Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves

2007–2017
Management Plan No 55

Department of Environment and Conservation

MPRA
MARINE PARKS & RESERVES AUTHORITY

MANAGEMENT PLAN FOR THE MONTEBELLO/BARROW ISLANDS MARINE CONSERVATION RESERVES 2007-2017

Management Plan No. 55

including the
Montebello Islands Marine Park,
Barrow Island Marine Park and
Barrow Island Marine Management Area.

VISION

To conserve the marine flora and fauna, habitats and water quality of the Montebello/Barrow islands area. The area will support commercial and recreational activities which are compatible with the maintenance of environmental quality and be valued as an important ecological, economic and social asset by the community.

Prepared by the Department of Environment and Conservation

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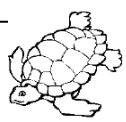

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EXECUTIVE SUMMARY

The *Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007 - 2017* (this document) was formally approved by the Minister for the Environment on 6 December 2006. It was produced on behalf of the Marine Parks and Reserves Authority (MPRA), by the Department of Environment and Conservation (DEC)[1], in consultation with the community.

The plan directs management for a ten year period for three reserves, namely the Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, which were gazetted on 10 December 2004. The reserves are located off the north-west coast of Western Australia, approximately 1,600 km north of Perth, and cover areas of approximately 58,331 ha, 4,169 ha and 114,693 ha respectively. The management objectives, strategies and targets documented in this management plan are applicable to all three marine conservation reserves unless otherwise stated. The majority of islands in the area are vested in the Conservation Commission of Western Australia and managed by DEC for conservation. The Montebello Islands are also managed to allow a level of recreation that is consistent with protecting the natural values or features of archaeological, historic or scientific interest.

The Montebello/Barrow islands marine conservation reserves have very complex seabed and island topography including sheltered lagoons, channels, beaches and cliffs. This complexity has resulted in a myriad of different habitats in the reserves supported by high sediment and water quality. These habitats include subtidal coral reefs, macroalgal and seagrass communities, subtidal soft-bottom communities, rocky shores and intertidal reef platforms, which support a rich diversity of invertebrates and finfish. The mangrove communities are made of up six species and are considered to be globally significant because they occur in lagoons of offshore islands. The reserves are important breeding areas for several species of marine turtles and seabirds, which use the undisturbed sandy beaches for nesting. Humpback whales migrate through the reserves and dugongs occur in the shallow warm waters.

The area's panoramic seascapes, abundance of wildlife and wilderness feeling are attracting a growing number of nature-based tourism operators, with people participating in activities such as fishing, diving, wildlife viewing, island exploration and surfing. Excellent recreational fishing opportunities exist in the reserves, with a variety of finfish and invertebrate species being targeted. The reserves also have a strong European and maritime heritage dating from 1622 which includes pearling, whaling, and fishing for turtles. The Montebello Islands also have a degree of notoriety as a result of British atomic weapons testing in the 1950s. The area is part of the State's most productive petroleum region, with approximately 59% of the State's oil and 93% of the State's gas production coming from the North West Shelf (at the time of publication). The pristine waters of the reserves also provide optimal conditions for the production of high quality pearls, and support a range of commercial fisheries.

The management plan reflects a pro-active approach to conserving these values and managing human activities. The plan has been prepared in the context of an over-riding community vision that reflects the aspirations of the community of Western Australia for conservation and sustainable management of human activities of the area, both now and in the future. The format of the management plan is based on key ecological and social values, an assessment of risks to these values and the formulation of operational management objectives, long-term management targets and key management strategies for the area. The plan has an emphasis on an outcome-based approach to facilitate more effective auditing of the implementation of the plan by the management agency (DEC) and the statutory vesting authority (MPRA).

Key outcomes of the management planning process detailed in the management plan include:

- implementation of a zoning scheme that includes sanctuary, recreation, special purpose, and general use zones. This reflects the Government's commitment to a multiple-use approach in marine reserves that meet a range of community and government aspirations for biodiversity conservation, sustainable use, nature appreciation, scientific study and public enjoyment;
- inclusion of approximately 28,626 ha or 49% of the Montebello Islands Marine Park and approximately 4,169 ha or 100% of the Barrow Island Marine Park in sanctuary zones;

[1] *The Department of Environment and Conservation was formed on 1 July 2006 through the amalgamation of the Department of Conservation and Land Management and the Department of Environment. Reference to the Department of Environment and Conservation prior to this date is interpreted to mean the former Department of Conservation and Land Management.*

- a highly protected area, covering approximately 1,642 ha or 1%, in the Barrow Island Marine Management Area, to provide additional protection for marine flora and fauna and migratory birds;
- approximately 26,827 ha or 46% of the Montebello Islands Marine Park zoned as general use and approximately 113,051 ha or 99% of the Barrow Island Marine Management Area that is unzoned, in which a range of recreational and commercial activities, including fishing, are permitted;
- an additional approximately 2,876 ha or 5% of the Montebello Islands Marine Park in recreation and special purpose zones, in which recreational and limited commercial fishing are permitted;
- a suite of strategies in seven program areas, including education, public participation, management intervention and visitor infrastructure, patrol and enforcement, research, and monitoring to help achieve the management objectives for biodiversity conservation and sustainable use;
- a collaborative approach between government agencies, particularly between the DEC and the Department of Fisheries;
- prioritised and coordinated research and monitoring programs to support adaptive management, and performance assessment; and
- complementary management of the adjacent island conservation reserves and the marine conservation reserves.

The implementation of this management plan will be regularly reviewed by DEC and audited by the MPRA every three years to ensure the management objectives are being met, and to ensure that the management arrangements and strategies for the reserves remain appropriate to meet these objectives.

1 INTRODUCTION

The coastal environment of Western Australia extends from latitudes 14° to 35° South and ranges from the warm, tropical waters of the Kimberley coast to the cool temperate waters of the Great Australian Bight. This coastline is over 13,000 kilometres in length and comprises about 40% of the continental coastline of Australia. A unique feature of the coastal waters of Western Australia is the Leeuwin Current, a flow of tropical water that moves southwards along the edge of the continental shelf. Although flowing year round, the current is stronger and closer to shore during autumn and winter due to the absence of the opposing southerly wind stress and the associated nearshore and northward flowing Capes and Ningaloo currents that occur during the late spring and summer months (Pearce & Pattiaratchi, 1999; Taylor & Pearce, 1999).

The Leeuwin Current has a major influence on the biogeography of the State's marine flora and fauna and is responsible for the occurrence of tropical biota at latitudes where these species are not typically found (Pearce & Walker, 1991). Three major biogeographical zones are recognised along the Western Australian coast: a *tropical* zone north of North West Cape; a *temperate* zone east of Cape Leeuwin; and a *biological overlap* zone in between. Other major influences on the marine environment of Western Australia are the regular occurrence of severe tropical storms (i.e. cyclones), particularly off the northwest coastline, the low level of freshwater and sediment input to most nearshore waters and the high wave energy of the west and south coasts.

The above natural characteristics and influences combine to produce a diversity of marine ecosystems and habitats unrivalled in other states of Australia. Much of the marine biodiversity of the State is poorly described, particularly along the west and south coasts where many endemic species are likely to occur. The conservation of Western Australia's marine biodiversity is not only important from an intrinsic point of view, but also as the fundamental basis of major recreational, nature-based tourism, fishing and, potentially, pharmaceutical opportunities.

In recognition of the importance of conserving the State's marine biodiversity, the then Minister for the Environment established the Marine Parks and Reserves Selection Working Group (MPRSWG) in 1986 to identify representative and unique areas of Western Australia's marine waters for consideration as part of a statewide system of marine conservation reserves under the *Conservation and Land Management Act 1984* (CALM Act). The MPRSWG's report was released in June 1994 and identified over 70 candidate areas throughout the coastal waters of Western Australia.

