Management (2002) – Project manager of a study team assessing stormwater management requirements for the proposed Varsity lake development on the Gold Coast.

Gold Coast Ecovillage WSUD and IWCM study (2000-2004) – Manager of team of WBM staff assisting with the conceptualisation, development and design of WSUD/IWCM strategies for the proposed Gold Coast Ecovillage in the Currumbin Valley.

Springfield Development Scoping and Detailed Design Investigations (1999-2002) – Principal researcher for Delfin to develop suitable stormwater quality management strategies to guarantee appropriate water quality levels in a proposed series of freshwater lakes in the Springfield Development to the west of Brisbane. The project involved conceptual and actual design of a number of water quality management measures (wetlands, GPT's, lake destratification systems, etc), development of relevant Water Quality Management Plans for the entire system and preparation of relevant Environmental Planning studies.

Stormwater Reuse Background Study (1998) - Project Manager of a study investigating the potential for Stormwater Reuse as a component of the Queensland Wastewater Reuse Strategy. This project involved extensive literature searches, visits to relevant locations around Australia to inspect stormwater reuse projects, and discussions with national and international experts in the field.

Artificial Wetlands for stormwater quality control design, Wollongong NSW (1995) - Project Manager responsible for the layout configuration and detailed design documentation of two (*2*) large artificial wetlands proposed (*and recently constructed*) at Wollongong.

Long Term Consultancy - Brisbane City Council (1993-1995) - Provision of a long term consultancy service to Brisbane City Council, advising on stormwater quality issues, catchment management and the establishment of a stormwater quality monitoring and modelling program

Catchment Management

Lake Samsonvale Integrated Catchment Management Strategy (2001-2002) – Project Manager of a study aimed at developing a sustainable land use planning framework for the catchment of Lake Samsonvale, one of the principal water supply resources for the Greater Brisbane region. This framework will be used as the basis for land use planning in the catchment in the next 10-15 years. The strategy had as one of its key requirements a need to reduce nutrient and sediment loads from the catchment to achieve a net improvement with time in water quality levels in the dam.

Task BSES - Broad Scale Evaluation of Sources (2001) – Project Manager of a major study for the SEQRWQMS to ascertain the magnitudes and sources of pollutant loads entering Moreton Bay from its catchment, and also to quantify the measures that are available to manage these loads, and their relative efficacy and costs in achieving various scenarios of non point source load management/reduction.

Gowrie Creek (Toowoomba) Catchment Management Study (1997-1998) - Project Manager supervising a major catchment management study for Gowrie Creek in Toowoomba. The project involved extensive community and stakeholder liaison, technical and financial assessments, ecological and water quality investigations and recreational planing.

Catchment Runoff Pollutant Load Estimation, Task PL2, Stage 2 of the Brisbane River and Moreton Bay Wastewater Management Study (1997-1998) - Project Manager of a study to develop catchment pollutant export models of the Brisbane River and Moreton Bay Study area.

Blue Gum Hills (Newcastle) Catchment Management Strategy (1996) - Project Manager of a study aimed at determining an ecologically sustainable development solution for a large catchment in Newcastle intended for urban development.

Bremer River Catchment Management Strategy (1995-1996) - Project Manager of Stage 1 of the Bremer River Catchment Management Strategy. This study involved extensive stakeholder representative consultation and workshop facilitation to identify key issues requiring management within the catchment, and a range of possible solution strategies for these issues. The study set the scene for subsequent more detailed implementation assessments.

Rose Bay Catchment Management Study (1991) - Project Engineer responsible for mathematical modelling aspects of a catchment management study of an area in Rose Bay, Sydney

Flood Management and Hydraulic Modelling

Banora Point/South Tweed Master Drainage Plan (1996) - Project Manager of a flood and pollutant export assessment study aimed at developing viable master drainage and water quality control infrastructure for a large catchment, under development pressure, in Tweed Shire.

Carseldine-Taigum Master Drainage Plan (1995-1996) - Project Manager of a flood and pollutant export assessment study aimed at developing viable master drainage and water quality control infrastructure for a large catchment, under development pressure, in Brisbane City.

Tidal hydraulic, hydrology and flooding assessments of Cudgen and Mooball Creeks, Clarence, Manning and Maroochy Rivers (1987-1991) - A wide range of modelling related assessments of a number of rivers in Northern New South Wales for various local government and industry clients.

Development of mathematical tidal model of the Gold Coast Broadwater (1989) - Project Engineer and Modeller responsible for the development, calibration and validation of a 1D hydraulic model of the Gold Coast Broadwater.

Evaluation of the impacts on flooding in the Manning River of various alternative Pacific Highway routes (1989-1991) - Project Manager and Modeller responsible for assessing the effects on flooding of various Pacific Highway alignments and configurations, with the study ultimately encompassing the design of major minimum energy culvert structures under the highway at several key locations.

Environmental Management

Thai Oil Spill Fingerprinting and Characterisation Study (2000) – Project manager of a multidisciplinary project team tasked by the Thai Pollution Control Department to develop protocols and procedures to 'fingerprint' oils commonly handled in Thailand, and to characterise how these oils weather in local conditions if spills occur.

Malaysian Wetland Sanctuary Hydraulic and Water Quality Studies (1997) - Project Manager of a study investigating hydraulic and water quality aspects of a major, and degraded, natural wetland area near Kuala Lumpur, Malaysia, with expert input into Master Planning to remediate the areas as a Wetland Sanctuary.

Logan Waterways Strategy Study (1993-1994) - Project Manager of a study aimed at developing a strategy for the remediation and sustainable development of the waterways of Logan City. This study involved extensive Community and Council liaison and input.

Environmental Appraisal of Lake Illawarra for NSW Public Works Department (1993-1994) - Project Manager of a multi disciplinary study aimed at appraising the proposed $20 million works program of the Lake Illawarra Authority (*including entrance modifications, dredging, wetland construction, habitat improvements etc.*), and making appropriate recommendations for continuation or modification of the program.

Investigation of dispersion and hydrodynamic processes - Halifax Bay, North Queensland (1992) - Project Engineer responsible for field investigations and modelling studies associated with a proposal to import nickel ore to Halifax Bay in Townsville. This work also included extensive involvement in an Administrative Appeals Tribunal with respect to the project, including considerable time under examination as an expert witness.

Alternative Dredging Strategy Study - Weipa (1990) - Project Manager of a field and model based study evaluating the potential efficacy of alternative dredging strategies (*e.g. sidecasting, alternative spoil dumping sites, agitation dredging*) at the Port of Weipa. The study involved a two week field investigation, comprising prototype testing of the alternative strategies.

Investigation of hydraulic, sediment transport and water quality implications of lower estuarine dredging, Tweed River (1990) - Project Engineer responsible for a wide range of hydraulic, water quality and sediment transport modelling studies associated with various lower estuarine dredging proposals for the Tweed River.

Participation in Weipa South Channel Siltation Study (1989) - Project Engineer responsible for all field and modelling investigations associated with the Weipa South Channel Siltation Study.

Evaluation of tidal hydrodynamic and siltation related impacts of a proposed marina at Fingal Head, Tweed River, NSW (1988) - Project Engineer responsible for hydrodynamic and siltation assessments as part of an EIS being prepared for a proposed marina development in Tweed Shire

Conference Papers and Presentations

Milligan, C.J. and McAlister, A.B. (1988), 'Water Quality Management at Palm Meadows Golf Course by Limited Tidal Exchange', IAWPRC/AWWA Conference - Water Quality and Management for Recreation and Tourism, Brisbane.

McAlister, A.B. (1989), 'Development and Testing of a Lagrangian Water Quality Model', I.E. Aust. Hydrology and Water Resources Symposium, Christchurch, N.Z.

McAlister, A.B. (1989), 'Dye Dispersion Studies and Mathematical Modelling of a Tidal Canal in the Clarence River, New South Wales', M.Eng.Sc Thesis, University of Queensland.

McAlister, A.B. and Stokoe, P.C. (1990), 'An Evaluation of Alternative Dredging Operations for the Shipping Channel-Weipa', Third Australian Port and Harbour Engineering Conference, Melbourne.

McAlister, A.B. (1991), 'Management of Urban Water Quality', AWWA Dirty Waters Workshop, Brisbane.

McAlister, A.B. (1991), 'Urban Stormwater Pollution - A Description of the Problem, Analysis and Solution Techniques', IE Aust QLD Division Technical Papers.

McAlister, A.B. and Witt, C.L. (1993), 'Providing a Better Understanding of Flooding Behaviour with Detailed Numerical Models', 33rd Annual N.S.W. Flood Mitigation Conference.

McAlister, A.B. (1994), 'The Importance of Accurately Simulating Hydraulic Processes in Water Quality Modelling Studies', IE Aust Conference on Hydraulics in Civil Engineering, Brisbane.

McAlister, A.B. and Hutchinson, R. (1994), 'The Practical Applications of Advanced Numerical Modelling Techniques in the Development of a Functional and Cost-Effective Layout for the Buran Darat Development - Sentosa Island, Singapore', Ninth Congress of the Asia Pacific Division of IAHR, Singapore.

McAlister, A.B., Syme, W., Bycroft, B., and Mack, P. (1995), 'The Application of a Common Australian Stormwater Quality and Quantity Model in the Sub-Tropical Environment'. The Second International Symposium on Urban Stormwater Management, Melbourne.

Bycroft, B., Mack, P., and McAlister, A.B. (1995), 'Stormwater Quality Data Collection Program for Brisbane City Council'. The Second International Symposium on Urban Stormwater Management, Melbourne.

Hogarth, W., Walden, W.J., McAlister, A.B. (1995), 'A Review of current water quality modelling practices in Australia', 3rd Princess Chulabhorn Science Conference, Thailand.

McAlister, A.B. (1997), 'Water Sensitive Urban Design', Keynote Address, Stormwater and Soil Erosion '97, Brisbane.

McAlister, A.B., Walden, W.J., and Taylor, L. (1997), 'The Application of Mathematical Water Quality Models in Areas of Limited Data Availability'. Pollution Control '97, Bangkok, Thailand.

McAlister, A.B. (1998), 'Brisbane City Council Water Sensitive Urban Design Case Study', Hydrastorm '99, Adelaide.

McAlister, A.B. and Keane, P. (1998), 'Gowrie Creek Catchment Management and Stream Restoration Program', Hydrastorm '99, Adelaide.

Walden, W.J., McAlister, A.B. and Robbins, P. (1998), 'Pollutant Export Assessments in Tropical and Sub-tropical Environments', Hydrastorm '99, Adelaide.

McAlister, A.B. and Walden, W.J.(1998), 'Water Quality Modelling in the Central Basin of Thailand', Hydrastorm '99, Adelaide.

McAlister, A.B. and Keane, P. (1998), 'Gowrie Creek Catchment Management Strategy', IMEAQ Conference, Toowoomba. - **awarded Best Paper of Conference**

McAlister, A.B. (2000), 'Water Sensitive Urban Design', Water Sensitive Urban Design in the Australian Context Conference, Melbourne 2000

McAlister, A.B. and Cavanagh, D.C. (2002), 'Past, present and Future Directions in Catchment and Stormwater Pollutant Modelling', 4th Queensland Environmental Conference, I.E. Aust Environmental Engineering Society.

McAlister, A.B. (2005), 'Integrated water cycle management considerations in a greenfield site: the way forward', Hallmark Publications Masterplanned Urban Communities Conference, Sydney 2005 - **awarded Best Paper of Conference**

Book Chapters and National Publications

Australian Runoff Quality (Engineers Australia 2006) – Principal author of Modelling Chapter and Co-author of Water Sensitive Urban Design chapter

Healthy Waterways, Healthy Catchments: Making the Connection in South East Queensland, Australia, Co-Author of Chapter 8 'Integration'.

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REPRESENTATIVE PROJECTS

2007: *PROJECTS*

Management of cultural heritage and native title aspects of the ZeroGen Project
- CLIENT: Stanwell

Management of the cultural heritage and native title aspects of the Gladstone Fitzroy water pipeline project
- CLIENT: Gladstone Area Water Board

Management of the cultural heritage aspects of the Emu Swamp Dam
CLIENT: Stanthorpe Shire Council and Sinclair Knight Merz

2006: *CULTURAL HERITAGE ASSESSMENTS*

Cultural heritage assessment of the Eastern Busway Project
- CLIENT: Translink

Cultural heritage assessment of the Northern Busway Project
- CLIENT: Translink

Heritage assessment of the Townsville to Ballera and Cape York Peninsula to Gove Gas Pipelines
- CLIENT: API and Enesar

Heritage Aspects of the Beaudesert Whole of Shire Strategic Plan
- CLIENT: Beaudesert Shire Council and Buckley Vann Town Planning

2005: *CULTURAL HERITAGE ASSESSMENTS*

Cultural heritage assessment of the Airport Link Tunnel
- CLIENT: Brisbane City Council and Connell Wagner/SKM Partnership

Management of Heritage Issues for the Brisbane Airport Parallel Runway Project
- CLIENT: Brisbane Airport Corporation and Arup Sustainability

Cultural Heritage Management Plan for the Stanwell QCE Project
- CLIENT; QLD Coke and Energy and URS

Cultural Heritage Management Plan for ML 1108, North Stradbroke Island
- CLIENT; UNIMIN

2004: *CULTURAL HERITAGE ASSESSMENTS*

Cultural heritage assessment of the North South Bypass Tunnel
- CLIENT: Brisbane City Council and Connell Wagner/SKM Partnership

Advice on management of Cleveland bora ring and development of Cultural Heritage Management Plan
- CLIENT: Euro Natural Fine Foods and Department of State Development and Innovation

Advice on duty of care protocols for cultural heritage, and implementation into administration systems
- CLIENT: Toowoomba City Council

Cultural heritage assessment of the Hamilton Wharves redevelopment masterplan area
- CLIENT: Port of Brisbane Corporation

2004: EXCAVATION AND ANALYSIS

Archaeological programme for mitigation strategy of Millennium Arts Project

- CLIENT: Arts Queensland

Archaeological investigation of sites near Teewah, Cooloolah Coast

- CLIENT: Energex

2003: *CULTURAL HERITAGE ASSESSMENTS*

Cultural heritage analysis of Musgrave Park, South Brisbane

- CLIENT: Brisbane City Council and Arts Queensland

Cultural heritage analysis of the Millennium Arts Project Site, South Brisbane

- CLIENT: Arts Queensland

Cultural heritage analysis of Wises Farm, Maroochydore

- CLIENT: Hills Property Group

Cultural heritage analysis of land at Dudgeon Point, near Mackay

- CLIENT: Ports Queensland Corporation

2003: EXCAVATION AND ANALYSIS

Excavation and analysis of recovered material from "Military Road" now the Kawana Way road corridor

- CLIENT: Department of Main Roads

Excavation and analysis of material from Buderim

- CLIENT: Stocklands

Excavation and analysis of material from Bribie Island (two sites)

- CLIENT: QM Properties

2002: *CULTURAL HERITAGE ASSESSMENTS*

Advice to the Kogan Project (coal mine and power station) on cultural heritage procedures for 20 year life

- **CLIENT: CS Energy**

Cultural heritage analysis of Toowong ferry terminal site

- CLIENT: Maunsell

Cultural heritage analysis of Musgrave Road, Red Hill

- CLIENT: Brisbane City Council

Cultural heritage analysis of land at Agnes Waters

- CLIENT: KBR

Photographic recording of the Brisbane Port Corporation development

- CLIENT: Brisbane Port Corporation

2002: EXCAVATION AND ANALYSIS

Mitigation, excavation and analysis of cultural heritage material from the Acland Coal Project area, Acland

- CLIENT: New Hope Coal Pty. Ltd.

2001: CULTURAL HERITAGE ASSESSMENTS

Toowoomba City Gowrie Creek cultural heritage analysis

- CLIENT: Toowoomba City Council

Cultural heritage analysis of “Chancellor Park”, Mooloolah

- CLIENT: Developer

Cultural heritage analysis of Mackay City landfill

- CLIENT: Mackay City Council and Maunsell

Cultural heritage analysis of “Tong Park’ at Warra

- CLIENT: Developer

2001: PLANNING STUDIES

Historical Interpretation of Glengallen Homestead

- **CLIENT: Convergence**

Training workshops on cultural heritage and workplace health and safety issues, Department of Main Roads

- **CLIENT: Department of Main Roads**

2001: EXCAVATION AND ANALYSIS

Reburial at Bundaberg Port Authority lands, Bundaberg

- **CLIENT: Gooreng Gooreng, Gurang and Taribelang People, Bundaberg Port Authority**

2000: CULTURAL HERITAGE ASSESSMENTS

Cultural heritage analysis of exploration sites, near Longreach

- CLIENT: Galilee Energy; chosen by the Traditional Owners

Cultural heritage analysis of proposed ferry sites, Brisbane River

- CLIENT: Maunsell McIntyre for the Brisbane City Council

Cultural heritage analysis of the Gold Coast Convention Centre site

- CLIENT: Weathered Howe for Jupiters Casino

Cultural heritage analysis of the Roma Street redevelopment
- CLIENT: Bovis Australia for the Department of Public Works

Cultural heritage analysis, artefact collection, excavations and analysis of the Georgina River bridge crossing, Camooweal
- CLIENT: Department of Main Roads; chosen by the Injilandji People

2000: PLANNING STUDIES

State of Environment of cultural heritage issues in Caboolture Shire
- CLIENT: WBM Oceanics

Cultural heritage issues in the IPA Planning Study for Southern Burnett Shires
- CLIENT: Gutteridge Haskins & Davey

2000: EXCAVATION AND ANALYSIS

Analysis of the material from the Victoria Park excavation
- CLIENT: Brisbane City Council

Excavation and analysis of material from the Caboolture Northern Bypass
- CLIENT: Department of Main Roads

Excavation and analysis of material from Carole Park Energy Park
- CLIENT: Hyder Consulting for the Department of State Development

1999: CULTURAL HERITAGE ASSESSMENTS

Cultural heritage analysis of the Boyne Valley for the Awoonga Dam raising project
- CLIENT: Gladstone Area Water Board; chosen by the Gooreng, Bailai and Gurang People

Archaeological assessment of the Millmerran Power mining lease, and adviser to the Gambuwal Reference Group
- CLIENT: Millmerran Power; chosen by the Gambuwal People

Cultural heritage assessment of the Southbank Bridge project
- Department of State Development

1999: MANAGEMENT AND ADVISORY PROJECTS

Adviser to Brisbane City Council regarding cultural heritage issues associated with their transport infrastructure developments

Preferred consultant for Transport Technology Section, Department of Main Roads

1999: *EXCAVATIONS*

Excavation of the Inner City Bypass corridor in Victoria Park
- CLIENT: Brisbane City Council

1998: *CULTURAL HERITAGE ASSESSMENTS*

Cultural heritage issues associated with the Kogan coal and power station project
- CLIENT: Southern Company; chosen by the Western Wakka and Iman People

Cultural heritage analysis and advice to the Acland coal and power station project
- CLIENT: Shell Australia

Cultural heritage analysis of the Infrastructure Corridor, Gladstone to Aldoga
- CLIENT: Department of Economic Development and Trade

Cultural Heritage Analysis of the Proposed Comalco Site, Aldoga, Gladstone.
- CLIENT: Dames & Moore Pty Ltd. for Comalco.

Cultural Heritage Analysis of a proposed Transmission Power line corridor between Ilfracombe and Longreach.
- CLIENT: Longreach Aboriginal Community and Capricornia Electricity Corp.

Cultural Heritage Issues associated with the Stuart Oil Project, Gladstone, Central Queensland.
- Sinclair Knight Mertz Pty Ltd. for SPP

1998: *MANAGEMENT AND ADVISORY PROJECTS*

Adviser on cultural heritage issues associated with the Gatton to Gympie Allgas pipeline corridor.
- CLIENT: Indigenous Steering Committee

Management of Cultural Heritage Issues Associated with the Proposed Power Transmission Line between Tarong and Calvale.
- CLIENT: Indigenous Steering Committee

Preferred consultant for Transport Technology Section, Department of Main Roads

1998: *EXCAVATIONS*

Excavation of specified areas near Little Rocky Creek axe grinding grooves
- CLIENT: Caloundra City Council

Excavation of specified areas of the proposed Southeast Transit corridor in South Brisbane
- CLIENT: Connell Wagner and Queensland Transport

1997: *CULTURAL HERITAGE ASSESSMENTS*

Cultural Heritage Assessment of the Wallangarra/Jennings Logistics Company Army Base, Queensland and New South Wales.

- CLIENT: Sinclair Knight Merz Pty. Ltd.

Cultural Heritage Assessment of a proposed Transmission Line between Tarong and Calvale. Stage One.

- CLIENT: Powerlink Qld.

Cultural Heritage Assessment of the Planned Bus Lanes Associated with the Southeast Freeway Between Southbank and the Logan Motorway.

- CLIENT: Connell Wagner for Main Roads Department.

1997: *PLANNING STUDIES*

Assessment of Historical Heritage of the southern Moreton Bay Islands, Redland Shire.

- CLIENT: Gutteridge Haskins and Davey Pty Ltd. for Redland Shire Council

Integration of Indigenous Cultural Heritage into the Ipswich City Town Plan.

- CLIENT: Ipswich City Council

1997: *MANAGEMENT AND ADVISORY PROJECTS*

Management of Selected Cultural Heritage Issues Associated with the Proposed Gas Pipeline from Papua New Guinea to Gladstone.

- CLIENT: Chevron Pty Ltd.

Management of Cultural Heritage Issues Associated with the Proposed Power Transmission Line between Tarong and Calvale.

- CLIENT: Indigenous Steering Committee

Production in conjunction with Transport Technology Section, of a handbook on cultural heritage issues.

- CLIENT: Department of Main Roads.

1997: *EXCAVATIONS*

Cultural Heritage Analysis and Artefact Collection, Landsborough Highway, Longreach

- By invitation of indigenous community; for Department of Main Roads.

Excavation of an Historical Precinct, William Street, Brisbane.

- CLIENT: Primary Industries Department

Excavation of an Historical Goal Site, Police Barracks Precinct, Petrie Terrace, Brisbane.

- CLIENT: QM Properties

1996: *CULTURAL HERITAGE ASSESSMENTS*

Cultural Heritage Assessment of Proposed New and Ungraded Ferry Terminals, Brisbane River.

- CLIENT: Maunsell

Cultural Heritage Assessment of a Proposed Power Sub-Station, Springdale, Western Moreton.

- CLIENT: Powerlink

Cultural Heritage Assessment of the Proposed Amberley Turnoff Upgrade, Cunningham Highway, Western Moreton.

- CLIENT: Arup & Partners

Assessment of Aboriginal Archaeological Values Associated with the Tennyson Powerhouse Site.

- CLIENT: Connell Wagner

1996: *MANAGEMENT AND ADVISORY PROJECTS*

Management of Selected Historical Cultural Heritage Issues Associated with the Proposed Gas Pipeline from Papua New Guinea to Gladstone.

- CLIENT: Chevron Pty Ltd.

Management of Cultural Heritage Issues Associated with the Proposed Power Transmission Line between Tarong and Calvale.

- CLIENT: Indigenous Steering Committee

1996: PLANNING STUDIES

Assessment of Cultural Values Associated with the Bayside Park Planning Study, Mount Cotton.

- CLIENT: Bayview Group.

Assessment of Heritage Values Associated with the Oxley Creek Catchment Study.

- CLIENT: Kinhill

1996: *EXCAVATIONS*

Excavation of a Midden Site, Peel Road, Beachmere.

- CLIENT: Pacific Sands Pty Ltd.

Analysis of Stone Artefacts Collected at Plainlands, Southeast Queensland.

- CLIENT: Sunwest

Excavation of Site of Convict Building, North Quay, Brisbane.

- CLIENT: Suncorp

1995: *CULTURAL HERITAGE ASSESSMENTS*

Cultural Heritage Assessment of the Proposed Expansion of the QCL Plant at Fisherman's Landing, Port Curtis.

- CLIENT: Connell Wagner

Cultural Heritage Assessment of a Potential Sand Extraction Site, Donnybrook.

- CLIENT: Kinhill

Cultural Heritage Assessment of the Upgrading Plans for the Warrego Highway Between Withcott and Minden.

- CLIENT: Department of Main Roads

Assessment of Cultural Heritage Values Associated with Department of Primary Industries' Land at Rocklea.

Assessment of the Cultural Heritage Values of the site of *Murrumba*, Petrie.

- CLIENT: GHD

1995: PLANNING STUDIES

Assessment of Heritage Values in the Mango Hill/Griffin Planning Study Area.

- CLIENT: Private development

Caloundra City Council Cultural Landscape Assessment.

- CLIENT: Caloundra City

1995: *EXCAVATIONS*

Interpretations and Excavations on the Glengallen Homestead Precinct, Darling Downs (with E. Crosby).

Archaeological Excavation, Interpretation and Analysis of Cultural Material from Pine Ridge Environmental Park, Oxley Drive, Hollywell.

- CLIENT: Ngarangwal Land Council

Archaeological Assessment, Interpretation and Analysis of Artefacts from the Bribie Island Haul Road.

- CLIENT: Maunsell Pty Ltd.

1994: *CULTURAL HERITAGE ASSESSMENTS*

Cultural Heritage Assessment of Three North/South Transport Corridor Options in the Kawana Area, Caloundra City Council and Maroochy Shire Council.

- CLIENT: SKM

Heritage Assessments of Proposed Telecom Fibre Optic Routes, 1. Toogum to Burrum Heads and 2. Mt. Morgan-Rockhampton

- CLIENT: Telstra

1994: *EXCAVATIONS*

Archaeological excavations of midden material in the "Noosa Springs" Estate, Noosa.

And numerous other projects...

BMT WBM Brisbane	Level 11, 490 Upper Edward Street Brisbane 4000 PO Box 203 Spring Hill QLD 4004 Tel +61 7 3831 6744 Fax +61 7 3832 3627 Email wbm@wbmpl.com.au Web www.wbmpl.com.au
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BMT WBM Melbourne	Level 5, 99 King Street Melbourne 3000 PO Box 604 Collins Street West VIC 8007 Tel +61 3 8620 6100 Fax +61 3 8620 6105 Email wbmmelbourne@wbmpl.com.au Web www.wbmpl.com.au
BMT WBM Newcastle	126 Belford Street Broadmeadow 2292 PO Box 266 Broadmeadow NSW 2292 Tel +61 2 4940 8882 Fax +61 2 4940 8887 Email wbmnewcastle@wbmpl.com.au Web www.wbmpl.com.au
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FOI 180804
Document 14k

Information Sheet on Ramsar Wetlands (RIS)

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

This Ramsar Information Sheet has been converted to meet the 2009 – 2012 format, but the RIS content has not been updated in this conversion. The new format seeks some additional information which could not yet be included. This information will be added when future updates of this Ramsar Information Sheet are completed. Until then, notes on any changes in the ecological character of the Ramsar site may be obtained from the Ecological Character Description (if completed) and other relevant sources.

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1. Name and address of the compiler of this form:

Division of Environmental Planning
Environmental Protection Agency
PO Box 155
BRISBANE ALBERT STREET QLD 4002
Ph: (07) 3227 6938
Fax: (07)3227 7237

FOR OFFICE USE ONLY

DD MM YY

Designation date Site Reference Number

2. Date this sheet was completed/updated:
June 1999

3. Country:
Australia

4. Name of the Ramsar site:
The precise name of the designated site in one of the three official languages (English, French or Spanish) of the Convention. Alternative names, including in local language(s), should be given in parentheses after the precise name.

Moreton Bay Queensland

5. Designation of new Ramsar site or update of existing site:
Moreton Bay was designated on 22 October 1993

This RIS is for (tick one box only)**:**
a) Designation of a new Ramsar site ❑; or
b) Updated information on an existing Ramsar site ❑

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area

The Ramsar site boundary and site area are unchanged: ❑

or
If the site boundary has changed:
i) the boundary has been delineated more accurately ❑; or
ii) the boundary has been extended ❑; or
iii) the boundary has been restricted** ❑

and/or

If the site area has changed:
i) the area has been measured more accurately ❑; or
ii) the area has been extended ❑; or
iii) the area has been reduced** ❑

** **Important note**: If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

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7. Map of site:
Refer to Annex III of the *Explanatory Note and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:
i**) a hard copy** (required for inclusion of site in the Ramsar List): ❑;

ii**) an electronic format** (e.g. a JPEG or ArcView image) ❑;

iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables ❑**.

b) Describe briefly the type of boundary delineation applied:
e.g. the boundary is the same as an existing protected area (nature reserve, national park, etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

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8. Geographical coordinates (latitude/longitude, in degrees and minutes):
Provide the coordinates of the approximate centre of the site and/or the limits of the site. If the site is composed of more than one separate area, provide coordinates for each of these areas.

Latitude: 27º 20' S; Longitude: 153º 10' E

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9. General location:
Include in which part of the country and which large administrative region(s) the site lies and the location of the nearest large town.

Immediately East and extending North-East and South-East of the City of Brisbane, the Capital of the State of Queensland.

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10. Elevation: (in metres: average and/or maximum & minimum)
Varying from sea level to 280 metres at Mt Tempest, Moreton Island.

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11. Area: (in hectares)
113 314 ha

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12. General overview of the site:
Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

Moreton Bay is a semi-enclosed basin bounded on its eastern side by two of the largest sand islands in the world. It is one of only three extensive intertidal areas of seagrass, mangroves and saltmarsh on the eastern coast of Australia that provide habitat for water birds.

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13. Ramsar Criteria:

Tick the box under each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11). All Criteria which apply should be ticked.

1	2	3	4	5	6	7	8	9
☑	☑	☑	☑	☑	☑	❑	❑	❑

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14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

[Justification against former Criterion **1(b)** under the Pre-1999 Criteria]:

Moreton Bay is one of the largest estuarine bays in Australia which are enclosed by a barrier island of vegetated sand dunes.

[Justification against former Criterion **1(c)** under the Pre-1999 Criteria]:

Moreton Bay plays a substantial role in the natural functioning of a major coastal system through its protection from oceanic swells providing habitat for wetland development, receiving and channeling the flow of all rivers and creeks east of the Great Dividing Range from the McPherson Range in the south to the north of the D'Aguilar Range.

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

[Justification against former Criterion **2(a)** under the Pre-1999 Criteria]:

Moreton Bay supports appreciable numbers of the vulnerable green and hawksbill turtles, the endangered loggerhead turtle and is ranked among the top ten dugong habitats in Queensland.

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

[Justification against former Criterion **2(b)** under the Pre-1999 Criteria]:

Moreton Bay supports over 355 species of marine invertebrates, at least 43 species of shorebirds, 55 species of algae associated with mangroves, seven species of mangrove and seven species of seagrass.

[Justification against former Criterion **3(b)** under the Pre-1999 Criteria]:

At least 43 species of shorebirds use intertidal habitats in the Bay, including 30 migratory species listed by JAMBA and CAMBA.

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Justification against former Criterion **2(c)** under the Pre-1999 Criteria]:

It is a significant feeding ground for green turtles and is a feeding and breeding ground for dugong. The Bay also has the most significant concentration of young and mature loggerhead turtles in Australia.

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.
[Justification against former Criterion **3(a)** under the Pre-1999 Criteria]:
Moreton Bay supports more than 50,000 wintering and staging shorebirds during the non-breeding season.

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
[Justification against former Criterion **3(c)** under the Pre-1999 Criteria]:
The Bay is particularly significant for the population of wintering Eastern curlews (3,000 to 5,000) and the Grey-tailed tattler (more than 10,000), both substantially more than 1% of the known Flyway population.

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15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):
Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

b) biogeographic regionalisation scheme (include reference citation):

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16. Physical features of the site:
Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

(a) Geology and Geomorphology: Moreton Bay is one of the largest estuarine bays in Australia which are enclosed by barrier island of vegetated sand dunes. Moreton Bay is about 80 km long, 35 km wide in the north, tapering to less than 5 km in the south. Only near Moreton Island does water depth exceed 40 m. Moreton Bay is situated close to the southernmost limit of reef-building corals. These occur around Peel, St Helena, and Green Islands, and from Wellington Point to Raby Bay (Hekel et al, 1978).

The mountains lying west of the coastal plains from south of Sydney to Fraser Island are formed chiefly by Mesozoic and Permian sedimentary rocks and granites. The eastern side of the range is and has been characterised by heavy rainfall and rapidly flowing rivers and creeks. A very large amount of detrital material is moved by these rivers to the sea, where strong longshore currents move the sediments, mainly quartz sand, northward. This process has continued all through the Quaternary to the present day (Benussi, 1975). Along the mainland shore, the Bay is bordered by extensive estuarine flats formed by coastal progradation during high sea levels of the Quaternary period of geologic time (approximately the last two million years)(Hekel et al 1978).

The coastline south of Fraser Island is characterised by sandy beaches alternating with rocky headlands. Because of these features, the movement of sand is not uniform but intermittent. The sand accumulates south of rocky headlands or river mouths, building up the beach and moving the shoreline eastward. Especially during seasonal summer storms, sand moves around obstacles towards the north (Benussi, 1975).

(b) Origins: Recent sediments are composed of two types:

A. Oceanic quartz sand giving rise to immense tidal deltas consisting of sand banks:

B. River sands and muds confined to the western side of the Bay. Unconsolidated Cainozoic sediments dominate, however rocks are exposed at Point Lookout, at Dunwich, and at the south-west of North Stradbroke Island near Canaipa Passage.

The stratigraphic and geomorphic succession of North Stradbroke Island (Laycock, 1975) is as follows:

- Mangrove muds (organic silt), freshwater swamps - in process of formation.
- Beach, beach ridges, and sand dunes, without vegetative cover - in process of formation.
- Cainozoic beach ridges, stabilised by vegetative cover post - Recent emergence.
- Sand dunes, stabilised by vegetative cover - post-Recent emergence.
- Freshwater swamps in coastal regions - post-Recent emergence.
- Sand dunes, stabilised by vegetative cover - pre-Recent emergence.
- Mesozoic Sandstone and conglomerate Rhyolite and rhyolitic tuff.
- Palaeozoic Greenstone.

Fringing coral reefs have formed around islands in the centre of the Bay. Notable coral reef areas include Peel Island, Goat Island, One Mile, the Rainbow Channel and a small reef off the south-west tip of Moreton Island.

Coastal headlands and most of the Bay islands of Moreton Bay are formed of Tertiary age basalts and freshwater shales, Mesozoic age sandstones, and Palaeozoic age metamorphic rocks with laterite soils developed at the surface.

In the Quaternary, the major influence on sedimentation was sizeable fluctuations (up to 150 m) in sea level. This resulted from changing volumes of the oceans when water was transferred between the ocean, and glaciers and ice sheets. Moreton Bay was filled and drained several times in response to these distant glacial cycles.

During low sea level phases the bed of the Bay was exposed. Sediments dried out, weathered, and soils developed. Rivers flowed across the emerged Bay to the ocean shore which, at times of extreme low sea level, coincided with the edge of the continental shelf. As the rivers crossed the Bay they incised river valleys and transported sediment to the ocean.

At times of rising sea level, the coastline moved westwards, the former river valleys were back filled with river gravels and subsequently estuarine mud and then with marine sand and mud.

Moreton and Stradbroke Islands are drowned sand dune island barriers anchored by rocky headlands. They formed by wave and wind action during several cycles of sea level change. The stages of dune development are marked by characteristic soil profiles (Hekel et al, 1978).

Four sedimentation zones are present in the Bay under present conditions:

- Nearshore zone of active sediment accumulation: This is the tidal flat environment where sand and muddy sand is deposited, and coral reef develops.

- Quiescent basin sedimentation: Depressions in the drowned former land surface have been filled by marine mud. The Brisbane, Pine, and Caboolture Rivers have been the main suppliers of sediment, which rarely exceeds 10 m in thickness in this zone.

- Zone of minimal deposition: Little sediment is supplied to this zone because of its distance from the source of sediment. In addition, any mud that does reach this zone tends to be kept in suspension by tidal currents thus preventing significant deposition. The older sediments remain exposed at the sea floor or are covered by only a thin layer of muddy sand.

- Tidal delta depositional zone: Much of the longshore drifting sand of the ocean beaches of Moreton and Stradbroke Islands is trapped in tidal deltas which have formed at the Southern, South Passage and Northern entrances to Moreton Bay.

(c) Climate: Being situated on a biogeographical boundary separating the tropical from the more temperate areas the climate of the bay is sub-tropical. Annual average rainfall is 113.5 cm. This occurs predominantly in summer during the months of October to April. Average annual temperatures for Brisbane are a maximum of 30°C and a minimum of 18°C. The site is subject to the effects of tropical cyclones which originate in the Coral Sea and may travel as far south as Moreton Bay before usually weakening into a low or rain depression as they cross the coast. Most of the rainfall from these lows usually falls in the catchment areas of the major rivers flowing into Moreton Bay and considerable silt, mud and sand is washed down into the bay when these rivers flood. From 1840 to 1893 there were eight major floods in the Brisbane River. The latest occurred in 1974 (Saunders, 1975).

(d) Hydrology: On the large sand islands of Moreton and North Stradbroke rainfall filters through the sand dunes to emerge in lakes and swamps and thence into Moreton Bay and the Pacific Ocean. On North Stradbroke Island some of this fresh water is extracted by the Local Authority for domestic use. Increased urbanisation of the central bay islands and the adjacent mainland may result in increased demands for water extraction from North Stradbroke Island. Increases in waste discharges and runoff into the bay may also occur. The bay receives most of the sewage and industrial effluent of the wider Caloundra-Brisbane-Gold Coast metropolitan areas as well as the storm water runoff containing sediment, fertilisers, pesticides and other pollutants from the urban and rural areas. These areas comprise the catchments of several large rivers and smaller creeks rising in the Lamington Plateau in the south, north along the Great Dividing Range to the D'Aguilar Range. These rivers are: Nerang, Pimpama, Coomera, Albert, Logan, Brisbane, Bremer, Pine, and Caboolture Rivers (Laycock, 1975).

The hydrodynamic nature of Moreton Bay is determined by interaction of the semi-diurnal tide, propagating mainly through the northern entrance, with the depth variations inside the bay. The tidal range inside the bay is about 20% greater than outside the bay. The patterns of the tide-height contours and the tidal currents in the bay are strongly influenced by the depth-topography of the bay. The tidal currents vary from 0.2 ms-' in the shallow western region to 1.0 ms^{-1} in the deep channels to the north-east.

The salinity of Moreton Bay is higher on the eastern side because freshwater flows into the western side. Therefore the spatial and temporal distribution of salinity in the bay depends on the varying rainfall in the catchment of the rivers flowing into it. Higher temperatures in summer and lower temperatures in winter are recorded in the shallow western bay compared with the north-eastern area of the bay and near South Passage due to the moderating influence of the Pacific Ocean on the latter areas.

Surges due to cyclones off the Queensland coast occur in Moreton Bay while severe local storms can cause transient changes in the water level of the bay. (Harding, 1979).

(e) Water quality: Depending on water depths and circulation patterns, the Bay has a limited capacity to assimilate the large quantity of waste it receives. A draft environmental policy on water seeks to grade all Queensland waters into one of four water quality classes, Q1 to Q4. The intention is for all the waters of Moreton Bay, except near waste discharges, to ultimately meet at least Q2 standard, defined as the maintenance of a high water quality with the only discharges to be permitted being those which, at the worst, result in minor changes to the biological community.

(f) Water depth fluctuations and permanence: Moreton Bay has experienced several sea level oscillations over the past 500,000 years and tides are semi-diurnal with an amplitude of more than 2 metres.

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17. Physical features of the catchment area:
Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

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18. Hydrological values:
Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

The two principal rivers entering the bay are the Brisbane and Logan Rivers which have an average annual discharge of 1 215 000 Ml and 810 000 M1 respectively. These are joined by tributaries from the southern slopes of the Brisbane Range, from the Great Dividing Range and from the southern eastern and western slopes of the D'Aguilar Range. The Logan and Albert Rivers extend from the northern slopes of the McPherson Range across the lowlands in the southern part of the region. The rivers are tidal for most of their course across the lowlands.

Moreton Bay consists of a deeper eastern section subject to strong north-south tidal circulation and a shallower western section with much weaker east-west mixing. Consequently, fine particles settle in the less turbulent western areas of the Bay while the eastern Bay is characterised by sandy sediments associated with higher tidal velocities. This maintains an ecological gradient based on particle size ensuring high levels of biodiversity.

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19. Wetland Types

a) presence:
Circle or underline the applicable codes for the wetland types of the Ramsar "Classification System for Wetland Type" present in the Ramsar site. Descriptions of each wetland type code are provided in Annex I of the *Explanatory Notes & Guidelines*.

Marine/coastal: $\boxed{\text{A}}$ • $\boxed{\text{B}}$ • $\boxed{\text{C}}$ • $\boxed{\text{D}}$ • $\boxed{\text{E}}$ • $\boxed{\text{F}}$ • $\boxed{\text{G}}$ • $\boxed{\text{H}}$ • $\boxed{\text{I}}$ • $\boxed{\text{J}}$ • K • Zk(a)

Inland: $\boxed{\text{L}}$ • $\boxed{\text{M}}$ • N • $\boxed{\text{O}}$ • P • $\boxed{\text{Q}}$ • R • Sp • Ss • $\boxed{\text{Tp}}$ • $\boxed{\text{Ts}}$ • U • Va • Vt • $\boxed{\text{W}}$ • $\boxed{\text{Xf}}$ • $\boxed{\text{Xp}}$ • Y • Zg • Zk(b)

Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • $\boxed{\text{9}}$ • Zk(c)

b) dominance:
List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

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20. General ecological features:
Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

The Moreton Bay region is an important habitat for many species of birds and is one of only four recognised sites of significance to wintering migratory wading birds along the eastern Australian coast (Thompson and Kikkawa, 1988). Australia is a signatory to the Japan-Australia (JAMBA) and China-Australia (CAMBA) migratory bird agreements which require the habitats used by certain species listed in the agreements to be set aside as reserves. At least 34 listed species have been recorded from Moreton Bay including the eastern curlew; whipbird; bar-tailed godwit; grey-tailed tattler; ruddy turnstone; rednecked stint; sanderling; curlew; sandpiper and common sandpiper (Thompson and Kikkawa, 1988). At least 254 species of bird have been recorded from North Stradbroke Island including gould's petrel, the arctic tern and the long-tailed jaeger (Vernon and Martin. 1975).

Image analysis of all intertidal areas in Moreton Bay, including Pumicestone Passage estimated that a total of 23,000 ha of tidal flats are exposed at low water datum characterised by marked differences in substrate type and species of waders present (Thompson, 1990b). Four types of roosts and four habitats have been determined for waders in Moreton Bay (Thompson, 1991 **Appendix 1**) using particle size analysis. The main habitats were:

- muddy intertidal, often with seagrass;
- muddy intertidal with no seagrass, usually associated with sewage outlets;
- sandy; and
- coral.

High amounts of silt were found at very muddy sites associated with slow currents. High amounts of fine sand occurred at very sandy sites with fast currents. The amount of fine sand and very fine sand in the substrate reflected estuarine conditions at a site. High percentages of fine sand were recorded at oceanic influenced sites where fast currents and limited riverine sediment deposition led to large average particle sizes. Sites with very fine sand are associated with muddy riverine conditions due to slower currents and the contribution of fine particles from nearby rivers. A relationship was shown to exist between the location of those habitat sites with high species numbers and the location of roosts. Species of waders present differed significantly among the four habitats.

The ruddy turnstone was found to be a key indicator species of the coral habitat strewn with coral rubble giving the surface considerable topographic relief. The bar-tailed godwit characterised the other extreme distinguished by sandy sites with a lush covering of seagrass (Thompson,1990 a, 1991) (**Appendix 1**) .

A total of 19 plant formations occur on the tidal wetlands. Six of those formations are dominated by the mangrove *Avicennia marina.* Climatic conditions in Moreton Bay provide optimum temperatures of 18-24 degrees for the growth of *Avicennia marina* for six to seven months of the year. Behind the fringing mangroves, salt-marsh is usually zoned parallel to the shoreline and consists of three plant communities broadly classified as:

- shrublands, the dominant species being Sarcocornia spp. and Suaeda australis;
- sedge *(Juncus krausii)* and rush swamps ; and
- grasslands *(Sporobolus virginicus)* as well as bare salt pans.

Seven species of mangroves are found in Moreton Bay and major areas of mangroves are located throughout the Bay and in particular along the Pimpama River, Coomera River, North Arm and the wetlands and waterways of McCoys Creek and Woogoompah Creek. Mangroves are the nursery areas and ultimate source of food for many commercial and recreational fish species and are necessary for the prevention of erosion, the provision of habitat, landscape value and to provide roosting areas for wildlife (Arthington and Hegerl, 1988). Four main types of shore bird roosts are identifiable in Moreton Bay (Thompson, 1991):

1. open sandy island or beach: found mainly on Moreton and North Stradbroke Islands with only two similar roosts known on, or adjacent to, the western side of Moreton Bay. These types of roosts are used by most species;

2. salt and clay pan: scattered within and behind the mangrove fringe. Birds may find cover under mangrove trees or shelter within clumps of samphire and sedge. These roosts are also used by most species;

3. inland freshwater marshes: restricted to the western side of the bay and used by species such as the sharp-tailed sandpiper, greenshank and the black-winged stilt at all stages of the tidal cycle;

4. mangroves: this is the preferred roosting situation of the grey-tailed tattler which roost standing on the branches of the mangrove trees. The whimbrel, curlew, sandpiper, terek sandpiper and the greenshank may also roost in this situation.

Saltmarsh and saltpan areas are integral with and generally adjacent to mangrove areas. Apart from providing valuable feeding and crucial roosting areas for waders (Thompson and Kikkawa, 1989), these areas also represent buffers for the mangroves and function as a source of material for detrital food chains.

North and South Stradbroke Islands are barrier islands feeding sand sediments from ancient dune deposits into the eastern part of Moreton Bay (Maxwell, 1970). The two islands are separated by an opening nearly 2 kilometres wide at Jumpinpin; this bar and the Southport Bar at the southern end of South Stradbroke Island are fairly unstable and do not allow a seagrass population to establish. At the northern end of North Stradbroke Island a different situation occurs. Here the orientation of this island and Moreton Island allow for large sheltered sand banks flushed twice daily by oceanic water.

From Amity Point to the northern end of Canaipa Passage shallow sand and muddy sand flats with protection from prevailing winds and strong currents make a good habitat for seagrasses. At South Passage sand has formed a fan-shaped bank known as Amity Banks. Further south the sand becomes muddier with clay and silt from the mainland and low offshore islands.

Between Canaipa Passage and the Southport Bay at the southern end of South Stradbroke Island a series of low, small islands form the deltaic complexes of the Logan, Albert, Coomera and Pimpama Rivers. Between these islands are shallow mud flats and deeper channels. These areas, protected on one side by Stradbroke Island and on the other by the mainland or offshore islands, offer excellent habitats for seagrasses (Kirkman, 1975).

Intertidal and shallow waters support seven species of seagrass which occur over an area of 6522 ha. This provides food and habitat for turtles, dugong, commercially and recreationally important fish and invertebrate populations in the bay.

Research indicates that seagrass meadows are particularly vulnerable to disturbance by humans and are very slow to recover (Poiner, 1989).

South Passage and the Rous Channel plus the sand banks of the bay, particularly the Moreton and Amity Banks area, represent an internationally significant habitat for dugong. Population estimates of at least 600 have been made for this species, a high number considering the proximity of their habitat to a major city such as Brisbane (Preen et al, 1989). Dugong feed mainly on seagrass and their survival is closely linked to the protection of these seagrass communities.

Three species of turtle inhabit Moreton Bay year round. Hawksbill turtles occur only occasionally while loggerhead turtles occur in their thousands and feed on molluscs, crabs and sponges (Bustard, 1972). Moreton Bay is also a significant site for feeding green turtles (Limpus,C in press).

Seagrass is a significant feature and likely to have influenced feeding behaviour and distribution of shore birds. Seagrass coverage is highest in those sites around Moreton Island and North Stradbroke Island where clean oceanic waters promote high rates of photosynthesis. Seagrass coverage is reduced in the muddy waters along the mainland of Moreton Bay and in sites with coral substrate.

The sewage affected sites in Bramble Bay are entirely devoid of seagrass, as are a few sites in Pumicestone Passage and Southern Moreton (Thompson, 1991).

Driscoll (1991), found that the substrate and conditions in Pumicestone Passage were not uniform throughout and that different locations had variations in the numbers of wader species present.

Most species showed a preference for particular locations but great knots and curlew sandpipers were not as consistent and habitat links for these species were hard to define.

The differences were related to:

- the pattern of substrate deposition;
- the extent of feeding areas; and
- the peculiarities of the tidal range in the Passage.

One third of all waders counted were bar-tailed godwits but data from Thompson (1990c) suggests that the numbers of this species present in the Passage decrease in autumn.

Conversely the number of grey-tailed tattlers was found to be higher in autumn and this was reflected in data from the Great Sandy Strait further north (Driscoll 1990).

It is possible that the numbers of grey-tailed tattlers present in south-east Queensland increase during their northward migration.

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21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Species dependent on mangrove estuarine areas comprise up to 67% of the entire commercial catch of fisheries in eastern Australia. Mangroves form a fringe around much of the shoreline of Moreton Bay. Seven species have been identified but only three are considered abundant - *Avicennia marina, Aegiceras corniculata, Ceriops tagal.* Other species of mangrove include *Rhizophora stylosa, Excoecaria agallocha* and *Bruguiera gymnorhiza.*

Fifty-five species of algae are associated with mangroves in the bay and 2000 ha of salt marsh vegetation have been identified.

Saltmarsh includes samphires, sedges, salt couch, bare saltflats and stunted mangroves. Important saltmarsh species include *Suaeda australia, Salicornia quinquelflora.* Threatened communities consisting of Wallum woodland *(Melaleuca quinquenervia)* grow in saturated areas close to the shores of Moreton Bay.

The high diversity of marine plants include seven species of seagrass belonging to five different communities. Species are: *Zostera capricorni, Halodule uninervis, Syringodium isoetifolium, Halophila ovalis, Halophila spinulosa, Cymodocea serrulata, Halophila dicipiens.* Seagrasses have been shown to be important in the life history stages of commercially important fishes and crustaceans (Hyland. 1988,1989). Dugongs, turtles, swans, waders, fishes feed in or on seagrasses. Seagrass allows long-billed waders (e.g. bar-tailed godwit) to penetrate deeply into the substrate. Seagrasses provide important settlement areas for the post-larval stage of penaeid prawns.

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22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14. Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

With the combination of muddy habitats (western side), sandy habitats (eastern side), coral and seagrass habitats, Moreton Bay is extremely important as a site for shorebird species (Thompson 1991). At least 43 species of wading birds use intertidal habitats in the bay, including 30 migratory species listed by JAMBA and CAMBA. More than 50 000 wintering and staging waders depend on Moreton Bay during the non-breeding season (Thompson, 1990b). The bay is particularly significant for the Eastern curlew *Numenius madagascariensis* (3000 to 5000 birds) and the Grey-tailed tattler *Tringa brevepes (*> 10 000 birds) in winter.

This diversity of habitats and species utilising the area indicates the importance of both sides of the bay when considering conservation measures. Moreton Bay also has particularly large populations of cormorants and terns, white herons, spoonbills, ibises and egrets. The bay is ranked among the top ten dugong habitats in Australia and together with the Gulf of Carpentaria and Torres Strait is considered one of the most important areas for dugong in Queensland. Herds of dugong of up to 104 individuals have been observed.

Three species of sea turtles inhabit Moreton Bay in significant numbers. Of these species, the hawksbill and green turtles are considered to be endangered and the loggerhead is regarded as threatened in a world context. However within Australia the loggerhead is listed as an endangered species while the green and hawksbill turtles are listed as vulnerable.

Feeding green turtles are found in Princess Charlotte Bay, Moreton Bay, Shoalwater Bay, Hervey Bay and Repulse Bay. Of these locations, Moreton Bay has the largest concentration of feeding green turtles in Australia. Tagging studies have shown that the green turtles resident in Moreton Bay migrate to the southern Great Barrier Reef (Lady Musgrave, Heron, Wreck and North West Islands) and the northern Great Barrier Reef (Raine Island) to breed.

Major concentrations of loggerhead turtles are found in Moreton and Hervey Bays and the southern part of the Great Barrier Reef. Significant numbers of young and mature loggerhead turtles inhabit Moreton Bay. This is the most significant concentration of loggerheads in Australia (C. Limpus in press).

A total of 175 species of fish are listed for Flinders Reef off Cape Moreton and at least 100 species occur inside the bay. In excess of 80 species of echinoderms have been recorded from Moreton Bay and adjacent reefs. One study identified 355 invertebrate species from 400 subtidal sites within the bay.

Chestnut teal and Pied oystercatchers breed on the shores of the bay and Fruit bats roost in mangroves during the day. A small number of Humpback whales enter the bay, probably accidentally, each year on their way north to their breeding grounds at Hervey Bay, north of Fraser Island. Nine species of birds are dependent on mangrove vegetation. Many first year-birds of migratory species remain in the bay during the breeding season when the number of migratory species present in the bay increases as they move northwards with the onset of winter. Large populations of resident birds depend on the fringing wetlands and large populations of marine birds feed in the open waters of the bay. Moreton Bay provides significant habitat for the water mouse (false water rat) *Xeromys myoides* which is listed as Vulnerable in EPBC and NCA.

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23. Social and cultural values:

a) Describe if the site has any general social and/or cultural values e.g., fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values:

Some of the best remaining evidence of Aboriginal adaptation to a marine-based resource is to be found on Moreton Island. Other sites of significant Aboriginal cultural heritage are located on Bribie, North Stradbroke, Peel, St Helena, Macleay, Lamb, Karragarra and Russell Islands as well as Toorbul Point, Caboolture River and Victoria Point. Types of sites include middens, fish traps, artefact scatters, quarries and scarred trees.

The shoreline of Moreton Bay was the first area in the Brisbane region to be settled by Europeans. Coochie Mudlo Island was the site of the first landing by Matthew Flinders during his exploration of Moreton Bay and the Brisbane River. St Helena Island which was used as a prison and quarantine station at different periods was the first historical area in Queensland to be reserved as a National Park solely because of its historic ruins. Other areas settled by Europeans include Peel Island, used first as a quarantine station and then as a leper colony, Dunwich and Amity Point on North Stradbroke Island and Redcliffe on the mainland which was the site initially chosen for the penal colony before it was moved up the Brisbane River to the site now occupied by the business centre of Brisbane.

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning?

If Yes, tick the box ❑ and describe this importance under one or more of the following categories:

i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:

ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:

iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:

iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

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24. Land tenure/ownership:
a) within the Ramsar site:
Moreton Bay lies within Queensland waters. Most of the land fronting the bay consists of land under the control of the Government of the State of Queensland but there are substantial areas of privately owned land along the western shore. A number of canal estates have access to the bay and some of the privately held land is also proposed for canal estates.

b) in the surrounding area:
This incorporates Moreton Island National Park and on the mainland a greater proportion of privately owned land and commercial forests.

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25. Current land (including water) use:
a) within the Ramsar site:
Fishing and collecting: The Moreton Bay region supports one of the most productive fisheries in Queensland, representing just under three percent of the Queensland coastline while annually producing about 20 percent of Queensland's commercial seafood catch by weight (Williams, 1991). The Bay is also a popular recreational fishing area. A variety of species is targeted, including yellowfin bream, whiting, tailor, flathead, black bream, mackerel, snapper and mullet. Eight species of prawn and four species of crab are commercially important, with mud and blue swimmer crabs also being of recreational importance.

Commercial collection of fish, invertebrates, anemones and live corals for aquarium purposes occurs within the Bay and the offshore reefs while bait collection, food gathering and viewing of coral and aquarium fish species are popular recreational pursuits. Commercial oyster banks operated by licensed oyster growers, commercial baitworm and shell collection also occurs.

During 1986, expenditure on commercial and recreational fishing activities was estimated at more than $100 million, while the retail value of the commercial fishing haul has been estimated at $100 million (McDonald and others, 1989).

Recreation and tourism: The Bay is a major area for recreational boating and water related activities offering opportunities for a wide range of water-based recreation including fishing, sailing, power boating, water skiing, parasailing, jet-skiing, sail-boarding, scuba diving, bird watching, marine study and snorkeling. The southern area of the bay receives the heaviest boating use for most activities because of its sheltered waters and proximity to many boat launching facilities.

The three barrier islands (Moreton, North Stradbroke and South Stradbroke) have unspoilt beaches, topographic diversity within the dunal system and largely undisturbed natural scenery, forest and wetlands .

Port facilities: The Port of Brisbane is the fastest growing capital city port on the east coast (POBA, 1990), and is expanding its capabilities to handle a wide variety of cargoes. The Moreton Bay Strategic Plan seeks to integrate the operation and development of shipping channels and other areas of port expansion with the natural environment.

Sand mining and extraction: Silica and heavy mineral sands are extracted primarily from North Stradbroke Island. Silica deposits used include the northern bay banks, Middle Banks and Rous Channel. These sources are highly valued in a regional sense due to the diminishing resources available from mainland streams and terrestrial areas. Rutile and zircon exist in offshore deposits for which exploration leases are being considered.

Water extraction: Redland Shire Council's mainland water supply is supplemented by water extracted from an unconfined aquifer on North Stradbroke Island.

Education and research: The bay is an important environmental and historical education resource for primary, secondary and tertiary education due to its range of undisturbed ecosystems. The University of Queensland has a field station at Dunwich. CSIRO has research facilities at Cleveland.

The Department of Primary Industries has research facilities at Deception Bay and Bribie Island. The Environmental Protection Agency has research facilities on South Stradbroke Island and educational facilities on St Helena and Moreton Islands. The Department of Education runs environmental education centres at Nudgee Beach, Darling Point and Jacobs Well for educating children on coastal and environmental matters The mangrove boardwalk at Wynnum North is also a significant educational resource.

Transport: Several of the Bay's marinas and harbours provide bases for the transport operations which service surrounding locations and the bay islands, servicing commercial, recreational and residential demands.

b) in the surroundings/catchment:

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26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:
a) within the Ramsar site:
Land reclamation and soil dumping or urban and industrial development and shipping and port activities are occurring at various sites in the Bay. Up to 1M tonnes of coral and 150 000 m3 of sand per annum are extracted from the Bay for use in the building, foundry and manufacturing industries. Most pressure from human activities is being exerted on the western shoreline, which also attracts large numbers of wader species that favour muddy habitats. A series of localised problems such as the occasional 'red tides' at Bramble Bay (Moss et al, 1989) have occurred due to a combination of concentrations of phosphorus and nitrogen higher than background levels combined with large quantities of treated industrial and domestic waste waters and contaminated storm water runoff. Such affects are to be reduced by minimising waste inputs from direct discharges and treating contaminated runoff.

b) in the surrounding area:

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27. Conservation measures taken:
a) List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site:
In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations.
Legislative protection:
National Parks in the Moreton Bay region and managed by the Queensland Parks and Wildlife Service of the Environmental Protection Agency are:

- Blue Lake NP on North Stradbroke Island
- Bribie Island NP
- Moreton Island NP
- St Helena Island NP

Conservation Parks administered by the Queensland Parks and Wildlife Service, but which may have the Local Government as trustee are:

- Beachmere CP on the western mainland side of the Bay
- Bird Island CP
- Buckleys Hole CP
- Cobby Cobby Island CP
- Coomera Island CP
- Goat Island CP
- Kangaroo Island CP
- King Island CP
- Myora CP (North Stradbroke Island)
- South Stradbroke Island Conservation Park 1

- South Stradbroke Island Conservation Park 2
- Woogoompah Island CP

Fish Habitat Areas administered by the Department of Primary Industries, cover approximately 15.3% of the Bay.

b) If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):

Ia ❑;Ib ❑; II ❑; III ❑; IV ❑; V ❑; VI ❑

c) Does an officially approved management plan exist; and is it being implemented?:
Management plans for the National Parks referred to above as well as National Parks in the catchment area have or are currently being prepared.

Moreton Bay has been declared a Marine Park and a Strategic Plan has been prepared with the goal "to provide for economically sustainable use of Moreton Bay and for protection of its natural, recreation, cultural heritage and amenity values". The Marine Park Zoning Plan has been approved as subordinate legislation under the Marine Parks Act 1982, and forms the basis of management of most of the site.

d) Describe any other current management practices:

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28. Conservation measures proposed but not yet implemented:
e.g. management plan in preparation; official proposal as a legally protected area, etc.

Because of the complex pattern of shore bird distribution in Moreton Bay some species that are common on the western shores of Moreton Bay, such as the terek sandpiper, lesser golden plover, sharp-tailed sandpiper, black-tailed godwit and the marsh sandpiper, are seldom seen in the eastern sector of the bay. Therefore conservation measures need to deal with both sides of the bay to ensure sufficient habitat for all waders (Thompson, 1991) Shorebird Management Plans are currently being developed.

Further areas of North Stradbroke Island are proposed as National Park. Treatment of domestic effluent discharge is being upgraded to secondary level with tertiary level contemplated for the future.

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29. Current scientific research and facilities:
e.g., details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

Queensland University, CSIRO and Department of Primary Industries have research stations in the Moreton Bay region. Other universities and colleges use Moreton Bay for research and education. Projects are underway for tracking certain species (e.g. eastern curlew). The Environmental Protection Agency is researching the population dynamics of loggerhead turtles within Moreton Bay.

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30. Current communications, education, participation and awareness (CEPA) activities related to or benefiting the site:
e.g. visitors' centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

University of Queensland's research station on North Stradbroke Island is regularly used by High School groups. Interpretation facilities are available on Moreton Island and St Helena Islands.

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31. Current recreation and tourism:
State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

An estimated 300 000 recreational fishers spend 1.5 person days in Moreton Bay. An estimated 2000 people visit Brisbane each year specifically to watch waders in Moreton Bay (RAOU data). Other activities include yachting, water skiing, sail boarding, scuba diving, picnicking, camping and boating.

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32. Jurisdiction:
Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept of Agriculture/Dept. of Environment, etc.

National Parks	Environmental Protection Agency (Queensland Parks and Wildlife Service)
Conservation Parks	Environmental Protection Agency (Queensland Parks and Wildlife Service) and Local Governments where they are the trustees
Coastal Protection	Environmental Protection Agency
Monitoring environment	Environmental Protection Agency
Fish Habitat Reserves	Department of Primary Industries
Unallocated Crown Land	Department of Natural Resources
Local Government Reserves	Local Governments

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33. Management authority:
Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Environmental Protection Agency (Queensland Parks and Wildlife Service)
Local Governments for areas under their jurisdiction

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34. Bibliographical references:
Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

A list of relevant references is provided in **Appendix 2.**

Please return to: **Ramsar Convention Secretariat, Rue Mauverney 28, CH-1196 Gland, Switzerland**
Telephone**: +41 22 999 0170** • Fax: **+41 22 999 0169** • e-mail: **ramsar@ramsar.org**

Appendix 1.

Not present.

Appendix 2.

Not present.

FOI 180804
Document 14l

DEPARTMENT OF THE ENVIRONMENT AND ENERGY

COMMONWEALTH ENVIRONMENTAL WATER OFFICE

EPBC ACT REFERRAL ADVICE FROM WETLANDS SECTION

REFERRAL: EPBC 2017/7939

DATE DUE BACK TO EACD: 22/5/2017

TOONDAH HARBOUR DEVELOPMENT, MORETON BAY, QLD

Brief Description of Proposal

The proposed action involves the filling in of marine areas for urban development and public open space, the excavation of a marina and the widening, deepening and lengthening of Fison Channel, which is the existing entrance channel to Toondah Harbour, on the foreshore of Moreton Bay about 30km southeast of Brisbane (Figure 1). The maximum development footprint (including land reclamation) is approximately 73 hectares with the reclamation component approximately 40 hectares (Figure 2).

The project is expected to take 15 to 20 years, with the initial dredging and reclamation occurring intermittently over a 3-5 year period.

The project involves:

- New ferry terminals to improve access to North Stradbroke Island
- Mixed use development including (high rise) residential, retail, commercial and tourism uses;
- A marina;
- Public open space and boardwalks providing foreshore access;
- Dredging of the existing Toondah Harbour marine access (Fison Channel) to allow for safe navigation for all vessels; and
- Reclamation of areas within Moreton Bay

There is no detailed description of the development in the referral, for example it does not provide the number of residential dwellings (style, height etc), commercial and tourism activities, boat movements, number of berths in marina and details of reclamation.

Issues Checklist

How far is the proposal from a Ramsar site?

The proposed action is both within and adjacent to the Ramsar site. The boundary of the Ramsar site and the Priority Development Area (within which much of the development is contained) is at Figure 3. Areas of reclamation will extend beyond the PDA to the east. The referral does not provide an area in hectares of the Ramsar site that overlaps with the proposed development.

The Moreton Bay Ramsar site is located in and around Moreton Bay, east of Brisbane in Queensland and was listed in 1993 under six of the 9 Ramsar criteria (details from 1999 RIS):

- **Criterion 1:** contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region – one of largest estuarine bays, enclosed by barrier island of vegetated sand dunes.
- **Criterion 2:** supports vulnerable, endangered, or critically endangered species or threatened ecological communities – supports vulnerable green and hawksbill turtles, the endangered loggerhead turtle and ranked among the top 10 dugong habitats in Queensland.

- **Criterion 3:** supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region – supports over 355 species of marine invertebrates, at least 43 species of shorebirds, 55 species of algae associated with mangroves, seven species of mangrove and seven species of seagrass.
- **Criterion 4:** supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions – significant feeding ground for green turtles, and feeding and breeding ground for dugong. Also has the most significant concentration of young and mature loggerhead turtles in Australia.
- **Criterion 5:** regularly supports 20,000 or more waterbirds – supports more than 50,000 wintering and staging shorebirds during the non-breeding season.
- **Criterion 6:** regularly supports 1% of the individuals in a population of one species or subspecies of waterbird – significant for population of wintering eastern curlews (3,000 to 5.000) and the grey-tailed tattler (more than 10,000), both substantially more than 1% of Flyway population.

Moreton Bay is a semi-enclosed basin bounded on its eastern side by two large sand islands. Islands in the site include all of Moreton Island, and parts of North and South Stradbroke Islands, Bribie Island and the Southern Bay Islands. Other parts of the site include waters and tributaries of Pumicestone Passage, some intertidal and subtidal areas of the western bay, southern bay and sandy channels of the Broadwater region, marine areas and sand banks within the central and northern bay and some ocean beach habitats.

Wetlands on the site include seagrass and shoals in the eastern banks, tidal flats and associated estuarine assemblages within the Pumicestone Passage, mangroves and saltmarsh in the southern bay, coral communities of the eastern bay, freshwater wetlands and peatland habitats on the Bay Islands and ocean beaches and foredunes on Moreton Island.

The extensive mangrove and tidal flats provide a nursery for fish and crustaceans, and also support birds and other marine life. The sandflats provide roosting sites for migratory birds.

The seagrass areas provide food and habitat for fish, crustaceans, the internationally vulnerable dugong, and the nationally threatened loggerhead turtles, hawksbill turtle and green turtle.

The site supports more than 50,000 migratory waders during their non-breeding season. At least 43 species of wading birds use the intertidal habitats, including 30 migratory species listed on international conservation agreements. Moreton Bay is one of only two Ramsar in Australia that supports the critically endangered eastern curlew all year round, with juvenile birds not migrating until they are 2-3 years old.

Is there a real chance or possibility that the proposed action will result in:

Issue	Y	N
areas of the wetland being destroyed or substantially modified?	X	
a substantial and measurable change in the hydrological regime of the wetland?	X	
the habitat or lifecycle of native species dependent upon the wetland being seriously affected?	X	
a substantial and measurable change in the physico-chemical status of the wetland?	X	
an invasive species that is harmful to the ecological character of the wetland being established or encouraging the spread of existing invasive species?		X

Issues to note

Potential impacts

Areas of the wetland being destroyed or substantially modified

Major elements of the proposed action are located inside the Ramsar site, with areas of the Moreton Bay Ramsar site to be destroyed or substantially modified. The size of the area within the Ramsar site to be affected by both dredging and reclamation is not provided in the referral.

The project involves 40 hectares of reclamation and 10.5 hectares of marina (to be dredged to 13 metres deep) and access channel (dredged to 4.25 metres deep), a large proportion of which will be within the Ramsar site. A total of 20 hectares will be subject to maintenance dredging. These activities will destroy or substantially modify wetlands within those areas, and this involves a permanent change. In addition, the development would alter the hydrodynamics of the local area, which could affect the flora and fauna in a much larger area than the development footprint itself. For instance, the mangroves on Cassim Island, adjacent to the development may be subject to significantly greater amplitude and frequency of waves. Hydrodynamic modelling would be required to confirm the area of direct impact on the Ramsar site.

If there is a net excess of material from dredging/reclamation, the proponent states it may be disposed of offshore, onshore or re-used. Mud Island is mentioned as a possible disposal site – and it is part of the Moreton Bay Ramsar site. If this material is disposed of anywhere within the Ramsar site, it may destroy or modify further areas of wetland.

Areas of the Moreton Bay Ramsar wetland in the immediate vicinity of the project are also likely to be affected by an intensively developed residential/commercial tourist hub, with expected impacts on hydrology, water quality and on threatened species, both during construction and operation (due to noise, light, vibration, pollution and pedestrian and boating activity).

The referral does not address the option of a smaller scale development (eg smaller marina, area or height of residential buildings), with a smaller footprint, which would reduce the impact on the Ramsar wetland.

The proposed action will have a substantially adverse impact in terms of destruction and modification of areas of the wetland.

A substantial and measurable change in the hydrological regime of the wetland

As the reclaimed land extends into Moreton Bay, it is possible that the proposed reclamation, marina and channel dredging could affect coastal currents in the area. These changes could result in changes to sand and sediment movement in the adjacent areas of the Ramsar site which could impact the biota in those areas, including through changes to light penetration and smothering of seagrasses.

The proponent identifies a number of studies to be undertaken to better understand the risks, but has made no commitments to particular mitigating measures to address those potential impacts.

The proposed action may have a substantially adverse impact on the hydrological regime of the wetland.

A substantial and measurable change in the physico-chemical status of the wetland

Any action involving the clearing of vegetation, dredging, excavation and/or reclamation creates the potential for sediments and/or other contaminates to be discharged. Regardless of the amount of disturbance or final design for any action, physico-chemical changes will occur and need to be managed to reduce the risk of impacts to the ecological character of a Ramsar site. These impacts have potential to impact well beyond the development site.

The proposed action will also expose coastal marine sediments to air which creates the risk of the exposure of acid sulphate soils (ASS), the associated acidification of water and the potential release of metals and other contaminants, dissolved in the acidified water. This may result in algal blooms, which have occurred in other parts of Moreton Bay.

The proponent has identified some of these risks but has not provided sufficient information on proposed management measures to assess whether they would be sufficient to mitigate the risks to the physico-chemical status of the wetland and potential impacts on the ecological character of the Moreton Bay Ramsar site.

The proposed action may have a substantially adverse impact on the physico-chemical status of the wetland.

The habitat or lifecycle of native species dependent on the wetland being seriously affected

The referral area contains intertidal and shallow subtidal habitats including:

- mangrove forests
- intertidal and subtidal mudflats and sand banks
- seagrass meadows
- subtropical coastal saltmarsh community.

These habitats are important for the ecological character of the Moreton Bay Ramsar site and support a range of native species dependent upon the wetland. They provide intertidal feeding habitat for migratory shorebirds, including the critically endangered eastern curlew and the vulnerable bar-tailed godwit. These areas of foraging habitat cover a large proportion of the development site, are within the Moreton Bay Ramsar site, and will be removed through construction of the marina and reclamation for construction of residential/commercial buildings.

Two high tide roost sites are adjacent to the development area, at the Nandeebie Claypan (to the south west) and Cassim Island (to the east). Oyster Point is also another roost site (600 m from the proposed action) which forms part of a network of feeding and roosting sites. These sites are of high importance to shorebirds in the region.

The proponent has identified a number of mitigating measures for these bird habitats, including measures to reduce sediment during construction, management of acid sulfate soils, buffers, barriers, management of public access, lighting, vegetation screening and sound attenuation and signage.

However, the impacts to these habitats will be difficult to mitigate, particularly disturbance during the construction period (over 3 years), including noise, light, vibration, sediment, etc. Development is proposed to come within 100 metres of the roosting sites. A separation of at least 200 metres is recommended for the eastern curlew, which is easily disturbed. In addition, these roosting sites will be overlooked by large high-rise developments and be impacted long-term, due to increase in numbers of residents and visitors, and increase in boating traffic.

The increased numbers of boats and visitors using the upgraded harbour and marina are also likely to access other less-developed areas of the Moreton Bay Ramsar site, such as North Stradbroke Island, creating broader impacts on native species within the Ramsar site.

The site and its surrounds also support important foraging habitat for green and loggerhead turtles, as well as dugongs, including 32.7 hectares of seagrass. Loss of this seagrass and increased recreational boat traffic are likely to have adverse impacts on turtles and dugongs within the Bay.

If the proposed action leads to a substantial increase in vessel traffic, there may be adverse impacts on whales and dolphins within Moreton Bay.

The referral does not address potential impacts on the adjacent coastal saltmarsh community (which is listed as vulnerable under the EPBC Act). While disturbed, this community is important as so much of it has already been lost.

It is not clear who will take responsibility for management actions in the longer term (operational phase), as the marina and residential sites will be sold to private owners.

The proponent has identified some of these risks but has not provided sufficient information on proposed management measures to assess whether they would be sufficient to mitigate the risks to habitat or life cycle of native species dependent upon the wetland and the potential impacts on the ecological character of the Moreton Bay Ramsar site.

The proposed action will seriously disrupt the lifecycle of an ecologically significant proportion of the population of eastern curlews and bar-tailed godwits, as well as the listed migratory species whimbrels and grey-tailed tattlers, and may adversely affect populations of turtles and dugongs.

An invasive species that is harmful to the ecological character of the wetland being established or encouraging of existing invasive species

The proposed action has a low risk of establishing new invasive species or encouraging existing invasive species.

Conclusion

On the basis of the available information, the proposed action is likely to result in substantially adverse impacts due to loss of areas of wetland, changes to the hydrological regime and physico-chemical status of the wetland and impacts on the habitat and life cycle of a number of species, including migratory shorebirds.

Although detailed project specification and/or environmental assessment has not been undertaken, the scale and nature of the action is such that a substantially adverse impact on the ecological character of the Moreton Bay Ramsar site is not only likely, but unavoidable. It is further concluded that impacts on the ecological character of the site, will be difficult to mitigate or offset.

Thus, on the basis of the available information, there is a real chance or possibility that there will be an adverse impact on the ecological character of the Moreton Bay Ramsar site as a result of the proposed action.

Advice prepared by:	s22 [redacted]
Other DoEE areas consulted:	Migratory Species
Is OWS providing advice?	No
EACD Referral Officer:	s22 [redacted]

Cleared by: s22 [redacted], Director: Wetlands Section

Signature:... s22 [redacted] ....

Date: 22 May 2017.

Cleared by: Mark Taylor, Assistant Secretary: Wetlands, Policy and Northern Basin Branch

Signature: ....

Date: 22 May 2017

Sources:

- ArcGIS
- Moreton Bay Ramsar Information Sheet
- Draft ECD
- Environment Management Mapping Application
- Referral Documentation

Location of Toondah Harbour proposal and Moreton Bay Ramsar site

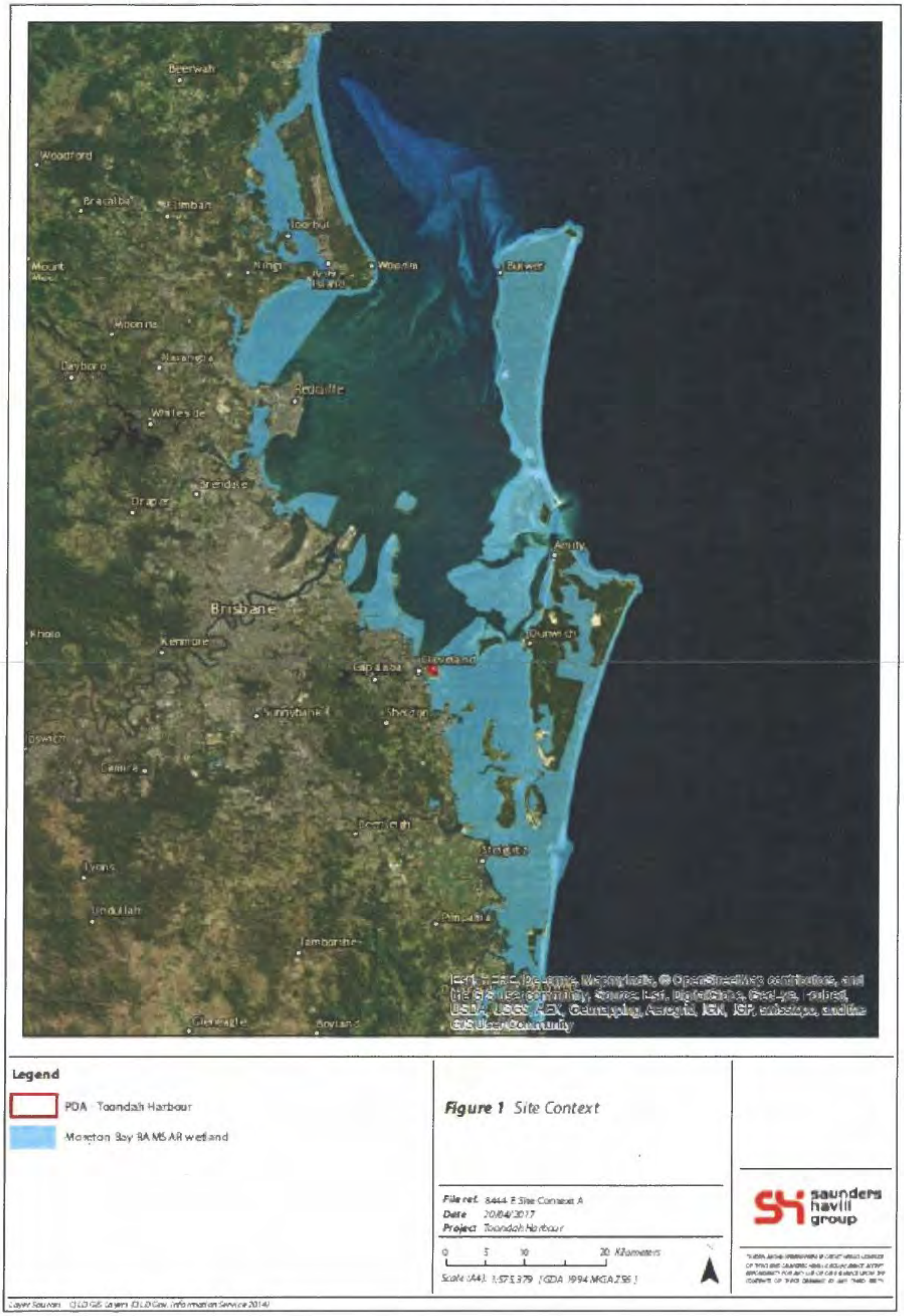

Figure 2

Toondah Harbour proposal, Moreton Bay

Legend

PDA - Toondah Harbour

Referral Area

Indicative Dredge Area

Figure 2 *Site Aerial*

File ref. 8444 E Site Aerial E
Date 11/05/2017
Project Toondah Harbour

0 50 100 200 300 Meters

Scale (A4): 1:8,000 (GDA 1994 MGA Z56)

saunders havill group

Layer Sources: QLD GIS Layers (QLD Gov. Information Service 2014)

Figure 3

Boundary of Ramsar site in vicinity of Priority Development Area

Legend

QLD DSDIP EDQ PDA

Ramsar

Department of the Environment and Energy

Wildlife Heritage and Marine Division

EPBC Act Referral Advice from the Migratory Species Section

Toondah Harbour Project, QLD (EPBC 2017/7939)

Proposed action

The proposed action involves the filling in of marine areas for urban development and public open space, the excavation of a marina and the widening, deepening and lengthening of Fison Channel, which is the existing entrance channel to Toondah Harbour, on the foreshore of Moreton Bay about 30km southeast of Brisbane. The maximum development footprint (including land reclamation) is approximately 73 hectares with the reclamation component approximately 40 hectares.

The project involves:

- New ferry terminals to improve access to North Stradbroke Island;
- Mixed use development including (high rise) residential, retail, commercial and tourism uses;
- A marina;
- Public open space and boardwalks providing foreshore access;
- Dredging of the existing Toondah Harbour marine access (Fison Channel) to allow for safe navigation for all vessels; and
- Reclamation of areas within Moreton Bay

The project footprint contains intertidal and shallow subtidal habitats including: mangrove forests; intertidal and subtidal un-vegetated mudflats and sand banks; seagrass meadows; and subtropical coastal saltmarsh community.

Migratory Birds

Moreton Bay supports more than 50,000 migratory waterbirds during their non-breeding season. At least 43 species of waterbirds use the intertidal habitats, including 30 migratory species listed on international conservation agreements. Moreton Bay is one of only two Ramsar sites in Australia that supports the critically endangered eastern curlew all year round, with juvenile birds not migrating until they are 2-3 years old. This means that the juveniles are residents in Moreton Bay until they reach maturity and are ready to migrate.

Migratory shorebirds need to maintain an energy intake greater than their energy expenditure to recover from the southward migration, and to build fat reserves in preparation for the northward migration. Relative amounts of time spent feeding and resting, and the distances between their feeding and roosting areas, are important factors in the energy budgets of individual shorebirds.

The Moreton Bay Ramsar site provides an important network of foraging and roosting habitats. Shorebirds move within these areas depending on the time of day, availability of resources, levels of disturbance and environmental conditions. Some habitats are important refuges during extreme high tides or when weather conditions prohibit occupancy of more commonly used habitats.

Because migratory shorebirds mostly feed on intertidal mudflats, they require safe roosting areas to rest during high tide periods. The high energy demands on migratory shorebirds resulting from their migratory lifecycle means that resting is critical when not breeding. Generally, migratory shorebirds prefer roosting areas in open habitat on slightly elevated ground so they can watch for potential predators.

The proposal is considered likely to result in adverse impacts to the EPBC listed eastern curlew (critically endangered; migratory), bar-tailed godwit (vulnerable/critically endangered; listed migratory), whimbrel (migratory) and grey-tailed tattler (migratory).

Eastern curlew (*Numenius madagascariensis*) (EPBC Act critically endangered; migratory)

Usually, eastern curlews feed singly or in loose flocks. Occasionally, this species is seen in large feeding flocks of hundreds (Marchant & Higgins, 1993). Moreton Bay Ramsar site is one of the most important areas for eastern curlew in Australia (maximum count 3,500 individuals on 1 January 1996). It remains internationally important all year round because of the high number of juvenile birds during the Austral winter.

Eastern curlew are sensitive to certain development activities due to their high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (DotE 2015). The eastern curlew is extremely wary and will take flight at the first sign of danger, long before other nearby shorebirds become nervous. The minimum recommended distance between a disturbance event (stimuli) and important eastern curlew habitat is 200m. (http://www.avianbuffer.com/)

The proposed development will remove a substantial amount of foraging habitat of this species and impact two known roosting sites (Nandeebie claypan and offshore mangrove roost), one of which has recorded a maximum count of 180 individuals (Nandeebie claypan). The mosaic of roost sites and foraging sites should be maintained.

The proposed development will:

- reduce the area of occupancy of the species by removing a considerable area of foraging habitat.
- adversely affect important habitat critical to the survival of the species, such as roosting habitat (Nandeebie claypan and Mangrove roost)
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, such as the proximity of the residential development and tourism providing humans and animals with greater access to foraging and roosting areas, thus increasing stressors on the birds.
- result in invasive species that are harmful to a critically endangered species becoming established in the species' habitat by linking the offshore mangrove roost sites to the mainland.
- interfere with the recovery of the species by removing important habitat and causing increased disturbance.
- will seriously disrupt the lifecycle (feeding, migration and resting behaviour) of an ecologically significant proportion of a population of eastern curlew.