The marine and coastal environments of the Montebello/Barrow/Lowendal islands region represent a unique combination of offshore islands, intertidal and subtidal coral reefs, mangroves, macroalgal communities and sheltered lagoons, and were identified in the MPRSWG report as a distinct coastal type with very significant conservation values (MPRSWG, 1994). Specifically, the MPRSWG recommended that the waters encompassing the Montebello Islands, Biggada Reef on the western side of Barrow Island and Bandicoot Bay on the southern end of Barrow Island be considered for reservation (MPRSWG, 1994). In May 2000, the then Minister for the Environment appointed a community-based committee, the Advisory Committee for the Proposed Montebello/Barrow Islands Marine Conservation Reserve, to assist the then Department of Conservation and Land Management in developing a management plan to guide the conservation and management of the marine environment in this area. The advisory committee met five times before finalising its advice to the Minister in May 2003.

The *Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves* provides a detailed description of the ecological and social values of the area, management objectives, strategies and targets. The goal of the plan is to facilitate the conservation of the marine biodiversity of the area and to ensure that the existing and future pressures on the reserves' values are managed within an ecologically sustainable framework. The plan also provides mechanisms for the community and visitors to actively participate in the day to day management of the area.

The management plan for the reserves should not be viewed in isolation, but as an integral part of a suite of complementary management practices that occur within and adjacent to the reserves. These include fisheries regulations, industry regulations, wildlife protection, pollution control and environmental impact assessment, as well as maritime transport and safety measures. The plan has been prepared to complement the management objectives of the adjacent island reserves. In addition, it should be noted that many marine species are not permanent residents of the reserves and move in and out of the reserves during different stages of their lifecycles. The water quality within the reserves may also be affected by activities outside the reserves and by land-based activities. It is therefore critical that the environmental management objectives of the environment external to

and within the reserves are compatible. The plan provides a framework to achieve the integration and close co-operation between marine management and regulatory agencies that is necessary to achieve the conservation and sustainable management objectives outlined in the plan.

2 MANAGEMENT CONTEXT

2.1 State Policy Context

The Department of Environment and Conservation (DEC) was formed on 1 July 2006 through the amalgamation of the Department of Conservation and Land Management (CALM) and the Department of Environment (DoE). References to DEC prior to this date are to be interpreted to mean the former Department of Conservation and Land Management.

The CALM Act provides the State legislation to create marine conservation reserves and seven such reserves were created between 1987 and 1990. In 1994, the State Minister for the Environment released a report entitled *A Representative Marine Reserve System for Western Australia* (MPRSWG, 1994) that identified over 70 areas in the coastal waters of Western Australia that were worthy of consideration for marine reservation under the CALM Act. In 1997, legislative changes were made to the CALM Act to alter mechanisms by which marine conservation reserves were established, vested and managed. These changes revised statutory consultative protocols for the establishment of marine reserves, provided clear guidance for commercial activities in marine reserves, and established the Marine Parks and Reserves Authority (MPRA). The New Horizons policy released in June 1998 (Government of Western Australia, 1998a) provided policy guidance in respect to the establishment and management of marine conservation reserves.

2.2 Legislative Framework

The CALM Act provides the legislative mechanism to create and manage marine conservation reserves in Western Australia. Marine conservation reserves are vested (i.e. legally entrusted) in the MPRA, and DEC is responsible for their management. The *Wildlife Conservation Act 1950* (WC Act), which is also administered by DEC, provides legislative protection for flora and fauna across the State's lands and waters. The *Conservation and Land Management Regulations 2002* provide a mechanism to manage human impacts in marine conservation reserves, through enforcement and licensing. The *Wildlife Conservation Regulations 1970* regulate interaction with fauna and flora through a licensing system. The Department of Fisheries (DoF) is responsible for the management and regulation of recreational and commercial fishing, aquaculture and pearling in CALM Act marine conservation reserves in accordance with the *Fish Resources Management Act 1994* (FRM Act) and the *Pearling Act 1990*. The *Fishing and Related Industries Compensation (Marine Reserves) Act 1997* provides the mechanism by which the holder of an existing DoF authorisation for commercial fishing, aquaculture, pearling or fish processing may seek compensation if the commercial value of the authorisation is apparently diminished. Events that can give rise to compensation are the establishment of a marine nature reserve, or the classification of an area of a marine park as sanctuary area, recreation area or special purpose area (in which commercial fishing activity is incompatible with the purpose of that area).

The *Western Australian Marine Act 1982* and *Navigable Waters Regulations 1983* regulate boating in State waters and apply within marine conservation reserves. Both Acts are administered by the Department for Planning and Infrastructure (DPI). In addition, any development that may have a significant impact on the environment in or adjacent to a marine conservation reserve is assessed in accordance with the *Environmental Protection Act 1986* (EP Act) by the Environmental Protection Authority (EPA). DEC is responsible for controlling pollution to marine waters. The *Barrow Island Bill 2003* ratifies an agreement between the State Government and Gorgon joint venturers relating to a proposal to undertake offshore production of natural gas and other petroleum and, a gas processing and infrastructure project on Barrow Island.

The reserves lie within State territorial waters, which extend three nautical miles seaward of the territorial baseline. Waters seaward of this limit and extending to the 200 nautical mile limit fall under the jurisdiction of the Commonwealth Government. The reserves encompass many islands which are terrestrial reserves vested in the Conservation Commission of Western Australia (hereafter referred to as the Conservation Commission) and managed by DEC. While these terrestrial reserves do not form part of the marine reserves and, in general, are not covered by this management plan, they do extend to mean low water mark and include substantial intertidal areas with a marine character. Thus, DEC will ensure that the management of the islands will be complementary to that of the marine conservation reserves. During the course of the management plan, the vesting authorities will further consider the most appropriate tenure for these intertidal areas and make any necessary changes.

2.3 National and International Context

At a national level, the conservation of marine biodiversity, maintenance of ecological processes and the sustainable use of marine resources are addressed by the Intergovernmental Agreement on the Environment. This is implemented through actions developed under national strategies such as the *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992), the *National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia, 1996a), *Australia's Oceans Policy* (Commonwealth of Australia, 1998) and the *Strategic Plan of Action for the National Representative System of Marine Protected Areas: A Guide for Action by Australian Governments* (ANZECC TFMPA, 1999).

The reserves form part of the National Representative System of Marine Protected Areas (NRSMPA). The NRSMPA is being developed cooperatively by the Commonwealth, State and Northern Territory governments responsible for the conservation, protection and management of the marine environment (ANZECC TFPMA, 1998a). The primary goal of the NRSMPA is to establish and manage a comprehensive, adequate and representative system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels.

The development of an NRSMPA helps fulfil Australia's international responsibilities and obligations as a signatory to the Convention on Biological Diversity, and provides a means of meeting obligations under the Convention on Migratory Species (Bonn Convention) and under bilateral agreements for migratory birds with Japan and China. In addition, it supports the World Conservation Union (IUCN) World Commission on Protected Areas Program that promotes the establishment and management of a global representative system of marine protected areas (ANZECC TFPMA, 1998b).

2.4 Responsibilities of Authorities and Government Agencies

DEC is responsible for the overall management of marine conservation reserves under the marine conservation reserve provisions of the CALM Act. DEC also collaborates with other agencies and authorities (i.e. MPRA, Conservation Commission, EPA, DoF, DPI and local government authorities) that have responsibilities within marine conservation reserves and in the surrounding waters and coastal areas, in order to ensure the various regulatory and management practices are complementary. The MPRA plays a pivotal role in the establishment of marine conservation reserves and their management plans, and in auditing the management of marine conservation reserves vested in the Authority. The MPRA audit function is fundamental in ensuring that management of these reserves is achieving stated objectives and targets. The management plan provides the principal framework to enable the MPRA to carry out this function.