Bar-tailed godwit (EPBC Act spp. *baueri* vulnerable; spp *menzbieri* critically endangered; listed migratory)

The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. Moreton Bay Ramsar site is likely to provide habitat for *Limosa lapponica baueri* (western Alaskan subspecies) but may also contain *Limosa lapponica menzbieri* (northern Siberian subspecies). In Australia, *L. l. baueri* mainly occur along the north and east coasts (Garnett et al.

2011) such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. The bar-tailed godwit (western Alaskan) usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. They prefer exposed sandy or soft mud substrates on intertidal flats, banks and beaches. The bar-tailed godwit (western Alaskan) usually roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh (Higgins & Davies 1996).

Migratory shorebirds, such as the bar-tailed godwit (western Alaskan), are sensitive to certain development activities due to their: high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b). Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance as well as habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers et al. 2006; Garnett et al. 2011; Department of the Environment 2015a,b).

Habitat loss and degradation

In Australia, the loss of important habitat reduces the availability of foraging and roosting sites. This affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss. These include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (Department of the Environment 2015a,b). Anthropogenic nutrient enrichment of wetland areas can cause cyanobacterium blooms that may impact the prey species of bar-tailed godwits (e.g. at Roebuck Bay; Estrella et al. 2011).

Disturbance

Human disturbance can cause shorebirds to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding or roosting habitat that is actually used. Disturbance from human recreation activities may force migratory shorebirds to increase the time devoted to vigilance and anti-predator behaviour and/or may compel the birds to move to alternative, less favourable feeding areas (Goss-Custard et al. 2006; Glover et al., 2011; Weston et al., 2012). Human disturbance can interrupt feeding and may restrict the area of feeding habitat available for bar-tailed godwits. Bar-tailed godwits (western Alaskan) at Phillip Island, Victoria, were recorded taking flight when humans approached within 10–70 m of them (Taylor & Bester 1999). The minimum recommended distance between a disturbance event (stimuli) and important bar-tailed godwit habitat is 50m. (http://www.avianbuffer.com/)

The proposed development will remove a substantial amount of foraging habitat of this species and impact two known roosting sites (Nandeebie claypan and offshore mangrove roost). The maximum count of bar-tailed godwits on Nandeebie claypan is 2,300 birds (approximately 20% of bar-tailed godwits recorded in Moreton Bay (Bamford et al. 2008)). Birds using the Nandeebie Claypan also use the nearby Oyster Point shoreline roost, moving between the two roost sites depending on the height of the tide and extent of disturbance at Oyster Point. The mosaic of roost sites and foraging sites should be maintained.

The proposed development will:

- reduce the area of occupancy of the species by removing a considerable area of foraging habitat.
- adversely affect important habitat critical to the survival of the species, such as roosting habitat (Nandeebie claypan, Oyster Point and Mangrove roost)
- modify, destroy, remove isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, such as the proximity of the residential development and tourism providing humans and animals with greater access to foraging and roosting areas, thus increasing stressors on the birds.
- interfere with the recovery of the species by removing important habitat and causing increased disturbance.
- will seriously disrupt the lifecycle (feeding, migration and resting behaviour) of an ecologically significant proportion of a population of bar-tailed godwit.

Migratory shorebirds (whimbrel, grey-tailed tattler, bar-tailed godwit, eastern curlew)

The proposed development is in an area of nationally important habitat for migratory shorebirds. At this site, >0.1% of the flyway population of eastern curlew, whimbrel, grey-tailed tattler and bar-tailed godwit occur, particularly at Nandeebie claypan and the Cassin Island roosting sites (see EPBC Act Policy Statement 3.21).

The proposed development:

- will substantially modify, destroy or isolate nationally important habitat for eastern curlew, whimbrel, grey-tailed tattler and bar-tailed godwit.
- could result in an invasive species that is harmful to listed migratory species becoming established in an area of important habitat by linking the offshore mangrove roost sites to the mainland (Cassin Island).
- will seriously disrupt the lifecycle (feeding, migration and resting behaviour) of an ecological significant proportion of the population of eastern curlew, whimbrel, grey-tailed tattler and bar-tailed godwit.

Marine turtle

Moreton Bay supports important foraging populations of green, hawksbill and loggerhead turtles and is close to the southern-most extent of their range. The area is considered a significant feeding ground for the green turtle (Australian Wetlands Database).

***Loggerhead turtle* (EPBC Act endangered; migratory)**

Loggerhead turtles in Australia are divided into two genetically distinct populations. Those found in Moreton Bay are part of the East Australian breeding stock (Limpus 2008) and are referred to as the loggerhead south-west Pacific stock (Recovery Plan for Marine Turtles in Australia, 2017). The *Marine Bioregional Plan for the Temperate East Marine Region* (2012) (bioregional plan) states that large concentrations of foraging loggerhead turtles have been found in Moreton Bay. Minor breeding aggregations occur in Moreton Bay, including Moreton Island and Stradbroke Island (Limpus 2008). The bioregional plan identifies the waters between Bustard Head QLD and Ballina in NSW as being biologically important for nesting loggerhead turtles. Moreton Bay forms the southern extent of their foraging range making this foraging population an important population.

Adults and large juvenile loggerhead turtles inhabit environments with both hard and soft substrata, including rocky and coral reefs, muddy bays, sand flats, estuaries and seagrass meadows (*Marine Bioregional Plan for the Temperate East Marine Region*, 2012). Loggerhead turtles are carnivorous, feeding primarily on benthic invertebrates including gastropod molluscs, clams and small amounts of jellyfish, starfish, corals, crabs and fish (SPRAT). In Moreton Bay, loggerhead turtles inhabit seagrass beds and are often found resting in channels.

Currently, the recovery plan (2017) identifies chemical and terrestrial discharge, vessel disturbance and habitat modification (through dredging/trawling and infrastructure/coastal development) as moderate threats for this species. The categorisation of these threats as moderate means that while they have not begun to reduce the population in their own right they are cumulatively acting with other threats to undermine population viability.

In addition, the Australian Government led the development of the Convention on the Conservation of Migratory Species (CMS) *Single Species Action Plan for Loggerhead Turtles (*Caretta caretta*) in the Pacific Ocean* (Loggerhead Plan). The Loggerhead Plan was unanimously adopted by the CMS Convention of the Parties in 2014 and calls on Australia to address threats to this population. The Loggerhead Plan identifies dredging and marina construction within foraging areas as a threat to the stock. In accordance with Australia's international obligations impacts to important loggerhead habitat in Moreton Bay should be minimised.

The proposed action is likely to reduce the area of occupancy of an important population of loggerhead turtles and may interfere with the recovery of the species. Adverse impacts to loggerhead turtles are considered likely.

***Green turtle* (EPBC Act vulnerable; migratory)**

Green turtles that occur in Moreton Bay are part of the southern Great Barrier Reef breeding stock (Recovery Plan for Marine Turtles in Australia, 2017). Important nesting sites for this stock generally occur from the Fraser Coast area north to the Capricornia Bunker Islands, however very low density nesting may occur on beaches in the Moreton Bay area.

Green turtles can be found in shallow waters where they forage principally on seagrass, algae and mangrove fruits, living in coral and rocky reefs, seagrass beds and algal mats. The *Marine Bioregional Plan for the Temperate East Marine Region* (2012) identifies Moreton Bay as being biologically important for foraging green turtles. The referral states that extensive areas of intertidal seagrass beds occur within and adjacent to the project footprint.

Currently, the recovery plan (2017) identifies light pollution, vessel disturbance and habitat modification (through dredging/trawling and infrastructure/coastal development) as moderate threats for this species. The categorisation of these threats as moderate means that while they have not begun to reduce the population in their own right they are cumulatively acting with other threats to undermine population viability.

The proposed action will result in the loss of important foraging habitat from dredging and reclamation activities. This will result in a reduced area of occupancy for an important population. Further, interactions with dredge vessels, construction and operational disturbance may lead to mortality of individuals within the population and changes to water quality may affect seagrass habitat outside the proposed footprint, thus reducing available foraging habitat further.

The project is also likely to facilitate activities that will adversely impact green turtles within the greater area such as disturbance from and collision with vessels and increased potential for the ingestion of marine debris. It is unclear if the project will result in additional ferry services which may also increase disturbance and the risk of vessel strike.

The proposed action is likely to reduce the area of occupancy of an important population of green turtle. Further, it is likely to modify, destroy, remove or isolate, or decrease the availability or quality of green turtle habitat to the extent that this important population is likely to decline. Adverse impacts to green turtles are considered likely.

***Hawksbill turtle* (EPBC Act vulnerable; migratory)**

Moreton Bay represents the southernmost extent of hawksbill distribution. Hawksbills forage in seagrass beds and coral reefs and as such may utilise areas within the proposed development. Hawksbills foraging in SE Queensland may be part of the north Queensland genetic stock, or may come from stocks nesting in other areas throughout the Pacific.

The proposed action may impact on a small number of foraging hawksbill turtles, but is unlikely to have an adverse impact on the north Queensland genetic stock, or other regional hawksbill stocks.

Dugong (EPBC Act migratory)

In Australia, dugongs occur from Shark Bay in Western Australia across the northern coastline to Moreton Bay in Queensland (Marsh, H., et al. (2011)).

In Moreton Bay, the eastern Amity Banks, Moreton Banks and areas adjacent to these sandbanks are considered the most important habitats with Rous Channel and east of South Passage also important in cooler months (SPRAT).

An assessment by Marsh et al (2011) on the status of the 'urban coast of Queensland' (Cooktown to Moreton Bay) dugong population indicates that this population meets the IUCN criteria for Critically Endangered. Delisle et al (2014) states that if the urban coast population is to recover it is essential that all anthropogenic sources of direct dugong mortality be minimised.

Dugongs are seagrass community specialists and the range of the dugong is broadly coincident with the distribution of seagrasses. There is also evidence that dugongs use specialised habitats for various activities, such as avoiding shark attack by resting on the edge of sandbanks (SPRAT).

Dugong have traits that make them susceptible to threats, including being long-lived with low reproductive potential, delayed sexual maturity, high female investment in each offspring, and a reliance on inshore habitats (GBRMPA 2014).

The Dugong Vulnerability Assessment for the GBR (GBRMPA 2014) identifies the following threats to the 'urban coast dugong management unit':

Incidental drowning in nets used by commercial fishing.

- Cumulative pressures to their primary food, seagrasses, from habitat loss and degradation as a result of extreme weather events (i.e. floods), coastal development (ports/mariners/harbours development and land reclamation), reduced water quality due to coastal development (ports/mariners/harbours operations and dredging).
- Increased occurrence of boat strike and disturbance.

- Ingestion of and entanglement in marine debris.
- Dugong face a variety of pressures that may reduce their resilience to current and future impacts of climate change and impede their capacity to adapt including, accelerated rates of climate change, depleted population, cumulative impacts of human related threats and a reduction of alternative habitats for foraging along the developing urban coast.

The proposed action is likely to substantially modify, destroy or isolate an area of important habitat for dugong; seriously disrupt the lifecycle of an ecologically significant proportion of a population of dugong. Adverse impacts to dugong are considered likely.

Cetaceans

***Southern right whale* (EPBC Act endangered; migratory)**

The core range of the southern right whale includes the coastal waters of southern Australia from Sydney to Perth, however they are known to occur further north with the extremities of their range recorded as far north as Hervey Bay in QLD (*Southern Right Whale recovery Plan 2012), and are known to visit Moreton Bay (Department of National Parks, Sport and Racing). Within their range they generally occur within two km off shore.

Preliminary data suggests that the south-eastern and south-western Australian whales may represent distinct genetic stocks. Southern right whales in south-western Australia appear to be increasing at the maximum biological rate, however there is limited evidence of increase in south-eastern waters (Recovery Plan 2012).

High risk threats identified in the Recovery Plan (2012) include:

- Vessel collision.
- Noise interference – loud noise or long exposure may lead to avoidance of important habitat areas. Potential forms of noise interference include industrial noise such as pile driving and dredging, and vessel noise.
- Habitat modification – through the development of infrastructure such as ports and marinas could lead to the displacement of whales from preferred habitat or disruption to behaviour.

The Recovery Plan (2012) states that vessel collision is greater for the southern right whale when they are in costal zones due to the higher probability of encountering vessels and that as shipping traffic increases '*the impact on an individual, especially in south east Australia, is likely to have a significant, potentially population-scale effect, if further evidence confirms this as a small demographically discrete population*'.

Southern right whales appear to be the primary whales species involved in vessel collision in the southern hemisphere (Van Waerebeek et al, 2007). According to media reports (http://www.abc.net.au/news/2014-08-17/whale-washes-up-in-moreton-bay-with-propeller-cuts-to-head/5676732) a southern right whale was killed in 2014 when it was struck by a ferry travelling between the existing Toondah harbour and Stradbroke Island.

In conclusion the proposed development may:

- Reduce the area of occupancy of the species: The proposed action may result in the disturbance and interference of whales due to an increase in vessel traffic and pilling

activities. Southern right whales that occur in Moreton Bay are part of a population that is at the limit of the species range.
- Interfere with the recovery of the species: A potential increase in ferry traffic is likely to increase the risk of vessel collision to the southern right whale.

There is insufficient information in the referral to understand the potential threats to this species, especially the risks associated with increased vessel traffic. The proposed action may result in adverse impacts to the southern right whale.

* The Conservation Management Plan for the Southern Right Whale is recognised as a Recovery Plan under section 269A of the EPBC Act.

Humpback Whale **(EPBC Act vulnerable; migratory)**

Humpback whales are frequent visitors to Moreton Bay as they migrate from the southern feeding grounds to breed in warmer waters. The *Marine Bioregional Plan for the Temperate East Marine Region* (2012) identifies Moreton Bay as being biologically important for migration, peaking in June–July (northbound) and August– mid-October (southbound). Resting females and calves can be present from August –October.

Threats identified in the Humpback Whale Conservation Advice (2015) include:

- Noise Interference – e.g. industrial noise (pile driving, some forms of dredging, use of explosives, blasting and drilling) and shipping noise;
- Habitat degradation including coastal development and port expansion; and
- Vessel disturbance and strike.

The referral lacks sufficient information to understand the expected increase of vessel traffic and how this might impacts on migrating or resting humpback whales. There is also insufficient information on the expected level of noise in the marine environment.

In the absence of adequate information, it is likely that the action will increase the likelihood of vessel disturbance and strike, and increase the level of anthropogenic noise, at times when humpback whales are present in Moreton Bay.

Dolphin

Indo-Pacific humpback dolphin (EPBC listed Migratory)

Indo-Pacific humpback dolphins are found in coastal and estuarine areas of Queensland and New South Wales, generally at depths less than 20 m, including inshore reefs, tidal and dredged channels, mangroves and river mouths (SPRAT).

The *Marine Bioregional Plan for the Temperate East Marine Region* (2012) identifies the waters off Cooloola National Park to the New South Wales border (including Moreton Bay) within the 20 m depth contour as being biologically important for foraging and breeding Indo-Pacific humpback dolphins.

The Plan states that pressures of concern for inshore dolphins in this region include physical habitat modification while pressures of potential concern include noise pollution and collision with vessels.

The referral lacks sufficient information to determine the presence of this species in the local and greater region and the potential impacts.

Australian snubfin dolphin (EPBC listed migratory) *dusky dolphin* (EPBC listed Migratory)

The Australian snubfin dolphin occur in coastal water off the northern half of Australia, including as far south as the Brisbane River on the east coast. This species shares similar habitat preferences as the Indo-Pacific humpback dolphins (SPRAT). While the dusky dolphin may occur in Moreton Bay, it is primarily found in temperate and sub-Antarctic waters. Adverse impacts are considered unlikely.

The referral lacks sufficient information to determine the presence of these species in the local and greater region and the potential impacts.

Advice prepared by: s22 (x s22), s22 (x s22), s22 (x s22).

Checked by: s22, Director Migratory Species Section

Cleared by: Geoff Richardson, Assistant Secretary Protected Species and Communities Branch.

Signature:.......................................

Date: 23/5/17

References

- Australian Wetlands Database- Moreton Bay RAMSAR Site https://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=41
- Conservation Management Plan for the Southern Right Whale – A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* – (2011- 2021).
- Department of National Parks, Sport and Racing (QLD) http://www.nprsr.qld.gov.au/parks/moreton-bay/culture.html
- Humpback Whale Conservation Advice (2015) http://www.environment.gov.au/biodiversity/threatened/species/pubs/38-conservation-advice-10102015.pdf
- *Marine Bioregional Plan for the Temperate East Marine Region* (2012)
- Marsh, H., et al. (2011). *Ecology and Conservation of the Sirenia. Dugong and Sirenia* Cambridge, University Press.
- Species Profile and Threat Database (SPRAT)
- Van Waerebeek et al (2007) Vessel collision s with small cetaceans worldwide and large whales in the Southern Hemisphere, and initial assessment, Latin American Journal of Aquatic Mammals.

- Great Barrier Reef Marne Park Authority: Vulnerability Assessment for the GBR – Dugong (2014)
  http://elibrary.gbrmpa.gov.au/jspui/bitstream/11017/2867/1/gbrmpa_VA_Dugong_15%20September%202014_final.pdf

FOI 180804
Document 14n

Queensland Government

Department of
Environment and Heritage Protection

Ref CTS 101/0003868-005

22 May 2017

s22 [redacted]
Queensland Major Projects Section
Assessments (Qld, Tas, Vic) & Policy Implementation Branch
Department of the Environment and Energy
GPO Box 787
CANBERRA ACT 2601

Dear s22 [redacted]

Invitation to comment on referral EPBC 2017/7939 – Toondah Harbour Development, Qld

Thank you for your letter dated 11 May 2017 requesting advice on whether the above action will be assessed in a manner described in Schedule 1 of the Agreement between the Commonwealth of Australia and the State of Queensland (the Bilateral Agreement) developed under Section 45 of the *Environment Protection and Biodiversity Conservation Act 1999*.

I advise the proposal will not be assessed using the EIS process in chapter 3 of the *Environmental Protection Act 1994*.

The Department of State Development has reviewed the referral documentation and advised that the Coordinator-General has not received a request for declaration of this proposal as a coordinated project under Part 4 of the *State Development and Public Works Organisation Act 1971*.

The Department of Infrastructure, Local Government and Planning has not advised that the proposed development will be assessed under Chapter 9, Part 2 of the *Sustainable Planning Act 2009*.

Should you have any further enquiries, please contact me on telephone (07) 3330 s22 [redacted]

Yours sincerely

s22 [redacted]

Director, Impact Assessment and Operational Support

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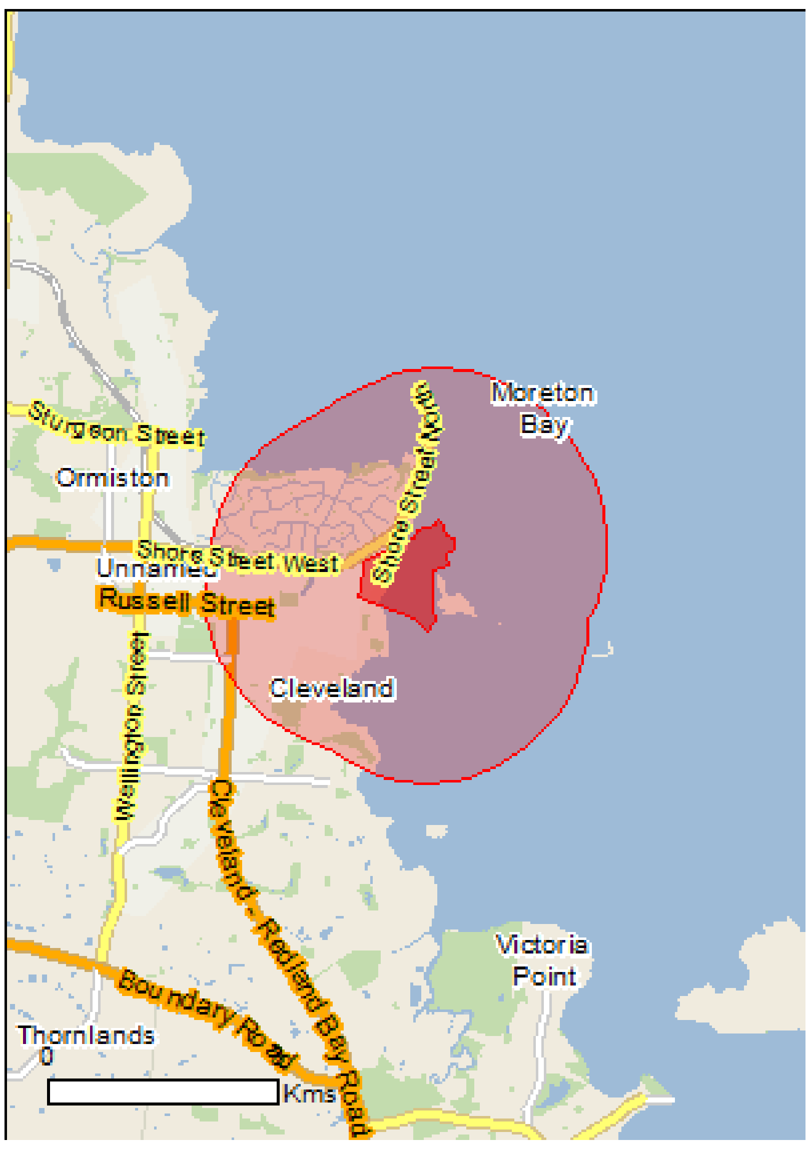
FOI 180804
Document 14o

EPBC Act Protected Matters Report

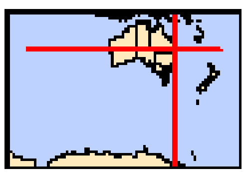
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 11/05/17 14:12:08



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

Coordinates
Buffer: 2.0Km



Summary

Matters of National Environment Significance

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	57
Listed Migratory Species:	72

Other Matters Protected by the EPBC Act

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	111
Whales and Other Cetaceans:	14
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.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	36
Nationally Important Wetlands:	1
EPBC Act Referrals:	8
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Moreton bay	Within Ramsar site

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
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]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris		
Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus		
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Dasyornis brachypterus		
Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Species or species habitat may occur within area
Diomedea antipodensis gibsoni		
Gibson's Albatross [82270]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Erythrotriorchis radiatus		
Red Goshawk [942]	Vulnerable	Species or species habitat 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
Lathamus discolor		
Swift Parrot [744]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, 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
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may 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	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed 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	Species or species habitat may occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may 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 may occur within

Name	Status	Type of Presence
		area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may 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 known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Cryptocarya foetida Stinking Cryptocarya, Stinking Laurel [11976]	Vulnerable	Species or species habitat may occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat likely to occur within area
Samadera bidwillii Quassia [29708]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may 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	Foraging, feeding or related behaviour known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour 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

Name	Status	Type of Presence
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding may 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		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, 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]		Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may 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 may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known 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
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat 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 may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

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		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, 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
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed 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	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus kelloggi Kellogg's Seahorse, Great Seahorse [66723]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		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
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
Micrognathus andersonii Anderson's Pipefish, Shortnose Pipefish [66253]		Species or species habitat may occur within area
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Microphis manadensis Manado Pipefish, Manado River Pipefish [66258]		Species or species habitat may occur within area
Solegnathus dunckeri Duncker's Pipehorse [66271]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		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
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		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
Mammals		
Dugong dugon Dugong [28]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Reptiles		
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known 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	Foraging, feeding or related behaviour known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Laticauda laticaudata a sea krait [1093]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may 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 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	Species or species habitat 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

Name	Status	Type of Presence
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
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

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
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		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
Lonchura punctulata Nutmeg Mannikin [399]		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
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
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
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
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
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
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		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

Name	Status	Type of Presence
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		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 within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Moreton Bay	QLD

EPBC Act Referrals

[Resource Information]

Further details about the referral or advice - including its current status if still active - are available in its PINK report; click on the title.

Title	Reference	Referral Outcome	Assessment Status
Referral			
Eprapah Heights Bushland Residential Subdivision	2001/286	NCA	Referral Decision Made-Completed
Prawn Aquaculture Enterprise Expansion	2001/294	NCA	Referral Decision Made-Completed
Eddie Santagiuliana Way Boardwalk	2005/2049	NCA	Referral Decision Made-Completed
establishment of a car wash and service station facility on Lot 12 RP 57455	2005/2077	NCA	Referral Decision Made-Completed
Residential estate Bunker Rd	2005/2130	NCA	Referral Decision Made-Completed
works within the Black Swamp	2005/2334	NCA	Referral Decision Made-Completed
Breeding program for Grey Nurse Sharks	2007/3245		Withdrawn-Completed
Toondah Harbour Project, Moreton Bay, Qld	2015/7612		Withdrawn-Close

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 and National Heritage properties, Wetlands of International and National 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.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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.

Coordinates

-27.52551 153.28159,-27.5235 153.28616,-27.52308 153.28626,-27.5233 153.28673,-27.52295 153.28767,-27.52208 153.28801,-27.5216 153.29007,-27.52113 153.29037,-27.52158 153.2911,-27.52265 153.2915,-27.52305 153.2923,-27.52419 153.29232,-27.52459 153.29153,-27.52567 153.29155,-27.52636 153.2899,-27.53037 153.28987,-27.53171 153.29024,-27.5327 153.2891,-27.53136 153.28771,-27.52902 153.281,-27.52879 153.281,-27.52855 153.28133,-27.52551 153.28159

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:

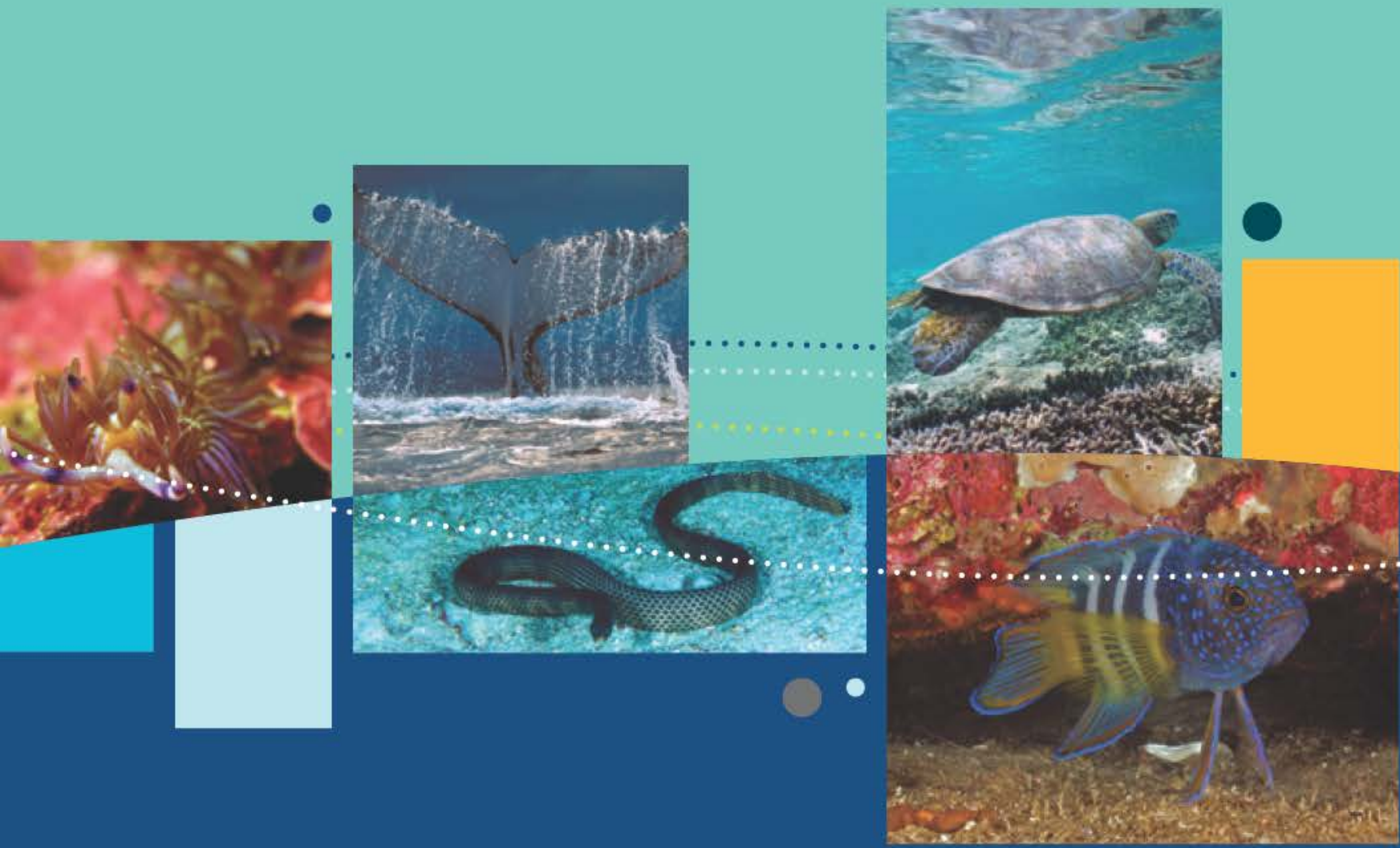
-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environment and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian 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, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-Forestry Corporation of NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-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.

FOI 180804
Document 14p

Australian Government
Department of Sustainability, Environment,
Water, Population and Communities



Marine bioregional plan for the Temperate East Marine Region

prepared under the *Environment Protection and Biodiversity Conservation Act 1999*

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Images:
A Green turtle swims in shallows over reef top – GBRMPA, Blue Devil – D.Harasti, Nudibranch – M.Lawrence, Dubois' Sea Snake – GBRMPA, Whale tail – D.Paton, Olive sea snake searching for food over coral and algae – GBRMPA, Flesh-footed shearwater and Balls Pyramid – I.Hutton, Runic wreck on Middleton Reef – Director of National Parks, Black-browed Albatross – M.Double, Acropora species – R.Chesher Ph.D, Red Sea Star – M.Lawrence

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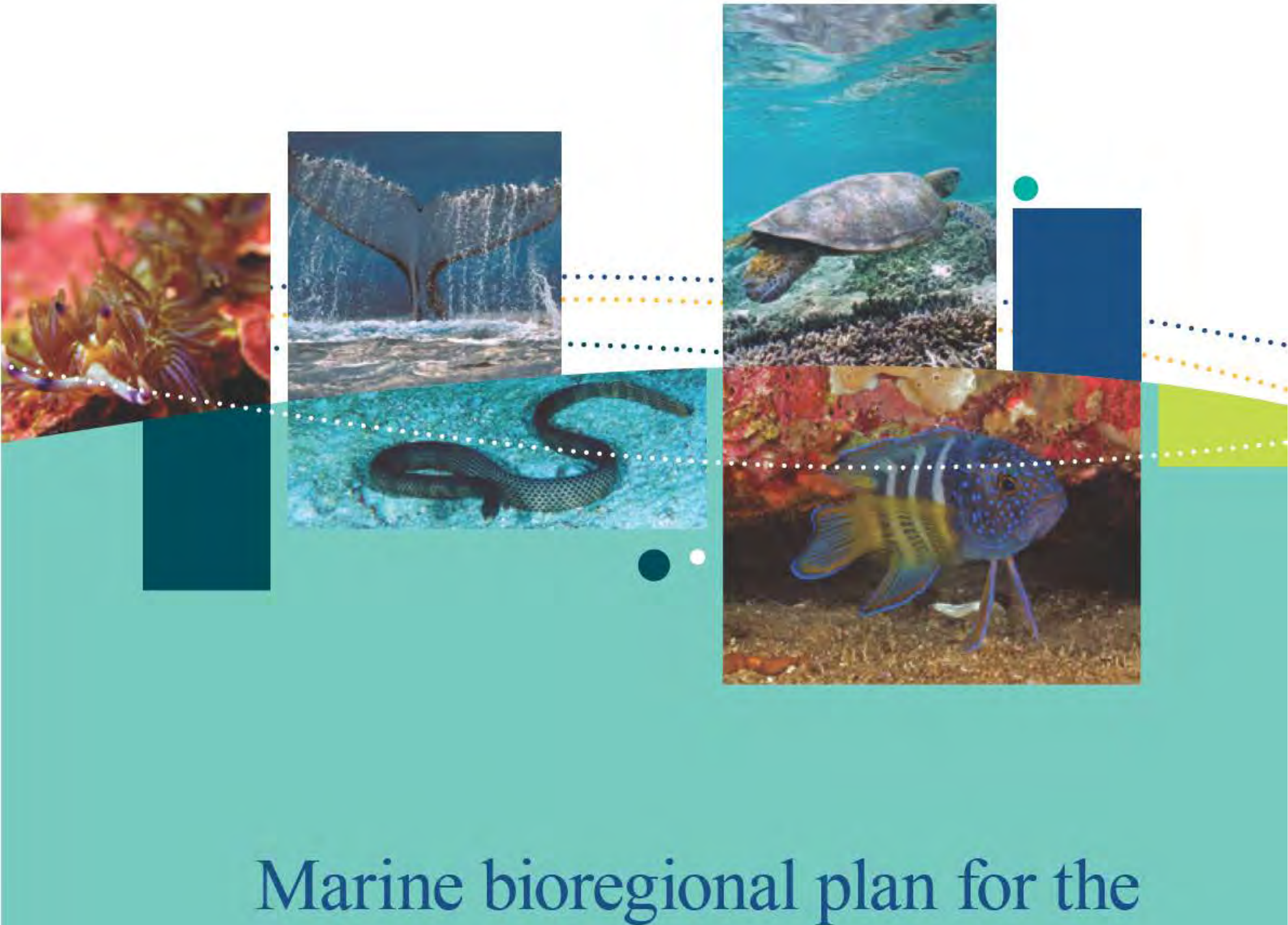


Marine bioregional plan for the Temperate East Marine Region

prepared under the *Environment Protection and Biodiversity Conservation Act 1999*

MINISTERIAL FOREWORD

Temperate East Marine Bioregional Plan

For generations, Australians have enjoyed a unique relationship with the sea.

Our oceans play a massive role in Australian life – they provide us with fish to eat, a place to fish, business and tourism opportunities and a place for families to enjoy.

Australians know, better than anyone, how important it is that our oceans remain healthy and sustainable.

Right now, our iconic marine environment is coming under more and more pressure from industry, from pollution and, increasingly, from climate change.

That is why the Australian Government has committed to creating a network of Commonwealth marine reserves around the country. We will protect our precious ecosystems in our oceans as we have done on land with our national parks.

The Temperate East Marine Region runs from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales, and includes the waters surrounding Lord Howe and Norfolk Islands.

It is home to the critically endangered east coast population of grey nurse shark and has important offshore reef habitat at Elizabeth and Middleton Reefs and Lord Howe Island that support the threatened black cod.

It includes the southern-most extent of many reef-building coral species. A number of seamount chains run parallel to the coast in this region, and scientists have recently discovered that these features support hundreds of species, including some previously unknown to science.

These plans have been developed under the *Environment Protection and Biodiversity Conservation Act 1999* and backed by the best available science.

During the statutory consultation period, submissions were received from a wide range of stakeholders in the Temperate East Marine Region. The comments and information provided by communities and industries have informed the finalisation of the plan.

Our oceans contain a diversity of species and ecosystems which deserve protection. In this Temperate East Marine Bioregional Plan, you will find information about this extraordinary array of marine life and ecosystems.

Tony Burke
Minister for the Environment

CONTENTS

1 THE TEMPERATE EAST MARINE BIOREGIONAL PLAN

1.1 Introduction to Marine Bioregional Planning

Australia has one of the largest marine jurisdictions of any nation in the world. Australian waters cover 14.7 million square kilometres, including waters around the external territories of Cocos (Keeling), Christmas, Heard and McDonald Islands as well as waters adjacent to Australia's Antarctic Territory. Within that area, Commonwealth waters surrounding the Australian continent and Tasmania cover 7.4 million square kilometres. The biodiversity of Australia's vast marine jurisdiction has been recognised as globally significant. Australia's oceans provide a home to a diverse array of marine species including marine mammals and reptiles, more than 4000 species of fish and tens of thousands of species of invertebrates, plants and micro-organisms. Many of Australia's marine species are endemic, and therefore occur nowhere else in the world. Others utilise Australian waters as part of their global migrations.

As well as being home to an amazing diversity of marine environments, Australia's oceans support a range of marine industries, providing a significant contribution to the national economy. These industries include commercial fishing and aquaculture, petroleum and mineral exploration and production, shipping, ports, recreational and charter fishing, and tourism.

With 80 per cent of Australia's population living in the coastal zone, the marine environment has important social and cultural values, including recreational opportunities, amenity, cultural heritage, conservation and scientific significance. Many Aboriginal and Torres Strait Islander peoples have a close, long-standing relationship with coastal and marine environments and continue to rely on these environments and resources for their cultural identity, health and wellbeing, as well as their domestic and commercial economies.

Marine bioregional planning is about improving the way Australia's marine environment is managed and helping our oceans to remain healthy and productive. Marine bioregional plans have been prepared under section 176 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the South-west, North-west, North and Temperate East marine regions in Commonwealth waters around Australia (Figure 1.1) and relate to a number of matters of national environmental significance (Box 1.1).

A draft marine bioregional plan was released for the Temperate East Marine Region in November 2011 for a 90 day statutory consultation period. This final plan has been informed by comments received from a range of stakeholders including Commonwealth and state government agencies, industry, recreational and conservation organisations and members of the public. The Australian Government will work with stakeholders to achieve the objectives of the plan.

The preparation of marine bioregional plans represents an important step towards a genuine "ecosystem approach" (Box 1.2) to biodiversity conservation and marine resource management. The plans provide a basis for the recognition and valuation of the many essential and largely irreplaceable ecosystem services provided by the Australian marine environment, including food production, waste management, climate stabilisation and recreation.

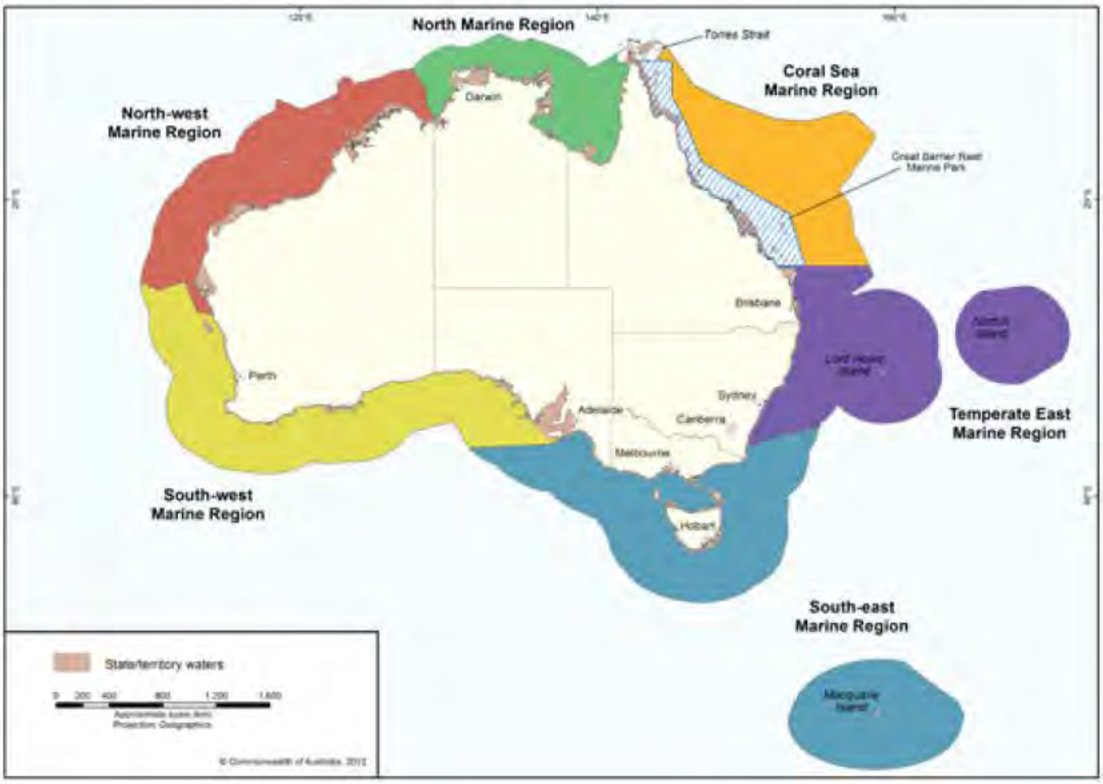


Figure 1.1: Australia's Marine Regions

Box 1.1 Matters of national environmental significance

Under the EPBC Act actions that have or are likely to have a significant impact on matters of national environmental significance require approval by the environment minister. There are currently eight matters of national environmental significance protected under the EPBC Act:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species (except those listed as extinct or conservation dependent) and ecological communities (except those listed as vulnerable)
- migratory species protected under international agreements
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- nuclear actions, including uranium mines.

Box 1.2 The ecosystem approach

What is it?

The ecosystem approach is one of the most important principles of sustainable environmental management. Essentially, it recognises that all elements of an ecosystem are interconnected and requires that the effects of actions on the different elements of an ecosystem be taken into consideration in decision-making.

Why do we do it?

Ecosystems are complex and interconnected—what affects one species or habitat will have cascading and possibly unpredictable implications for other species or habitats. In addition, different activities within a marine environment may affect different parts of the interconnected whole or amplify the impacts on particular parts of the natural system.

We wish to prevent problems rather than react to them. This is why we want to address the drivers of biodiversity loss, rather than their symptoms. A focus on building and maintaining the resilience of ecosystems is more efficient and effective than trying to address problems after they have occurred.

1.2 Goal and objectives of the plan

The Temperate East Marine Bioregional Plan aims to strengthen the operation of the EPBC Act in the region to help ensure that the marine environment remains healthy and resilient. The plan will be used by government and industry to improve the way the marine environment is managed and protected.

Consistent with the objectives of the EPBC Act, and in the context of the principles for ecologically sustainable development as defined in the Act, the plan sets the following objectives for the region:

- conserving biodiversity and maintaining ecosystem health
- ensuring the recovery and protection of threatened species
- improving understanding of the region's biodiversity and ecosystems and the pressures they face.

The marine bioregional plan will contribute to these objectives by:

- supporting strategic, consistent and informed decision-making under Commonwealth environment legislation in relation to Commonwealth marine areas
- supporting efficient administration of the EPBC Act to promote the conservation and ecologically sustainable use of the marine environment and its resources
- providing a framework for strategic intervention and investment by government to meet its policy objectives and statutory responsibilities.

The Temperate East Marine Bioregional Plan describes the marine environment and conservation values of the region, identifies and characterises the pressures affecting these conservation values, identifies regional priorities and outlines strategies to address them, and provides advice to decision-makers and people planning to undertake activities in the Temperate East Marine Region in relation to some of the region's conservation values.

1.3 Application of the plan

This plan is for the Temperate East Marine Region, which covers the Commonwealth marine area (Box 1.3) extending from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales, as well as the waters surrounding Lord Howe and Norfolk islands (Figure 1.2). The plan does not cover state or territory waters but, where relevant, does include information about inshore environments and the way they interact with species and habitats of the Commonwealth marine area.

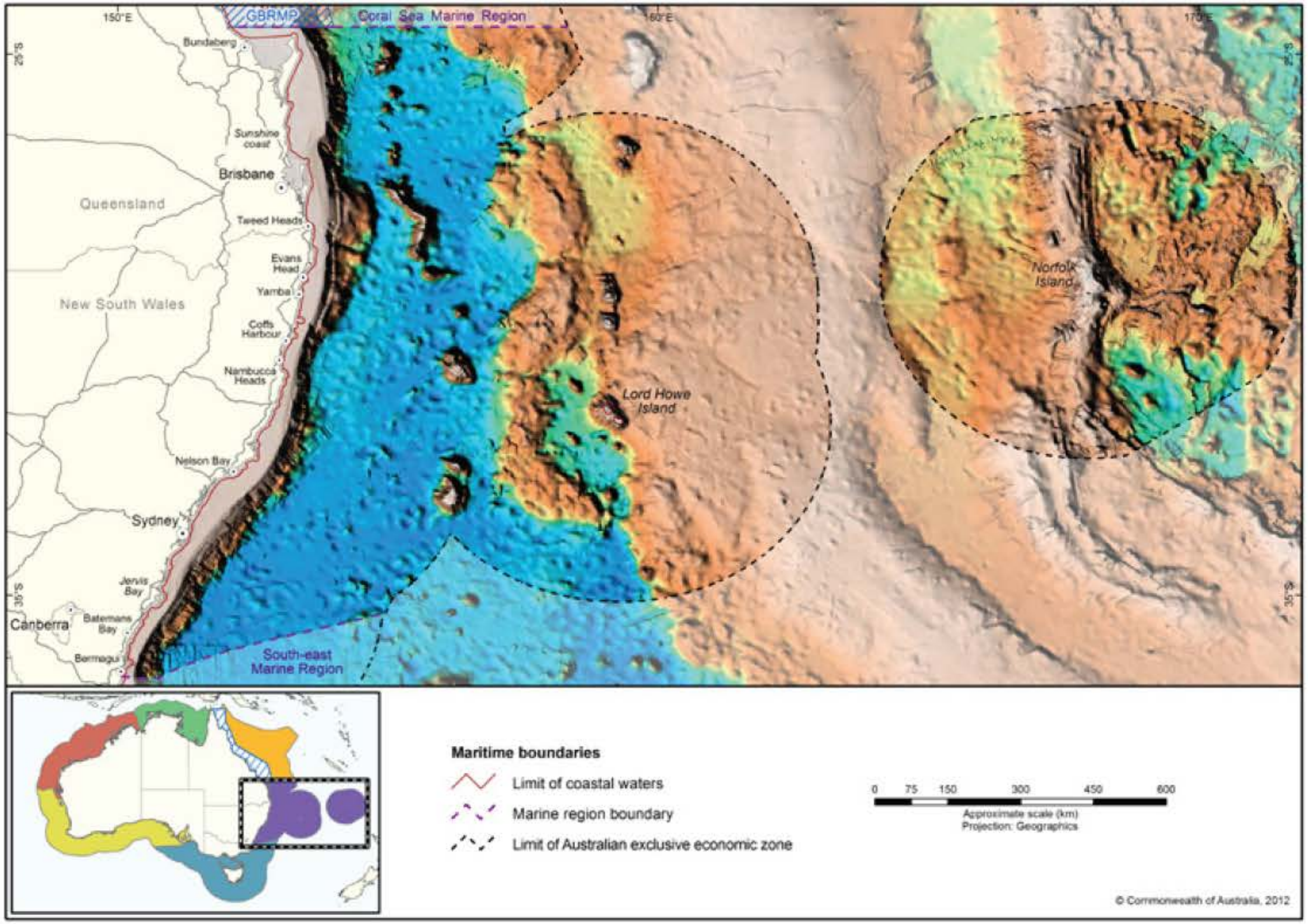


Figure 1.2: Temperate East Marine Region

Under section 176 of the EPBC Act, once a bioregional plan has been prepared, the minister responsible for the environment must have regard to it when making any decision under the Act to which the plan is relevant. The plan does not alter the scope of the minister's statutory responsibilities or narrow the matters the minister is required to take into account or may wish to take into account in making decisions. The EPBC Act provides that this plan is not a legislative instrument. This plan will commence six weeks after it is approved by the minister.

Box 1.3 Commonwealth marine areas

The Australian Government is responsible for the Commonwealth marine area (also known as Commonwealth waters) as defined in section 24 of the EPBC Act (glossary **www.environment.gov.au/marineplans**). The Commonwealth marine area extends beyond the outer edge of state/territory waters, generally some 3 nautical miles (or 5.5 kilometres) from the coast, to the boundary of Australia's exclusive economic zone, generally around 200 nautical miles (or 370 kilometres) from shore (Figure 1.3). In this plan, the Commonwealth marine environment refers to the environment in a Commonwealth marine area.

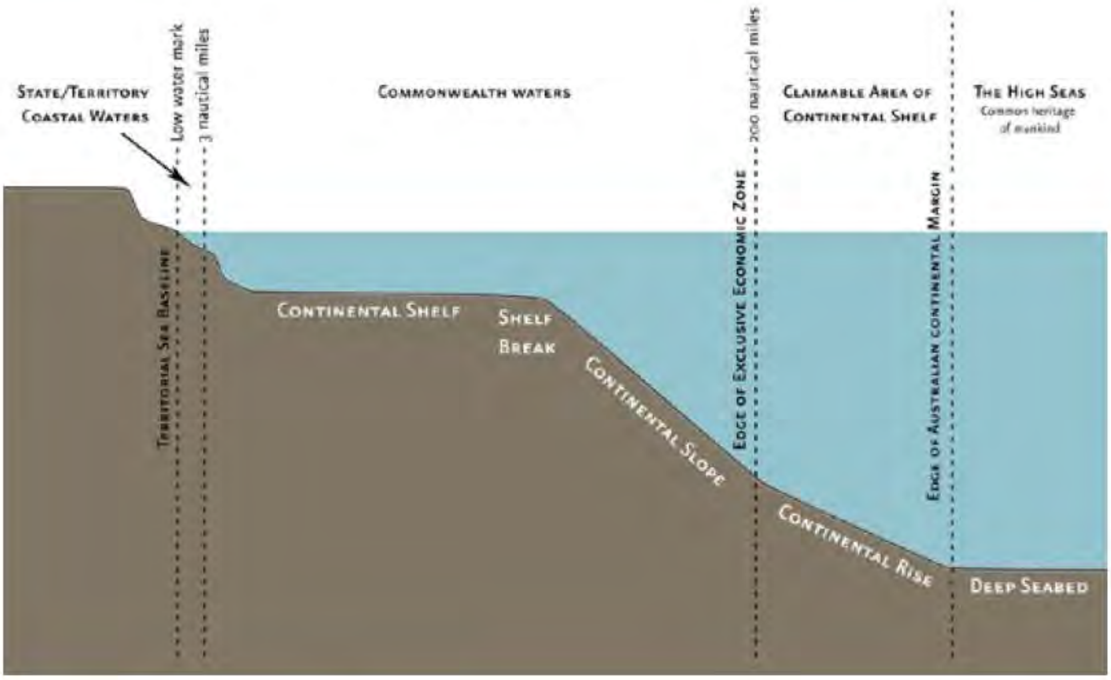


Figure 1.3: Australia's maritime zones

1.4 Key elements of the plan and supporting information

There were five key steps in the preparation of this marine bioregional plan.

1. Characterisation of the marine region

Currently available scientific and other information were used to describe the bio-physical environment and socio-economic characteristics of the marine region and its conservation values, including key ecological features, protected places and species and species groups protected by the EPBC Act. This information was combined in a Bioregional Profile for the region.

2. Regional analysis of the conservation values

The pressures potentially affecting conservation values were identified and characterised against a scale *of concern* in relation to their impacts on the values. The regional pressure analysis was informed by peer reviewed scientific literature, and its findings subject to external review by experts in the relevant fields. The outcomes of the regional pressure analysis are described in schedule 1 and informed both the identification of regional priorities (Part 4) and regional advice on matters of national environmental significance (Schedule 2).

3. Development of regional priorities

The regional pressure analysis assisted in the identification of conservation values that were, or potentially were, adversely affected by multiple pressures, as well as pressures that were impacting on multiple conservation values. Where warranted by the level *of concern*, these conservation values or pressures have been identified as regional priorities and consideration given to the strategies required to address them (Part 4).

4. Development of regional advice

The regional pressure analysis has also informed the development of regional advice in relation to matters of national environmental significance. This advice has been developed to assist people planning to undertake activities in Commonwealth marine areas to better understand and comply with their obligations under the EPBC Act, including helping them to decide whether to refer their proposed activity and determine what information would most usefully accompany any referral.

5. Public consultation on the draft marine bioregional plan

This marine bioregional plan was released in draft form for a 90 day public consultation period. The comments received have been taken into account in finalising this plan.

The plan is made up of a number of parts and is supported by a suite of information resources.

The plan

Part 1 (this part) of the plan provides context about marine bioregional plans. Part 2 of the plan describes the conservation values of the Temperate East Marine Region. Part 3 presents a summary of the analysis of pressures affecting conservation values in the region, undertaken to inform the development of regional priorities. Part 4 introduces the regional priorities and outlines strategies and actions to address them.

Schedules

Schedule 1 of the plan presents a full description of the pressures on conservation values of the Temperate East Marine Region that have been assessed as being *of concern* or *of potential concern*. Schedule 2 provides specific advice on matters of national environmental significance in the region. This regional advice will assist people who plan to undertake activities in, or potentially impacting on, the Commonwealth marine environment to better understand and meet their obligations under the EPBC Act. It will also assist in deciding whether a proposed action should be referred to the minister for assessment, and identify any information that is likely to be required as part of the referral.

Glossary

A glossary of terms used in this plan and relevant to marine bioregional planning is located at **www.environment.gov.au/marineplans**.

Conservation values report cards

The conservation values report cards contain comprehensive information about the conservation values of the Temperate East Marine Region. Conservation values include species and places protected under the EPBC Act and key ecological features. There are three types of conservation value report cards:

- protected species groups
- Commonwealth marine environment (including key ecological features)
- protected places.

The report cards support the information provided in this plan and are available at **www.environment.gov.au/marineplans/temperate-east**. They include:

- a description of the conservation values of the region
- an overview of the vulnerabilities and pressures on the conservation values (*of concern* and *of potential concern*)
- a list of relevant protection measures
- references.

Conservation Values Atlas

The Department of Sustainability, Environment, Water, Population and Communities, as the Australian Government department responsible for administering the EPBC Act, maintains a suite of interactive tools that allow users to search, find and generate reports on information and data describing matters of national environmental significance and other conservation values in the marine environment.

The Conservation Values Atlas is designed to provide a visual representation of the conservation values in each marine region. It shows the location and spatial extent of conservation values (where sufficient information exists) and is available at **www.environment.gov.au/cva**.

Other resources

A number of important reference documents for the Temperate East Marine Region are available at **www.environment.gov.au/marineplans**.

1.5 Who will use the plan?

People who have responsibility for, or interest in, management of marine based activities, environment protection and marine science

The Temperate East Marine Bioregional Plan is an important document for individuals and organisations with an interest in the region and the way national environmental law is administered within Commonwealth waters. The plan provides information that enables people to better understand the Australian Government's marine environment protection and biodiversity conservation responsibilities, objectives and priorities in the region.

People planning to undertake activities in Commonwealth waters, or planning to undertake activities that are likely to have a significant impact on the Commonwealth marine environment

The plan is not a legislative instrument and therefore does not alter the EPBC Act referrals process. People planning to undertake activities within the Temperate East Marine Region can use the plan and supporting information to help decide whether their proposal should be referred in accordance with the EPBC Act.

The minister and department administering the EPBC Act

The minister must have regard to the Temperate East Marine Bioregional Plan in making any decision under the EPBC Act to which the plan is relevant.

Other government agencies

The requirement to have regard to the Temperate East Marine Bioregional Plan in making decisions applies only to the Commonwealth minister administering the EPBC Act. However, the plan provides comprehensive information about the region that assists government decision-making relevant to the Commonwealth marine environment. The plan is underpinned by an ecosystem approach (Box 1.2). This approach requires government decision-makers to consider issues across jurisdictional, sectoral and disciplinary boundaries, so that actions are not considered in isolation from one another. The information provided in the plan assists decision-makers in the Australian Government and other jurisdictions to collaborate more effectively across jurisdictional and sectoral boundaries.

2 THE TEMPERATE EAST MARINE REGION AND ITS CONSERVATION VALUES

The Temperate East Marine Region comprises Commonwealth waters from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales. It also includes the waters surrounding Lord Howe and Norfolk islands (Figure 1.2). The region covers approximately 1.47 million square kilometres of temperate and subtropical waters and abuts the coastal waters of southern Queensland and New South Wales. It extends from shallow waters on the continental shelf, 3 nautical miles (5.5 kilometres) from shore, to the deep ocean environments at the edge of Australia's exclusive economic zone, 200 nautical miles from shore.

The main physical features of the region are:

- three seamount chains that run parallel to the East coast—the Tasmantid and Lord Howe seamount chains and the Norfolk Ridge
- the East Australian Current, which dominates the oceanography of the region. The East Australian Current brings warm waters from the Coral Sea south along the outer edge of the continental shelf until it moves offshore at approximately 33 degrees south (offshore from the central coast of New South Wales). Along its path, it gives rise to large eddy features that support important areas of enhanced productivity
- the Tasman Front, which forms between 20 and 30 degrees south and represents the meeting point for two distinct bodies of water—the warm, nutrient-poor Coral Sea and the cold, nutrient-rich Tasman Sea. Localised oceanographic processes along the Tasman Front trap nutrients and plankton, creating an important region of enhanced productivity and connectivity pathways
- the canyons of the eastern continental slope, which add critical habitat diversity to the region.

The remainder of this chapter describes the conservation values of the region, including the Commonwealth marine environment and its protected species and places.

2.1 Identification of conservation values

A range of conservation values have been identified in the Temperate East Marine Region. Conservation values are defined as those elements of the region that are:

- key ecological features of the Commonwealth marine area
- species listed under Part 13 of the EPBC Act that live in the Commonwealth marine area or for which the Commonwealth marine area is necessary for a part of their life cycle
- protected places including marine reserves, heritage places and historic shipwrecks in the Commonwealth marine area.

2.2 Conservation values—the Commonwealth marine environment

Biodiversity

The Temperate East Marine Region is characterised by a narrow continental shelf, significant variation in sea-floor features (including seamount chains and canyons), dynamic oceanography, and a unique mix of tropical and cold water reef systems. Temperate species dominate the southern parts of the region, and tropical species become progressively more common towards the north.

The region supports high levels of species richness and diversity, particularly among corals, crustaceans, echinoderms, molluscs, sea sponges and fish. Due to the latitudinal range of the region, this diversity includes both tropical and temperate species. Oceanography is a strong driver for the region's biodiversity. This is particularly true in places like Lord Howe Island and the Elizabeth and Middleton reefs where both warm and cold water species flourish alongside each other. These unusual communities are mainly supported by the tongue of warm water that is driven southwards by the East Australian Current, extending the geographic range of the tropical species.

Further offshore, the East Australian Current influences biodiversity by connecting remote communities, such as those found on the seamounts, through the transport of species between areas. Our understanding of these deeper areas is constantly developing; current data suggests that these areas support exceptional levels of species endemism (as high as 34 per cent) with little overlap in distribution across seafloor features. The varied sea-floor features in the region may function as isolated systems and could support species that may be new to science.

Key ecological features

Key ecological features (KEFs) are elements of the Commonwealth marine environment in the Temperate East Marine Region that, based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity.

The criteria used to identify KEFs in the region are:

- a species, group of species or community with a regionally important ecological role, where there is specific knowledge about why the species or species group is important to the ecology of the region, and the spatial and temporal occurrence of the species or species group is known
- a species, group of species or community that is nationally or regionally important for biodiversity, where there is specific knowledge about why the species or species group is regionally or nationally important for biodiversity, and the spatial and temporal occurrence of the species or species group is known
- an area or habitat that is nationally or regionally important for
  - enhanced or high biological productivity
  - aggregations of marine life
  - biodiversity and endemism
- a unique seafloor feature with ecological properties of regional significance.

KEFs were first described in the bioregional profile for each region and have since been modified as a result of further analysis and review by scientific experts.

Eight key ecological features have been identified in the Temperate East Marine Region (Figure 2.1 and Table 2.1). Further information on the KEFs can be found in the Commonwealth marine environment report card (**www.environment.gov.au/marineplans/temperate-east**). Understanding of KEFs may evolve as new scientific information emerges.

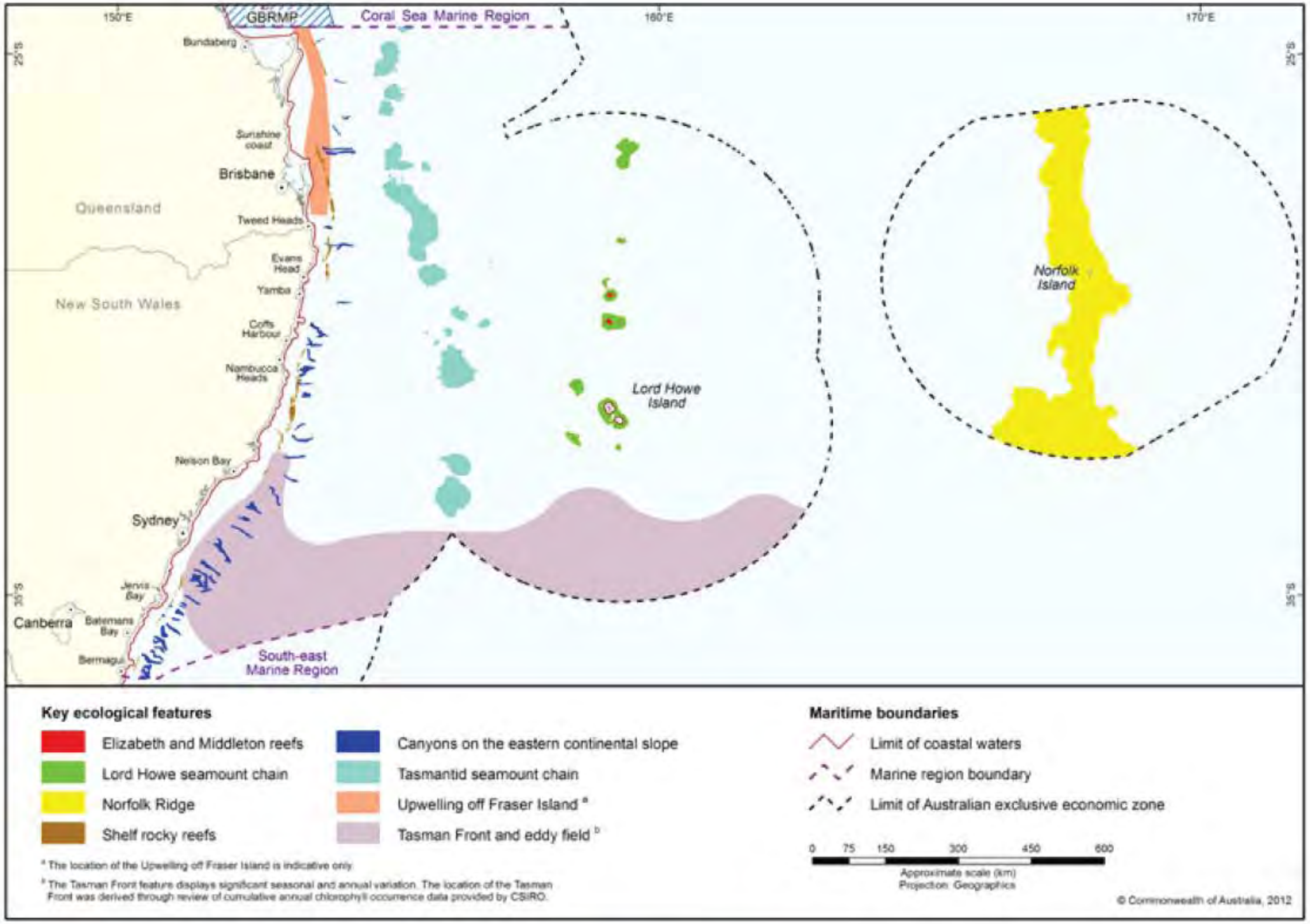


Figure 2.1: Key ecological features of the Temperate East Marine Region

Table 2.1: Key ecological features of the Temperate East Marine Region

Feature	Values	Description
Shelf rocky reefs	Unique sea-floor feature with ecological properties of regional significance	Along the continental shelf south of the Great Barrier Reef, communities associated with the shift from algae-dominated sea-floor communities to those dominated by attached invertebrates (including large sponges, moss animals and soft corals). This shift generally occurs at a depth of 45 m. These invertebrates create a complex habitat that supports a multitude of animals including crabs, snails, worms and starfish. The habitats also contain a diverse assemblage of bottom-dwelling fishes that show distinct patterns of association with shelf-reef habitats.
Canyons on the eastern continental slope	Unique sea-floor feature with ecological properties of regional significance	Canyon systems have a marked influence on the diversity and abundance of species, driven by the combined effects of steep and rugged topography, ocean currents, sea-floor types and nutrient availability. They significantly contribute to the overall habitat diversity of the sea floor, by providing hard surfaces in depth zones where soft sediment habitats prevail. Large benthic animals such as sponges and feather stars are abundant, with particularly high diversity found in the upper slope regions (150–700 m). Canyons also create localised changes in productivity in the water column above them, providing feeding opportunities for a range of species, many of which are commercially important or threatened.
Tasman Front and eddy field	High productivity; aggregations of marine life; biodiversity and endemism	The Tasman Front is a region of intermediate productivity that separates the warm, nutrient-poor waters of the Coral Sea from the cold, nutrient-rich waters of the Tasman Sea. The front is located between 27º S and 33º S, moving north during winter and south in summer. It is associated with warm-core eddies, a number of which are semipermanent features.

Feature	Values	Description
Upwelling off Fraser Island	High productivity; aggregations of marine life	In two areas near Fraser Island, upwellings of cold, deep waters mix with surface waters. Tides, wind and currents draw these nutrient-rich waters onto the shelf, where they generate blooms of phytoplankton that support animals higher in the food chain, including a number of commercially valuable and threatened species.
Tasmantid seamount chain	High productivity; aggregations of marine life; biodiversity and endemism	The Tasmantid seamount chain is a prominent chain of underwater volcanic mountains, plateaux and terraces that runs north–south at approximately 155° E, extending into the Tasman Basin. At the deepest point of the chain, features rise to a depth of 1400–900 m below sea level. At the northernmost extent, features rise to a depth of 400–150 m below sea level, with some breaking the surface to form islands. The Tasmantid seamount chain contains a range of habitats, from deep sea sponge gardens to near-pristine tropical coral reef systems. Collectively, these are biological hotspots with high species diversity. They are also known feeding and breeding grounds for a number of open ocean species (e.g. billfish, marine turtles, marine mammals) and have high species endemism.
Lord Howe seamount chain	High productivity; aggregations of marine life; biodiversity and endemism	The Lord Howe seamount chain runs for approximately 1000 km along the western margin of the Lord Howe Rise, extending from Lord Howe Island in the south to Nova Bank in the north. It supports tropical shallow coral reefs and deep cold water corals.

Feature	Values	Description
Norfolk Ridge	High productivity; aggregations of marine life; biodiversity and endemism	The Norfolk Ridge occurs in a region of remnant volcanic arcs, plateaux, troughs and basins. The ridge runs southward from New Caledonia to New Zealand, between the New Caledonia Trough to the west and the Norfolk Basin to the east. There are likely to be high levels of diversity in seamount communities, caused by relatively productive sea-floor habitats that support population densities far higher than surrounding areas. Benthic habitats along the Norfolk Ridge are also thought to act as 'stepping stones' for animal dispersal, connecting deep water species from New Caledonia to New Zealand.
Elizabeth and Middleton reefs	Aggregations of marine life; biodiversity and endemism	Elizabeth and Middleton reefs are small, isolated, oceanic platform reefs that occur on top of the volcanic seamounts of the Lord Howe seamount chain. The reefs are impacted by the East Australian Current, exposing the area to its warm waters as well as the surrounding cooler ocean. This key ecological feature supports tropical and temperate marine life, including both warm and cold water corals and over 300 fish species. The lagoons of both reefs are important areas for populations of black cod and the Galapagos shark.

2.3 Conservation values—protected species

The Temperate East Marine Region is an important area for protected species. Species listed under the EPBC Act are commonly referred to as protected species and can be listed as threatened species (critically endangered, endangered, vulnerable, conservation dependent), migratory species, cetaceans and marine species (see glossary for a full definition). An individual species may be listed under more than one category.

Threatened species are, in broad terms, those species that have been identified as being in danger of becoming extinct. Species may be listed in the following categories:

- conservation dependent
- vulnerable
- endangered
- critically endangered
- extinct in the wild
- extinct.

(see the glossary for further explanation of these categories).

Migratory species are those species that are listed under:

- the *Convention on the Conservation of Migratory Species of Wild Animals 1979* (CMS or Bonn Convention)
- the *Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment 1974* (JAMBA)
- the *Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986* (CAMBA)
- the *Agreement between the Government of Australia and the Government of the Republic Of Korea on the Protection of Migratory Birds 2007* (ROKAMBA)
- any other international agreement, or instrument made under other international agreements approved by the environment minister.

Further information on the CMS, JAMBA, CAMBA and ROKAMBA is provided at **www.environment.gov.au/biodiversity/migratory/index.html**

Cetaceans (whales, dolphins and porpoises) are all are protected under the EPBC Act in the Australian Whale Sanctuary and, to some extent, beyond its outer limits.

Marine species belong to taxa that the Australian Government has recognised as requiring protection to ensure their long-term conservation (in accordance with sections 248–250 of the EPBC Act). (Refer to Table A in Schedule 2 for listed marine species in the region).

The lists of protected species established under the EPBC Act are updated periodically. This plan refers to the lists of protected species in the region and includes detailed information about species distribution and ecology in the Temperate East Marine Region. Species groups identified as conservation values in the Temperate East Marine Region are:

- bony fishes (10 species)
- cetaceans (9 species)
- marine reptiles (families Cheloniidae, Dermochelyidae, Hydrophiidae and Laticaudidae) (24 species)
- seabirds—(i.e. bird species that occur naturally in Commonwealth marine areas) (34 species)
- sharks (6 species).

Report cards describe the protected species (as of May 2012) and include detailed information about species distribution and ecology in the Temperate East Marine Region.

Biologically important areas have been identified for some of the region's protected species. These are areas that are particularly important for the conservation of protected species and where aggregations of individuals display biologically important behaviour such as breeding, foraging, resting or migration. They have been identified using expert scientific knowledge about species' distribution, abundance and behaviour in the region. The presence of the observed behaviour is assumed to indicate that the habitat required for the behaviour is also present. The selection of species for which biologically important areas have been identified was informed by the availability of scientific information, the conservation status of listed species and the importance of the region for the species. The range of species for which biologically important areas are identified will continue to expand as reliable spatial and scientific information becomes available.

The process for identifying biologically important areas involves mapping proposed areas digitally, based on expert advice and published literature, then obtaining independent scientific review of the maps and descriptions of the proposed areas.

Biologically important area maps and descriptions are available in the Temperate East Marine Region Conservation Values Atlas (**www.environment.gov.au/cva**).

2.4 Conservation values—protected places

Protected places are those places protected under the EPBC Act as matters of national environmental significance—places listed as World Heritage, National Heritage, or wetlands of international importance. Protected places may also include Commonwealth marine reserves and places deemed to have heritage value in the Commonwealth marine environment such as places on the Commonwealth heritage list or shipwrecks under the *Historic Shipwrecks Act 1976*.

Protected places in the region are shown in Figure 2.2 and described in Table 2.2.

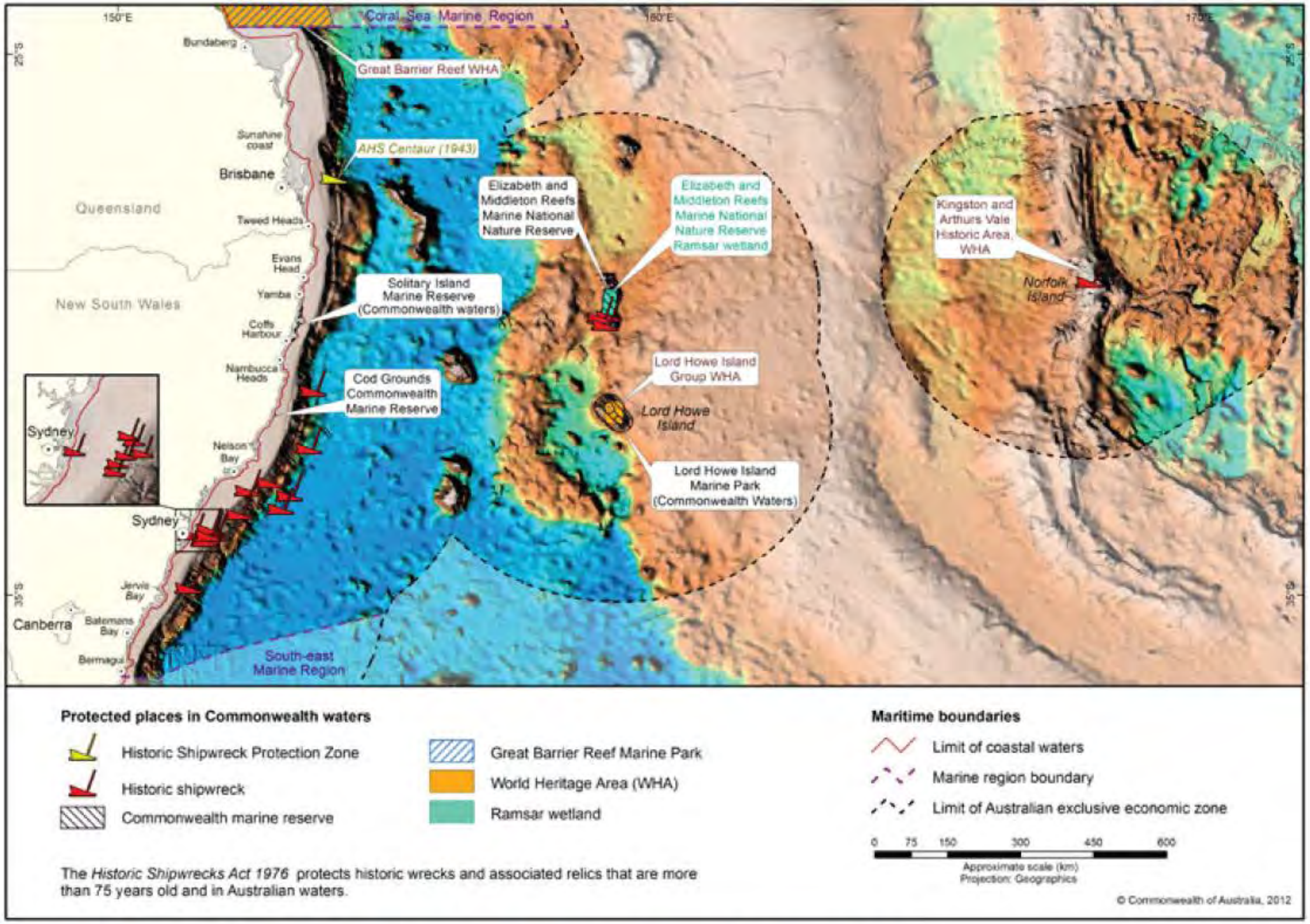


Figure 2.2: Protected places in the Temperate East Marine Region as of May 2012

Table 2.2: Protected places in the Temperate East Marine Region as of May 2012

Protected place	Protection measure	Relevant key ecological feature
Elizabeth and Middleton Reefs Marine National Nature Reserve	Commonwealth marine reserve Ramsar site	Elizabeth and Middleton Reefs
Solitary Islands Marine Reserve (Commonwealth waters)	Commonwealth marine reserve	
Cod Grounds Commonwealth Marine Reserve	Commonwealth marine reserve	
Lord Howe Island Marine Park (Commonwealth waters)	Commonwealth marine reserve World Heritage List National Heritage List	Lord Howe seamount chain

Commonwealth marine reserves are relevant in EPBC Act decision making on referred matters and explicitly referenced in the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*.

3 PRESSURES AFFECTING CONSERVATION VALUES

3.1 Analysis of pressures on conservation values

The pressure analysis assessed present and emerging pressures affecting conservation values in the Temperate East Marine Region and the effectiveness of mitigation and management arrangements that are currently in place to address these pressures. The analysis enabled pressures to be categorised in terms of their relative importance or concern, and has informed the identification of regional conservation priorities and the development of regional advice. For the purpose of this plan, pressures are defined broadly as human-driven processes and events that do or can detrimentally affect the region's conservation values.

The analysis considered pressures affecting all key ecological features and protected places and a number of species belonging to the species groups bony fishes, cetaceans, reptiles, seabirds and sharks. Considerations used for selecting the species for analysis were specific to the biological characteristics of the species groups, but broadly centred on the relative significance of the region to the conservation of the particular species. In assessing the significance of the region for a species' conservation, key considerations included the species' conservation status, distribution, population structure within the region and life history characteristics, and the potential for the population(s) in the region to be genetically distinct from populations elsewhere. Table 3.1 lists and provides an explanation of the species selected for inclusion in the pressure analysis for the Temperate East Marine Region.

A range of pressures from a range of sources was considered in the pressure analysis. Table S1.1 in Schedule 1 provides a list of the type and source of pressures available for inclusion in the analysis. Not every type and source of pressure in this list was assessed against every conservation value. Only those pressures relevant to the conservation value being analysed were considered.

The analysis included a review of scientific and expert literature, and was informed by the findings of relevant environmental and impact assessment studies, risk assessments and expert opinion. The pressure analysis considered, for each selected conservation value, information derived from available reports and research about:

- the spatial location and intensity of the pressure(s), both current and anticipated
- the location of the conservation value—that is, its distribution and the location of areas important to it

- current understanding of impacts (at relevant scales) resulting from the interaction between the pressure(s) and the conservation value
- the effectiveness of current management and impact mitigation measures.

Table 3.1: Protected species selected for the pressure analysis

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Bony fishes	Species were selected on the basis of their occurrence in the region, their listing under the EPBC Act, and the importance of the region to their survival.	**Eastern gemfish** **Orange roughy** **Black cod** **Big-bellied or pot-bellied seahorse** **Bullneck seahorse** **Duncker's pipehorse** **Great (Kellogg's) seahorse** **Hardwick's pipehorse** **Sad seahorse** **Weedy seadragon**
Cetaceans	Species were selected on the basis of their occurrence in the region, their listing as threatened and/or migratory and/or cetacean species under the EPBC Act, and the importance of the region to their survival. The two inshore dolphin species selected, although generally coastal species, also occur in the Commonwealth marine environment of the Temperate East Marine Region. The Indo-Pacific humpback dolphin occurs in a variety of habitats, usually less than 20 m deep, including inshore reefs, tidal and dredged channels, mangroves and river mouths. The Indo-Pacific bottlenose dolphin occurs in riverine and coastal waters, shallow waters on the continental shelf and around oceanic islands.	**Blue whale** **Dwarf minke whale** **Humpback whale** **Killer whale** **Fin whale** **Sei whale** **Southern right whale** **Indo-Pacific (coastal) bottlenose dolphin** **Indo-Pacific humpback dolphin**

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Marine Reptiles	Marine turtle species were selected on the basis of their occurrence in the region, their listing as threatened species under the EPBC Act, and the presence of important breeding or foraging areas for the species in and adjacent to the region. Sea snake species were selected on the basis of their occurrence in the region, and their listing under the EPBC Act as marine species.	**Green turtle** **Hawksbill turtle** **Leatherback turtle** **Loggerhead turtle** **Beaked seasnake** **Blue-lipped sea krait** **Colubrine sea krait** **Dubois' seasnake** **Elegant seasnake** **Horned seasnake** **Laboute's seasnake** **Little file snake** **Marbled or spine-tailed seasnake** **Olive-headed seasnake** **Olive seasnake** **Plain-banded seasnake** **Small-headed seasnake** **Spectacled seasnake** **Spotted seasnake** **Stokes' seasnake** **Turtle-headed seasnake** **White-bellied mangrove snake** **Yellow seasnake** **Yellow-bellied seasnake**

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Seabirds	Seabird species were selected on the basis of their occurrence in the region, their listing as threatened and/or migratory and/or marine species under the EPBC Act, and the presence of important breeding or foraging areas for the species in and adjacent to the region. The Lord Howe Island group and Norfolk Island group support internationally and nationally significant breeding sites for a number of seabirds in the region.	**Black noddy** **Common noddy** **Crested tern** **Roseate tern** **Sooty tern** **White tern** **Grey ternlet** **Flesh-footed shearwater** **Little shearwater** **Short-tailed shearwater** **Sooty shearwater** **Wedge-tailed shearwater** **Black petrel** **Black-winged petrel** **Gould's petrel** **Great-winged petrel** **Kermadec petrel** **Providence petrel** **White-bellied storm-petrel** **White-faced storm-petrel** **White-necked petrel** **Wilson's storm-petrel** **Northern giant-petrel** **Southern giant-petrel** **Antipodean albatross** **Black-browed albatross** **Campbell albatross** **Indian yellow-nosed albatross** **Salvin's albatross** **Wandering albatross** **White-capped albatross** **Little penguin** **Masked booby** **Red-tailed tropicbird**

Species group	Group-specific considerations for selection	Species selected for detailed pressure analysis
Sharks	Shark species were selected on the basis that they were protected under the EPBC Act and have or are presumed to have important feeding, breeding or nursery areas within the region. They include species under consideration for listing under the EPBC Act known to occur in the Temperate East Marine Region.	**Grey nurse shark** **Porbeagle shark** **Longfin mako shark** **Shortfin mako shark** **Whale shark** **White shark**

3.2 Outcome of pressure analysis

Human pressures on marine ecosystems and biodiversity in the Temperate East Marine Region are, by global standards, low. However, the region is adjacent to the highly populated coasts of New South Wales and southern Queensland, and parts of the region closest to the coast will be subject to higher impact. These pressures are addressed, in part, by Australia's generally sound management of the marine environment.

A number of sources of pressures nevertheless exist in the region. The main drivers and sources of anthropogenic pressure on conservation values in the region are:

- climate change and associated large-scale effects, including shifts in major currents, rising sea levels, ocean acidification, and changes in the variability and extremes of climatic features (e.g. sea temperature, winds, storm frequency and intensity)
- extraction of living resources
- increasing urban and industrial development in areas adjacent to the region
- increasing shipping and port activities.

The findings of the pressure analysis are presented in Schedule 1 of the plan and in the Temperate East Marine Region conservation value report cards (**www.environment.gov.au/marineplans/temperate-east**).

4 REGIONAL PRIORITIES, STRATEGIES AND ACTIONS

4.1 Regional priorities

Regional priorities are key areas of focus that have been identified to inform decision-making about marine conservation and planning, as well as industry development and other human activities. The regional priorities provide context for implementing the government's statutory responsibilities, such as recovery planning for threatened species and the development and implementation of threat abatement measures. They also point to where future government initiatives and future investments in marine conservation, including in research and monitoring, would be best directed.

The identification of regional priorities for the Temperate East Marine Region has been guided by the outcomes of the pressure analysis. In identifying regional priorities, consideration has been given to the following:

- conservation values that are subject to
  - a pressure considered *of concern* for the conservation value, and
  - pressures that together are likely to result in cumulative impacts on the value, and/or
  - pressure(s) that are likely to increase substantially in intensity and extent over the next 5–10 years
- pressures that are considered *of concern* for multiple conservation values
- areas where better knowledge would improve the government's capacity to meet conservation and ecologically sustainable use objectives
- Australian Government policy priorities for the marine region.

Only a subset of conservation values and pressures assessed as being *of concern* or *of potential concern* has been identified as regional priorities. Generally, when a pressure affects multiple values and its effects are *of concern* for at least some of these values, then the pressure is identified as a regional priority. Similarly, if a conservation value is, or is likely to be, affected detrimentally by multiple pressures, and at least one of the pressures has been assessed as *of concern*, it is considered to be a regional priority. Other key considerations in determining pressure-based regional priorities included issues of scale, legislative responsibility, conservation status, effectiveness of existing management arrangements, and level of uncertainty about distribution, abundance and status of conservation values and the pressures acting on them.

Temperate East Marine Region priorities

This plan identifies 16 regional priorities for the Temperate East Marine Region: 12 conservation values and four pressures, which are further discussed in Tables 4.1 and 4.2 respectively. The strategies and actions to address these priorities are detailed in Section 4.2.

Building on the identification of regional priorities, available information and existing administrative guidelines, this plan provides advice to assist decision-makers, marine industries and other users to understand and meet the obligations that exist with respect to these priorities under the EPBC Act (Schedule 2).