In some cases Memoranda of Understanding (MOUs) are developed to facilitate co-operation and promote operational efficiency. A MOU has been developed between the Minister for the Environment and the Minister for Fisheries to establish principles of cooperation and integration between DEC and DoF in the management of the State's marine protected areas. Under this MOU, DEC works closely with DoF through joint working plans for efficient and effective delivery of the strategies contained within the management plan for which there is a lead or shared agency responsibility of mutual interest. A MOU between the EPA and the Department of Industry and Resources (DoIR) has been developed to guide assessment of petroleum activities, including within marine reserves.

The State agencies with statutory responsibilities in marine conservation reserves in Western Australia are listed in Table 1.

Table 1: State authorities and agencies with responsibilities in the reserves

Marine Parks and Reserves Authority	• vesting body for marine conservation reserves; • provides policy advice to the Minister for the Environment; and • audits management plan implementation by DEC.
Department of Environment Conservation	• manages marine conservation reserves vested in the MPRA. This includes: a) preparation of management plans; b) implementation of the management plan; c) co-ordination with other agencies; d) implementation of education, public participation, and monitoring programs; e) wildlife research and management; f) management of nature-based tourism; and g) lead role in enforcement (non-fisheries issues). • ensures integrated management of marine conservation reserves with adjoining mainland and island conservation reserves; • assists the Environmental Protection Authority in the process of assessing proposals that may significantly affect the marine environment, including marine conservation reserves; and • administers pollution control legislation.
Department of Fisheries	• manages and regulates commercial and recreational fishing, aquaculture and pearling in all State waters, including marine conservation reserves. This includes the application of restricted seasons, bag and size limits; and • leads enforcement of fisheries legislation within marine conservation reserves.
Department for Planning and Infrastructure	• responsible for all boating regulations including licensing, safety standards, vessel navigation, marker buoys, moorings, jetties and support facilities such as navigation marks, navigation charts and harbour facilities (NB mooring controls can be delegated to other agencies); • chairs and supports the State Coordinating Committee which provides the mechanism to coordinate the management of marine pollution incidents; and • responsible for management of vessel navigation and in the development and management of support facilities.
Environmental Protection Authority	• assesses reports and makes recommendations on proposals that may significantly affect the marine environment, including marine conservation reserves.
Department of Water	• responsible for licensing, regulation and allocation of water supplies; and • monitor stream and groundwater quality and flows;
Department of Industry and Resources	• administers Acts that control mineral and petroleum exploration and development; and • regulates petroleum and mining industry operations.
Western Australian Maritime Museum	• protects pre-1900 shipwrecks and artefacts under the *Marine Archaeology Act 1973*. Shipwrecks over 75 years old are declared and protected under the Commonwealth *Historic Shipwrecks Act 1976.*
Department of Indigenous Affairs	• protects indigenous heritage and culture under the *Aboriginal Heritage Act 1972*.

3 MANAGEMENT FRAMEWORK

3.1 'Best Practice' Management Model

The conservation of marine biodiversity and management of human activities to maintain their sustainability are achieved through a number of complementary mechanisms that include marine conservation reserves, fisheries regulations, pollution control, environmental impact assessments of development proposals and maritime safety regulations. In this way, the management of the reserves will employ both specific management strategies (provided in Section 9) and generic strategies (provided in Sections 7-8) to ensure that human activities are carefully managed to meet conservation and sustainable use objectives.

The content of this section is based on the best practice principles outlined in the report entitled *Best Practice in Performance Reporting in Natural Resource Management* (ANZECC, 1997). The model is also broadly consistent with the performance assessment framework being developed in the *Strategic Plan of Action for the National Representative System of Marine Protected Areas: A Guide for Action by Australian Governments* (ANZECC TFMPA, 1999). The values, objectives, strategies, performance measures and management targets provided in Section 9 reflect an outcome-based best practice approach from which the effectiveness of management can be assessed. This model has been adopted by the MPRA to facilitate better conservation and management outcomes and a more objective and effective approach to auditing DEC's management.

Ecological and Social Values

The conservation of marine biodiversity and the management of human uses are the major objectives of the reserves. These broad objectives need to be defined operationally to be useful in a management context. This is achieved by first identifying the key ecological and social values of the reserves, and then setting management objectives, strategies and targets in relation to these values.

Ecological values are the intrinsic physical, chemical, geological and biological characteristics of an area. For management purposes, the major ecological values are listed individually in this plan. However, in reality, the marine environment of the reserves is a structurally and functionally complex array of relationships between plants and animals interacting with their physical environment.

The ecological vales should (where appropriate) include:

- species and communities that have special conservation status;
- key species endemic to the reserve;
- key structural components of the ecosystem (e.g. coral reef and macroalgal communities);
- exploited species and communities (e.g. targeted fish populations); and
- key physical-chemical components of the ecosystem (e.g. water and sediment quality and geomorphology).

Social values are the major cultural, aesthetic, recreational and economic attributes of the area.

Management Objectives

Management objectives identify **what** the primary aims of management are and reflect the statutory responsibilities of the CALM Act. Objectives have been developed for all of the ecological and social values of the reserves. Where a significant pressure/s on an ecological value has been identified, the management objective addresses the specific pressure/s. When there is not an obvious existing pressure or threat, the management objective provides broader direction to management in relation to protecting the value from the most likely future threats. Management objectives for social values address, where appropriate, the effect of the activity on other values of the reserves and the complementary interests of other statutory management arrangements or activities that exist in the reserves.

Management Strategies

Specific management strategies or actions provide direction on **how** the management objective/s for each value will be achieved. All strategies outlined in this plan have been defined as high (**H**), medium (**M**) or low (**L**) priority to provide an indication of their relative importance. The strategies considered to be critical to achieving the long-term objectives of the reserves are designated as *key management strategies* (**H–KMS**). A proposed timeline for implementing the management strategies is outlined in Appendix IV. It should be noted that management priorities may alter in response to changes in usage patterns or to new knowledge acquired during the life of the management plan.

Performance Measures
Performance measures are **indicators of management effectiveness** in achieving the reserves' objectives and targets. Performance measures should be quantitative, representative and, where possible, simple and cost-effective. The management plan usually contains generic performance measures (e.g. often diversity and abundance/biomass). Specific performance indicators will be developed during the design and implementation of monitoring programs. Performance measures for indirect (e.g. nutrient enrichment impacts on corals) and direct (e.g. anchoring impacts on corals) impacts should focus on surrogate (e.g. changes in phytoplankton biomass and species composition) and direct (e.g. changes in coral cover) measures of the value respectively. These will be developed during the early phase of the implementation of the plan.

In regard to the *active* social values (i.e. those social values that have the potential to negatively affect the ecological values of the reserves) the performance assessment approach incorporates information on the status and level of the human activities. This information is important in monitoring human activities to assist in determining trends in use, and in assessing impacts of these social values on the ecological values of the reserves.

Management Targets
Management targets represent the **end points of management**. Targets should be measurable, time bound and expressed spatially. Ecological targets will be set as either the 'natural state' or some acceptable departure from the 'natural state'. Quantitative targets for marine habitats in unzoned areas of the marine management area will be developed in consultation with stakeholders in the early phase of the management plan's implementation, following additional habitat mapping to more accurately define the extent of habitats. The long-term target provide specific benchmarks to assess the success or otherwise of management actions within the life of the management plan. The short-term target, where identified, provides a rehabilitation milestone and is used when the condition of the value is well below the desired condition (i.e. the long-term target). The targets for *active* social values (e.g. recreational fishing, commercial fishing, nature-based tourism, pearling, water sports, hydrocarbon exploration and production industry, and scientific research) are process-based and are generally stated as *"Implementation of management strategies within agreed timeframes"*. This ensures that strategies for the social values are implemented in accordance with the management objectives.