Table 4.1: Conservation values of regional priority for the Temperate East Marine Region

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
1	**Inshore dolphins** Indo Pacific humpback dolphin (EPBC Act listed as cetacean and migratory) Indo Pacific bottlenose dolphin (EPBC Act listed as cetacean)	The Indo-Pacific humpback dolphin and Indo-Pacific bottlenose dolphin are known to occur in the Temperate East Marine Region. Both species are listed as cetacean, while the Indo-Pacific humpback is also listed as migratory under the EPBC Act. The Temperate East Marine Region and adjacent waters are known breeding and foraging/feeding areas for both species. Dolphins are particularly vulnerable to impacts from human activities because of the overlap between their preferred inshore habitats and the highly populated coastal fringe. This vulnerability is compounded by biological characteristics such as late-age sexual maturation and low reproduction rates. Inshore dolphin species in the Temperate East Marine Region are subject to a number of pressures assessed as *of concern*: physical habitat modification (urban and coastal development), bycatch (commercial fishing) and bycatch (bather protection). A further suite of pressures are *of potential concern*. These are physical habitat modification (dredging and dredge spoil), climate change (ocean acidification, sea level rise, changes in sea temperature, changes in oceanography, changes in hydrological regimes), oil pollution (shipping), chemical pollution (onshore activities e.g. agriculture) and nutrient pollution (onshore activities e.g. agriculture), noise pollution (shipping, urban development), collision with the vessels and marine debris.	Strategy A, Action 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 and 5 Strategy E, Action 3

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
2	**Marine turtles** Green turtle Hawksbill turtle (EPBC Act listed as vulnerable, migratory and marine) Leatherback turtle Loggerhead turtle (EPBC Act listed as endangered, migratory and marine)	Four of the world's seven marine turtles are known to inhabit the Temperate East Marine Region. All four species are listed as threatened under the EPBC Act. The region and adjacent areas are known to support important nesting and/or foraging areas for all four species. The varied use of the marine environment by marine turtles across different developmental stages (e.g. juvenile, young adult) means that they are exposed to a wide range of pressures. In the Temperate East Marine Region, marine turtles are subject to a number of pressures assessed as *of concern* and *of potential concern*, with differences in the two ratings varying between the four species. For example, bycatch was assessed as *of concern* to green, loggerhead and leatherback turtles, and *of potential concern* to hawksbill turtles. Climate change, including sea level rise, changes in sea temperatures and sand temperatures was assessed as *of concern* to loggerhead turtles. Changes in sea temperatures and oceanography are *of potential concern* to green, hawksbill and leatherback turtles, while sea level rise is *of potential concern* to green turtles. Other pressures, such as chemical pollution/contaminants, nutrient pollution, marine debris, light pollution, physical habitat modification, extraction of living resources, invasive species and oil pollution were rated *of potential concern* to one or more of the four species assessed. The conservation status of marine turtles, the significance of the Temperate East Marine Region to their recovery, and the pressures facing them in the region make this species group a priority for conservation effort.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 and 5 Strategy E, Actions 1 and 2 Strategy G, Action 1
3	**Grey nurse shark** *(east coast population)* (EPBC Act listed as critically endangered)	The Temperate East Marine Region and adjacent state waters are known to support aggregation, mating and pupping areas for the grey nurse shark. The Cod Grounds and Solitary Islands are also recognised as important areas for this species in Commonwealth waters. The eastern grey nurse shark population is subject to bycatch from both the commercial and recreational sectors; these pressures are assessed as *of concern*. Pressures *of potential concern* include climate change (changes in sea temperature, changes in oceanography) and human presence at sensitive sites. The grey nurse shark is a regional priority because of the species' conservation status, the importance of the region to the species and the pressures impacting the population in the region.	Strategy A, Actions 2 and 3 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 Strategy E, Actions 1 and 2

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
4	**White shark** (EPBC Act listed as vulnerable)	The Temperate East Marine Region and adjacent waters are known to support aggregations of the white shark. White sharks move seasonally along the coast between temporary residence sites which typically correspond to regions of high prey density. The Stockton Beach–Hawks Nest area and Fraser Island are recognised as aggregation areas. The white shark is vulnerable to a number of pressures. Bycatch from the recreational fishing sector is considered *of concern*, while a range of additional pressures are considered *of potential concern*. These include bycatch (commercial fishing), extraction of living resources (non-domestic commercial fisheries), extraction of living resources (illegal, unreported and unregulated fishing) and climate change (changes in sea temperature and oceanography). The white shark is a regional priority because of the species' conservation status, the importance of the region to the species and the pressures impacting the population in the region.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Action 1 Strategy E, Actions 1 and 2

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
5	**Seabirds breeding on islands in the Temperate East Marine Region** **Terns *(including noddies)*** Black noddy Common noddy Crested tern Sooty tern White tern Grey ternlet **Shearwaters** Flesh footed shearwater Little shearwater Short-tailed shearwater Wedge-tailed shearwater **Petrels** Black-winged petrel	A number of islands across the region support globally important nesting sites, most notably the Lord Howe and Norfolk Island groups, as well as a series of smaller islands along the NSW coast, including Cabbage Tree, Broughton, Little Broughton and Montague islands. In addition to nesting activity, the surrounding waters support foraging areas for parents to provide food for chicks. Seabirds breeding in the region are subject to a range of pressures. Invasive species are considered to be *of concern*. Pressures rated *of potential concern* are: climate change (changes in sea temperature and oceanography, ocean acidification), oil and chemical pollution and contaminants (shipping), marine debris, light pollution (for selected petrel and shearwater species), bycatch (for selected shearwater species) associated with commercial and recreational fishing and human presence at sensitive sites. The analysis of these pressures varied across the twenty species, and these rating examples have not been applied uniformly. Breeding seabirds are a regional priority because of their conservation status, the importance of the region in the provisioning of young, the pressures impacting populations in the region, and their status as an Australian Government policy priority.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D Actions 1 and 5 Strategy E, Actions 1 and 2 Strategy G, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
5	Gould's petrel (EPBC Act listed as endangered) Kermadec petrel Providence petrel White-bellied storm-petrel (EPBC Act listed as vulnerable) White-faced storm-petrel White-necked petrel Other Little penguin Masked booby Red-tailed tropicbird	A number of islands across the region support globally important nesting sites, most notably the Lord Howe and Norfolk Island groups, as well as a series of smaller islands along the NSW coast, including Cabbage Tree, Broughton, Little Broughton and Montague islands. In addition to nesting activity, the surrounding waters support foraging areas for parents to provide food for chicks. Seabirds breeding in the region are subject to a range of pressures. Invasive species are considered to be *of concern*. Pressures rated *of potential concern* are: climate change (changes in sea temperature and oceanography, ocean acidification), oil and chemical pollution and contaminants (shipping), marine debris, light pollution (for selected petrel and shearwater species), bycatch (for selected shearwater species) associated with commercial and recreational fishing and human presence at sensitive sites. The analysis of these pressures varied across the twenty species, and these rating examples have not been applied uniformly. Breeding seabirds are a regional priority because of their conservation status, the importance of the region in the provisioning of young, the pressures impacting populations in the region, and their status as an Australian Government policy priority.	Strategy A, Actions 2, 3 and 6 Strategy B, Action 1 Strategy C, Action 3 Strategy D Actions 1 and 5 Strategy E, Actions 1 and 2 Strategy G, Action 1
6	**Shelf rocky reefs**	Shelf rocky reefs of the Temperate East Marine Region support a range of complex benthic habitats that, in turn, support diverse benthic communities. The ecosystem functioning and integrity of Temperate East shelf rocky reefsare subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), physical habitat modification (fishing gear), climate change (ocean acidification, changes to sea temperature and oceanography) and marine debris. It has been identified as a regional priority on the basis of its important contribution to the region's biodiversity. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
7	**Canyons on the eastern continental slope**	The canyons on the eastern continental slope provide habitat (through changes in topography and productivity) that supports a diverse range of benthic, demersal and pelagic species. The ecosystem functioning and integrity of the canyons are subject to a number of pressures rated as *of potential concern*: physical habitat modification, bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and oil and chemical pollution/ contaminants (shipping). The canyons on the eastern continental slope have been identified as a regional priority on the basis of their important contribution to the region's biodiversity. This selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1
8	**Tasman Front and eddy field**	The Tasman Front and eddy field contains complex and dynamic oceanographic processes support transient patches of enhanced productivity that, in turn, attract aggregations of species across trophic levels, including top predators such as tuna and sharks. This feature also supports biological connectivity with seamount habitats further offshore. The ecosystem functioning and integrity of this key ecological feature is subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and shipping-related oil and chemical pollution/ contaminants. This key ecological feature has been identified as a regional priority on the basis of its important contribution to the region's biodiversity. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
9	**Upwelling off Fraser Island**	The upwelling off Fraser Island provides nutrient-rich waters which support a range of species, including a number of commercially valuable and protected species. The ecosystem functioning and integrity of the upwelling are subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and ship-related oil and chemical pollution. The upwelling has been identified as a regional priority on the basis of its important contribution to the region's biodiversity. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1
10	**Tasmantid seamount chain**	The Tasmantid seamount chain supports aggregations of marine life, biodiversity and endemism. The feature supports a range of habitats in temperate and subtropical waters, significant demersal and pelagic diversity, important feeding and breeding sites for a number of open ocean species (e.g. billfish, marine turtles, marine mammals) and high levels of endemism. The ecosystem functioning and integrity of this key ecological feature is subject to a number of pressures rated as *of potential concern*: bycatch and extraction of living resources (commercial fishing), climate change (changes to sea temperature and oceanography), marine debris, and shipping-related oil and chemical pollution. This key ecological feature has been identified as a regional priority on the basis of its important contribution to the region's biodiversity and endemism. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1

	Conservation value	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
11	**Lord Howe seamount chain**	The Lord Howe seamount chain supports aggregations of marine life, biodiversity and endemism. It provides important benthic habitat diversity and is thought to act as an important biological 'stepping stone', connecting deepwater fauna from New Caledonia to New Zealand. The ecosystem functioning and integrity of the seamount chain are subject to a number of pressures rated *of potential concern*: bycatch and extraction of living resources (commercial fishing activities), climate change (ocean acidification, changes to sea temperature and oceanography), marine debris, and shipping-related oil and chemical pollution. The Lord Howe seamount chain has been identified as a regional priority on the basis of its important contribution to the region's biodiversity and endemism. Its selection also acknowledges the need to prioritise research to further understand its ecological functioning.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy D, Actions 1 and 2 Strategy F, Action 1
12	**Elizabeth and Middleton reefs**	The Elizabeth and Middleton reefs support aggregations of marine life, biodiversity and endemism. A small and isolated area, the reefs supports a diverse range of tropical and temperate marine life, including both warm water and cold water corals, and over 300 fish species. The lagoons of both reefs are strongholds for populations of black cod and the Galapagos shark. The ecosystem functioning and integrity of the reefs are vulnerable to climate change impacts, particularly changes in sea temperature and ocean acidification, pressures that have been rated as *of concern*. Pressures rated *of potential concern* are: sea level rise, changes in oceanography, marine debris, and shipping-related oil, chemical and light pollution. The Elizabeth and Middleton reefs are identified as a regional priority on the basis of their important contribution to the region's biodiversity and endemism, the pressures impacting on those values, and its status as an Australian Government priority as an existing Commonwealth marine reserve.	Strategy A, Actions 3 and 4 Strategy B, Action 1 Strategy C, Action 3 Strategy F, Action 1

Table 4.2: Pressures of regional priority for the Temperate East Marine Region

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
13	**Climate change**	Climate change-related pressures including changes in sea temperature and oceanographic processes, ocean acidification, sea level and storm intensity, are predicted to increase in the Temperate East Marine Region, with the potential to impact the region's conservation values (key ecological features and protected species) to varying extents. There is considerable variation in the ratings *of concern* and *of potential concern* across the conservation values. Overall, changes in sea temperatures and oceanography were considered *of potential concern* to many of the key ecological features and species, with ocean acidification of greater significance for deep and shallow water reef features, cetaceans and seabirds and sea level rise more important for habitats associated with inshore dolphins and some breeding seabirds. Increasing sand temperature was identified as a pressure for nesting marine turtles. Climate change has been identified as a priority because of the extent of predicted impacts on conservation values in the region, particularly the cumulative nature of these impacts. Its selection also acknowledges the need to prioritise research to further understand the nature and extent of climate change impacts in the region.	Strategy A, Action 3 Strategy B, Action 2 Strategy E, Action 1 Strategy G, Action 1

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
14	**Marine debris**	The EPBC Act lists *'injury and fatality to vertebrate marine life caused by the ingestion of, or entanglement in, harmful marine debris'* as a key threatening process. Information on the extent and impact of marine debris in the Temperate East Marine Region is limited; however, a number of activities in and adjacent to the region increase the likelihood of the prevalence of marine debris, including commercial and recreational fishing, shipping, and urban and industrial development along the coast. In the Temperate East Marine Region, marine debris has emerged as a pressure with the potential to impact on many of the region's conservation values to varying extents. It has been assessed as *of concern* for marine turtles (green and loggerhead) and *of potential concern* for cetaceans, seabirds, school shark and all key ecological features. Marine debris has been identified as a priority because of its interaction with a range of conservation values across the region, and its status as an Australian Government policy priority. Its selection also acknowledges the need to prioritise research to further understand the nature and extent of its impacts in the region.	Strategy A, Action 5 Strategy B, Action 2 Strategy E, Actions 1 and 4 Strategy G, Action 1

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
15	**Bycatch**	Bycatch associated with fishing activities is one of the most pervasive pressures on conservation values in the region. Bycatch refers to marine life that is accidentally caught during fisheries operations and cannot be retained, thereby impacting on species populations and the diversity associated with key ecological features. The Temperate East Marine Region supports a significant commercial fishing industry and bycatch from commercial fishing activities has been assessed as *of concern* for inshore dolphins, killer whale, marine turtles (green, loggerhead and leatherback), the grey nurse shark and foraging seabirds (selected petrel, albatross and shearwater species). It is considered *of potential concern* for hawksbill turtle, white shark, , foraging seabirds (selected shearwater, albatross and petrel species) and a number of key ecological features (Tasman Front and eddy field, upwelling off Fraser Island, Norfolk Ridge, Tasmantid and Lord Howe seamount chains, shelf rocky reefs and canyons). Bycatch from recreational fishing has also been identified as *of concern* for grey nurse and white sharks, and *of potential concern* for the fleshfooted shearwater. In addition, bycatch from bather protection schemes is *of concern* for the Indo-Pacific (coastal) bottlenose dolphin and the Indo-Pacific humpback dolphin and bycatch from illegal fishing activities is *of concern* to four turtle species, and *of potential concern* for the humpback whale. Bycatch has been identified as a priority because of its interaction with a high number of priority conservation values across the region.	Strategy A, Action 5 Strategy B, Action 2 Strategy D, Action 1 Strategy E, Actions 1 and 4

	Pressure	Rationale	Strategies and actions identified to address the priority (see Section 4.2)
16	**Extraction of living resources**	A number of conservation values in the Temperate East Marine Region are vulnerable to the extraction of living resources by commercial and recreational fishing and illegal, unregulated and unreported fishing. Commercial fishing effort overlaps with seven of the eight key ecological features in the region, and was assessed as *of potential concern* for these features. Currently, it is difficult to quantify the exact impacts of target and by-product species take at these features, however, depending on the intensity of effort and composition of catch, the extraction of living resources from these key ecological features has the potential to affect trophic structures and ecological functioning. Extraction of living resources has been identified as a priority because it interacts with multiple conservation values, and because there is a limited understanding of its impacts on ecosystem function.	Strategy A, Action 5 Strategy B, Action 2 Strategy D, Action 2 Strategy E, Action 1 and 4 Strategy G, Action 1

4.2 Strategies and actions

The Temperate East Marine Bioregional Plan includes seven strategies to address its priorities:

Strategy A: Increase collaboration with relevant research organisations to inform and influence research priorities and to increase the uptake of research findings to inform management and administrative decision-making.

Strategy B: Establish and manage a Commonwealth marine reserve network in the Temperate East Marine Region as part of a national representative system of marine protected areas.

Strategy C: Provide relevant, accessible and evidence-based information to support decision-making with respect to development proposals that come under the jurisdiction of the EPBC Act.

Strategy D: Increase collaboration with relevant industries to improve understanding of the impacts of anthropogenic disturbance and address the cumulative effects on the region's key ecological features and protected species.

Strategy E: Develop targeted collaborative programs to coordinate species recovery and environmental protection efforts across Australian Government and state and territory agencies with responsibilities for the marine environment.

Strategy F: Improve monitoring, evaluation and reporting on ecosystem health in the marine environment.

Strategy G: Participate in international efforts to manage conservation values and pressures of regional priority.

Within each strategy, actions have been designed to address one or more of the regional priorities. A few actions are not linked directly to regional priorities but have been included as enabling actions—that is, they provide the necessary foundation and/or mechanisms for addressing the regional priorities in a coordinated, effective and efficient way.

Actions under the strategies are classified in terms of their implementation timeframe:

- **immediate actions** are those expected to be implemented within 6–12 months (these usually relate to priorities where the level *of concern* is high and management responses are either under way or expected to begin in the near future)
- **short-term actions** are those expected to be implemented within 2 years
- **medium-term actions** are those expected to be implemented within 3–5 years
- **long-term actions** are those expected to be implemented within 8–10 years, and usually relate to research into ecological effects that involves observational studies requiring long timeframes
- **ongoing actions** commonly cover routine administrative decision-making under the EPBC Act (e.g. administration of the fisheries assessment provisions).

The actions identified to address the Temperate East Marine Region's priorities are listed under each strategy (in no particular order) below:

Strategy A:
Increase collaboration with relevant research organisations to inform and influence research priorities and to increase the uptake of research findings to inform management and administrative decision-making

1. Improve existing mechanisms and establish new mechanisms to facilitate the uptake of marine research findings so that they can inform administrative and management decisions (short term).

2. Support research undertaken through relevant recovery plans for marine turtles, seabirds, white shark and grey nurse shark (regional priorities 2–5— short term).

3. Support research to improve information on the impacts of climate change on protected species and key ecological features; in particular, their vulnerability and adaptive capacity to predicted changes (regional priorities 1–13—medium to long term).

4. Improve knowledge of the processes driving biodiversity and ecosystem functioning of priority key ecological features of the Temperate East Marine Region (regional priority 6–12—medium to long term).

5. Improve knowledge on the pressures of marine debris, bycatch and extraction of living marine resources on conservation values in the Temperate East Marine Region (regional priorities 14–16—short to medium term).

6. Improve information on biologically important areas for protected species and species considered under pressure within the Temperate East Marine Region, with priority given to:

– inshore dolphin (regional priority 1—short to medium term)
– marine turtles (regional priority 2—short to medium term)
– white shark (regional priority 4—short to medium term)
– seabirds (regional priority 5—short to medium term).

Strategy B:
Establish and manage a Commonwealth marine reserve network in the Temperate East Marine Region as part of the national representative system of marine protected areas

1. Ensure that management arrangements for marine reserves contribute to the protection and conservation of the region's biodiversity and ecosystem function and integrity (regional priorities 1–8 and 10–12—medium to long term).

2. Ensure that management arrangements for the reserves minimise, where appropriate, the risk and impacts of pressures rated as being *of concern* or *of potential concern* in the Temperate East Marine Region (regional priorities 13–16—medium to long term).

Strategy C:
Provide relevant, accessible and evidence-based information to support decision-making with respect to development proposals that come under the jurisdiction of the EPBC Act

1. Improve access to information, particularly spatial data, on the region's key ecological features and protected species and the pressures on them (short to medium term).

2. Assess the need for—and, if appropriate, promote—strategic assessments under the EPBC Act of coastal and inshore marine environments adjacent to the region that are expected to experience rapid change and have the potential to increase pressure on the Commonwealth marine environment (short to medium term).

3. Provide regional advice to assist in assessing and determining the significance of potential impacts on the region's conservation values to the extent that they are (or are components of) matters of national environmental significance (see Schedule 2) (regional priorities 1–12—immediate).

4. Evaluate the role of the plan and its supporting information resources in streamlining the decision-making under the EPBC Act at all levels (i.e. the environment minister, the environment department, or persons proposing to take actions likely to impact on matters of national environmental significance in the Temperate East Marine Region (short to medium term).

Strategy D:
Increase collaboration with relevant industries to improve understanding of the impacts of anthropogenic disturbance and address the cumulative effects on the region's key ecological features and protected species

1. Collaborate with relevant fisheries management organisations and industry to support research, information exchange and the development of improved management initiatives to address bycatch of protected species—particularly marine turtles, inshore dolphins, grey nurse shark, white shark, killer whale and breeding seabirds—focusing on improving information on the cumulative effects of bycatch across multiple fisheries and the establishment of ongoing monitoring indicators (regional priorities 1–4, 6–11 and 15—short to medium term).

2. Collaborate with relevant fisheries management organisations and industry to support research into the impacts of the extraction of living marine resources on key ecological features and improve management initiatives where appropriate (regional priorities 6–11 and 16—short to medium term).

3. Collaborate with industry and research organisations to improve mechanisms for data collection, management and reporting of interactions between industries and biodiversity (short to medium term).

4. Pursue, where feasible, collaborative agreements authorising the shared use of industry-gathered marine information, particularly spatial data (short to medium term).

5. Collaborate with industry to improve understanding of the effects of: vessel collision and marine debris on marine turtles; invasive species on breeding seabirds; and physical habitat modification arising from urban and coastal development on inshore dolphins (regional priorities 1, 2 and 5—short to medium term).

Strategy E:
Develop targeted collaborative programs to coordinate species recovery and environmental protection efforts across Australian Government, state and territory agencies and coastal communities with responsibilities for the marine environment

1. Collaborate with relevant government agencies and coastal communities to implement mitigation measures to address the key pressures on marine turtles, seabirds, grey nurse and white shark, and assess their effectiveness in reducing the risk to the species' recovery (regional priorities 2–5, 13–16—short to medium term).

2. Collaborate with the Queensland and New South Wales governments and coastal communities to develop protection measures to limit disturbances during the nesting season for marine turtles and seabirds, the pupping season for grey nurse shark, and seasons of aggregation for white shark, focusing on areas in proximity to inhabited areas or areas where sources of disturbance exist or are emerging (regional priorities 2–5—short to medium term).

3. Collaborate with the Queensland and New South Wales governments to develop protection measures to minimise the impacts of bather protection programs on inshore dolphins (regional priority 1—short to medium term).

4. Increase information on the sources and impacts of marine debris, bycatch and extraction of living resources on the region's marine life and ecosystems, including supporting monitoring of these pressures at selected locations in and adjacent to the Temperate East Marine Region (regional priorities 14–16—short to medium term).

Strategy F:
Improve monitoring, evaluation and reporting on ecosystem health in the marine environment

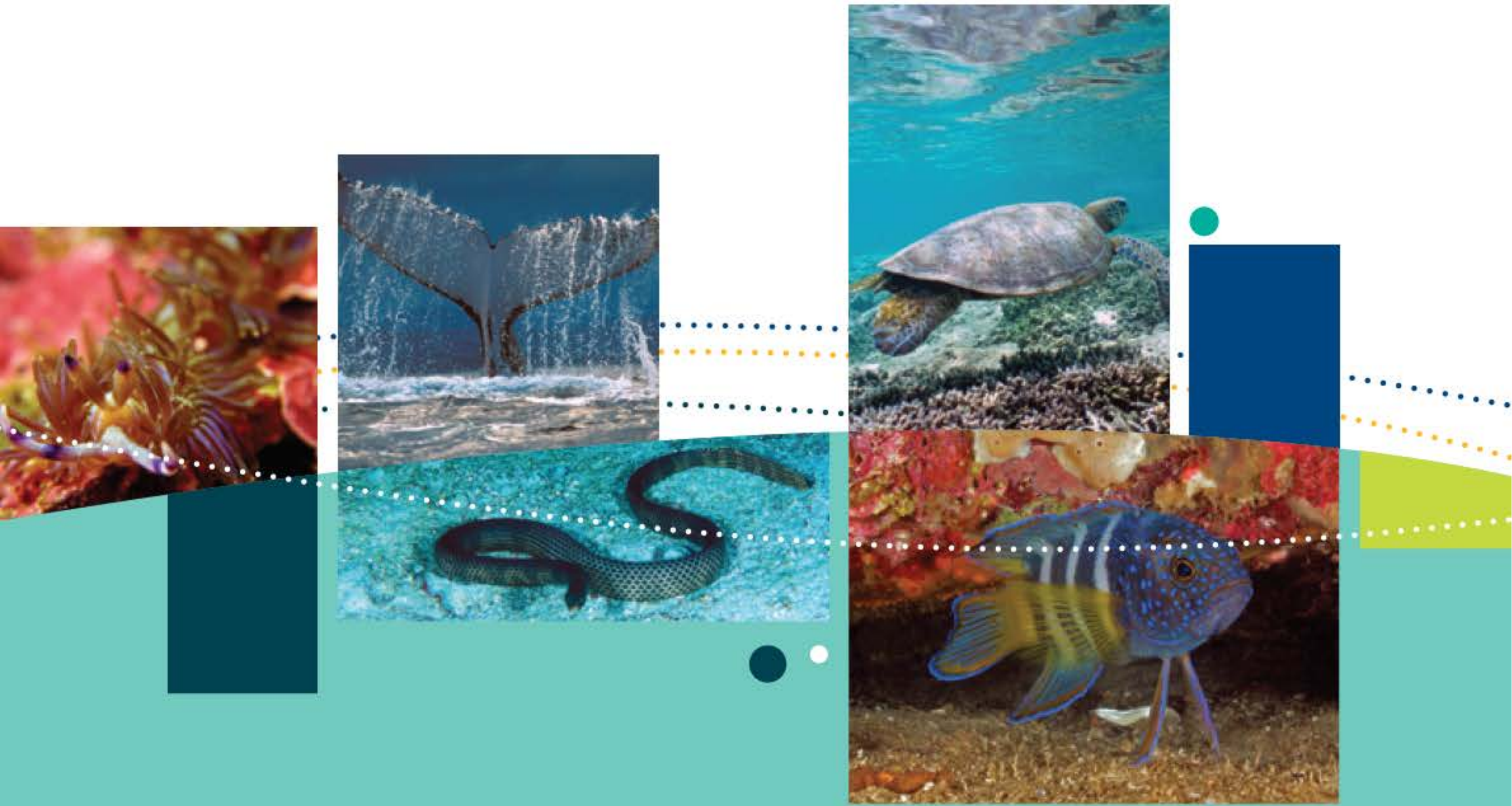
1. Collate information on the ecosystem components, functioning, pressures and potential cumulative impacts on key ecological features in the region and develop effective ecological indicators that will facilitate future monitoring, evaluation and reporting of marine ecosystem health (medium to long term).

   Key ecological features to be investigated are:
   - shelf rocky reefs (regional priority 6)
   - canyons on the eastern continental slope (regional priority 7)
   - Tasman Front and eddy field (regional priority 8)
   - upwelling off Fraser Island (regional priority 9)
   - Tasmantid seamount chain (regional priority 10)
   - Lord Howe seamount chain (regional priority 11)
   - Elizabeth and Middleton reefs (regional priority 12).

Strategy G:
Participate in international efforts to manage conservation values and pressures of regional priority

1. Collaborate with government and non-government organisations through regional and international initiatives to protect conservation values and address pressures of regional priority (regional priority 2, 5, 13, 14, 16—ongoing).

The Australian Government will work towards implementing these strategies and actions in order to address the regional priorities for conservation effort identified for the Temperate East Marine Region.



SCHEDULE 1

Analysis of pressures affecting conservation values of the Temperate East Marine Region

SCHEDULE 1 ANALYSIS OF PRESSURES AFFECTING CONSERVATION VALUES OF THE TEMPERATE EAST MARINE REGION

This schedule summarises the methods and findings of the regional pressure analysis undertaken for the Temperate East Marine Region.

S1.1 How were the pressures on conservation values analysed?

The pressure analysis process considered the impact of pressures on the region's conservation values, with a focused evaluation of the effectiveness of current mitigation and management arrangements in place to respond to those pressures. For the purpose of this plan, pressures are defined broadly as human-driven processes and events that do or can detrimentally affect the region's conservation values. Table S1.1 lists the type and source of pressures available for inclusion in the analysis. Only those pressures relevant to the conservation value being analysed were considered.

The analysis enabled pressures to be categorised in terms of their relative importance and has contributed to identification of regional priorities for the Temperate East Marine Region. Regional priorities are described in section 4.1 of the plan. The conservation values selected for the pressure analysis are discussed in Part 3 of the plan.

Table S1.1: Pressures and sources of pressures available for selection in the Temperate East Marine Region pressure analysis

Pressure	Source
Sea level rise	Climate change
Changes in sea temperature	Climate change
	Urban development
Changes in oceanography	Climate change
Ocean acidification	Climate change
Changes in terrestrial sand temperature	Climate change
Chemical pollution/contaminants	Shipping
	Vessels (other)
	Aquaculture operations
	Renewable energy operations
	Urban development (urban and/or industrial infrastructure)
	Agricultural activities
	Onshore and offshore mining operations
Nutrient pollution	Aquaculture operations
	Agricultural activities
	Urban development
Changes in turbidity	Dredging (spoil dumping)
	Land-based activities
	Onshore and offshore mining operations
	Climate change (changes in rainfall, storm frequency)
Marine debris[1]	Land-based activities
	Fishing boats
	Shipping
	Vessels (other)
	Oil rigs
	Aquaculture infrastructure
	Renewable energy infrastructure
	Urban development

Pressure	Source
Noise pollution	Seismic exploration
	Urban development
	Defence/surveillance activities
	Shipping
	Vessels (other)
	Aquaculture infrastructure
	Renewable energy infrastructure
	Onshore and offshore mining operations
	Onshore and offshore construction
Light pollution	Oil and gas infrastructure
	Fishing boats
	Vessels (other)
	Land-based activities
	Onshore and offshore activities
	Renewable energy infrastructure
	Onshore and offshore mining operations
Physical habitat modification	Fishing gear (active and derelict)
	Dredging (and/or dredge spoil)
	Shipping (anchorage)
	Defence/surveillance activities
	Telecommunications cables
	Offshore construction and installation of infrastructure
	Onshore and offshore construction
	Offshore mining operations
	Ship grounding
	Tourism (diving, snorkelling)
	Climate change (changes in storm frequency etc.)
	Urban/coastal development

Pressure	Source
Human presence at sensitive sites	Aquaculture operations
	Seismic exploration operations
	Tourism
	Recreational and charter fishing (burleying)
	Research
	Defence/surveillance activities
	Aircraft
Nuisance species[2]	Aquaculture operations
Extraction of living resources[3]	Commercial fishing (domestic or non-domestic)
	Recreational and charter fishing
	IUU fishing (domestic or non-domestic)
	Indigenous harvest
	Commercial fishing—prey depletion
	Commercial, recreational and charter fishing—fisheries discards
Bycatch[4]	Commercial fishing
	Recreational and charter fishing
	IUU fishing (domestic or non-domestic)
Oil pollution	Shipping
	Vessels (other)
	Oil rigs
	Onshore and offshore mining operations
Collision with vessels	Shipping
	Fishing
	Tourism
Collision/entanglement with infrastructure	Aquaculture infrastructure
	Renewable energy infrastructure
	Oil and gas infrastructure

Pressure	Source
Disease	Aquaculture operations
	Fishing
	Shipping
	Tourism
Invasive species	Shipping
	Fishing vessels
	Vessels (other)
	IUU fishing and illegal immigration vessels
	Aquaculture operations
	Tourism
	Land-based activities
Changes in hydrological regimes	Land-based activities
	Aquaculture infrastructure
	Renewable energy infrastructure
	Climate change (e.g. changes in rainfall, storm frequency)

IUU = illegal, unreported and unregulated

1 Marine debris is defined in the Threat Abatement Plan for the impacts of marine debris on vertebrate marine life May 2009 (**www.environment.gov.au/biodiversity/threatened/publications/tap/marine-debris.html**) and refers to 'land-sourced plastic garbage, fishing gear from recreational and commercial fishing abandoned into the sea, and ship-sourced, solid non-biodegradable floating materials disposed of at sea'. In concordance with International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78), plastic material is defined as bags, bottles, strapping bands, sheeting synthetic ropes, synthetic fishing nets, floats, fiberglass, piping, insulation, paints and adhesives.

2 Nuisance species are opportunistic native species (e.g. seagulls) whose populations boom when humans modify the ecosystem by increasing food supply.

3 Extraction of living resources includes the removal of target and byproduct species.

4 Bycatch includes all non-targeted catch from fishing operations, including by-product, discards and gear interactions. By-product refers to the unintended catch that may be kept or sold by the fisher. Discards refer to the product that is returned to the sea. Gear interactions refer to all species and habitat affected by the fishing gear.

Levels of concern for the interactions between pressures and conservation values

Based on a review of scientific and expert literature, and informed by the findings of relevant environmental and impact assessment studies, risk assessments and expert opinion, the interaction between selected conservation values and each pressure was assigned a level *of concern*. The levels *of concern* are:

- *of concern*
- *of potential concern*
- *of less concern*
- *not of concern*.

A pressure is *of concern* for a conservation value when:

- there is evidence that it interacts with the conservation value within the region and there are reasonable grounds to expect that it may result in a **substantial impact** (Box S1.1), and
- there are no management measures in place to mitigate the impact(s), or there is inadequate or inconclusive evidence of the effectiveness of management measures within the region.

A pressure is *of potential concern* for a conservation value when:

- there is evidence that the conservation value is vulnerable to the type of pressure, although there is limited evidence of a **substantial impact** within the region, and
- the pressure is widespread or likely to increase within the region, and
- there are no management measures in place to mitigate potential or future impacts, or there is inadequate or inconclusive evidence of the effectiveness of management measures.

A pressure is *of less concern* for a conservation value either when:

- there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that the impacts are unlikely to be substantial, or
- there is evidence of interaction with the conservation value within the region and there are reasonable grounds to expect that current management measures in place are effective in minimising or mitigating the impact.

A pressure is *not of concern* for a conservation value when:

- the pressure is rare or absent from the region, or
- there are reasonable grounds to expect that the impacts are minimal or the pressure does not interact with the conservation value, or
- there is evidence that the pressure is managed effectively through routine management measures.

In some instances, where a pressure operating outside of the region is having a substantial impact on a region's conservation value, consideration has been given to it.

Only those interactions between conservation values and pressures assessed as being *of concern* and *of potential concern* are described in this Schedule. Further information on the findings of the pressure analyses can be found in the conservation value report cards (**www.environment.gov.au/marineplans/temperate-east**).

Box S1.1 What is a substantial impact?

A pressure was considered likely to cause a substantial impact on a conservation value if there was a reasonable possibility that it would have any of the following effects:

- introduction of a known or potential pest or invasive species
- extensive modification, destruction, fragmentation, isolation or disturbance of habitat, which results in changes to community composition and/or trophic relationships and/ or ecosystem services
- modification, destruction, fragmentation, isolation or decline in availability of quality habitat important for a species of conservation value, to the extent that the species' conservation status is affected or its recovery is hindered
- substantial change in air or water quality, which may adversely impact biodiversity, ecological function or integrity, social amenity or human health
- introduction of persistent organic chemicals, heavy metals or potentially harmful chemicals, which adversely impact on biodiversity, ecosystem function or integrity, social amenity or human health
- change in community dynamics or structure that results in adverse impacts on biodiversity, ecological function or integrity, social amenity or human health
- increase in mortality of conservation values to an extent that may affect their conservation status or hinder recovery
- reduction in the area of occupancy of a species of conservation value, which may affect its conservation status or hinder recovery
- fragmentation of populations of conservation value
- reduced breeding success of a species or population of conservation value
- extensive or prolonged disturbance that affects the conservation status of a species or population of conservation value.

Note that the criteria above for defining substantial impact have been informed by *EPBC Act Policy Statement 1.1—Significant Impact Guidelines*.

S1.2 Findings of the analysis

A summary of the pressure analysis findings on the key ecological features and historic shipwrecks of the Temperate East Marine Region is presented in Table S1.2. A summary of the pressure analysis findings on selected protected species in the Temperate East Marine Region is presented in Table S1.3.

A more detailed overview of the pressures assessed as *of concern* and *of potential concern* for these conservation values is presented in Tables S1.4–S1.14:

- Key ecological features of the Temperate East Marine Region
  - Pressures *of concern*—Table S1.4
  - Pressures *of potential concern*—Table S1.5
- Selected bony fish species
  - Pressures *of potential concern*—Table S1.6
- Selected cetacean species
  - Pressures *of concern*—Table S1.7
  - Pressures *of potential concern*—Table S1.8
- Selected marine reptile species
  - Pressures *of concern*—Table S1.9
  - Pressures *of potential concern*—Table S1.10
- Selected seabird species
  - Pressures *of concern*—Table S1.11
  - Pressures *of potential concern*—Table S1.12
- Selected shark species
  - Pressures *of concern*—Table S1.13
  - Pressures *of potential concern*—Table S1.14

Further information on the pressure analyses and their findings are provided in the conservation value report cards.

Table S1.2: Summary of pressures on key ecological features and historic shipwrecks of the Temperate East Marine Region

Key ecological feature	Pressure[5]								
	Sea level rise	Changes in sea temperature	Change in oceanography	Ocean acidification	Chemical pollution / contaminants	Nutrient pollution	Marine debris	Noise pollution	Light pollution
1. Shelf rocky reefs	not of concern	of potential concern	of potential concern	of potential concern	of less concern	of less concern	of potential concern	not of concern	not of concern
2. Canyons on the eastern continental slope	not of concern	of potential concern	of potential concern	of less concern	of potential concern	of less concern	of potential concern	not of concern	not of concern
3. Tasman Front and eddy field	not of concern	of potential concern	of potential concern	of less concern	of potential concern	not of concern	of potential concern	not of concern	of less concern
4. Upwelling off Fraser Island	not of concern	of potential concern	of potential concern	of less concern	of potential concern	of less concern	of potential concern	not of concern	of less concern
5. Tasmantid seamount chain	not of concern	of potential concern	of potential concern	of potential concern	of potential concern	not of concern	of potential concern	not of concern	not of concern
6. Lord Howe seamount chain	not of concern	of potential concern	of potential concern	of potential concern	of potential concern	not of concern	of potential concern	not of concern	not of concern
7. Elizabeth and Middleton reefs	of potential concern	of concern	of potential concern	of concern	of potential concern	not of concern	of potential concern	not of concern	of potential concern
8. Norfolk Ridge	not of concern	of potential concern	of potential concern	of potential concern	of less concern	of less concern	of potential concern	not of concern	not of concern
Historic Shipwrecks									
On shelf shipwrecks	data deficient or not assessed	of potential concern	data deficient or not assessed	data deficient or not assessed	of less concern	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed
Off shelf shipwrecks	data deficient or not assessed	of less concern	data deficient or not assessed	data deficient or not assessed	not of concern	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed

Legend: of concern; of potential concern; of less concern; not of concern; data deficient or not assessed

5 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.2 continued: Summary of pressures on key ecological features and historic shipwrecks of the Temperate East Marine Region

Key ecological feature	Pressure[5]							
	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collisions with vessels	Invasive species	Changes in hydrological regimes
1. Shelf rocky reefs	of potential concern	not of concern	of potential concern	of potential concern	of less concern	of less concern	of less concern	of less concern
2. Canyons on the eastern continental slope	of potential concern	not of concern	of potential concern	of potential concern	of potential concern	not of concern	not of concern	not of concern
3. Tasman Front and eddy field	not of concern	not of concern	of potential concern	of potential concern	of potential concern	not of concern	not of concern	not of concern
4. Upwelling off Fraser Island	not of concern	of less concern	of potential concern	of potential concern	of potential concern	of less concern	of less concern	of less concern
5. Tasmantid seamount chain	of less concern	not of concern	of potential concern	of potential concern	of potential concern	not of concern	not of concern	not of concern
6. Lord Howe seamount chain	of less concern	not of concern	of potential concern	of potential concern	of potential concern	not of concern	not of concern	not of concern
7. Elizabeth and Middleton reefs	of less concern	of less concern	of less concern	of less concern	of potential concern	of less concern	of less concern	of less concern
8. Norfolk Ridge	not of concern	not of concern	of potential concern	of potential concern	of less concern	not of concern	not of concern	not of concern
Historic Shipwrecks								
On shelf shipwrecks	of less concern	of less concern	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed	of less concern	data deficient or not assessed	of less concern
Off shelf shipwrecks	not of concern	of less concern	data deficient or not assessed	data deficient or not assessed	data deficient or not assessed	not of concern	data deficient or not assessed	of less concern

Legend of concern | of potential concern | of less concern | not of concern | data deficient or not assessed

5 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6] Sea level rise	Changes in sea temperature	Changes in oceanography	Ocean acidification	Changes in terrestrial sand temperatures	Chemical pollution/ contaminants	Nutrient pollution	Marine debris	Noise pollution
Bony fishes	Eastern gemfish	not of concern	of potential concern	of potential concern	of less concern	data deficient or not assessed	of less concern	of less concern	of less concern	not of concern
	Orange roughy	not of concern	of potential concern	of potential concern	of less concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Black cod	of less concern	of potential concern	of potential concern	of less concern	data deficient or not assessed	of potential concern	of potential concern	of less concern	not of concern
	Seahorses, pipehorses and sea dragons	of less concern	of potential concern	of potential concern	of less concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
Cetaceans	Blue whale	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of less concern	not of concern	of potential concern	of less concern
	Dwarf Minke whale	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of less concern	not of concern	of potential concern	of less concern
	Humpback whale	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of less concern	not of concern	of potential concern	of less concern
	Killer whale	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of less concern	not of concern	of potential concern	of less concern
	Fin whale	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of less concern	not of concern	of potential concern	of less concern
	Sei whale	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of less concern	not of concern	of potential concern	of less concern
	Southern right whale	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of less concern	not of concern	of potential concern	of less concern
	Indo-Pacific (coastal) bottlenose dolphin	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of potential concern	of potential concern	of potential concern
	Indo-pacific humpback dolphin	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of potential concern	of potential concern	of potential concern
Marine reptiles *Marine turtles* *Sea snakes*	Green turtle	of potential concern	of potential concern	of potential concern	of less concern	of potential concern	of potential concern	of potential concern	of potential concern	of less concern
	Hawksbill turtle	not of concern	of potential concern	of potential concern	of less concern	not of concern	of potential concern	of potential concern	of less concern	of less concern
	Leatherback turtle	not of concern	of potential concern	of potential concern	of less concern	not of concern	of potential concern	of less concern	of less concern	of less concern
	Loggerhead turtle	of concern	of concern	of potential concern	of less concern	of concern	of potential concern	of potential concern	of potential concern	of less concern
	Sea snakes	of less concern	of potential concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	of less concern

Legend of concern | of potential concern | of less concern | not of concern | data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]: Light pollution	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collision with vessels	Invasive species	Changes in hydrological regimes
Bony fishes	Eastern gemfish	not of concern	not of concern	not of concern	of less concern	of less concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Orange roughy	not of concern	of potential concern	not of concern	of less concern	of less concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Black cod	not of concern	of potential concern	not of concern	of potential concern	of potential concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Seahorses, pipehorses and sea dragons	not of concern	of potential concern	not of concern	of less concern	of potential concern	of less concern	not of concern	of less concern	data deficient or not assessed
Cetaceans	Blue whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Dwarf Minke whale	not of concern	not of concern	of less concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Humpback whale	not of concern	not of concern	of less concern	not of concern	of potential concern	of less concern	not of concern	not of concern	not of concern
	Killer whale	not of concern	not of concern	not of concern	not of concern	of concern	of less concern	not of concern	not of concern	not of concern
	Fin whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Sei whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Southern right whale	not of concern	not of concern	not of concern	not of concern	not of concern	of less concern	not of concern	not of concern	not of concern
	Indo-Pacific (coastal) bottlenose dolphin	not of concern	of concern	of less concern	not of concern	of concern	of potential concern	of potential concern	not of concern	of potential concern
	Indo-pacific humpback dolphin	not of concern	of concern	of less concern	not of concern	of concern	of potential concern	of potential concern	not of concern	of potential concern
Marine reptiles *Marine turtles* *Sea snakes*	Green turtle	of potential concern	of potential concern	of less concern	of potential concern	of concern	of potential concern	of concern	of potential concern	of less concern
	Hawksbill turtle	of less concern	of less concern	of less concern	of potential concern	of potential concern	of potential concern	of concern	of less concern	of less concern
	Leatherback turtle	of less concern	of less concern	not of concern	not of concern	of concern	of potential concern	of less concern	not of concern	not of concern
	Loggerhead turtle	of potential concern	of potential concern	of less concern	of less concern	of concern	of potential concern	of concern	of potential concern	of less concern
	Sea snakes	not of concern	of potential concern	not of concern	not of concern	of potential concern	of potential concern	of less concern	not of concern	data deficient or not assessed

Legend of concern | of potential concern | of less concern | not of concern | data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]: Sea level rise	Changes in sea temperature	Changes in oceanography	Ocean acidification	Changes in terrestrial sand temperatures	Chemical pollution/ contaminants	Nutrient pollution	Marine debris	Noise pollution
Seabirds	Black noddy	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Common noddy	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Crested tern	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Roseate tern	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Sooty tern	of less concern	of potential concern	of concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	White tern	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Grey ternlet	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Flesh-footed shearwater	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Little shearwater	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Short-tailed shearwater	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Sooty shearwater	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Wedge-tailed shearwater	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Black petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Black-winged petrel	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Gould's petrel	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Great-winged petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Kermadec petrel	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Providence petrel	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	White-bellied storm petrel	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	White-faced storm petrel	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	White-necked petrel	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern

Legend of concern | of potential concern | of less concern | not of concern | data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Pressure[6]: Light pollution	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collision with vessels	Invasive species	Changes in hydrological regimes
Seabirds	Black noddy	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Common noddy	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Crested tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Roseate tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Sooty tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White tern	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Grey ternlet	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Flesh-footed shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Little shearwater	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Short-tailed shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Sooty shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Wedge-tailed shearwater	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Black petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Black-winged petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Gould's petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Great-winged petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Kermadec petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Providence petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White-bellied storm petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White-faced storm petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	White-necked petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of concern	data deficient or not assessed

Legend of concern | of potential concern | of less concern | not of concern | data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Sea level rise	Changes in sea temperature	Changes in oceanography	Ocean acidification	Changes in terrestrial sand temperatures	Chemical pollution/ contaminants	Nutrient pollution	Marine debris	Noise pollution
		Pressure[6]								
Seabirds	Wilson's storm petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Northern giant-petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Southern giant-petrel	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Antipodean (Gibson's) albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Black-browed albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Campbell albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Indian yellow-nosed albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Salvin's albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Wandering albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	White-capped albatross	not of concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Little penguin	of less concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Masked booby	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
	Red-tailed tropicbird	of potential concern	of potential concern	of potential concern	of potential concern	data deficient or not assessed	of potential concern	of less concern	of potential concern	of less concern
Sharks	Grey nurse shark	not of concern	of potential concern	of potential concern	of less concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Porbeagle shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Longfin mako shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Shortfin mako	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	Whale shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	not of concern
	White shark	not of concern	of potential concern	of potential concern	not of concern	data deficient or not assessed	of less concern	not of concern	of less concern	of less concern

Legend of concern | of potential concern | of less concern | not of concern | data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.3 continued: Summary of pressures on selected protected species in the Temperate East Marine Region

Species group	Protected species	Light pollution	Physical habitat modification	Human presence at sensitive sites	Extraction of living resources	Bycatch	Oil pollution	Collision with vessels	Invasive species	Changes in hydrological regimes
		Pressure[6]								
Seabirds	Wilson's storm petrel	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Northern giant-petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Southern giant-petrel	of potential concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Antipodean (Gibson's) albatross	of less concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Black-browed albatross	of less concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Campbell albatross	of less concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Indian yellow-nosed albatross	of less concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Salvin's albatross	of less concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Wandering albatross	of less concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	White-capped albatross	of less concern	not of concern	of potential concern	of less concern	of potential concern	of potential concern	not of concern	of potential concern	data deficient or not assessed
	Little penguin	of potential concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Masked booby	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
	Red-tailed tropicbird	not of concern	not of concern	of potential concern	of less concern	not of concern	of potential concern	not of concern	of concern	data deficient or not assessed
Sharks	Grey nurse shark	not of concern	not of concern	of potential concern	of less concern	of concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Porbeagle shark	not of concern	not of concern	not of concern	not of concern	of less concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Longfin mako shark	not of concern	not of concern	not of concern	not of concern	of less concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Shortfin mako	not of concern	not of concern	not of concern	not of concern	of less concern	of less concern	not of concern	not of concern	data deficient or not assessed
	Whale shark	not of concern	not of concern	not of concern	of less concern	not of concern	of less concern	not of concern	not of concern	data deficient or not assessed
	White shark	not of concern	not of concern	not of concern	not of concern	of concern	of less concern	not of concern	not of concern	data deficient or not assessed

Legend of concern | of potential concern | of less concern | not of concern | data deficient or not assessed

6 Some pressures considered in this analysis are made up of more than one category but are presented in this summary table under one heading. For example, some conservation values were assessed against the pressures of *bycatch from commercial fishing* and *bycatch from recreational fishing*; however these categories are presented in the summary table under *bycatch*. Where the ratings for a conservation value differ across the pressures in a category, the highest rating has been listed in the table. For example, if *bycatch from commercial fishing* is rated *of potential concern* and *bycatch from recreational fishing* is rated *of less concern*, the pressure of *bycatch* will be rated *of potential concern* for the conservation value in the table. More information about the pressure analyses for key ecological features and heritage places can be found in the conservation value report cards.

Table S1.4: Pressures *of concern* to key ecological features of the Temperate East Marine Region

Key ecological features assessed = 8		
Pressure	**KEF**	**Rationale**
Changes in sea temperature (climate change)	Elizabeth and Middleton reefs	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Elizabeth and Middleton reefs are valued for their aggregations of marine life and biodiversity. Ocean warming is expected to alter food web dynamics (Hoegh-Guldberg & Bruno 2010), potentially increase the frequency or severity of coral bleaching events and result in southerly distribution shifts of pelagic fish species (Hobday et al. 2006). The reefs are at risk from these expected impacts, however, the overall implications for ecosystem processes and responses are not known, and will be influenced by species tolerance and adaptive capacity.
Ocean acidification (climate change)	Elizabeth and Middleton reefs	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, ocean acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). Elizabeth and Middleton reefs are valued for their aggregations of marine life and biodiversity, and expected impacts of acidification include a reduction in coral growth rates and resilience, which may make the reef systems more vulnerable to erosion and disturbance from storms (Anthony & Marshall 2009) and affect the ability of molluscs, echinoderms and some planktonic organisms to form skeletal material (Doney et al. 2009). Corals provide structural habitat complexity for a range of invertebrates and fish (Althaus et al. 2009); therefore, any impact on coral reef habitat is likely to result in changes to the distribution and abundance of species that depend on the reefs for food and shelter.

Table S1.5: Pressures *of potential concern* to key ecological features of the Temperate East Marine Region

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Sea level rise (climate change)	Elizabeth and Middleton reefs	Global sea levels rose by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). Elizabeth and Middleton reefs are shallow water reefs valued for their aggregations of marine life and biodiversity. Over time, rising sea levels are expected to decrease the amount of light that reaches the corals, thereby reducing coral growth rates (Anthony & Marshall 2009). Any impact on coral reef habitat is likely to change the distribution and abundance of species that depend on the reefs for food and shelter (Chambers et al. 2009b).
Changes in sea temperature (climate change)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Ocean warming is *of potential concern* for all of the region's key ecological features, except the Elizabeth and Middleton reefs, where it is *of concern* **(see Table S1.4**). Expected impacts include changes to food web dynamics (Hoegh-Guldberg & Bruno 2010), potentially increasing the frequency or severity of coral bleaching events, and a southerly shift in the distribution of pelagic fish species (Hobday et al. 2006). For features located in the deeper waters of the region (such as the shelf rocky reefs, seamounts and ridges), the impacts of rising sea temperatures are more complex. Rising temperatures drive changes such as thermal expansion (Hoegh-Gulberg & Bruno 2010), resulting in greater stratification in the water column, reducing mixing in some parts of the ocean, and consequently affecting nutrient availability and primary production at depth (Hoegh-Gulberg & Bruno 2010).

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Changes in oceanography (climate change)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs Norfolk Ridge	Changes in oceanography include consideration of circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. In the region, changes in oceanography will be primarily influenced by the East Australian Current, which is one of the key drivers of the region's biological productivity, species distribution and abundance (Dambacher et al. 2011). The East Australian Current has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km) (Ridgway & Hill 2009). Changes in the strength and extent of the current are likely to impact on productivity, shifting trophic webs, and changing migration patterns and reef and shelf habitats, all of which have implications for marine species (Chin et al. 2010). Offshore, the current is partly responsible for the unique mix of warm and cold water species associated with Elizabeth and Middleton reefs and the Tasmantid and Lord Howe seamount chains (Dambacher et al. 2011).

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Ocean acidification (climate change)	Shelf rocky reefs Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, ocean acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Furthermore, climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). The key ecological features listed here are particularly vulnerable to ocean acidification because they support a range of shallow and deepwater coral reef systems. The direct impacts of ocean acidification are expected to be most marked for organisms with calcareous skeletons, such as corals, plankton, molluscs and echinoderms (Doney et al. 2009). Increasing acidity reduces the ability of these organisms to form skeletal structures, which is likely to affect not only their ability to function within the ecosystem, but the functioning of the ecosystem as a whole (Kleypas & Yates 2009). For example, research on coral cores in the Great Barrier Reef identified a 14% decline in coral calcification rates between 1990 and 2005 (De'ath et al. 2009), which the authors attribute to excessive temperature increases, ocean acidification, or a combination of the two. For this region, increased ocean acidification and sea surface temperatures are predicted to have combined impacts, prompting reef conditions to shift from 'marginal' (Kleypas et al. 1999) to 'extremely marginal' by the middle of this century (Noreen 2010). For the subtropical regions of the Tasmantid and Lord Howe seamount chains, it is likely that increased ocean acidity will reduce coral growth rates and resilience, making the reef systems more susceptible to erosion and disturbance from storms (Anthony & Marshall 2009). Predictive climate models indicate that the unique, deep, cold water reefs and sponge gardens of the Norfolk Ridge, shelf edge and seamount chains are also at risk from a similar range of impacts (Cohen & Holcomb 2009; Howard et al. 2009; Hyder Consulting 2008). Corals provide structural habitat complexity for a range of invertebrates and fish (Althaus et al. 2009). Consequently, any impact on coral reef habitat is likely to change the distribution and abundance of species that depend on them for food and shelter.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Chemical pollution	Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs	Chemical pollution/contaminants is *of potential concern* for key ecological features with values that make them particularly vulnerable to the impacts of a chemical spill, such as important aggregations of marine life at or near the sea surface. Vulnerable key ecological features include the Tasman Front and eddy field; the Fraser upwelling; the Tasmantid and Lord Howe seamount chains; canyons on the eastern continental slope; and Elizabeth and Middleton reefs. As is the case with oil spills, chemical spills are unpredictable events and their likelihood is low in the context of the international and domestic regulatory mitigation measures that apply in Australia. The effects of a major chemical spill can be similar to those of oil spills (GBRMPA 2009), particularly in areas and at times of biological significance for important or threatened species. The impacts vary depending on the toxicity of chemicals, how the materials are packaged and transported, the quantity spilled, the site and ecological sensitivity.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Marine debris	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs Norfolk Ridge	Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of, or abandoned, in the marine and coastal environment (UNEP 2005). This includes a range of materials from plastics (e.g. bags, bottles, ropes, fibreglass and insulation) to derelict fishing gear, and ship-sourced, solid, non-biodegradable floating materials (DEWHA 2009a). Although region-specific marine debris data is limited, key sources for the introduction and spread of debris (such as shipping, commercial fishing and major current systems) are present across the region. This suggests that all key ecological features will experience a high degree of overlap with this pressure (Katsanevakis 2008). Marine debris has been listed as a key threatening process under the EPBC Act, in recognition of its negative impacts on substantial numbers of Australia's marine wildlife, including protected species of birds, turtles and marine mammals. Therefore, this pressure has implications for key ecological feature values such as biodiversity and aggregations of marine life. The Australian Government has developed a threat abatement plan that provides a coordinated national approach to prevent and mitigate the effects of harmful marine debris on marine life (DEWHA 2009a).
Light pollution	Elizabeth and Middleton reefs	Light pollution is *of potential concern* to Elizabeth and Middleton reefs as they are known to support important aggregations of marine life that are vulnerable to light (e.g. turtles). Light quality is important for turtles (Salmon 2003) and lighting from shipping and fishing vessels offshore can attract hatchlings to vessel hulls, exposing them to predation. Shipping traffic, including fishing vessels anchoring in close proximity to Elizabeth and Middleton reefs, have the potential to negatively impact turtles that forage in these areas.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Physical habitat modification (fishing gear)	Shelf rocky reefs Canyons on the eastern continental slope	Physical habitat modification due to fishing gear can result in loss or significant degradation of key ecological features that are subject to bottom trawl activities or are inherently vulnerable to habitat modification, including the shelf rocky reefs and canyons on the eastern continental slope. Both of these features are characterised by complex communities of benthic species that are highly vulnerable to the impacts of demersal trawl fishing, which removes, modifies or disturbs seabed flora and fauna (Furlani et al. 2007). These communities, particularly the deepwater coral species, are highly fragile, long lived and therefore susceptible to disturbance (Williams et al. 2010). Potential impacts include declines in the richness, diversity and density of benthic species and the range of invertebrates and fish that depend on these habitats for prey opportunities and shelter (Althaus et al. 2009).
Extraction of living resources (commercial fishing)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	The ecosystem effects of fishing are not well understood. The key ecological features highlighted here are considered valuable for their aggregations of marine life and unique features which support ecological properties of regional significance. The rating *of potential concern* is primarily driven by the impact of the targeted take of commercial fisheries on top-order predators, which are considered to be a key functional species group within these features. The extraction of top predators by fishing activities has implications for ecological communities as it influences the abundance, recruitment, species composition, diversity and behaviour of prey species. Removal of top predators can have a 'cascading' effect on all the components of a food web (Baum & Worm 2009; Ceccarelli & Ayling 2010). Reef sharks, cod and groupers are important for coral reef communities, while tuna and billfish are important for pelagic systems (Ceccarelli & Ayling 2010). In the context of active fisheries management and the steady move towards ecosystem-based management of fisheries by all jurisdictions in Australia, the *of potential concern* rating is considered a conservative assessment. This rating highlights the limited understanding of both the ecosystem effects of individual fisheries and the cumulative effects of a number of fisheries on protected species, marine communities, habitats and ecosystems.

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Bycatch (commercial fishing—domestic)	Shelf rocky reefs Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Norfolk Ridge	Commercial fishing operations are a key activity in the region and overlap, to varying extents, with these ecological features (e.g. Eastern Tuna and Billfish Fishery, Southern and Eastern Scalefish and Shark Fishery). In the context of active fisheries management and the steady move towards ecosystem-based management of fisheries by all jurisdictions in Australia, the *of potential concern* rating is considered a conservative assessment. For example, a recent review of all Commonwealth fisheries found that the current numbers of independent observers are not sufficient to allow a cumulative assessment of the catch of non-target species (Phillips et al. 2010). The review stated that such assessment is important to understand the environmental performance of fisheries more broadly and to underpin a holistic approach to the management of ecosystem impacts (Phillips et al. 2010). Generally, there is also a need to increase our understanding of the effectiveness of bycatch mitigation measures (Bensley et al. 2010).

Key ecological features assessed = 8		
Pressure	**KEFs**	**Rationale**
Oil Pollution	Canyons on the eastern continental slope Tasman Front and eddy field Upwelling off Fraser Island Tasmantid seamount chain Lord Howe seamount chain Elizabeth and Middleton reefs	Oil pollution is *of potential concern* for key ecological features with values that make them particularly vulnerable to the impacts of an oil spill, such as important aggregations of marine life at or near the sea surface. Vulnerable key ecological features include the Tasman Front and eddy field; upwelling off Fraser Island; Tasmantid and Lord Howe seamount chains; canyons on the eastern continental slope; and Elizabeth and Middleton reefs. These key ecological features are highlighted because of their characteristics that make their ecosystems and communities vulnerable to the effects of an oil spill; for example, features that include regions of high productivity that attract aggregations of marine life. Australia has a strong system for regulating industry activity that is the potential source of oil spills and this system has been strengthened further in response to the Montara oil spill. While oil spills are unpredictable events and their likelihood is low based on past experience, their consequences, especially for threatened species at important areas can be severe. The level of impact that actually occurs depends on a number of factors including the concentration of oil; chemical and physical properties of the oil (or oil and dispersant mixture). Also influencing the impact of an oil spill event are the timing of breeding cycles and seasonal migrations of species, the amount of contact, the susceptibility of particular species; and the health, age and reproductive status of the individuals (AMSA 2011a). Particular ecological values associated with the KEFs that may be impacted by such an event include seasonal feeding aggregations of pelagic invertebrates, fish and mammals associated with the Tasman Front and eddy field and the upwelling off Fraser Island, seabirds and turtles that forage at Elizabeth and Middleton reef and the tropical and temperate demersal and pelagic fish assemblages supported by these reefs; fish that seek refuge on seamounts; and predatory fish and seabirds that forage in waters surrounding seamounts. Both the intensity and distribution of activities that might lead to oil spills (such as transport) are expected to increase in the region.

Table S1.6: Pressures *of potential concern* to bony fishes of the Temperate East Marine Region

Species assessed = 10 (seahorses, pipehorses and sea dragons assessed as a group)		
Pressure	**Species**	**Rationale**
Changes in sea temperature (climate change)	Eastern gemfish Orange roughy Black cod Seahorses, pipehorses and sea dragons	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Research from Europe suggests that the warming of deep waters may have negative consequences for ecosystem function and community distribution (Weaver et al. 2009). All species assessed are likely to experience shifts in distribution and abundance due to sea temperature rises, with impacts on their life cycle stages, prey availability and habitat. Adult black cod and syngnathids are particularly vulnerable given the species' tendency to have specific habitat preferences within a small home range, thus reducing their ability to find and adapt to new habitats (Malcolm 2011; McClatchie et al. 2006).
Changes In oceanography (climate change)	Eastern gemfish Orange roughy Black cod Seahorses, pipehorses and sea dragons	Changes in oceanography include consideration of circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events and climatic oscillations such as the El Niño–Southern Oscillation. Although species-specific responses to oceanographic changes are limited, consequences are expected for the structure, function and dynamics of deep sea habitats. For example, there is likely to be an impact on the transport of matter and energy to depths (Entoyer 2010; Weaver et al. 2009), thereby impacting on food supplies reaching these systems. Evidence from Europe suggests that this change alone will alter the population dynamics of commercial deep sea species such as orange roughy (Weaver et al. 2009). In New South Wales ocean current changes resulting from climate change are predicted to cause a reduction in the flow of freshwater to estuaries, and an increase in nutrient laden waters in near coastal areas. These changes will alter species distribution and abundance and potentially decrease sources of prey for juvenile black cod which use these habitats (DTIRIS 2012). Eastern gemfish are considered vulnerable to changes in productivity associated with changes in wind strength (Hobday et al. 2008), and the annual pre-spawning migration may also be impacted by changes in oceanography; however, it is unclear whether the impacts on migration will be positive or negative on the species (Prince & Griffin 2001; Rowling 2001). Black cod, seahorses, pipehorses and sea dragons have specific habitat preferences with small home ranges, and this may reduce their ability to find and adapt to new habitats (Malcolm 2011; McClatchie et al. 2006).

Species assessed = 10 (seahorses, pipehorses and sea dragons assessed as a group)		
Pressure	**Species**	**Rationale**
Chemical pollution/ contaminants **Nutrient pollution (agricultural activities, urban development)**	Black cod	Black cod's use of estuaries as juvenile development grounds makes them vulnerable to the effects of water pollution, in the form of pollutants contained within run-off from urban development and agricultural activities. These pollutants can degrade the quality of habitats, alter the water chemistry, encourage the growth of algae and smother benthic flora and fauna species. In particular, heavy metals and organochlorine pesticides pose high risks to estuarine biota, as they persist in the environment, magnify along food chains and reduce the relative abundance of top-order predators (ANZECC 2000; DECC 2009). Over time, changes in the water chemistry, food chain and turbidity caused by urban and agricultural run-off may significantly impact the long term viability of black cod within estuaries (DTIRIS 2012).
Physical habitat modification (dredging)	Seahorses, pipehorses and sea dragons	Physical habitat modification due to dredging activities is expected to increase adjacent to the Temperate East Marine Region due to the growth in recreational boating activity (Bay Journal 2008; MSQ 2011). Seahorses, pipehorses and sea dragons have a sedentary lifestyle and close affinity to sponge and reef habitats, which makes them vulnerable to impacts arising from this pressure. Impacts on habitat include a reduction in structural diversity and fewer opportunities for the settlement of new coral colonies, due to the removal of biogenic substratum (Althaus et al. 2009; Lack et al. 2003; Pogonoski et al. 2002).
Physical habitat modification (fishing gear)	Orange roughy Seahorses, pipehorses and sea dragons	Physical habitat modification from fishing gear (e.g. trawling) has the potential to impact on seahorses, pipehorses and sea dragons due to their specific habitat requirements and limited geographic range (Foster & Vincent 2004; Kuiter 2009). These species are distributed across the fishing grounds of the Queensland East Coast Otter Trawl Fishery. As is the case with dredging, mobile fishing gear crushes, buries and exposes marine animals and their habitat (e.g. sponge gardens and rocky reefs), and reduces the structural diversity of preferred habitat (Althaus et al. 2009; Lack et al. 2003; Pitcher et al. 2009; Pogonoski et al. 2002). Commercial bottom trawling on seamounts can cause physical damage to benthic environments affecting benthic fauna. Damage to seamounts could affect orange roughy recruitment due to the link between their spawning aggregations and this habitat feature.
Physical habitat modification (urban/coastal development)	Black cod	Estuaries provide a nursery, refuge and feeding opportunities for black cod in its juvenile development stages. Physical habitat modification of estuaries as a result of urban and coastal development can impact black cod prior to their migration to coastal rocky reefs. In particular, the ongoing building and repair of seawalls, designed to protect low-lying foreshore infrastructure from sea level rise associated with climate change (DTIRIS 2012) can have a detrimental effect on flows, vegetation and habitat, impacting juvenile black cod.

Species assessed = 10 (seahorses, pipehorses and sea dragons assessed as a group)		
Pressure	**Species**	**Rationale**
Extraction of living resources (illegal, unregulated and unreported fishing)	Black cod	Isolated incidences of the illegal take of black cod by recreational spear fishers along the New South Wales coast are occasionally reported (DTIRIS 2012), and illegal fishing is *of potential concern* for black cod. The New South Wales Fisheries' 2003 draft recovery plan for black cod reported anecdotal evidence of large catches of black cod in the early 1980s from Elizabeth and Middleton Reefs, and in 1993 a commercial fishing boat crew was found to have taken 24 black cod from the same area (TSSC 2012).
Bycatch (commercial fishing)	Black cod Seahorses, pipehorses and sea dragons	There is evidence that black cod, seahorses, pipehorses and sea dragons are caught in commercial fisheries in the region. Commercial take of black cod is prohibited, however, the species is still caught as bycatch in Commonwealth fisheries, with fish suffering mortality due to hooks from fishers and barotrauma (Baker 2009). Indiscriminate fishing methods such as bottom-set baited lines (e.g. setlining, trotlining, handlining) are the most widely used methods with the potential to have a significant negative impact on black cod numbers and distribution (DTRIS 2012). Commercial fisheries targeting estuarine species may also impact juvenile black cod numbers, in particular those fisheries trapping in the lower reaches of estuaries on the north coast of New South Wales (DTIRIS 2012). Seahorses, pipehorses and sea dragons are considered vulnerable to Danish-seine operations, as these activities occur in relatively shallow waters and use nets with a small mesh size. They are also caught as bycatch in the Queensland East Coast Otter Trawl Fishery, particularly Duncker's and Hardwick's pipehorses, although numbers are low and considered to be declining (Coles et al. 2008). In New South Wales, bycatch of these species, particularly *Solegnathus* spp. (pipehorses) is a concern (Bowles & Martin-Smith 2003).
Bycatch (recreational fishing)	Black cod	As for commercial fishing, recreational fishing of black cod is prohibited; however recreational fishers are still known to occasionally catch black cod. Limited recognition or knowledge of the species has meant that it is not always released, or even when released does not survive due to barotrauma. New fishing technologies have improved recreational fishing effectiveness, particularly in deeper waters where adult black cod are found, which may increase the risk of recreational bycatch of the species (TSSC 2012).

Table S1.7: Pressures *of concern* to selected cetaceans of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Physical habitat modification (urban/coastal development)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Increased physical habitat modification associated with urban and coastal development is expected adjacent to the region, along the south-east Queensland and New South Wales coastline. Studies on coastal and riverine cetaceans worldwide indicate that habitat degradation is a serious threat that fragments populations and, in some cases, eliminates habitat (Reeves & Smith 1999). In the Temperate East, the overlap between coastal development and habitats used by inshore dolphins makes them vulnerable to this pressure. Indo-Pacific humpback dolphin populations are particularly susceptible because they are highly localised, occur in small subpopulations and are extremely sensitive to disturbance in their preferred habitats (Corkeron et al. 1997; Parra et al. 2006).
Bycatch (commercial fishing)	Killer whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Bycatch of cetacean species predominantly results in drowning and may cause changes to species distribution and population health. Diet studies of inshore dolphins by Heinshohn (1979), Marsh et al. (1989) and Parra & Jendensjo (2009) indicate that coastal estuarine waters are important foraging habitats for these species and, as a result, they are at greater risk of directly or indirectly interacting with fisheries operating in coastal waters (Parra & Jendensjo 2009). For inshore dolphins, bycatch in gillnets has emerged as a key threat to their survival (D'Agrosa et al. 2000; Northridge 1991; Rojas-Bracho & Taylor 1999). Australian net fisheries' catch is taken close to the coast, at depths less than 50 m (Kearney et al. 1996) and there is evidence that coastal dolphin bycatch occurs in these fisheries (Corkeron et al. 1997). For example, the outcome of the ecological risk assessment process by AFMA for the Small Pelagic Fishery (purse seine) assessed both the coastal bottlenose and Indo-Pacific humpback dolphin as at high risk of capture. The Small Pelagic Fishery Bycatch Action Plan is intended to reduce bycatch in this fishery. The rating assigned for the killer whale has been led by the outcomes of the AFMA ecological risk assessment process, which assessed the species as at high risk of capture within the Eastern Skipjack Tuna Fishery. *Australia's tuna purse seine fisheries bycatch action plan* (AFMA 2005) is intended to reduce bycatch and associated impacts in the Commonwealth tuna purse-seine fisheries.

Species assessed = 9		
Pressure	**Species**	**Rationale**
Bycatch **(bather protection programs)**	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Bather protection (shark meshing) programs have been in operation for over 70 years, deploying nets and drumlines to protect swimmers from the risk of shark attacks in coastal waters adjacent to the Temperate East Marine Region (Queensland and New South Wales). However, these programs lead to the bycatch of other marine species, including inshore dolphins. Between 1995 and 2009, 257 dolphins were caught in nets and drumlines associated with the bather protection programs (228 were caught in nets and 29 on drumlines); of these, 47 were bottlenose dolphins and 26 were Indo-Pacific humpback dolphins (Nias 2011).

Table S1.8: Pressures *of potential concern* to selected cetaceans of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Global sea levels rose by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). Inshore dolphins are vulnerable to rising sea levels because of the predicted impacts on their preferred foraging habitat (seagrass). In general, seagrass abundance and extent is predicted to decline as sea level rise decreases the light available for photosynthesis (Connolly 2009). A decrease in the extent of seagrass is expected to impact negatively on inshore dolphins.
Changes in sea temperature (climate change)	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Inshore dolphins are vulnerable to rising sea temperatures because of the expected impacts on their preferred foraging habitat (seagrass) (Connolly 2009; Parra & Corkeron, 2001; Parra et al. 2002; Parra, 2006). Temperature is a key factor determining the distribution of seagrasses (Poloczanska et al. 2007) and shallow subtidal species are considered at risk from warming ocean and air temperatures (Seddon et al. 2000). Climate variability may also affect other cetaceans; for example, research on climate variability and reproduction in southern right whales suggests a detrimental impact on reproductive success with warming events (Pirzl et al. 2008). Environmental fluctuations may impact on reproduction by affecting body condition and health through changes in foraging conditions, with krill availability in the summer feeding grounds influencing reproductive success the following winter (Trathan & Murphy 2002; Trathan et al. 2003).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Changes in oceanography include consideration of circulation patterns, current intensities, wind strength and direction, the location and strength of eddy and upwelling events and climatic oscillations such as the El Niño–Southern Oscillation. Oceanographic changes in the region will be primarily driven by the East Australian Current. Studies indicate this major boundary current has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Predictive climate models have medium confidence that this trend will increase (Ridgway & Hill 2009). There will also be associated circulation effects arising from expected changes to the El Niño–Southern Oscillation. Potential consequences of changes in ocean circulation patterns and the bifurcation point of the East Australian Current include shifts in upwelling events, increased thermal stratification, increased eddy activity and a shift in the thermocline depth (Chin et al. 2010). For cetaceans, these changes may influence the availability of prey, migration patterns and selection of calving sites (Chin et al. 2010).
Ocean acidification (climate change)	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Furthermore, climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). Recent research indicates significant impacts of ocean acidification on Antarctic krill (Kawaguchi et al. 2011), which are a key food source for many whale species that visit Australian waters. While there are no observed impacts of climate change on zooplankton in Australian waters, based on knowledge of impacts elsewhere, Australia is likely to start losing calcifying zooplankton from its southern waters (Richardson et al. 2009).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Chemical pollution/ contaminants (urban development, agricultural activities)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Cetaceans that frequent nearshore areas, such as the Indo-Pacific bottlenose dolphin and the Indo-Pacific humpback dolphin, may be exposed to higher levels of chemical pollutants than wholly offshore species (Jacob 2009). Shipping is a key activity in the region, with shipping routes servicing a number of ports that are adjacent to the region and inshore dolphin habitat. Higher levels of polychlorinated biphenyls (PCBs) have been found in dolphins from the Gold Coast compared to anywhere else in Australia; high levels of PCBs have been linked to impaired reproductive capacity in dolphins (Gaus et al. 2001). There is limited data on the likelihood of chemical spills in the region; however, like oil spills, they are unpredictable events that may have severe consequences for marine species. Inshore dolphins are particularly vulnerable because of their highly localised populations along the east coast.
Nutrient pollution (urban development, agricultural activities)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Nutrient pollution, also known as eutrophication, refers to an increase in the rate of supply of organic matter into an ecosystem, particularly nitrogen, phosphorus and silica. Eutrophication is considered a threat to coastal marine environments, leading to an increased frequency of harmful algal blooms, loss of ecosystem integrity and changes to biodiversity. High rainfall and catchment run-off, particularly in south-east Queensland, increases the exposure of dolphins to bioaccumulated toxins (Lawler et al. 2007). For example, inshore dolphins can be directly exposed to toxins through algae outbreaks associated with increased nutrient loads, absorbing toxins from water or ingesting algal cells; or indirectly through eating prey that contain toxins (Carmago & Alonso 2006).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Marine debris	Blue whale Dwarf minke whale Humpback whale Killer whale Fin whale Sei whale Southern right whale Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	*Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris* was listed in 2009 as a key threatening process under the EPBC Act (DEWHA 2009a). Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of or abandoned in the marine and coastal environment (UNEP 2005). Cetaceans are considered vulnerable to entanglement in marine debris, and the threat abatement plan lists a number of cetaceans that are known to be adversely affected by marine debris, including the southern right whale, blue whale and humpback whale (DEWHA 2009a). The potential for marine debris to affect inshore dolphin habitat is high because of the high number of people living adjacent to the coast (ABS 2001), the popularity of recreational fishing, and the number of commercial fisheries operating in and adjacent to the region (DEWHA 2009b). The Australian Government has developed a threat abatement plan that provides a coordinated national approach to prevent and mitigate the effects of harmful marine debris on marine life (DEWHA 2009a).
Noise pollution (shipping, urban development)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	There is growing concern that the impacts of human-made noise on marine life, particularly cetaceans, may result in physical or behavioural effects on these species (DEWHA 2008a). With pressures such as coastal development, a number of important ports and associated shipping activity, there is concern that noise may interfere with the ability of inshore dolphins to communicate, resulting in displacement from preferred habitat, or physical trauma and damage to sensory systems (Bejder & Samuels 2003; Mattson et al. 2005; Nowacek et al. 2007; Richardson et al. 1995). Evidence of changes in behaviour can be found in Moreton Bay, where the rate of whistling by humpback dolphins has increased in the presence of travelling boats, particularly in mother–calf pairs (van Parijs & Corkeron 2001).
Physical habitat modification (dredging/ dredge spoil)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Physical habitat modification from dredging activities is expected adjacent to the Temperate East Marine Region due to the growth in recreational boating activity (Bay Journal 2008; MSQ 2011). Dredging can also occur in association with development projects for extractive purposes and for the installation of pipelines and cables. Dredging modifies nearshore habitats by removing or smothering benthic flora and fauna, and changing water flows (GBRMPA 2009). Studies on coastal and riverine cetaceans worldwide indicate that habitat degradation is a serious threat that fragments populations and, in some cases, eliminates habitat (Reeves & Smith 1999). In the region, the overlap between coastal development and habitats used by inshore dolphins makes them vulnerable to this pressure. The Indo-Pacific humpback dolphin populations are particularly susceptible because they are highly localised, occur in small subpopulations and are extremely sensitive to disturbance in their preferred habitats (Corkeron et al. 1997; Parra et al. 2006).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Bycatch (bather protection programs)	Humpback whale	Bather protection (shark meshing) programs have been in operation for over 70 years, deploying nets and drumlines to protect swimmers from the risk of shark attacks along the New South Wales and Queensland coasts. However, these programs lead to the bycatch of other marine species. The number of humpback whales caught in nets along the Queensland coast during migration has remained relatively constant over recent years (DERM 2009); however, as the population recovers, the interaction between humpback whales and shark meshing may increase.
Oil pollution (shipping, vessels)	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Oil spills are unpredictable events and their likelihood is low, particularly in the context of the international and domestic regulatory mitigation measures that apply in Australia. However, their consequences can be severe, particularly in biologically significant areas or times. Shipping is a key activity in the region, with shipping routes servicing a number of ports that are adjacent to the region and inshore dolphin habitat. In the event of an oil spill, dolphins have been known to detect oil and avoid it; however, at other times they have been exposed to floating oil (AMSA 2010). Inshore dolphin species are particularly vulnerable to oil spills because of their highly localised populations along the east coast.
Collisions with vessels **(shipping, tourism, fishing)**	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Collisions between dolphins and vessels have been recorded in Australian waters, with records of dolphin mortality attributed to boat strike in Victoria (DSE 2011) and South Australia (News Limited 2010). The growth in recreational boating activity in the region (Bay Journal 2008; MSQ 2011), combined with a preference for nearshore habitats, makes inshore dolphins vulnerable to collisions with vessels.
Changes in hydrological regimes **(climate change)**	Indo-Pacific (coastal) bottlenose dolphin Indo-Pacific humpback dolphin	Changes in hydrological regimes through, for example, an increase in the frequency and intensity of storm and flooding events could impact on nearshore environments used by inshore dolphins. The predicted increase in intensity of storm events, combined with rising sea levels, is expected to cause shoreline erosion, thereby increasing turbidity of shallow coastal waters (Cabaco et al. 2008; Hennessy et al. 2007; Waycott et al. 2007) and reducing the amount of light available for photosynthesis in seagrasses (Connolly 2009), the preferred habitat of inshore dolphins. Increases in turbidity within mangrove environments may also reduce the efficiency of predators (Abrahams & Kattenfeld, 1997), including both species of inshore dolphin.

Table S1.9: Pressures *of concern* to selected marine reptiles of the Temperate East Marine Region

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Loggerhead turtle	Global sea levels rose by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). The implications of sea level rise for marine turtles include an increased risk of tidal inundation or destruction of nests, the selection of suboptimal nesting areas, and risk of nest destruction by other turtles associated with higher nesting densities (Hamann et al. 2007; Poloczanska et al. 2010). Collectively, these impacts may reduce breeding success. It is expected that the effects of sea level rise will be particularly marked in regions of extensive coastal development, such as eastern Australia, where development acts as a barrier to the landward movement of beaches or hinders natural accretion of beach material and the evolution of beach morphology (Poloczanska et al. 2010).
Changes in sea temperatures (climate change)	Loggerhead turtle	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Increasing sea temperatures have the potential to impact on marine turtles in a number of ways, including a shift in distribution, which may either increase or decrease the species range (Hawkes et al. 2009; Milton & Lutz 2003); alterations to life history characteristics such as growth rates and age at maturity (Balazs & Chaloupka 2004; Chaloupka & Limpus 2001; Hamann et al. 2007); and reduced prey availability (Chaloupka et al. 2008; Fuentes et al. 2009). For example, higher mean annual sea surface temperatures in core loggerhead foraging areas correlate with trends towards smaller annual nesting populations during the following summer in eastern Australia (Chaloupka et al. 2008).
Changes in terrestrial sand temperatures (climate change)	Loggerhead turtle	Changes in terrestrial sand temperature have implications for nesting marine turtles: higher sand temperatures increase the female bias in the sex ratio of turtle hatchlings, which may lead to a female bias in marine turtle populations (Fuentes et al. 2009). A rise in sand temperature may also compromise egg incubation, leading to lower hatchling success and reduced hatchling survival (Fuentes et al. 2009). Emerging research suggests that turtles are responding to these pressures in a highly adaptive manner; for example, by shifting nesting periods to correspond to lower temperatures (Poloczanska et al. 2010).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Green turtle Leatherback turtle Loggerhead turtle	Bycatch associated with commercial fisheries operating in the region is *of concern* to marine turtles that are listed as threatened, including the green, leatherback and loggerhead turtle. Turtles are vulnerable to trawl, gillnet and longline fisheries gear, and bycatch interactions typically result in the death of individuals by drowning. All three gear types are used across the region and records indicate that all three species of turtle are caught (Limpus 2008a, 2008b, 2009). The population effects of bycatch mortality are unknown for some species; however, for others such as the loggerhead and green turtle, it has led to population declines. For example, mortality associated with otter trawl operations across eastern and northern Australia were identified as the cause of the 86% decline in loggerhead annual nesting numbers in eastern Australia from the mid-1970s to 2000. In the past decade, the introduction of turtle excluder devices (TEDs) in several key trawl fisheries such as the Queensland East Coast Otter Trawl Fishery has resulted in a significant reduction of bycatch. Despite their success, TEDs are not universally used. For example, New South Wales trawl fisheries (e.g. New South Wales Otter Trawl Fishery) do not use these devices and it is expected this will slow the recovery of threatened species across the Temperate East Marine Region and in the south-west Pacific. For other fisheries, such as longline operations, where TEDs cannot be used, bycatch levels continue to be considered a high risk. For example, in the Eastern Tuna and Billfish Fishery, green and leatherback turtles are the most frequently caught turtle species.
Collision with vessels	Green turtle Hawksbill turtle Loggerhead turtle	Boat strikes are a common cause of death and injury in marine turtles, with turtles' poor hearing and vision hampering their ability to avoid boats. Turtles are most vulnerable to boat strike when they are in shallow waters, or basking or breathing at the surface. Growing coastal development and the associated rise in recreational boating activities in the region are expected to exacerbate this issue (Limpus 2008a, b, 2009a). Adult turtles are particularly vulnerable, and this compounds the impact of this pressure on turtle populations by disproportionately reducing the numbers of breeding-age individuals (Limpus 2008a). Some very effective mitigation measures are in place, such as the 'Go slow' zones in the Moreton Bay Conservation Park; however, experts remain concerned about the impact of boat strikes on turtle populations within the region.