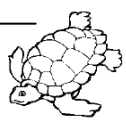
Key Performance Indicators
Key performance indicators (KPIs) are a **measure of the overall effectiveness** of management in relation to the strategic objectives of the reserves. KPIs relate specifically to the management targets for key ecological and social values and reflect the highest conservation (from biodiversity and ecosystem integrity perspectives) and management (social) priorities of the MPRA, DEC and the community. KPIs are a key element of the MPRA audit process (Section 10).

The values of the reserves were prioritised and a risk assessment of the pressures on these values was developed and will be periodically reviewed. The KPIs for the reserves will be the management targets for *water quality, coral reef communities, mangrove communities, macroalgal and seagrass communities, turtles* and *finfish*.

3.2 Determining Management Priorities

Management of the reserves aims to conserve the marine biodiversity, while maintaining opportunities for people to appreciate and enjoy the area, where these activities are compatible with maintaining the reserves' values. A pro-active and precautionary approach to conserving marine biodiversity is used to determine management priorities. A risk assessment is undertaken by considering the likelihood of existing and potential pressures affecting the ecological and social values and their associated ecological and social consequences. The relative level of risk posed by existing and/or potential pressures on the values of the reserves can be assessed by considering the following factors:

- the *biological intensity* of the pressure – pressures that impact lower trophic levels (i.e. primary producers such as seagrasses and macroalgal communities) are often of greater management concern than pressures on higher trophic levels;
- the *temporal* scale of the pressure – ongoing pressures are generally of greater management concern than pressures that are short-lived;
- the *spatial* scale of the pressure - pressures that occur over a large area are often of greater management concern than localised pressures;
- the *social consequence* – acknowledges that different pressures have different social and political consequences. A high socio-economic/political consequence is often of greater management concern; and
- the *probability* of a pressure occurring within the timeframe of the management plan.



The natural attributes and the major uses of the Montebellos/Barrow Island area are relatively well known, but the short-term and long-term cumulative ecological effects of pressures are not fully understood. For the purposes of developing management priorities, pressures on the values are confined to current pressures and pressures likely to occur during the life of the management plan and considered to be manageable within a marine conservation reserve context. By definition, this excludes global pressures such as climate change. The potential impact of these global pressures is, however, considered in the development of the strategies for the management of the reserves. The vision and strategic objectives of the plan (Section 6) provide the longer term (>10 years) direction for management of the reserves.

4 REGIONAL PERSPECTIVE

4.1 Bioregional Setting

The reserves lie approximately 1,600 km north of Perth and are in the Pilbara Offshore (PIO) marine bioregion (IMCRA, 1997), which covers an area of 41,491 km^2 (41,491,000 ha) seaward of the 10 m depth contour between North West Cape and Cape Keraudren. The reserves cover a broad range of habitats, flora and fauna, which are typical of this bioregion. The PIO marine bioregion is characterised by a series of limestone islands on a section of coast where the continental shelf is wide and the Montebello/Barrow islands comprise a geomorphological and ecological unit that is unique in this area. Because of the range of substrate types and oceanographic conditions, the structural variety of the system creates exceptional habitat diversity and these habitats are species-rich. While most species in the region are tropical and are distributed widely throughout the Indo-West Pacific region, there is a significant endemic component. The PIO marine bioregion also contains mangroves that occur in isolated communities in sheltered lagoons and as scattered mangrove trees, typically on the eastern sides of islands. The area is considered to be in a generally undisturbed condition, largely as a result of the relatively low human usage and the existing management of industry activities in the area. The Montebello/Barrow islands region was identified for consideration as a marine conservation reserve in the MPRSWG report for these reasons (MPRSWG, 1994).

4.2 Geology and Geomorphology

The Montebello Islands complex consists of 265 distinct, low lying islands and islets composed of limestone and cross-bedded sandstones. The islands are generally irregular with convoluted coastlines that comprise a mixture of lagoons, channels, intertidal embayments, barrier and fringing reefs, intertidal rocky and occasionally sandy shores and shallow limestone platforms that are exposed to open ocean conditions. The islands may be capped with sand dunes up to 40 m high, although most are characterised by bare rocky terrain. The Lowendal Island group contains more than 40 limestone islands, islets and rocky stacks, which typically have steep shorelines. The larger islands have dunes of white sand, while the smaller islands consist mostly of low lying, bare rocky islets and stacks. Barrow Island is the largest island within the reserves, and there are nine smaller islands nearby. Barrow Island is composed almost entirely of limestone outcrops and deposits overlain by sands and gravels. It reaches a height of 62 m above sea level, and has steep, undercut limestone shores with intertidal limestone pavements.

4.3 Climate

The climate of the area is both arid and tropical. It is controlled largely by the seasonal movement of high pressure anti-cyclonic weather systems that migrate northwards in winter. This results in warm, dry winters from May to September and hot, humid summers between October and April. Rainfall is low and extremely variable, with the annual average for Barrow Island being 320 mm. However, dews are common and provide a more reliable source of fresh water. Cyclones can form off the coast at any time during the year, but are most prevalent between November and April.

The hottest month is March with an average maximum temperature of 34.7ºC and an average minimum of 25.7ºC. July is the coolest month, with an average maximum temperature of 24.4ºC and an average minimum of 16.8ºC (Bureau of Meteorology, 2006). During the winter season, winds are predominantly easterly and can be very strong, peaking at 60 knots offshore. During summer, westerly to south-westerly winds dominate. Winds are at their weakest and most variable during the seasonal changeovers between summer and winter, around April and September.

4.4 Oceanography

The Montebello/Barrow islands are located in an area considered to be the headwaters of the Leeuwin Current.

This relatively low salinity, narrow current flows southwards along the Western Australian coastline from the North West Shelf to the Great Australian Bight. Nearshore water movements and mixing patterns in the Montebello/Barrow islands region are driven primarily by strong current flows, moderate tidal ranges and winds, but are also influenced by wave pumping, seabed topography and the steering effect of islands and reefs. These processes cause strong currents and flushing in most parts of the region, although some areas, including the lagoons and intertidal embayments of the Montebello Islands, may be subject to weaker currents and limited flushing. Water clarity in the region varies according to water movement and sediment type but is generally clearer on the western sides of the Montebello Islands and Barrow Island.

4.5 Ecology

The marine flora and fauna of the Montebello/Barrow islands region is dominated by tropical species, and the region is biologically connected to more northern areas by the Leeuwin Current and the Indonesian Throughflow. Preliminary surveys indicate that, while most of the diverse marine biota is typical of the Indo-West Pacific flora and fauna, there is a significant degree of endemism in the region. Furthermore, the region is likely to support many undescribed species. While macroalgae-dominated limestone reef and subtidal reef platform/sand mosaic are the main marine habitat types in the Montebello/Barrow islands region, coral reef, mangroves and subtidal sand and soft-bottom habitats are also common. Macroalgal communities, which are the major primary producer for the area, mainly comprise species of brown algae, particularly of the genera *Sargassum*, *Turbinaria* and *Pandina*, while green algae from the genera *Caulerpa* and *Cladophora* are also abundant. A wide range of invertebrate life is associated with this habitat. The subtidal coral reef communities in the reserves have a high diversity of invertebrates, with at least 150 species of hard corals recorded from fringing and patch coral reef areas. Sand habitats are generally unvegetated but may have seasonal vegetation or permanent patches of seagrass or macroalgae and a significant invertebrate fauna. Rocky shores are typically undercut, unvegetated, low limestone cliffs, which support a variety of mollusc species and other invertebrates. The six species of mangroves that occur in the reserves represent the unique offshore mangrove communities of the Pilbara, and are considered to be globally significant (Semeniuk, 1997). Mangrove communities support a range of invertebrate fauna and provide nursery habitat for fishes and crustaceans. The benthic and shoreline habitats in the reserves are shown in Figures 3 and 4.

Five of the six species of marine turtle found in Western Australia have been recorded in the reserves. Of these, green, hawksbill and flatback turtles regularly nest on the sandy beaches in the reserves, while occasional nesting by loggerheads has also been recorded on Barrow Island. The Western Australian hawksbill turtle population is the only large population of this species remaining in the Indian Ocean. The nesting populations of green and flatback turtles in the reserves are large and significant. The northernmost breeding limit for loggerheads in Western Australia is within the reserves.

Seven species of toothed whale and three species of baleen whale have been recorded from the Montebello/Barrow islands region. Humpback whales use the reserves as a resting area, and some whale migration paths pass through the reserves. Dugongs are found in the vicinity of the Montebello Islands, Lowendal Islands and Barrow Shoals, where they feed on seagrass and algae. The Montebello/Barrow islands region is a significant rookery for at least 15 seabird species, with the largest breeding colony of roseate terns in Western Australia found on the Montebello Islands.

4.6 Social Context

In 2005/06, Western Australia's petroleum industry was worth $15,210 million per annum, making it the State's most valuable industry. The North West Shelf produces approximately 59% and 93% of the State's oil and gas, respectively, and the value of petroleum production from the Montebello/Barrow area was worth $515 million in 2005/06.

Culture of the pearl oyster, *Pinctada maxima*, in the reserves produces some of the highest quality pearls in the world. There are currently two pearling leaseholders in the reserves. Attributes of the reserves which make the area suitable for pearl production include warm water temperatures, high nutrient levels, protection from wave damage, clear sandy bottoms above which the pearl oysters can be suspended, relatively shallow water, and a relatively high latitude in comparison to other locations suitable for pearl production. While most of the pearls produced in the reserves are sold to Japan, some are exported to the United States, Hong Kong and Europe.

The major commercial fishing activities in the reserves are fish trapping and line fishing. The Pilbara Trap Managed Fishery has a total of six licences issued and is worth $1.9 million with a total catch of 395 tonnes (Penn *et al.*, 2005). Although any fisher with a Western Australian Fishing Boat Licence can potentially fish in the Montebello/Barrow islands area (in 2003 there were 1,200 licences in operation), a very small proportion of

these actually fish in the area. The estimated total line fishing catch in the Pilbara region in 2004 was 217 tonnes worth $1 million (DoF, 2002), comprising mainly goldband snapper and emperor species. In addition, fishing for shark, beche de mer, rock lobsters (for aquarium purposes only) and collecting of specimen shells and aquarium fishes are carried out within the reserves.

The reserves, and particularly the Montebello Islands area, are a potentially important area for nature-based tourism, even though current tourism usage is low. The appeal for tourists includes the wide variety of wildlife and the wild, natural appearance of the land and seascapes, as well as the rich maritime heritage that includes exploration, whaling, fishing for turtles, cultured pearl farming and military use (including atomic testing). However, due to the area's isolation from major mainland centres, the lack of visitor facilities, landing restrictions on some islands and fast tidal currents, the use of the reserves for nature-based tourism and recreation is low at this time. Nature-based tourism is limited to the charter vessel industry, where passengers participate in diving, snorkelling, recreational fishing, mud crabbing, wildlife appreciation, island exploring and a limited amount of surfing.

The productive coral reefs in the reserves support an abundance of prized table fishes. However, due to the remoteness of the area, relatively few recreational fishers visit the reserves as only larger vessels can safely travel to the area. Most recreational fishing activity occurs from charter vessels, though there is some recreational fishing from yachts, either passing through the area or using the Montebello Islands as a safe anchorage. There is also some recreational fishing undertaken by people who live/work in the area (e.g. petroleum industry employees). Recreational fishers who do visit the reserves commonly target spangled emperor, red emperor, Spanish mackerel, coral trout, mangrove jack, oysters and squid.

There are no recorded seabed aboriginal sites in the waters of the reserves. However, it is possible that there are aboriginal archaeological sites on the seabed that were created before the most recent sea level rise. All aboriginal sites, registered or otherwise, are protected under the *Aboriginal Heritage Act 1972*.

Given the high conservation value of the relatively undisturbed marine environment of the Montebello/Barrow islands region and the potentially incompatible uses of the area, the commercial, recreational and nature-based tourism uses need to be managed to ensure compatibility with and, to minimise impact on, the reserves' conservation values.

4.7 Ecological and Social Values

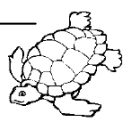
The specific ecological and social values of the reserves are listed below.

Summary of Ecological Values

- ***Geomorphology:*** *A complex seabed and island topography consisting of subtidal and intertidal reefs, sheltered lagoons, channels, beaches and cliffs.*
- ***Sediment quality:*** *The sediments of the reserves are generally pristine, which is essential to the maintenance of healthy marine ecosystems.*
- ***Water quality:*** *The waters of the reserves are generally pristine, which is essential to the maintenance of healthy marine ecosystems.*
- ***Coral reef communities:*** *Undisturbed intertidal and subtidal coral reefs and bommies with a high diversity of hard corals.*
- ***Mangrove communities:*** *Six species of mangroves are found in the reserves, with the Montebello Islands' mangrove communities considered globally unique as they occur in lagoons of offshore islands.*
- ***Macroalgal and seagrass communities:*** *Extensive subtidal macroalgal and seagrass communities are important primary producers and refuge areas for fishes and invertebrates.*
- ***Rocky shore/intertidal reef platform communities:*** *Rocky shores predominate on most of the islands of the reserves and provide habitat for a variety of intertidal organisms, which in turn provide food for shorebirds.*
- ***Intertidal sand/mudflat communities:*** *The intertidal sand/mudflat communities are primary producers with an abundant invertebrate fauna, which provides a valuable food source for shorebirds.*
- ***Subtidal soft-bottom communities:*** *Subtidal sand and silt habitats support a variety of fauna including burrowing invertebrates and filter-feeding communities.*
- ***Marine mammals:*** *Ten species of cetaceans are recorded from the reserves, with the humpback whale passing through the area during its annual migration. Dugongs are found in the shallow warm waters.*
- ***Turtles:*** *Green, flatback, hawksbill, loggerhead and leatherback turtles are found in the reserves, with the Western Australian hawksbill population being the largest remaining in the Indian Ocean. Four species use sandy beaches in the reserves for nesting.*
- ***Seabirds:*** *The reserves provide important feeding and resting areas for migrating shorebirds. Islands within the reserves are nesting areas for 15 species of seabirds.*
- ***Finfishes:*** *A rich finfish fauna with at least 456 species.*
- ***Invertebrates:*** *A diverse marine invertebrate fauna comprising mostly tropical species.*

Summary of Social Values

- ***Hydrocarbon exploration and production industry:*** *The Montebello/Barrow islands region is within the State's most productive petroleum area (for both oil and gas).*
- ***Pearling:*** *The warm pristine waters of the reserves provide optimal conditions for production of high quality pearls by the existing pearling operations.*
- ***Nature-based tourism:*** *The reserves are developing rapidly as an important area for the nature-based tourism industry, with charter boats taking tourists to the Montebello Islands to participate in activities such as fishing, diving, wildlife viewing, island exploring and surfing.*
- ***Commercial fishing:*** *The reserves are used by commercial fishers targeting a variety of finfish, sharks and beche de mer.*
- ***Recreational fishing****: Excellent shore and boat-based recreational fishing opportunities targeting a variety of pelagic and reef finfish species, mud crabs and other edible invertebrates.*
- ***Water sports:*** *The natural values, climate, and scenic values provide the basis for a wide range of recreational activities.*
- ***European history/maritime heritage:*** *The Montebello Islands have a history of European contact dating from 1622, which includes pearling, whaling, fishing for turtles and, more recently, British atomic testing.*
- ***Scientific research:*** *The undisturbed nature and wide variety habitats and communities within the reserves provide unique opportunities for scientific research.*