Table S1.10: Pressures *of potential concern* to selected marine reptiles of the Temperate East Marine Region

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Green turtle	Global sea levels have risen by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5–1 m by 2100, relative to 2000 levels (Climate Commission 2011). The implications of sea level rise for marine turtles include an increased risk of tidal inundation or destruction of nests, the selection of suboptimal nesting areas, and risk of nest destruction by other turtles associated with higher nesting densities (Hamann et al. 2007; Poloczanska et al. 2010). Collectively, these impacts may reduce breeding success. It is expected that the effects of sea level rise will be particularly marked in regions of extensive coastal development, such as eastern Australia, where development acts as a barrier to the landward movement of beaches or hinders natural accretion of beach material and the evolution of beach morphology (Poloczanska et al. 2010).
Changes in sea temperature (climate change)	Green turtle Hawksbill turtle Leatherback turtle Sea snakes	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Increasing sea temperatures have the potential to impact on marine turtles in a number of ways, including a shift in distribution that may either increase or decrease the species range (Hawkes et al. 2009; Milton & Lutz 2003), alterations to life history characteristics (e.g. growth rates, age at maturity and reproductive periodicity) (Balazs & Chaloupka 2004; Chaloupka & Limpus 2001; Fuentes et al. 2009; Hamann et al. 2007) and reduced prey availability (Chaloupka et al. 2008). Sea snakes depend on water temperatures for their body heat while foraging (Guinea 1995; Heatwole 1981). Little is known about the thermal requirements and tolerances of sea snakes and how they will respond to increasing water temperatures (Hamann et al. 2007). Potential impacts from changes in sea temperatures include changes to the availability of prey species and seasonal movements for breeding or feeding (Fuentes et al. 2009; Hamann et al. 2007).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle	Changes in oceanography broadly refer to changes in ocean circulation patterns, current intensities, wind strength and direction, the location and strength of eddy and upwelling events and climatic oscillations such as the El Niño–Southern Oscillation. For turtles, changes to these ocean characteristics may have implications for hatchling dispersal, migration and feeding. For example, dispersal of loggerhead and green turtle hatchlings from the Great Barrier Reef occurs via offshore currents (Boyle 2006; Hamann et al. 2007), and any changes in offshore current will influence this dispersal.
Changes in terrestrial sand temperature (climate change)	Green turtle	Changes in terrestrial sand temperature have implications for nesting marine turtles: higher sand temperatures increase the female bias in the sex ratio of turtle hatchlings, which may lead to a female bias in marine turtle populations (Fuentes et al. 2009). A rise in sand temperature may also compromise egg incubation, leading to lower hatchling success and reduced hatchling survival (Fuentes et al. 2009). Emerging research suggests that turtles are responding to these pressures in a highly adaptive manner; for example, by shifting nesting periods to correspond to lower temperatures (Poloczanska et al. 2010).
Chemical pollution/ contaminants (shipping, vessels, urban development, agricultural activities)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle	The Temperate East Marine Region is highly exposed to possible vectors for chemical pollutants, including significant shipping, fishing and agricultural activities in and adjacent to the region. It is expected that the effects of a major chemical spill would be similar to, or possibly exceed, those of a major oil spill (GBRMPA 2009). The implications of small and gradual influxes of chemicals (e.g. agricultural run-off) are harder to ascertain, and the effects on turtle populations are unknown (Muusee et al. 2006). Studies indicate that turtles, as high-order predators, bioaccumulate and biomagnify chemicals, meaning that chemicals can reach high concentrations in individuals, with potentially negative consequences (Muusee et al. 2006). A number of management measures are in place to respond to this risk, including the National plan to combat pollution of the sea by oil and other noxious and hazardous substances and the International Convention for the Prevention of Pollution from Ships (MARPOL), both of which are implemented through the Australian Maritime Safety Authority. Although these measures mitigate the risk of a significant pollution event, the potential for such an event remains.

Species assessed = 24 (sea snakes assessed as a group)

Pressure	Species	Rationale
Nutrient pollution (urban development, agricultural activities)	Green turtle Hawksbill turtle Loggerhead turtle	Nutrient pollution, also known as eutrophication, refers to an increase in the rate of supply of organic matter into an ecosystem, particularly nitrogen, phosphorus and silica. Eutrophication is considered a threat to coastal marine environments, leading to an increased frequency of harmful algal blooms, loss of ecosystem integrity and changes to biodiversity. Algal blooms have been associated with substandard diets in turtles, which may hamper growth and development and reduce reproduction (Arthur et al. 2006). It is also suggested that these blooms are associated with tumour-promoting toxins in turtles. Given the expected increase in nutrient pollution associated with the growth in coastal development, experts consider this pressure to be of increasing concern to turtle populations that are already compromised.
Marine debris	Green turtle Loggerhead turtle	*Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris* was listed in 2003 as a key threatening process under the EPBC Act (DEWHA 2009a). Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of, or abandoned, in the marine and coastal environment (UNEP 2005). The green and loggerhead turtles are known to be adversely affected by marine debris. Ingestion of debris is common, particularly plastic bags, which can be mistaken for prey (i.e. jellyfish) (Derraik 2002). This can cause turtles to float, thereby affecting foraging and animal health. Young turtles are especially vulnerable, as they drift within convergence zones (e.g. rips, fronts and drift lines formed by ocean currents) where high densities of marine debris accumulate. In a recent study by Boyle & Limpus (2008), synthetic materials accounted for up to 46% of total stomach content in green turtle post-hatchlings. Hatchlings are not able to compensate for the intake of non-nutritional items, and this results in reduced energy uptake. Research also indicates that toxins within materials are absorbed by turtles (Bjorndal et al. 1994).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Light pollution (onshore activities and offshore activities)	Green turtle Loggerhead turtle	The Temperate East Marine Region is adjacent to a highly populated coastline where lighting from coastal development, ports and associated shipping activity is considered *of potential concern* to marine turtles, particularly during the breeding season. Light pollution along, or adjacent to, nesting beaches may alter nocturnal turtle behaviours, particularly the selection of nesting sites and the passage of adult females and emerging hatchlings from the beach to the sea (Limpus 2008b). The impacts of these changes in behaviour include a decrease in nesting success, beach avoidance by nesting females and disorientation, leading to increased mortality through predation, road kill and dehydration (Limpus 2008b; Lorne & Salmon 2007; Witherington & Martin 2000). Managers have addressed the issue by applying management zones to the majority of nesting sites (Limpus 2008b); for example, at Mon Repos Conservation Park, a 1.5 km radius darkness zone has been applied to protect nesting turtles. However, lighting from nearby towns is extensive and thought to remain visible out to sea for distances greater than 3 km, thereby influencing hatchling behaviour at Mon Repos (Limpus 2008b).
Physical habitat modification (dredging)	Green turtle Loggerhead turtle Sea snakes	Physical habitat modification due to dredging activities is expected to increase in areas adjacent to the Temperate East Marine Region due to the growth in recreational boating activity (Bay Journal 2008; MSQ 2011). Dredging can also occur in association with development projects for extractive purposes and for the installation of pipelines and cables. Dredging modifies nearshore habitats by removing or smothering benthic flora and fauna, and changing water flows (GBRMPA 2009). Marine turtles and sea snakes are likely to use habitats that are affected by dredging and are therefore vulnerable to this pressure.
Extraction of living resources (commercial fishing, non-domestic)	Green turtle Hawksbill turtle	Marine turtles are protected in Australian waters but, because they roam internationally, declines may be due to unsustainable fishing in other parts of the species' range. Evidence indicates that fishing occurs in neighbouring South Pacific countries (Meylan & Donnelly 1999), with green and hawksbill turtles preferentially taken for their meat and shells, respectively, and sold in markets (e.g. Daru and Koki markets in Papua New Guinea). Long life spans and late sexual maturity make these species vulnerable to continued harvesting and impacts on populations both within and beyond the region (Dethmers et al. 2010).

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Hawksbill turtle Sea snakes	Turtles are vulnerable to trawl, gillnet and longline fisheries gear and bycatch interactions typically result in the death of individuals by drowning. All three gear types are used across the region, and records indicate that hawksbill turtles are caught as bycatch (Limpus 2008a; 2008b; 2009). In the past decade, the introduction of turtle excluder devices (TEDs) in several key trawl fisheries has significantly reduced bycatch levels. Despite their success, TEDs are not universally used; for example, New South Wales trawl fisheries (e.g. New South Wales Ocean Trawl Fishery) do not use these devices. Bycatch from the Queensland trawl fishery is the main pressure impacting on sea snakes (Cogger 2000). In particular, the redspot king prawn fishery records significant sea snake bycatch (Courtney et al. 2010. This fishery has the potential to impact on all species, especially the spectacled and small-headed seasnakes. Very little is known about either of these species, other than that they are slow to mature, have few young and do not survive well in trawl nets.
Bycatch (illegal, unregulated and unreported fishing)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle	Illegal, unregulated and unreported (IUU) fishing is considered *of potential concern* for all turtle species. IUU fishing encompasses a complex range of fisheries activities, but generally refers to fisheries operations that violate the governing laws and conventions of that fish stock. Although not explicitly targeting turtle species, IUU fisheries operations create significant collateral damage to ecosystems. By their nature, such operations do not respect national and international actions designed to reduce bycatch and mitigate the incidental mortality of marine animals such as marine turtles (Agnew et al. 2009). Although IUU fishing is not a significant issue within the region, it is widespread in adjacent waters and is thought to be contributing to declines in turtle populations within the Temperate East Marine Region.

Species assessed = 24 (sea snakes assessed as a group)		
Pressure	**Species**	**Rationale**
Oil pollution (shipping, vessels)	Green turtle Hawksbill turtle Leatherback turtle Loggerhead turtle Sea snakes	Oil spills are unpredictable events and their likelihood is low, particularly in the context of the international and domestic regulatory mitigation measures that apply in Australia. However, their consequences can be severe, particularly in biologically significant areas and times. Shipping is a key activity in the region, with shipping routes servicing a number of ports adjacent to the region, and adjacent to habitat for turtles and sea snakes. Marine reptiles are affected by oil pollution through exposure when surfacing to breath, contaminated food supplies, fouling of nesting beaches and absorption through the skin (Anon 2010; Gagnon 2009; Watson 2009). Physical contact may result in a range of impacts including burns, damage to internal organs, and toxicity resulting in reduced hatchling success and deformities in developing embryos (AMSA 2010).
Invasive species	Green turtle Loggerhead turtle	Egg predation by invasive or introduced species is a significant issue for marine turtle populations. An invasive species is defined as one that occurs and thrives outside its normal geographical distribution as a result of human activities, and can include animals, weeds, diseases and parasites (Olsen et al. 2006). Of particular concern to turtle populations within the region are the European red fox and feral pig, both of which have had impacts on turtle populations, particularly the eastern loggerhead stocks (Limpus & Limpus 2003; Limpus & Parmeter 1985; Tisdell et al. 2004). Extensive monitoring of (index) nesting sites both within the region (e.g. Mon Repos) and beyond (e.g. Gulf of Carpentaria) indicate that a high proportion of nests are destroyed by foxes and pigs. In the case of Mon Repos, a key nesting site for the loggerhead, predation has seriously impacted on the recruitment of females to the population, reducing overall stocks (Limpus & Limpus 2003). A Queensland Government fox eradication program has reduced fox impacts to negligible levels at key sites (i.e. Mon Repos); however, uncontrolled predation remains an issue. Threat abatement plans have been prepared under the EPBC Act for foxes and pigs (DEWHA 2008c; DEH 2005a).

Table S1.11: Pressures *of concern* to selected seabirds of the Temperate East Marine Region

Species assessed = 34		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Sooty tern	Changes in oceanography broadly refer to changes in ocean circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. The sooty tern is considered especially vulnerable to changes in oceanography through impacts on the distribution and availability of prey species, and on its breeding success. In the region, changes in oceanography will be primarily driven by the East Australian Current, which has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Models suggest with medium confidence that this trend will increase (Ridgway & Hill 2009). For the sooty tern, El Niño events have also been linked to breeding failure. In 2002, following an El Niño–Southern Oscillation event, sooty terns at Lord Howe Island experienced almost complete breeding failure, with the majority of chicks dying of starvation (Congdon et al. 2007).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Invasive species	Black noddy Common noddy Crested tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Little penguin Masked booby Red-tailed tropicbird	Invasive species impact on seabird populations by preying on adults and nest contents (eggs and chicks), destroying nests and modifying habitat (DEH 2005). Invasive species are considered to be the greatest threat to seabirds after habitat loss, contributing to the threatened status of many species breeding within the region (Olsen et al. 2006). An invasive species is defined as one that occurs and thrives outside its normal geographical distribution as a result of human activities, and can include animals, weeds, diseases and parasites (Olsen et al. 2006). European settlers are implicated in the introduction of Australia's most established invasive species—the rat, rabbit and fox—all of which are known to threaten seabirds. More recent invaders also known to threaten seabirds include the Argentine ant and kikuyu grass. Rat predation on Lord Howe Island have resulted in the localised extinction of the Kermadec petrel, little shearwater and white-bellied storm-petrel (Garnett et al. 2011); severe degradation by rabbits of nesting habitat for Gould's petrel on Cabbage Tree Island (NSW NPWS 2000); and kikuyu grass mats on Montague Island that entangle little penguin adults and chicks (DECC 2009). Threat abatement plans have been prepared under the EPBC Act for pigs, rabbits, foxes, and exotic rodents on small islands (DEH 2005b; DEWHA 2008b; DEWHA 2008c; DEWHA 2009c).

Table S1.12: Pressures *of potential concern* to selected seabirds of the Temperate East Marine Region

Species assessed = 34		
Pressure	**Species**	**Rationale**
Sea level rise (climate change)	Black noddy Common noddy Crested tern Masked booby Red-tailed tropicbird	Global sea levels have risen by 20 cm between 1870 and 2004, and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5 to 1 m by 2100, relative to 2000 levels (Climate Commission 2011). Seabird species nesting on the lowland parts of the Lord Howe Island group are at risk from sea level rise (Congdon et al. 2007). The impacts of rising sea levels on seabirds include loss of habitat through inundation of breeding sites, greater effect from storms (compounded by the predicted increase in frequency and intensity of storms), and impacts from altered erosion and deposition patterns (Chambers et al. 2009a). Impacts are expected to vary with breeding habitat and location, and high rocky islands are at lower risk than low-lying, less stable islands. However, there are no known quantitative links between observed sea level rise and changes in the distribution and abundance of nesting Australian seabirds (Chambers et al. 2009b).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Changes in sea temperature (climate change)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Seabirds are expected to be impacted by rising sea temperatures through changes in the availability and distribution of prey species (Feng et al. 2009), thereby shifting the distribution of seabirds in the region. Distributions are most likely to move southward, which may alter reproductive timing and success (Chambers et al. 2009a). Beyond the region, impacts have been observed in the Great Barrier Reef on populations of sooty tern, black noddy and wedge-tailed shearwater. These species have experienced decreased breeding success linked to reduced prey rates driven by increasing water temperatures (Congdon et al. 2007; Peck et al. 2004; Smithers et al. 2003). Data from across the central and eastern Pacific, Indian and Southern oceans also indicate similar impacts in a number of seabird species (Chambers et al. 2009a). For species such as those breeding on the Lord Howe Island group that are already at the extremity of their breeding range and travel long distances to obtain food, any southward shifts in prey distribution are likely to greatly impact breeding success.

Species assessed = 34		
Pressure	**Species**	**Rationale**
Changes in oceanography (climate change)	Black noddy Common noddy Crested tern Roseate tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Changes in oceanography broadly refer to changes in ocean circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. In the region, changes in oceanography will be primarily driven by the East Australian Current, which has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Models suggest with medium confidence that this trend will increase (Ridgway & Hill 2009). At sea, seabirds commonly seek out regions of enhanced productivity (e.g. eddies or fronts) for foraging opportunities (BirdLife International 2010; Hyrenbach et al. 2000), and the breeding success of seabirds in the region is linked to the stability of a small number of highly productive nutrient hotspots along the edge of the continental shelf (Chambers et al. 2009a; Congdon et al. 2007). Temporal or spatial shifts in areas of upwelling are expected to influence the distribution, migration, foraging and breeding habits of seabirds (Chambers et al. 2009a). For example, El Niño events have been linked to breeding failure in seabirds (particularly temperate species) due to changes in ocean stratification and associated impacts on prey species. The southward movement of the East Australian Current is also expected to bring subtropical species into temperate waters, thereby increasing competition in foraging and nesting habitats (Chambers et al. 2009a).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Ocean acidification (climate change)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Driven by increasing levels of atmospheric CO_2 and subsequent chemical changes in the ocean, ocean acidification is already under way and detectable. Since pre-industrial times, acidification has lowered ocean pH by 0.1 units (Howard et al. 2009). Climate models predict this trend will continue, with a further 0.2–0.3 unit decline by 2100 (Howard et al. 2009). The impacts of ocean acidification on seabirds are expected to be indirect, through changes in the abundance, availability and distribution of prey species. For example, research indicates potentially significant impacts on Antarctic krill (Kawaguchi et al. 2011) and squid (Frisch 2006), which are important food sources for seabirds that visit the Temperate East Marine Region.

Species assessed = 34		
Pressure	**Species**	**Rationale**
Chemical pollution/ contaminants (shipping, vessel)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	The Temperate East Marine Region is highly exposed to possible vectors for chemical pollutants, including significant shipping and fishing activities in and adjacent to the region. It is expected that the effects of a major chemical spill would be similar to, or possibly exceed, those of a major oil spill (GBRMPA 2009). As top-order predators, seabirds are vulnerable to persistent chemical pollutants such as organochlorines, which accumulate through the food chain. Data in other regions show that chemical bioaccumulation results in seabird mortality and breeding failure (Becker 1989). A number of management measures are in place to respond to the risk of chemical spills, including the National plan to combat pollution of the sea by oil and other noxious and hazardous substances and the International Convention for the Prevention of Pollution from Ships (MARPOL), both of which are implemented through the Australian Maritime Safety Authority.

Species assessed = 34		
Pressure	**Species**	**Rationale**
Marine debris	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	*Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris* was listed in 2003 as a key threatening process under the EPBC Act (DEWHA 2009a). Marine debris is defined as any persistent, manufactured or processed solid material that has been disposed of or abandoned in the marine and coastal environment (UNEP 2005). Impacts of marine debris on seabirds include death through drowning, injury through entanglement, or starvation following ingestion (Baker et al. 2002). Seabirds are particularly prone to ingesting polystyrene balls and plastic buoys (which they confuse with fish eggs) and entanglement (which can kill individuals or slow them down, reducing their ability to catch prey and avoid predators) (Ceccarelli 2009). A regional study analysing 205 known interactions between seabirds and plastic debris across 29 species found approximately 70 per cent of birds perished (C&R Consulting 2009).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Light pollution (land-based activities)	Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Little penguin	Light pollution from onshore sources is *of potential concern* for shearwaters, petrels and the little penguin because it can attract and disorientate seabirds. Petrels, shearwaters and penguins are vulnerable to this pressure as they commonly return to their breeding colonies at night (Aubrecht et al. 2010). Juvenile seabirds are thought to be particularly vulnerable to disorientation from artificial lighting because they are less familiar with visual cues (e.g. moon and stars) (Aubrecht et al. 2010). Although research on the impact of light pollution on seabird populations is limited, preliminary studies in Hawaii, the Reunion Islands and the Canary Islands indicate that light-induced mortality rates are an issue for petrels and small shearwaters (Aubrecht et al. 2010).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Human presence at sensitive sites (tourism, recreational and charter fishing, research)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Disturbance to seabirds during the breeding season may result in decreased the breeding success and fitness of adult birds, particularly when adult birds are distracted from foraging, roosting or resting (WMB Oceanics & Claridge 1997). For example, if adult birds are disturbed from a nest, the unattended eggs and chicks become vulnerable to predation. The extent of the impact at a breeding site is influenced by visitor frequency, approach distances and the sensitivity of particular species to disturbance. In general, ground nesting species (e.g. tern and booby species) are more vulnerable to disturbance; highly sensitive species include the roseate tern, little tern and crested tern (Langham & Hulsman 1986; Surman & Nicholson 2006; WMB Oceanics & Claridge 1997).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Flesh-footed shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Great-winged petrel White-necked petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross	Bycatch associated with commercial fisheries operating in the region is *of concern* for 16 species of seabird. Direct interactions with commercial fishing operations can lead to seabird death by drowning (e.g. on longline hooks), death by collision (e.g. warp strike) and more broadly, decreased fecundity. Bycatch generally affects larger species of seabird because they can swallow baited hooks and habitually follow ships (Baker et al. 2002). Seabirds are known to be particularly vulnerable to longline operations, and these fisheries (e.g. the Eastern Tuna and Billfish Fishery) implement bycatch mitigation measures guided by the threat abatement plan for the incidental catch of seabirds in longline fishing operations (DEWR 2006). However, further efforts are required to reduce the impacts of bycatch on seabirds and this pressure remains *of concern* (Bensley et al. 2010; DEWR 2006; Phillips et al. 2010; Wilcox & Donlan 2007).
Bycatch (recreational and charter fishing)	Flesh-footed shearwater	Bycatch associated with the domestic recreational and charter fishing sector is considered *of potential concern* for the flesh-footed shearwater. Recreational and charter fishing activities are widespread along Australia's east coast, and recreational boating activity is growing (Bay Journal 2008; MSQ 2011). The likelihood of seabird–fisher interactions is high, and these interactions can result in seabird injury and death from the ingestion of baited hooks and fishing line, and entanglement (McPhee et al. 2002). Trolling in particular is known to affect flesh-footed shearwaters (Australian Bird and Bat Banding Scheme, unpublished data).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Oil pollution (shipping, vessels)	Black noddy Common noddy Crested tern Roseate tern Sooty tern White tern Grey ternlet Flesh-footed shearwater Little shearwater Short-tailed shearwater Sooty shearwater Wedge-tailed shearwater Black petrel Black-winged petrel Gould's petrel Great-winged petrel Kermadec petrel Providence petrel White-bellied storm-petrel White-faced storm-petrel White-necked petrel Wilson's storm-petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross Little penguin Masked booby Red-tailed tropicbird	Oil spills are unpredictable events and their likelihood is low, particularly in the context of the international and domestic regulatory mitigation measures that apply in Australia. However, their consequences can be severe, particularly in biologically significant areas and times. Shipping is a key activity in the region, with shipping routes servicing a number of ports adjacent to the region, and adjacent to seabird habitat. Seabirds are vulnerable to oil pollution because oil sticks to feathers, affecting their insulation and waterproofing properties, rendering some birds flightless or vulnerable to predation. Oil may also indirectly impact seabirds through effects on prey species such as damage to fish eggs, larvae and young fish (AMSA 2010). Chemicals used to disperse oil can themselves be toxic to marine life (AMSA 2010). Adjacent to the region, a study on the effects of oil spills on birds at Moreton and Bribie islands found that sites affected by the spill contained 50% fewer species than unaffected sites. Seabirds such as terns and gulls were considered among those most at risk (Birds Australia 2010).

Species assessed = 34		
Pressure	**Species**	**Rationale**
Invasive species	Roseate tern Great-winged petrel Wilson's storm petrel Northern giant petrel Southern giant petrel Antipodean albatross Black-browed albatross Campbell albatross Indian yellow-nosed albatross Salvin's albatross Wandering albatross White-capped albatross	Invasive species impact on seabird populations by preying on adults and nest contents (eggs and chicks), destroying nests and modifying habitat (DEH 2005b). Invasive species are considered to be the greatest threat to seabirds after habitat loss, contributing to the threatened status of many species within the region (Olsen et al. 2006). An invasive species is defined as one that occurs and thrives outside its normal geographical distribution as a result of human activities, and can include animals, weeds, diseases and parasites (Olsen et al. 2006). European settlers are implicated in the introduction of Australia's most established invasive species—the rat, rabbit and fox—all of which are known to threaten seabirds. More recent invaders also known to threaten seabirds include the Argentine ant and kikuyu grass. Threat abatement plans have been prepared under the EPBC Act for exotic rodents on islands and rabbits (DEWHA 2009c, 2008a).

Table S1.13: Pressures *of concern* to selected sharks of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Bycatch (commercial fishing)	Grey nurse shark	The grey nurse shark is listed as threatened under the EPBC Act and is protected in Australian waters. The species interacts with a range of commercial fisheries, and there are reports of sharks with fishing gear trailing from their mouths (Bansemer & Bennett 2010). The effectiveness of management measures is not fully understood and bycatch mortality will continue to be *of concern* for this species until evidence of management effectiveness is conclusive.
Bycatch (recreational and charter fishing)	Grey nurse shark White shark	The grey nurse shark is listed as threatened under the EPBC Act and is protected in Australian waters. The species interacts with the recreational and charter fishing sector, and there are reports of individuals with recreational fishing gear (e.g. trolling lures) trailing from their mouths (Bansemer & Bennett 2010). Due to the small population size and conservation status, any fishing-related mortality is *of concern* to the species. The white shark is listed as threatened under the EPBC Act and is protected in Australian waters. Evidence suggests there is a partial failure to report captures of individuals and interactions within the recreational fishing sector (DEWHA 2009b). Data from the Great Barrier Reef Marine Park suggests post-release mortality could account for the majority of recreational fishing mortality. Mortality can occur as a result of capture and subsequent handling or, as seen in grey nurse shark populations, attached fishing gear (Lynch et al. 2009).

Table S1.14: Pressures *of potential concern* to selected sharks of the Temperate East Marine Region

Species assessed = 9		
Pressure	**Species**	**Rationale**
Changes in sea temperature (climate change)	Grey nurse shark Porbeagle shark Longfin mako shark Shortfin mako shark Whale shark White shark	Sea temperatures have warmed by 0.7 °C between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be a further 1 °C warmer by 2030 (Lough 2009). Increasing sea temperatures may result in changes in the metabolism, behaviour and movement patterns of sharks (Chin & Kyne 2007). Climate change vulnerability assessments for the grey nurse shark and white shark in the Great Barrier Reef assessed both species as moderately vulnerable to rising sea temperatures (Chin et al. 2010). Indirect effects on sharks in general relate to potential changes in abundance and distribution of prey species. For example, studies predict that ocean warming will cause a large southward shift in the distribution of many tropical and subtropical zooplankton (Hobday et al. 2006), which may influence the distribution of whale sharks both within the region and beyond.
Change in oceanography (climate change)	Grey nurse shark Porbeagle shark Longfin mako shark Shortfin mako shark Whale shark White shark	Changes in oceanography broadly refer to changes in ocean circulation patterns; current intensities; wind strength and direction; the location and strength of eddy and upwelling events; and climatic oscillations such as the El Niño–Southern Oscillation. In the region, changes in oceanography will be primarily driven by the East Australian Current, which has been strengthening, pushing warmer, saltier water further southward along the east coast (for up to 350 km). Models suggest with medium confidence that this trend will increase (Ridgway & Hill 2009). These changes are likely to impact on productivity, resulting in subsequent shifts in trophic webs and migration patterns, and changes to reef and shelf habitats, all of which have implications for shark species (Chin et al. 2010). For example, a climate change vulnerability assessment of sharks in the Great Barrier Reef region suggested that white sharks would have high exposure and vulnerability to oceanographic change (Chin et al. 2010). As a specialist plankton feeder, whale sharks are also considered to have high exposure and vulnerability to oceanographic change due to expected impacts on the abundance and distribution of plankton populations (Chin et al. 2010). Other migratory species (e.g. mako and porbeagle sharks) are expected to be similarly impacted.

Species assessed = 9		
Pressure	**Species**	**Rationale**
Human presence at sensitive sites (tourism, recreational and charter fishing, research)	Grey nurse shark	Aggregation sites for grey nurse sharks off New South Wales and Queensland are popular recreational diving locations, and this threatened species is considered a major drawcard for recreational divers (Pollard et al. 1996). Interactions between divers and grey nurse sharks are common, and studies have found that sharks milled less in the presence of six or more divers, and the frequency of behaviours such as jaw gaping, rapid withdrawal and stiff or jerky movements correlated with the distance between divers and sharks (Pollard et al. 1996). Diving regulations are in place to limit the adverse effects of divers on sharks, particularly diver harassment of sharks (Smith et al. 2010). As recreational diving continues to grow in popularity, however, so does the potential for negative impacts at sensitive grey nurse shark sites.
Extraction of living resources (commercial fishing)	Shortfin mako shark	The shortfin mako is listed as migratory under the EPBC Act and the targeted commercial take of shortfin mako is prohibited in Commonwealth waters; however, individuals can be retained (as byproduct) if they are dead upon capture. Since their migratory listing in 2010, there has been a 30% reduction in the level of byproduct take and a number of management arrangements are in place; however, they remain vulnerable to capture in commercial fishing operations and this pressure remains *of potential concern*.
Extraction of living resources (commercial fishing—non-domestic)	Porbeagle shark Longfin mako shark Shortfin mako shark White shark	The white shark is listed as both threatened and migratory under the EPBC Act and is protected in Australian waters; the shortfin and longfin mako sharks and porbeagle shark are listed as migratory under the EPBC Act. All are highly migratory, and it is expected that these species will cross over the region's exclusive economic zone boundary and thus be exposed to international commercial fisheries targeting sharks for their meat and fins. This pressure is devastating northern Australian shark populations and although temperate east populations are not expected to interact with this pressure to the same extent, it nonetheless has the potentially to significantly impact them (Lack & Sant 2008).

Species assessed = 9		
Pressure	**Species**	**Rationale**
Extraction of living resources (illegal, unregulated and unreported fishing—non-domestic)	Longfin mako shark Shortfin mako shark	The shortfin and longfin mako sharks are listed as migratory under the EPBC Act and the targeted commercial take of both species is prohibited in Commonwealth waters; however, individuals can be retained (as byproduct) if they are dead upon capture. Mako sharks are an important component of the international shark fin trade (Clarke et al. 2006) and are vulnerable to capture in longline operations. It is likely that all non-domestic illegal, unregulated and unreported take, both within and beyond Australian waters, will impact on populations of mako sharks within the region.
Extraction of living resources (illegal, unregulated and unreported fishing—domestic)	White shark	The white shark is listed as threatened under the EPBC Act and is protected in Australian waters. Although fishing of white shark is prohibited, the illegal capture of white sharks by the commercial and recreational fishing sector and the illegal trade in white shark products threaten populations in Australian waters (DEWHA 2010). Demand for white shark products as trophies (e.g. jaws and teeth), as well as fins for the fin trade, has increased their value and there is evidence that these items support both international and national illegal trade (EA 2002). Despite strict regulations in both sectors, the high prices obtained for white shark products continue to provide incentive for this illegal trade (DEWHA 2010).
Bycatch (commercial fishing)	White shark	The white shark is listed as threatened under the EPBC Act and is protected in Australian waters. Individuals have been recorded hooked on longlines and caught in the nets of commercial fishing operations and aquaculture cages (e.g. tuna farms) (DEWHA 2010). Given the lack of data on white shark populations, it is unknown whether the species is recovering. Consequently, the effectiveness of management measures is not fully understood and bycatch mortality continues to be *of potential concern* for this species until conclusive evidence of management effectiveness is provided.

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SCHEDULE 2

Regional advice on matters of national environmental significance

SCHEDULE 2 REGIONAL ADVICE ON MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Introduction

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), an action requires approval from the environment minister if it has, will have or is likely to have a significant impact (refer to glossary **www.environment.gov.au/marineplans**) on a matter of national environmental significance. A person proposing to take an action that they think is, or may be, such an action must refer it to the minister for a decision as to whether further assessment and approval are required under the EPBC Act. Substantial penalties apply for taking such an action without approval.

There are currently eight matters of national environmental significance protected under the EPBC Act:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species (except those listed as extinct or conservation dependent) and ecological communities (except those listed as vulnerable)
- migratory species protected under international agreements
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- nuclear actions, including uranium mines.

This schedule to the Temperate East Marine Bioregional Plan has been prepared under the EPBC Act. It contains information about matters of national environmental significance within the Temperate East Marine Region and should be considered when deciding whether a proposed action needs to be referred to the environment minister for a decision.

Under section 176 of the EPBC Act, once a bioregional plan has been made, the environment minister must have regard to it when making any decision under the Act to which the plan is relevant. The minister will have regard to the information provided in Schedule 2 when making decisions about referrals, assessments and approvals, as well as other relevant decisions under the EPBC Act. However, this does not limit the information the minister may consider when making decisions.

The advice contained in this schedule is not comprehensive (i.e. it does not cover all matters of national environmental significance occurring in the Temperate East Marine Region) and should not be regarded as definitive in relation to those matters for which advice is provided.

The regional advice should be read as supplementary to, and not as replacing, EPBC Act policy statements. In particular, the following policy statement is the key guidance document for determining whether a referral is required:

- *EPBC Act Policy Statement 1.1: Significant impact guidelines—matters of national environmental significance*.

Depending on the type of action proposed, industry policy statements also provide important information:

- *EPBC Act Policy Statement 2.1: Interaction between offshore seismic exploration and whales*
- *EPBC Act Policy Statement 2.2: Industry—offshore aquaculture*
- *EPBC Act Policy Statement 2.3: Wind farm industry*.

Other policy statements and guidelines may also be developed and provide important information. Further information and assistance can be obtained by contacting the referral business entry point through the department's community information unit on 1800 803 772 or by sending an email to **epbc.referrals@environment.gov.au**.

Schedule 2 does not provide advice for the assessment of the environmental performance of fisheries managed under Commonwealth legislation and state export fisheries. Guidelines for the strategic assessment of fisheries under Part 10 of the EPBC Act; assessments relating to impacts on protected marine species under Part 13; and assessments for the purpose of export approval under Part 13A are contained within the document Guidelines for the Ecologically Sustainable Management of Fisheries (**www.environment.gov.au/coasts/fisheries/publications/guidelines.html**).

Using the regional advice

This schedule is a guide and is not definitive. The regional advice provided in this schedule is augmented by information provided in the conservation value report cards, which are available on the website of the Department of Sustainability, Environment, Water, Population and Communities at **www.environment.gov.au/marineplans/temperate-east**.

The rating of risks in this schedule was developed to provide practical information on the kinds of actions which should be referred to determine if approval under the EPBC Act is needed. The ratings here are not designed to prioritise environmental risks. They relate to the risk of a proposed action needing to be referred under the EPBC Act. The highlighted advice provide further assistance in identifying types of activities that are at low risk of needing to be referred and those that are at higher risk of needing to be referred.

Considerations underpinning the rating of a risk include:

- pressure rating (of key ecological features and species, see Tables S1.2 and S1.3)
- conservation status (of species)
- presence of a biologically important area (for species; see Conservation Values Atlas **www.environment.gov.au/cva**)
- trends in pressures.

Commonwealth marine environment: Section 24 of the EPBC Act defines a Commonwealth marine area (see glossary for further details). It is the area that extends beyond the outer edge of State and Territory waters, generally 3 nautical miles (or 5.5 kilometres) from the coast, to the boundary of Australia's exclusive economic zone generally 200 nautical miles (370 kilometres) from shore. Under the EPBC Act, the environment within the Commonwealth marine area is a matter of national significance.

Where sufficient information exists to aid decision-making, this schedule presents regional advice on the Commonwealth marine environment in relation to:

- key ecological features of the Temperate East Marine Region and protected places
- protected species that occur in the Temperate East Marine Region that are not otherwise matters of national environmental significance.

Some advice provided in this schedule refers to **biologically important areas**. These are areas that are particularly important for the conservation of protected species and where aggregations of individual species display biologically important behaviour, such as breeding, foraging, resting or migration. The presence of the observed behaviour is assumed to indicate that habitat required for the behaviour is also present. Regional advice has been developed for biologically important areas due to their relevance to a protected species. The advice focused on these areas should not be construed to mean that legislative obligations do not apply outside these areas. Biologically important areas are not protected matters and should not be confused with ‘critical habitat’ as defined in the EPBC Act.

A register of **critical habitat** is maintained under the EPBC Act. The register lists habitats considered critical to the survival of a listed threatened species or listed threatened ecological community. If a habitat occurs in or on a Commonwealth area and is listed in the register, it is an offence under the EPBC Act to take an action when it is known that the action significantly damages the critical habitat.

Species protected under the EPBC Act may be listed as threatened, migratory or marine species. Those protected species that are matters of national environmental significance are:

- threatened species (other than those categorised as extinct or conservation dependent)
- migratory species.

Species that are listed under the EPBC Act but are *not* matters of national environmental significance include those species that are listed as:

- marine (s. 248 of the EPBC Act)
- cetaceans (whales, dolphins and porpoises)
- threatened species listed as extinct or conservation dependent.

However, it is possible for listed marine species and cetaceans to also be matters of national environmental significance; that is, where they have been listed as a threatened species (other than in the conservation dependent category) or as migratory. For example, the humpback whale is listed as a cetacean but it is also a matter of national environmental significance because it is listed as vulnerable and migratory under the EPBC Act.

A number of terms related to protected species that are matters of national environmental significance have specific meaning under the EPBC Act, namely:

- **Population:** A population of a species is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to species that are categorised as critically endangered, endangered or vulnerable occurrences include but are not limited to:
  - a geographically distinct regional population or collection of local populations
  - a population or collection of local populations that occurs within a particular bioregion.
- **Important population:** This term relates to populations of threatened species that are categorised as vulnerable under the EPBC Act. An important population is a population that is necessary for a species’ long-term survival and recovery. This may include populations identified as such in recovery plans, and/or populations that are:
  - key source populations either for breeding or dispersal
  - necessary for maintaining genetic diversity
  - near the limit of the species’ range.

This definition is consistent with that provided in EPBC Act *Policy Statement 1.1: Significant impact guidelines—matters of national environmental significance*. In accordance with these guidelines, in determining the significance of an impact on a vulnerable species, consideration should be given to whether an important population is found in the area.

- **Ecologically significant proportion of a population:** This term applies to species listed as migratory. In accordance with Policy Statement 1.1: Significant impact guidelines—matters of national environmental significance, for migratory listed species, consideration should be given to whether an ecologically significant proportion of a population is found in an area. Whether the species in an area represents an ecologically significant proportion of a population needs to be determined on a case-by-case basis, as different species have different life histories and populations. Some key factors that should be considered include the species' population status, genetic distinctiveness and species-specific behavioural patterns (for example, site fidelity and dispersal rates).

Schedule 2.1
The Commonwealth marine environment of the Temperate East Marine Region

The Commonwealth marine environment, including the Temperate East Marine Region, is a matter of national environmental significance under the EPBC Act. An action requires approval if it is taken:

- in a Commonwealth marine area (refer to glossary **www.environment.gov.au/marineplans**), and the action has, will have, or is likely to have a significant impact on the environment, or
- outside a Commonwealth marine area but within Australian jurisdiction and the action has, will have, or is likely to have a significant impact on the environment in a Commonwealth marine area.[7]

7 Actions taken outside the Commonwealth marine area may impact on its environment through downstream effects—for example, by resulting in water quality changes that can spread offshore beyond 3 nautical miles or by adversely affecting species that are an important component of the Commonwealth marine environment, either throughout, or at specific stages of, their lifecycle. For example, seagrass beds are an important nursery habitat for a number of species, some of which move offshore in their adult stages. Reductions in seagrass beds—for example, as a result of dredging—depending on their extent, have the potential to impact on the population dynamics of a number of species that inhabit the Commonwealth marine area

The Temperate East Marine Region covers Commonwealth waters extending from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales, as well as the waters surrounding Lord Howe and Norfolk islands. The marine environment is made up of numerous habitats, biological communities and ecosystems. Determining whether a proposed action has the potential to cause a significant impact on the marine environment requires consideration of its individual and combined components at a scale relevant to the action.

The EPBC Act Policy Statement 1.1 outlines criteria to assist in determining the significance of impacts on the Commonwealth marine environment. Specifically, an action is likely to have a significant impact on the Commonwealth marine environment if there is a real chance or possibility that the action will:

- result in a known or potential pest species becoming established in the Commonwealth marine area
- modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that there will be an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area
- have a substantial adverse effect on a population of a marine species or cetacean, including its lifecycle (e.g. breeding, feeding, migration behaviour or life expectancy) and spatial distribution
- result in a substantial change in air quality or water quality (including temperature) that may adversely impact on biodiversity, ecological integrity, social amenity or human health
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected
- have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

The regional advice in this schedule has been developed to assist the interpretation of some of these criteria within the context of the Temperate East Marine Region. The regional advice addresses:

- S2.1.1: establishment of marine pest species
- S2.1.2: adverse impacts on marine ecosystem functioning and integrity
- S2.1.3: adverse effects on populations of a marine species or cetacean (excluding those listed as threatened or migratory)
- S2.1.4: adverse impacts on heritage values
- S2.1.5: actions in Commonwealth marine reserves.

S2.1.1 Establishment of marine pest species

Although the Commonwealth waters of the Temperate East Marine Region contain introduced marine species, no pest species[8] has been recorded yet in this region. Adjacent to the region, Queensland has no recorded established invasive marine pests; however, 26 invasive marine pests are listed as posing a potential threat to the state (Hayes et al. 2004). In New South Wales waters, six listed marine pest species occur (Table S2.1) (NSW Industry & Investment 2011).

The invasive strain of the green alga Caulerpa which occurs in State waters adjacent to the region, is capable of invading benthic communities in depths up to 100 metres. Other species in State waters capable of spreading into deeper water environments include the European/green shore crab, European fan worm, Japanese goby, and the New Zealand screw shell. The National System for the Prevention and Management of Marine Pest Incursions maintains a ‘trigger list’ of species that may become invasive if introduced as part of its Emergency Marine Pest Plan.[9]

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8 Introduced marine pests are marine plants or animals that are not native to Australia but have been introduced by human activities such as shipping and have become aggressive pests.