5 DEFINITION OF THE AREA AND RESERVE TENURE

The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are located off the north-west coast of Western Australia, approximately 1,600 km north of Perth (Figure 1), and cover areas of approximately 58,331 ha, 4,169 ha and 114,693 ha respectively. In the north and west of the reserves, the boundaries are congruent with the seaward limit of Western Australian waters (three nautical miles from the territorial baseline). The remaining boundary has been defined to include habitats in their entirety, use east-west and north-south boundary lines where possible for ease of enforcement, and to avoid areas of high industry use where this did not result in the exclusion of significant ecological features of the reserves. The areas of the Barrow Island and Varanus Island ports are excluded from the marine reserves. The boundaries of the reserves and tenure in the Montebello/Barrow islands region are shown in Figure 2. A detailed description of the boundaries is provided in Appendices II and III.

The area contains a number of islands that are vested in the Conservation Commission and managed by DEC for the purpose of conservation. These include the Montebello Islands Conservation Park, Barrow Island Nature Reserve, Boodie, Double and Middle Islands Nature Reserve, and the Lowendal Islands Nature Reserve. The boundary of the majority of the island reserves extends to the low water mark and therefore the intertidal communities are part of these terrestrial reserves. The exception is the Lowendal Islands Nature Reserve, which extends to the high water mark. Intertidal areas contain important ecological communities (e.g. mangroves, mudflats, intertidal reefs), and many marine-related activities (e.g. fishing, swimming, reef-walking) occur in the area covering both the intertidal and nearshore subtidal areas. Furthermore, the geographic position of the low water mark is often difficult to determine accurately in macrotidal areas like the Pilbara. With these considerations in mind, the intertidal areas will be managed by DEC to ensure close integration with the adjoining marine conservation reserves. Strategies for the management of intertidal areas in the Montebello/Barrow islands marine conservation reserves are recommended in this management plan, despite these areas being part of the island conservation reserves. The most appropriate mechanism to give legal effect to these strategies will be addressed by the MPRA and the Conservation Commission.

The Montebello Islands Marine Park and the Barrow Island Marine Park are vested as marine parks due to the presence of high ecological values and the reliance of the primary social values (e.g. pearling, nature-based tourism, recreational and commercial fishing) on the maintenance of these ecological values. The remainder of the area is vested as a marine management area on the basis of the different balance of ecological and social values. The use of this area is dominated by petroleum activities with a lower level of use for commercial and recreational fishing. Given these values, and in keeping with MPRA policy, marine management area is considered the most appropriate reserve category to provide an appropriate management framework for this area.

Marine parks and marine management areas are marine conservation reserves declared under the CALM Act. The CALM Act (Section 13B (1)) states that a marine park is established *"… for the purpose of allowing only that level of recreational and commercial activity which is consistent with the proper conservation and restoration of the natural environment, the protection of indigenous flora and fauna and the preservation of any feature of archaeological, historic or scientific interest."*

The CALM Act (Section 13C (1)(2)) states that a marine management area is established *"… for the purpose of managing and protecting the marine environment so that it may be used for conservation, recreational, scientific and commercial purposes. Commercial purposes include:*

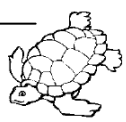
a) aquaculture, commercial fishing and pearling activity;
b) mining, within the meaning of the Mining Act 1978;
c) seismic surveys and exploratory drilling for petroleum; and
d) production of petroleum, and associated activities."

The CALM Act (Section 6 (6)) also states that a marine park and a marine management area *"… includes:*

a) the airspace above such waters or land;
b) in the case of waters, the sea-bed or other land beneath such waters and the subsoil below the sea-bed or other land to a depth of 200 m; and
c) in the case of land other than waters, the subsoil below such land to a depth of 200 m."

As the reserves are Class A reserves, the amendment of the purpose and boundaries of the reserves, once created, requires the tabling of an order in both Houses of Parliament. Either House can resolve to disallow an order and, as such, Class A vesting provides high security of tenure. By contrast, the zoning scheme and the management

plan can be amended through a formal public consultation process and do not require Parliamentary consideration. This approach provides the flexibility to respond to changing management priorities and community aspirations, and new information on the values and uses of the area. Any substantial change to the management plan requires a statutory three-month public submission period and approval by the Minister for Fisheries and the Minister for Resources.