9 **www.marinepests.gov.au**

Table S2.1: Marine pests known to be established in State waters, adjacent to the Temperate East Marine Region

Pest name	Location	Impact	Habitat
Caulerpa *(Caulerpa taxifolia)*	Batemans Bay Botany Bay Brisbane Waters Burril Lake Durras Lake Lake Conjola Narrawallee Inlet Hawkesbury River Pittwater Port Hacking Port Jackson St Georges Basin Wallagoot Lake	Overgrows native habitat and can establish vast beds on soft sediment, degrading fish habitat Tangles in nets and anchors	Depths up to 100 m Exposed and sheltered estuaries, coastal lagoons and bays Rock, sand, mud and seagrass beds

Pest name	Location	Impact	Habitat
European or green shore crab *(Carcinus maenas)*	Clyde River Batemans Bay Tomaga River/ Barlings Beach Candlagan Creek Coila Lake Wagonga Inlet Nangudga Lake Corunna Lake Tilba Tilba Lake Bermagui River Cuttagee Lake Wapengo Lake Nelson Lagoon Merimbula Lake Pambula Lake Twofold Bay Towamba River Kiah Creek Wonboyn River Nadgee Lake	Aggressive predator, outcompetes native species for food and habitat	Prefers bays and estuaries but found on all types of shores at depths up to 60 m Tolerates temperatures up to 30 °C

Pest name	Location	Impact	Habitat
European fan worm (*Sabella spallanzanii*)	Twofold Bay (near Eden)	Forms dense colonies that consume vast amounts of food No known predators in Australia	Tubes attached to hard surfaces, artificial structures, rocks, shells and seagrass on soft sediments Sheltered waters, depths up to 30 m
Japanese goby *(Tridentiger trigonocephalus)*	Sydney Harbour Port Kembla	Competes with native species	Prefers estuaries and rocky reef areas
New Zealand screw shell *(Maoricolpus roseus)*	Continental shelf off Merimbula and Bermagui	Forms a dense covering on the sea floor and competes with native shellfish for food	Depths up to 130 m Prefers sand, mud or gravel in intertidal to subtidal areas
Pacific oyster *(Crassostrea gigas)*	Most New South Wales estuaries south of the Macleay River and some offshore areas	Establish dense populations in some areas, displacing native intertidal species, with the potential to modify habitat for non-oyster species	Depths up to 3 m On hard substrate in intertidal and shallow subtidal areas Favours brackish waters in sheltered estuaries but tolerates a range of salinity and water quality Can also occur offshore

Marine pests can be introduced through ballast water exchange or via biofouling. High-risk vessels for the introduction of species include those that are slow moving, have space where marine species can settle, come in close contact with the sea bottom or remain in a single area for extended periods. These characteristics increase the likelihood that a species can establish on a vessel, from where it can be introduced to new regions. Vessels in this category include dredges, supply boats, drilling rigs and some fishing boats. Other high-risk ships include some of the flag-of-convenience carriers that are low-cost operators with poorly maintained vessels, as well as small private recreational vessels from other parts of the world.

Shallow and inshore areas, particularly port areas and sites where infrastructure development and maintenance take place, have the highest risk of marine pests becoming established. Some introduced species have the potential to settle or expand into deeper waters, including in the offshore Commonwealth marine environment.

The introduction of marine pests is a particularly important issue for the Temperate East Marine Region given the high levels of sea transport to and through the region, and fishing activity in the region.

The following types of actions have a real chance or possibility of resulting in marine pests becoming established in the Commonwealth marine environment, thereby affecting the biodiversity values and/or ecological integrity of the Commonwealth marine environment:

- development of new ports or upgrades of existing port facilities that substantially increase shipping traffic
- construction of infrastructure or any other action involving the translocation into the region of marine equipment (e.g. dredges or platforms), from within or outside Australia.

There is a low risk of marine pests becoming established in the Commonwealth marine environment or affecting its biodiversity values and/or ecological integrity as a result of these actions when appropriate mitigation measures are adopted. Mitigation measures consistent with the National System for the Prevention and Management of Marine Pest Incursions, the Australian Ballast Water Management Requirements and the *National biofouling management guidelines for commercial vessels*[10] and the *National biofouling management guidelines for recreational vessels*[11] aim to reduce the risk that actions will result in the introduction of marine pests, which may significantly impact on the Commonwealth marine environment, in port and inshore environments. Further information on responsibilities regarding the management of marine pest incursions is provided at **www.marinepests.gov.au**.

S2.1.2 Adverse impacts on marine ecosystem functioning and integrity

The Temperate East Commonwealth marine environment report card provides an overview of key ecological features defined for the region and their relevance to ecosystem processes and structure. While the report card provides useful context, determining potential impacts of specific activities on the Commonwealth marine environment requires consideration of habitats and biodiversity at an appropriate subregional and local scale.

10 **www.marinepests.gov.au/_data/pdf_file/001/1109594/Bifouling_guidelines_commercial_vessels.pdf**.
11 **www.marinepests.gov.au/_data/pdf_file/001/1109594/Bifouling_guidelines_rec.pdf**.

The regional advice below provides further guidance for considering impacts on areas and habitats that are defined as key ecological features in the Temperate East Marine Region by virtue of their regional importance for biodiversity and/or ecosystem functioning and integrity. The Temperate East Commonwealth marine environment report card provides further information, including references to relevant scientific literature, on the region's key ecological features.

The advice here provides information of relevance to people considering impacts on the Commonwealth marine environment. It is essential to note that provision of advice in relation to the key ecological features does not imply that they are the only habitats, areas, species or species groups that should be considered when determining the significance of potential impacts on the Commonwealth marine environment. It remains the responsibility of a person proposing to take an action to determine whether there is a real chance or possibility that the action is likely to result in a significant impact on the Commonwealth marine environment.

The Temperate East Marine Region has eight areas and/or types of habitats that are key ecological features (see Figure S1). Further information on these key ecological features is provided in the Temperate East Commonwealth marine environment report card (**www.environment.gov.au/marineplans/temperate-east**).

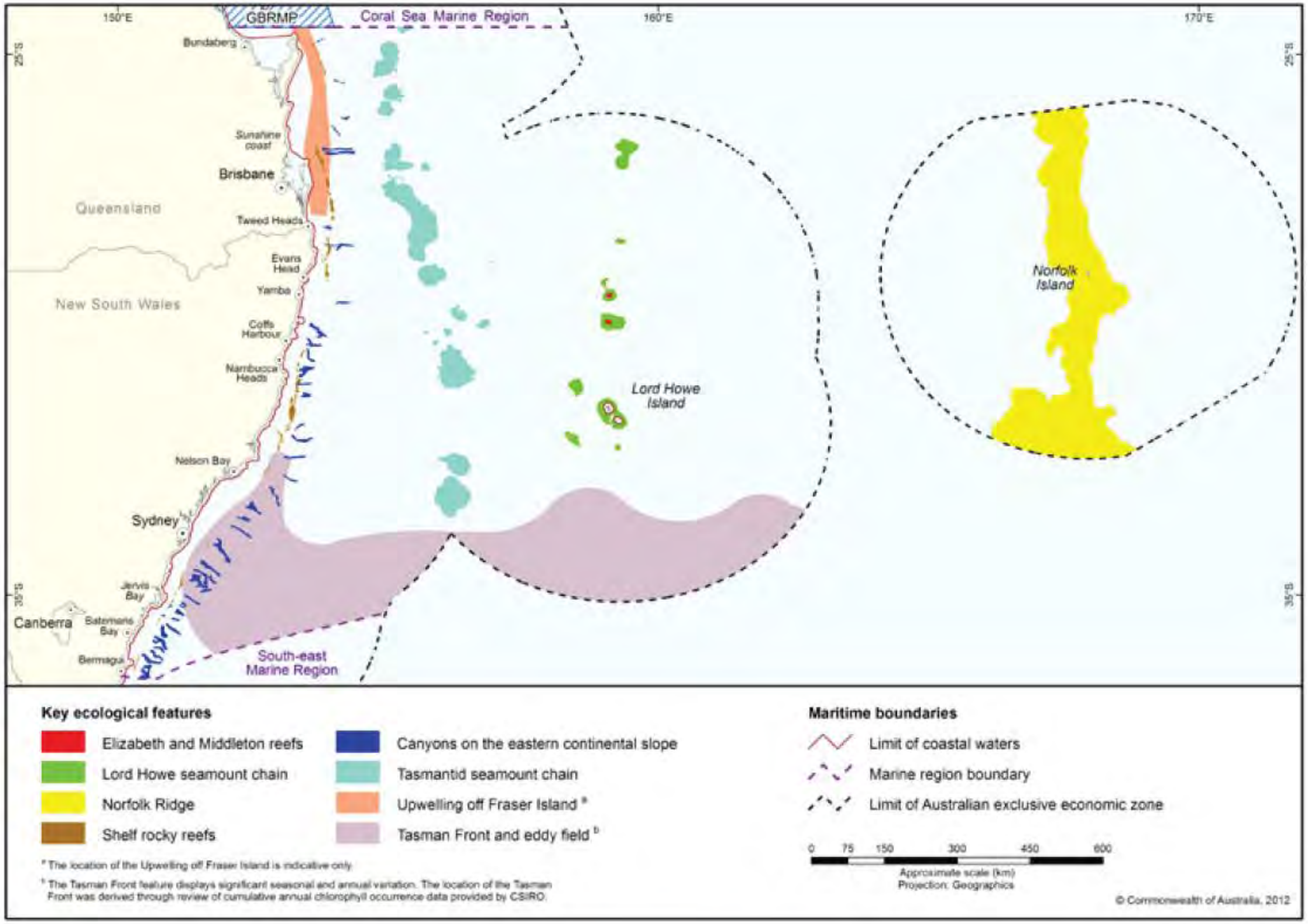

Figure S2.1: Key ecological features in the Temperate East Marine Region

In assessing the impacts of a proposed action on the Commonwealth marine environment and their significance, the relevance of the proposed action to the regional importance and vulnerabilities of the key ecological features described below should be considered.

Shelf rocky reefs: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to its benthic habitats.

Along the continental shelf south of the Great Barrier Reef, benthic communities on rock outcrops and boulder substrates shift from algae-dominated communities to those dominated by attached invertebrates. This shift generally occurs at a depth of 45 metres, and these habitats are densely populated by large sponges, with a mixed assemblage of moss animals and soft corals. Below wave-influenced areas, massive and branched forms of sponges are more prevalent, and sponge species richness and density generally increases with depth along the New South Wales coast. Collectively, these invertebrates create a complex habitat–forming community that supports a multitude of microorganisms and invertebrates, such as crustaceans, molluscs, annelids and echinoderms. These habitats also provide refuge from predation for juvenile fishes, thereby increasing their survival. Rocky reef habitats on Australia's east coast support a diverse assemblage of demersal fish, which show distinct patterns of association with shelf reef habitats. For example, jackass morwong, barracouta, orange-spotted catshark, eastern orange perch, butterfly perch and warehou are species that distinguish rocky reef habitats at depths greater than 45 metres from those of soft sediments.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- marine debris from vessel based sources
- physical habitat modification from fishing gear
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Generally, most actions in or adjacent to the Temperate East Marine Region are unlikely to impact adversely on the ecosystem functioning and integrity of the Shelf rocky reefs.

Canyons on the eastern continental slope: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

Submarine canyons are widespread features around the Australian continent and island margins, and a large number of these features are present on the eastern continental slope. Canyon systems have a marked influence on the diversity and abundance of species, driven by the combined effects of steep and rugged topography, ocean currents, varied sea-floor types and nutrient availability. Large benthic species such as attached sponges and feather stars are abundant, with high diversity at upper-slope canyon depths of 150–700 metres. Canyons also provide critical feeding grounds for a wide range of species, including many which are commercially important (e.g. tuna) and threatened (e.g. marine turtles). Canyons contribute to habitat diversity by providing a hard surface that offers anchoring points and vertical relief for filter feeder benthic species (e.g. sponges and bryozoans). A range of higher trophic level species, including crustaceans, echinoderms, bivalves, cephalopods and fish are then attracted to these regions.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the canyons on the eastern continental slope
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding the canyons on the eastern continental slope

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) in the canyons on the eastern continental slope have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Tasman Front and eddy field: This key ecological feature is recognised for its significant ecological functioning and integrity, and biodiversity, which apply to its pelagic habitats.

The Tasman Front is described as a region of intermediate productivity that separates the nutrient-poor waters of the Coral Sea from the nutrient-rich waters of the Tasman Sea. The front is formed by a meandering current located between 27° S and 33° S, which moves northward in winter months and southward in summer months. Across the southern portion of the Temperate East Marine Region, the Tasman Front creates a complex oceanographic environment where waters mix vertically. Patches of productivity are important for mid-level consumers including turtles and top fish predators, as well as catch in the Eastern Tuna and Billfish Fishery. Fishery oceanography studies describe a positive relationship between catch rates and proximity to frontal features, and a predominance of bigeye tuna and swordfish associated with the Tasman Front. The feature is also important for providing connectivity of tropical species to the Lord Howe seamount chain and Norfolk Ridge.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the Tasman Front and eddy field
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters in the area of the Tasman Front and eddy field

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) in the area around the Tasman Front and eddy field have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Upwelling off Fraser Island: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to its pelagic habitats.

In the vicinity of Fraser Island, two areas of upwelled waters mix with surface waters and are drawn onto the shelf through a number of processes, including tidal currents, wind and eddy influence. The upwelled waters support blooms of large diatoms that are important to food chains for commercially valuable species in the area. Examples of food chains include diatoms → macrozooplankton → laternfish → squid → tuna and billfish (long-chain), and diatoms→ crustaceans → tuna (short-chain). However, the entire food web for this system is complex and includes small pelagic fishes, mid-sized fish predators and top predators. The feature also appears to be an important node of connectivity in migrations of small pelagic fishes and top predators. The subtropical waters are an important spawning area for temperate small pelagic fishes (e.g. tailor, sardine, round herring and Australian anchovy), the adults of which appear to migrate from the south, and their larvae are subsequently transported back into temperate nursery areas by the East Australian Current.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution

- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the upwelling off Fraser Island
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters in the area of the Fraser upwelling

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill has a reasonable potential of arising (e.g. port developments that increase shipping and drilling) in the area of the upwelling off Fraser Island have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Tasmantid seamount chain: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Tasmantid seamount chain is a prominent chain of submarine guyots, plateaux and terraces, running north–south at approximately 155° E, and extending down into the Tasman Basin. At its deepest, features rise from 1400–900 metres below sea level; at its northern extent, features rise to from 400–150 metres below sea level, with some breaking the surface to form islands. The Tasmantid seamount chain supports a diverse range of habitats, including deep sea sponge gardens and near-pristine tropical coral reef systems. Collectively, these are known to be biological hotspots, supporting significant demersal and pelagic diversity, and feeding grounds and reproduction sites for a number of open ocean species (e.g. billfish, marine turtles, marine mammals). There is limited information regarding pelagic species composition around these seamounts, but little information on benthic species. High species diversity and endemicity has been reported from the neighbouring Lord Howe seamount chain, however, which may be used as an indicator for biodiversity levels for the Tasmantid chain.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the Tasmantid seamount chain
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding the Tasmantid seamount chain (i.e. waters adjacent to areas of the seamount chain that break the surface and those above areas that do not break the surface)

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) over the Tasmantid seamount chain have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Lord Howe seamount chain: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Lord Howe seamount chain runs for approximately 1000 kilometres along the western margin of the Lord Howe Rise, extending from Lord Howe Island in the south to Nova Bank in the north. The chain includes Lord Howe Island, Balls Pyramid, Elizabeth Reef, Middleton Reef and Gifford Guyot within the Temperate East Marine Region, and to the north of the Region are Capel, Kelso, Argo and Nova banks. The seamount chain supports tropical shallow coral reefs and deep cold water corals (depths greater than 40 metres). The fringing coral reefs around Lord Howe Island, and Elizabeth and Middleton reefs to the north, are the southernmost tropical coral reefs in the Pacific Ocean. The seamount chain lies in the path of the Tasman Front, which brings a mix of warm tropical waters and colder, nutrient-rich waters from the south, depending on the season. In general, waters surrounding this feature are nutrient-deficient and relatively unproductive. However, significantly higher catch rates of a range of tuna species along the seamounts suggest periodic bursts of productivity, presumably from subantarctic waters to the south. Deep-water, large, benthic animals occur on the Lord Howe Rise and southern portion of the Norfolk Ridge, with distributions influenced by the Tasman Front. The distribution of benthic invertebrates does extend from the Lord Howe Rise across to the northern part of the Norfolk Ridge as these features lack a hydrographic connection.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of the Lord Howe seamount chain
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding the Lord Howe seamount chain (i.e. waters adjacent to areas of the seamount chain that break the surface and those above areas that do not break the surface)

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping and drilling) over the Lord Howe seamount chain have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Elizabeth and Middleton temperate and tropical reefs: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Elizabeth and Middleton reefs are small, isolated, oceanic platform-reefs on volcanic seamounts of the Lord Howe seamount chain. The reefs are within the present filaments of the East Australian Current and represent an overlapping area of tropical, reef-building corals and cool-water, non-reef-building corals, which provide habitat for both tropical and temperate species of fish and invertebrates. The lagoons of both reefs are strongholds for populations of the black cod and Galapagos shark. A recent study of the genetic diversity of the reefs and their connectivity suggests that their gene pools are periodically supplemented by long-distance migrants and they are likely to have population sizes that are large enough to avoid inbreeding and maintain genetic diversity. For example, 48 per cent of the coral species of the southern Great Barrier Reef are also found on Elizabeth and Middleton reefs.

A pressure *of concern* on this key ecological feature is climate change, which has the potential to alter the ecological values of this feature through changes to sea temperature and ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution.

Pressures *of potential concern* on the ecosystem functioning and integrity of this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea levels and oceanographic processes. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- oil pollution and chemical pollution/contaminants from shipping traffic which can impact on water quality and ecosystem functioning and integrity
- marine debris from vessel based sources
- light pollution from offshore activities such as shipping traffic.

Actions that, irrespective of where they occur, have a real chance or possibility of resulting in:

- a substantial change in water quality that may adversely impact on biodiversity or ecological integrity in the area of Elizabeth and Middleton reefs
- persistent organic chemicals, heavy metals or other potentially harmful chemicals accumulating in the waters surrounding Elizabeth and Middleton reefs
- the introduction of a new source from which light pollution may modify, destruct, fragment, isolate or disturb an important or substantial area of habitat within the Elizabeth and Middleton reef ecosystems

have a **high risk** of a significant impact on the Commonwealth marine environment.

Actions that introduce a new source from which a severe oil spill or other chemical pollution has a reasonable potential of arising (e.g. increased shipping) at Elizabeth and Middleton reefs have a **risk** of significant impact on the Commonwealth marine environment of the Temperate East Marine Region.

Norfolk Ridge: This key ecological feature is recognised for its enhanced ecological functioning and integrity, and biodiversity, which apply to both its benthic and pelagic habitats.

The Norfolk Ridge is set within a region of remnant volcanic arcs, plateaux, troughs and basins. The ridge runs southward from New Caledonia to New Zealand, and lies between the New Caledonia Trough to the west and the Norfolk Basin to the east. The high level of diversity in seamount benthos in this area is likely to be caused by relatively productive benthic habitats that support far higher population densities than surrounding regions. The Tasman Front conveys tropical species to the southern portion of the ridge within the Temperate East Marine Region, supporting a diverse assemblage of tropical and temperate species, with evidence of connectivity to the benthic fauna of Lord Howe Rise. The semipermanent Norfolk Eddy may create a closed system that limits connectivity and increases endemism within the South Norfolk Basin.

Pressures *of potential concern* on this key ecological feature include:

- climate change, which has the potential to alter ecological values through changes to sea temperatures and oceanographic processes, and causing ocean acidification. These changes alter localised productivity and/or community structures through shifts in marine species distribution
- marine debris from vessel based sources
- extraction of living resources by commercial fishing impacting on the feature's ecosystem functioning and integrity
- bycatch.

Generally, most actions in or adjacent to the Temperate East Marine Region are unlikely to impact adversely on the ecosystem functioning and integrity of the Norfolk Ridge.

S2.1.3 Adverse impacts on populations of a marine species or cetacean (excluding those listed threatened or migratory)[12]

An impact on the Commonwealth marine environment might be significant if there is a real chance or possibility that it will result in a substantial adverse effect on a population of a marine species, including its lifecycle and spatial distribution. The regional advice below provides further guidance that might assist in considering impacts on the Commonwealth marine environment of the Temperate East Marine Region and their significance, with respect to:

- protected marine species, which are not considered matters of national environmental significance, including
  - cetaceans of known regional importance (that are not listed as threatened or migratory species under the EPBC Act)
  - listed marine species of known regional importance (that are not listed as threatened or migratory species under the EPBC Act)
  - threatened species listed as conservation dependent that are of known regional importance
- species and/or communities that have been defined as key ecological features, as they are believed to play an important role in the Temperate East Marine Region's ecosystem structure and functioning and/or to have particular relevance to its biodiversity and conservation.

It is essential to note that the provision of advice in relation to these species does not imply that they are the only species that should be considered in determining the significance of potential impacts on the Commonwealth marine environment. It remains the responsibility of a person proposing to take an action to determine whether the action will adversely and substantially affect any other marine species in a way that results in a significant impact on the Commonwealth marine environment.

12 Advice on the significance of actions for species listed as threatened and/or migratory that are matters of national environmental significance is provided in Schedules 2.2 to 2.5. (Listed threatened species that are conservation dependent and are not, of themselves, matters of national environmental significance are discussed here.)

Protected species of known regional importance (not listed as threatened or migratory)

Sixty-eight species protected under Part 13 of the EPBC Act (but not listed as threatened or migratory) are currently known to occur in the Temperate East Marine Region (see Table A appended to this schedule). The information currently available on many of these species is insufficient to provide separate regional advice. Six species are of known importance in the context of the region's biodiversity and/or ecological functioning. These species are described below to assist in the interpretation of the significant impacts criteria of EPBC Act Policy Statement 1.1.

The **Indo-Pacific (coastal) bottlenose dolphin** *(Tursiops aduncus)* is listed as cetacean and protected under the EPBC Act. Biologically important areas are defined for this species within the Temperate East Marine Conservation Values Atlas (**www.environment.gov.au/cva**). The Indo-Pacific bottlenose dolphin was only recently recognised and is considered taxonomically distinct from the common bottlenose dolphin. The common bottlenose dolphin is found throughout offshore waters of the region (including Norfolk and Lord Howe islands), but Indo-Pacific bottlenose dolphins occur in riverine and coastal waters, over shallow coastal waters on the continental shelf and around oceanic islands.

Pressures *of concern* to this species include:

- physical habitat modification associated with urban/coastal development
- bycatch associated with commercial fishing and bather protection programs.

Pressures *of potential concern* include:

- climate change (sea level rise, changes in sea temperature, oceanography and storm events and ocean acidification)
- chemical pollution/contaminants and nutrient pollution associated with urban development and agricultural activities
- marine debris
- noise pollution associated with shipping and urban development
- physical habitat modification associated with dredging activities
- oil pollution associated with shipping
- collision with vessels
- changes in hydrological regimes.

Actions that have a real chance or possibility of increasing the likelihood of chemical contamination, oil pollution and sediments in biologically important areas for the Indo-Pacific (coastal) bottlenose dolphin have a **risk** of resulting in substantial adverse effects on populations of these species.

Actions that have a real chance or possibility of increasing localised vessel traffic, including small crafts, in areas where Indo-Pacific (coastal) bottlenose dolphins reside, have a **risk** of substantial adverse impact on populations of these species.

Actions that have a real chance or possibility of increasing noise levels above ambient levels (e.g. dredging, pile-driving or blasting) have a **risk** of substantial adverse impact on populations of both bottlenose dolphin species.

Actions that have a real chance or possibility of modifying, destroying or isolating habitat (e.g. dredging or changes to hydrological regimes) have a **risk** of substantial adverse impact on populations of both bottlenose dolphin species.

Actions that have a real chance or possibility of introducing marine debris to the biologically important areas of the Indo-Pacific (coastal) bottlenose dolphins have a risk of resulting in substantial adverse effects on populations of these species.

The **little shearwater** *(Puffinus assimilis)* breeds on islands of the Lord Howe and Norfolk Island groups and, after breeding, disperses over the Tasman Sea and possibly the Coral Sea. Lord Howe Island has one of the larger breeding colonies of little shearwater in the Australian region. Biologically important areas are defined for this species within the Temperate East Marine Conservation Values Atlas. The little shearwater is vulnerable to a range of impacts from a number of invasive species. Other potential pressures include climate change (changes in sea temperature and oceanography, ocean acidification), oil pollution and chemical pollution/contaminants associated with shipping, light pollution associated with land-based activities, marine debris and human presence at sensitive sites associated with tourism, recreational and charter fishing and research activities.

The **white-necked petrel's** *(Pterodroma cervicalis)* only known breeding location in Australia is Phillip Island, off Norfolk Island. However, no breeding pairs were recorded during a recent survey of Phillip Island. Globally, the species has a very small range, breeding on two to three small islands (BirdLife International 2011). Biologically important areas are defined for this species within the Temperate East Marine Conservation Values Atlas. This species is vulnerable to a range of impacts from a number of sources. Other potential pressures include bycatch associated with commercial fishing activities, climate change (changes in sea temperatures and oceanography, ocean acidification), oil pollution and chemical pollution/contaminants associated with shipping, light pollution associated with land-based activities shortfin and longfin, marine debris and human presence at sensitive sites associated with tourism, recreational and charter fishing and research activities.

The **eastern gemfish** *(Rexea solandri)* is listed as conservation dependent under the EPBC Act. The species is distributed from southern Queensland to the central western Australian coast, including Tasmania. Genetic studies have indicated two distinct populations in Australia, one in eastern Australian waters (referred to as the eastern gemfish) and another west of Bass Strait. Gemfish are meso-pelagic, inhabiting oceanic waters around the continental shelf and upper slope, and are known to feed near the ocean floor at 100–800 metres. The only confirmed spawning area for eastern gemfish in Australian waters is off the central New South Wales coast, and fish migrate there during the spawning season. Potential pressures on this species include climate change (changes in sea temperatures and oceanography). Biologically important areas have not been identified for this species.

Orange roughy *(Hoplostethus atlanticus)* is listed as conservation dependent under the EPBC Act. A high-value commercial species, it is highly vulnerable to depletion because of its long-lived and late maturing nature. It is a deep water species associated with pinnacles, seamounts (e.g. Lord Howe Rise) and other features where its prey aggregates. In Australia, the species is widely distributed in temperate waters between southern Western Australia and central New South Wales, including Tasmania, and is most commonly found on the continental slope at depths of 500–1400 metres. Potential pressures on this species include climate change (changes in sea temperature and oceanography) and physical habitat modification. Biologically important areas have not been identified for this species.

S2.1.4 Adverse impacts on heritage values

Historic shipwrecks

There are likely to be hundreds of historic shipwrecks in the Temperate East Marine Region, but the precise location in Commonwealth waters of many of these shipwrecks in unknown (Figure S2.2). The protected places report card provides further information (**www.environment.gov.au/marineplans/temperate-east**). It is an offence under the Historic Shipwreck Act 1976 to damage, destroy or interfere with a historic shipwreck without a permit.

> Actions that have a real chance or possibility of resulting in substantial adverse impacts on the heritage values of the Commonwealth marine area, including damage to or destruction of a historic shipwreck, have a **high risk** of a significant impact on the Commonwealth marine environment.

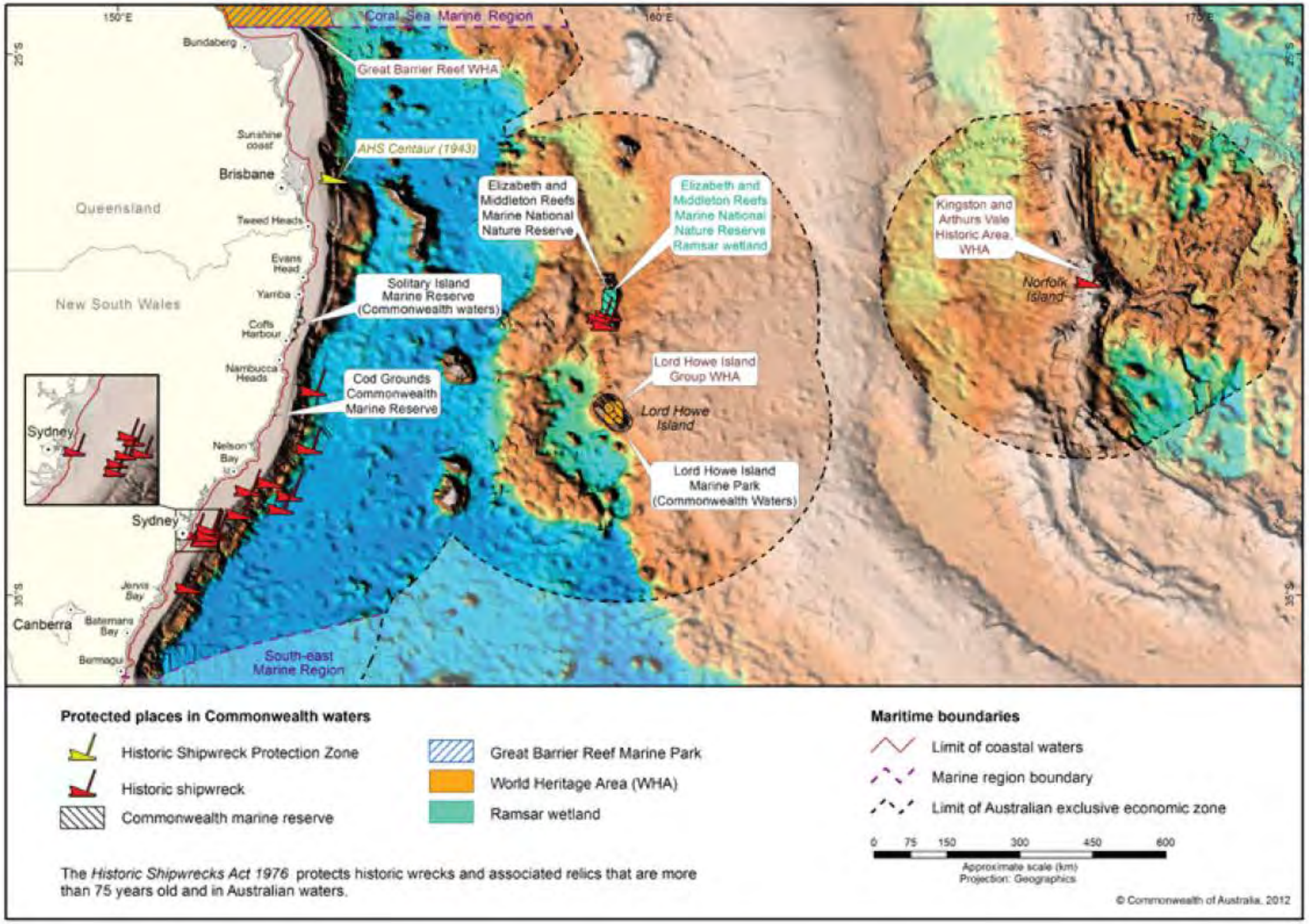

Figure S2.2: Heritage places in the Temperate East Marine Region

Other heritage places

The Lord Howe Island group is listed within several heritage categories under the EPBC Act (Table S2.2).

Table S2.2: Heritage places in the Temperate East Marine Region as of May 2012

Heritage place	Commonwealth marine reserve	World Heritage List	Commonwealth Heritage List	National Heritage List	Ramsar site	Relevant key ecological feature
Lord Howe Island group	✓	✓	✗	✓	✗	Lord Howe seamount chain

* The Lord Howe Island group World Heritage place and National Heritage place sits partly within the Lord Howe Island Marine Park (Commonwealth waters).

Heritage places adjacent to the region include the Great Barrier Reef and Kingston and Arthurs Vale Historic Area on Norfolk Island. These sites, along with the Lord Howe Island group, are listed on both the World Heritage and National Heritage lists therefore they are protected under the EPBC Act. The Act requires approval to be obtained before any action takes place that could have a significant impact on the world heritage or national heritage values of a listed place. For information on the specific world heritage and national heritage values of the three sites, visit the Australian Heritage Database at **www.environment.gov.au/heritage**.

Actions that have a real chance or possibility of causing one or more of the world heritage and/or national heritage values to be lost, degraded, damaged, or notably altered, modified, obscured or diminished, have a **high risk** of significant impact on the Lord Howe Island Group.

S2.1.5 Actions in Commonwealth marine reserves

Commonwealth marine reserves (also called marine protected areas) in the Temperate East Marine Region are areas recognised as having high conservation value. Marine protected areas in the region (Figure S2.2) for which information is provided in this plan include:

- Elizabeth and Middleton Reefs Marine National Nature Reserve
- Solitary Islands Marine Reserve (Commonwealth Waters)
- Cod Grounds Commonwealth Marine Reserve
- Lord Howe Island Marine Park (Commonwealth Waters).

The Director of National Parks is the statutory authority responsible for managing all Commonwealth reserves (including marine protected areas) as specified by the EPBC Act. The Act also requires all Commonwealth reserves (terrestrial and marine) to have a management plan. The Act prohibits some activities being carried out on or in a Commonwealth reserve unless they are expressly provided for by a management plan for the reserve or are approved in writing by the Director of National Parks when a management plan is not in operation. This includes actions that affect native species, commercial activities and mining operations.

People considering actions in or adjacent to the Temperate East Marine Region should check the Commonwealth environment department's web site (**www.environment.gov.au/marinereserves**) for the current list and location of Commonwealth marine reserves in the Temperate East Marine Region.

Elizabeth and Middleton Reefs Marine National Nature Reserve

Elizabeth and Middleton Reefs Marine National Nature Reserve is located in the Tasman Sea, approximately 600 kilometres east of Coffs Harbour and to the north of Lord Howe Island. The reserve includes two separate reefs, Elizabeth Reef and Middleton Reef. The reserve was proclaimed in 1987 and has two zones: Habitat Protection Zone (IUCN Category II) and Sanctuary Zone (IUCN Category Ia). Activities undertaken in the reserve are regulated under the management plan for the Elizabeth and Middleton Reefs Marine National Nature Reserve. This management plan is due to expire in 2013. People intending to undertake activities in Elizabeth and Middleton Reefs Marine National Nature Reserve must apply for approval from the Director of National Parks. For more information on Elizabeth and Middleton Reefs Marine National Nature Reserve, please visit **www.environment.gov.au/coasts/mpa/elizabeth/index.html**.

Solitary Islands Marine Reserve (Commonwealth Waters)

Solitary Islands Marine Reserve (Commonwealth Waters) (SIMR) is located off the coast of northern New South Wales, 600 kilometres north of Sydney, between Coffs Harbour and Plover Island. It is adjacent to the Solitary Islands Marine Park (New South Wales waters) and extends from the 3-nautical mile state limit seaward to the 50-metre depth contour. The Solitary Islands Marine Reserve encompasses the waters, seabed and subsoil beneath the seabed to a depth of 1000 metres. The Solitary Islands Marine Park covers 710 square kilometres; the Solitary Islands Marine Reserve covers a further 160 square kilometres. The reserve was proclaimed in 1993 and has three zones: General Use Zone (IUCN Category VI); Sanctuary Zone (IUCN Category Ia) and Habitat Protection Zone (IUCN Category IV). Activities undertaken in the reserve are regulated under management arrangements. People intending to undertake activities in the Solitary Islands Marine Reserve (Commonwealth waters) must apply for approval from the Director of National Parks. For more information on the Solitary Islands Marine Reserve, please visit **www.environment.gov.au/coasts/mpa/solitary/index.html**.

Cod Grounds Commonwealth Marine Reserve

The Cod Grounds Reserve comprises a 1000-metre radius from a point at 152°54’37”E 31°40’52”S, offshore of Laurieton, New South Wales. The reserve was proclaimed in 2007 as an IUCN Category 1a strict nature reserve (Sanctuary Zone) to protect important habitat of the critically endangered east coast population of grey nurse shark. Activities undertaken in the reserve are regulated under interim management arrangements. People intending to undertake activities in the Cod Grounds Commonwealth Marine Reserve must apply for approval from the Director of National Parks. For more information on the Cod Grounds Commonwealth Marine Reserve, please visit **www.environment.gov.au/coasts/mpa/cod-grounds/index.html**.

Lord Howe Island Marine Park

The Lord Howe Island Marine Park is approximately 700 kilometres north-east of Sydney. The park comprises State waters around Lord Howe Island and Ball’s Pyramid and the Commonwealth waters between 3 nautical miles and 12 nautical miles around Lord Howe Island and Ball’s Pyramid form the Lord Howe Island Marine Park (Commonwealth Waters). The perimeter of the Lord Howe Island Marine Park (Commonwealth Waters) roughly corresponds to the 1800-metre depth contour, which follows the base of the seamounts that underlie Lord Howe Island and Ball’s Pyramid. The sea area of the Commonwealth Marine Park is estimated to be 3005 square kilometres and includes the seabed to a depth of 100 metres. The reserve was proclaimed in 2000 and has two zones: Sanctuary Zone (IUCN Category 1a) and Habitat Protection Zone (IUCN Category IV). Activities undertaken in the reserve are regulated under management arrangements. People intending to undertake activities in the Lord Howe Island Marine Park (Commonwealth Waters) must apply for approval from the Director of National Parks. For more information on the Lord Howe Island Marine Park (Commonwealth Waters), please visit **www.environment.gov.au/coasts/mpa/lordhowe/index.html**.

Actions in or near Commonwealth marine reserves have a **greater risk** of significant impacts on the Commonwealth marine environment.

Advice for preparing a referral with respect to impacts on the Commonwealth marine environment of the Temperate East Marine Region

The 'referral of proposed action' form is available electronically at **www.environment.gov.au/epbc/index.html** and can also be obtained in hard copy by telephoning 1800 803 772. It includes detailed instructions about the type of information that is required in referring a proposed action for consideration.

In addition to the instructions included in the referral of proposed action form, if an action is referred because of the risk of significant impact on the Commonwealth marine environment of the Temperate East Marine Region, consideration of the following matters is recommended:

- For actions associated with physical habitat modification, for example dredging, independent dredge plume modelling undertaken to predict suspended sediment levels and the extent of sediment dispersal as a result of the proposed action would assist in assessing the action.
- For actions involving physical habitat modification, for example the dumping of dredge spoils or other materials into the Commonwealth marine environment, requirements under the Environment Protection (Sea Dumping) Act 1981 and the National assessment guidelines for dredging 2009 (DEWHA 2009) apply. An application for a sea dumping permit should be submitted. Further information on sea dumping is available at **www.environment.gov.au/coasts/pollution/dumping/index.html**.
- For actions likely to release nutrients or pollutants into the Commonwealth marine environment, modelling of nutrient or pollutant dispersal and accumulation undertaken to determine potential impacts on marine ecosystems would assist in assessing the action.
- To mitigate the effects of an accidental hydrocarbon spill from a vessel, an approved shipboard oil pollution emergency plan should be in place. For actions relating to petroleum facilities and pipelines, an approved environment plan containing an oil spill contingency plan should be in place. Further information on responsibilities regarding the protection of the marine environment from oil spills is available on the National Offshore Petroleum Safety and Environmental Management Authority's website: **www.nopsema.gov.au**.

References

DEWHA (Australian Government Department of the Environment, Water, Heritage and the Arts) 2009, *National Assessment Guidelines for Dredging, Commonwealth of Australia*, DEWHA, Canberra.

Hayes, K, Sliwa, C, Migus, S, McEnnulty, F & Dunstan, P 2004, *National priority pests: part II—ranking of Australian marine pests*, final report for the Australian Government Department of Environment and Heritage, Canberra.

BirdLife International, 2011, Species factsheet: *Pterodroma cervicalis,* BirdLife International, Cambridge, UK, viewed July 2011, **<www.birdlife.org>**.

NSW Department of Primary Industries 2011, Marine Pests, viewed October 2011, **<www.dpi.nsw.gov.au/fisheries/pests-diseases/marine-pests>**.

Schedule 2.2
Cetaceans of the Temperate East Marine Region

All cetaceans are protected under the EPBC Act in the Australian Whale Sanctuary[13] (and, to some extent, beyond its outer limits). Of the 45 cetacean species (whales, dolphins and porpoises) recorded in Australian waters, 11 are known to occur in the Temperate East Marine Region, and one other species may occur infrequently in the region. Please refer to the conservation values report card—cetaceans, for a complete list of cetaceans and additional information (**www.environment.gov.au/marineplans/temperate-east**).

The Temperate East Marine Region supports diverse and abundant cetacean populations, whose use of the region's marine habitats and resources varies markedly. Toothed whales found in the region include killer whales, the Indo-Pacific humpback and Indo-Pacific (coastal) bottlenose dolphins, known to feed on a wide range of prey including fish and squid, are also found in the region, and the area is used as a migration pathway for humpback whales between their feeding and breeding areas.

The following advice relates only to those species listed above for which it has been possible to identify biologically important areas (Table S2.3). The Indo-Pacific bottlenose dolphin is listed as cetacean and is considered in Schedule 2.1.

Table S2.3: Cetaceans listed as threatened and/or migratory with known biologically important areas in or adjacent to the Temperate East Marine Region

Species	Listing status
Humpback whale (*Megaptera novaeangliae*)	Vulnerable, migratory
Indo-Pacific humpback dolphin (*Sousa chinensis*)	Migratory

13 The Australian Whale Sanctuary was established under the EPBC Act to protect all whales and dolphins in Australian waters. The Australian Whale Sanctuary comprises the Commonwealth marine area and covers all of Australia's Exclusive Economic Zone which generally extends out to 200 nautical miles from the coast and includes the waters surrounding Australia's external territories such as Christmas, Cocos (Keeling), Norfo k, Heard and Macdonald Islands. Within the Australian Whale Sanctuary it is an offence to kill, injure or interfere with a cetacean. Severe penalties apply to anyone convicted of such offences. More information about the Australian Whale Sanctuary can be found at **www.environment.gov.au/coasts/species/cetaceans/conservation/sanctuary.html**.