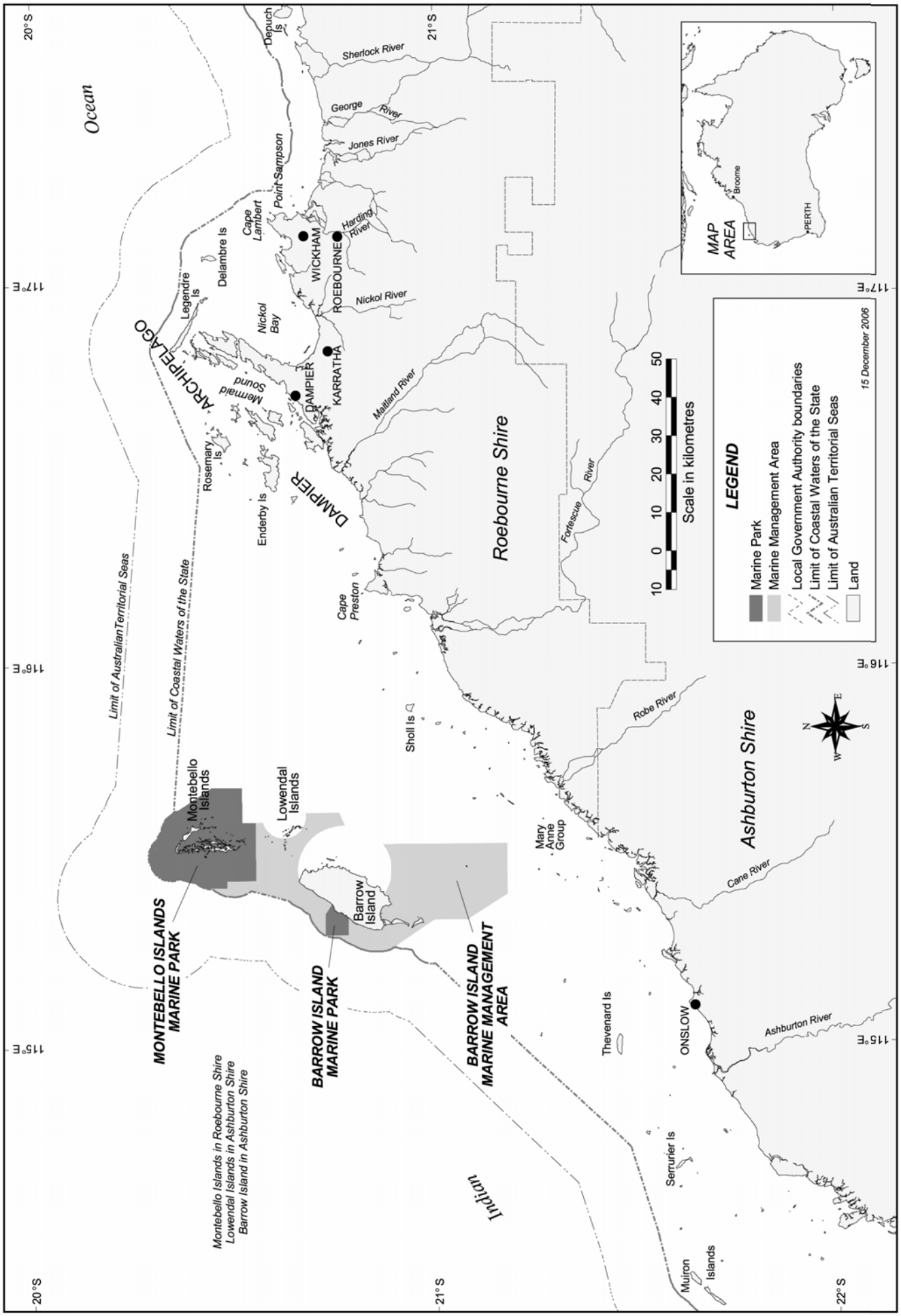


FIGURE 1: Locality of the Montebello/Barrow islands marine conservation reserves

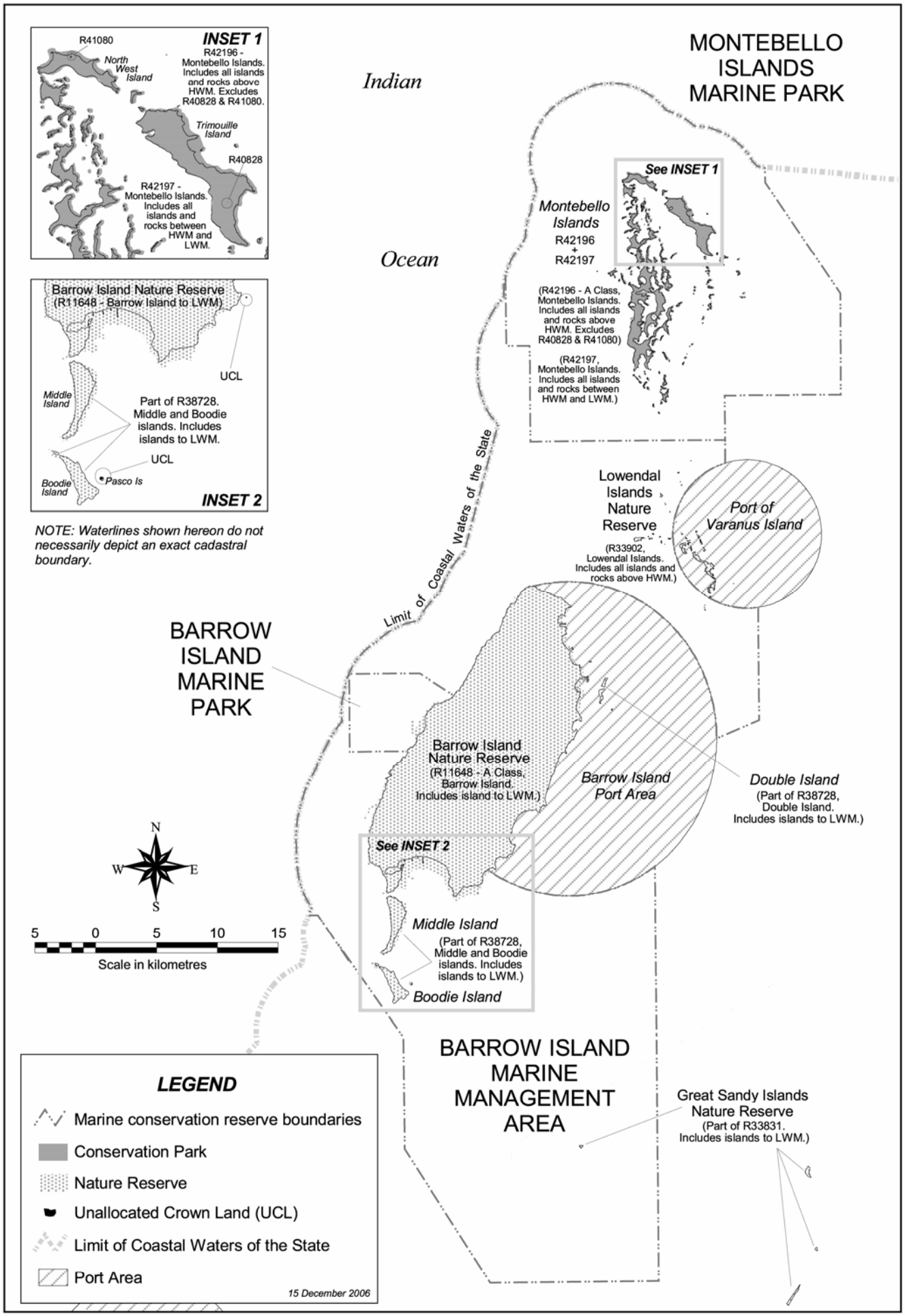
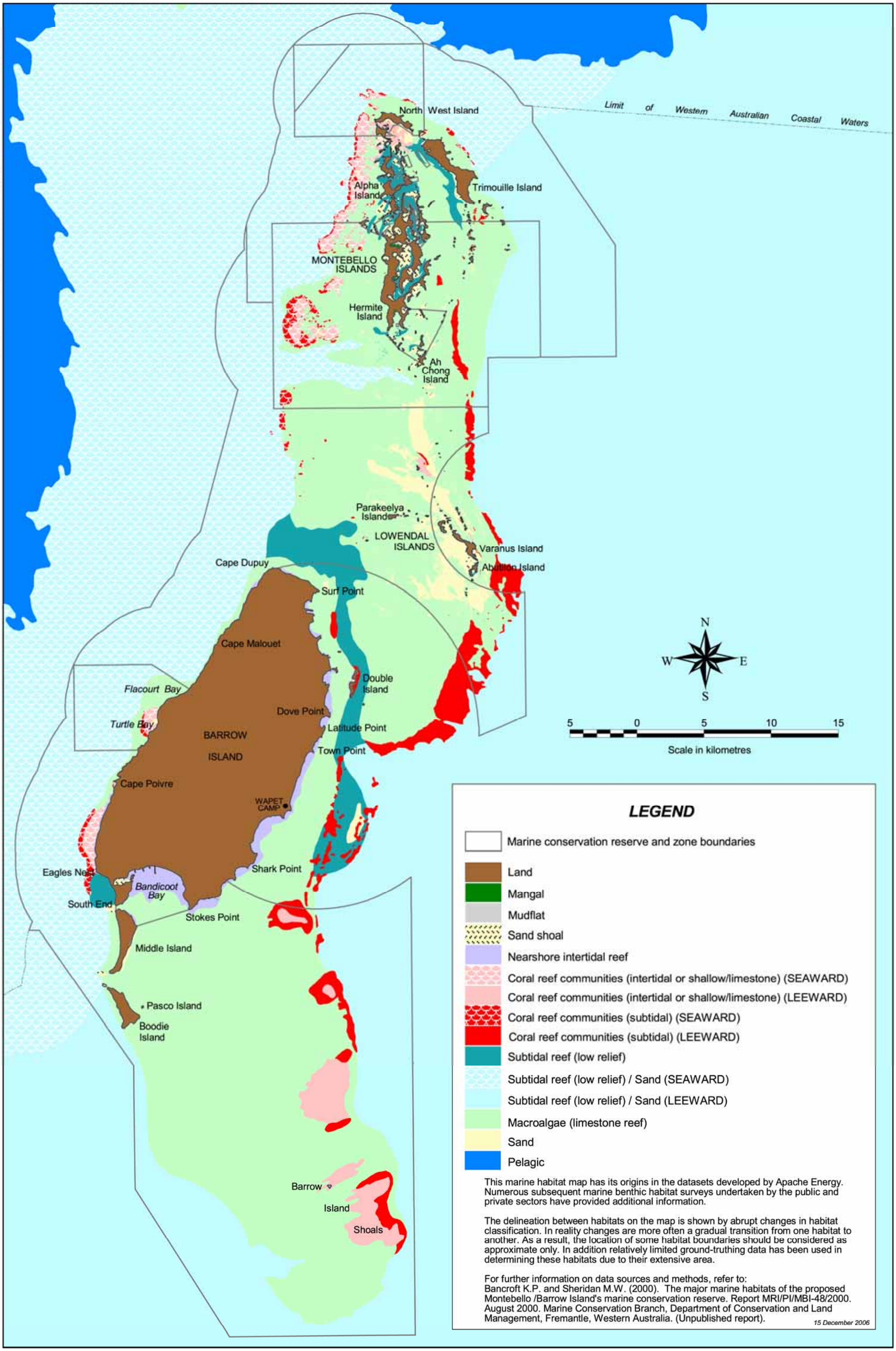
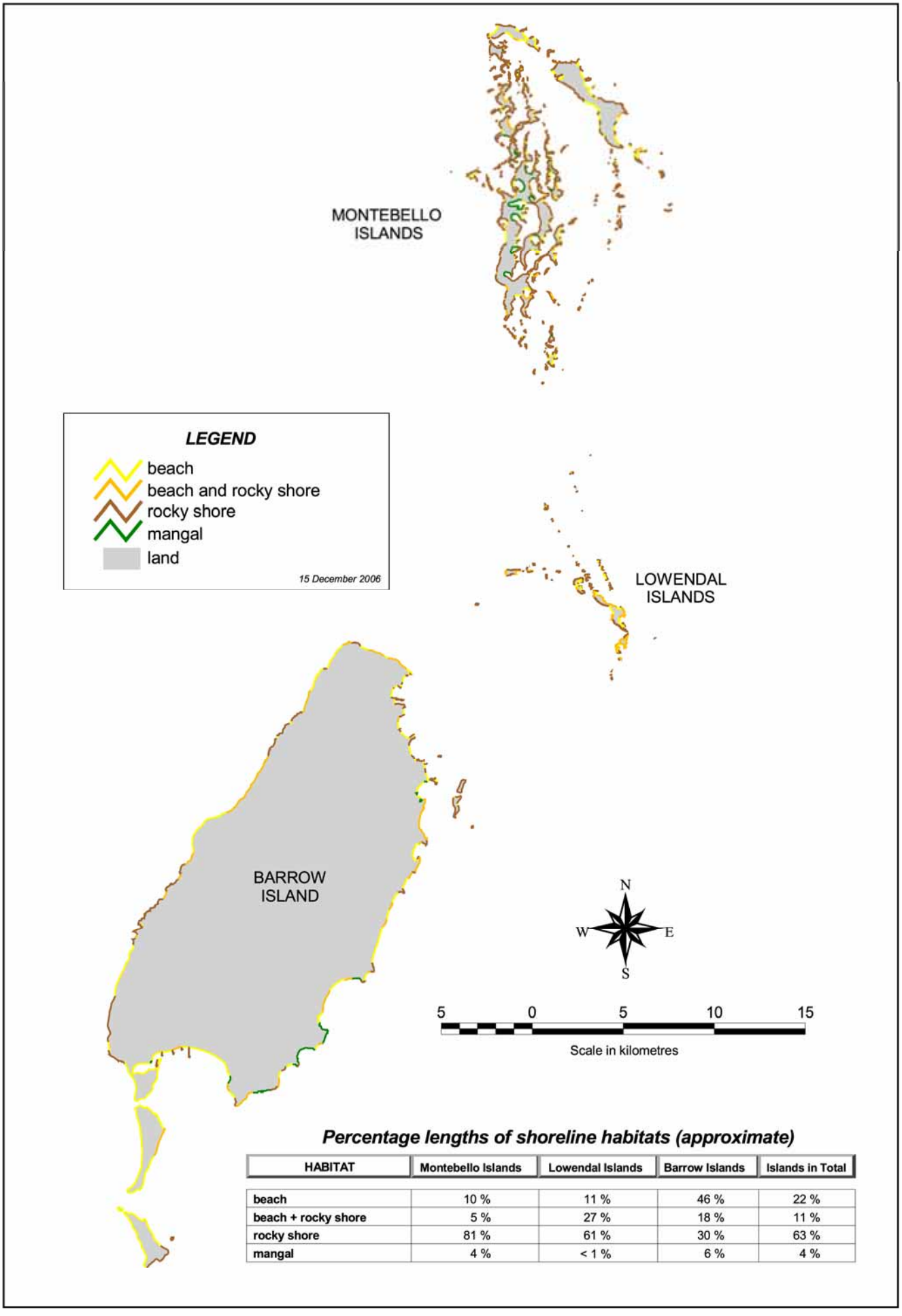


FIGURE 2: Tenure within the Montebello/Barrow islands marine conservation reserves

FIGURE 3: Major marine benthic habitats of the Montebello/Barrow islands





Percentage lengths of shoreline habitats (approximate)

HABITAT	Montebello Islands	Lowendal Islands	Barrow Islands	Islands in Total
beach	10 %	11 %	46 %	22 %
beach + rocky shore	5 %	27 %	18 %	11 %
rocky shore	81 %	61 %	30 %	63 %
mangal	4 %	< 1 %	6 %	4 %

FIGURE 4: Major shoreline habitats of the Montebello/Barrow islands

6 VISION AND STRATEGIC OBJECTIVES

6.1 Vision

The vision statement represents the community's aspirations for the area and provides a broad direction for management of the reserves.

Vision for the Montebello/Barrow islands marine conservation reserves

To conserve the marine flora and fauna, habitats and water quality of the Montebello/Barrow islands area. The area will support commercial and recreational activities that are compatible with the maintenance of environmental quality and be valued as an important ecological, economic and social asset by the community.

6.2 Strategic Objectives

Government policy includes the establishment of a comprehensive, adequate and representative (CAR) system of marine conservation reserves in Western Australia, based on the principle of multiple-use. The objectives of the marine conservation reserve system are to:

- preserve representative as well as special ecosystems in the marine environment; and
- put a formal management framework in place to ensure the various uses of marine conservation reserves are managed in an equitable, integrated and sustainable manner.

Within the context of Government policy and the CALM Act, the strategic objectives for the reserves are to:

Conservation

- maintain and enhance the marine biodiversity of the reserves;
- maintain the ecological integrity (i.e. ecosystem structure and function);

Science and Education

- promote education, nature appreciation (through recreation and tourism opportunities) and scientific research in the reserves;

Public Participation

- promote community involvement in the management of the reserves;

Recreational Uses

- facilitate, manage and, where appropriate, assist in the management of recreational activities in the reserves within an equitable and ecologically sustainable framework; and

Commercial Uses

- facilitate, manage and, where appropriate, assist in the management of commercial activities in the reserves within an equitable and ecologically sustainable framework.

The strategic objectives of the reserves cannot be achieved in isolation from other statutory and non-statutory management measures both within and external to the reserves. The management of the reserves must thus be seen as part of a complementary suite of management practices including management of adjacent terrestrial areas, fisheries management, wildlife management, pollution control, environmental impact assessment and maritime transport and safety measures, as well as community cooperation and participation.

7 GENERIC MANAGEMENT STRATEGIES

The vision, strategic objectives, management targets and management objectives outlined in Sections 6-9 provide the framework for the development of specific management actions designed to conserve ecological and social values. These actions are achieved by applying one or more of seven generic management strategies:

- the development of an appropriate management and administrative framework;
- education and interpretation;
- public participation;
- patrol and enforcement;
- management intervention and visitor infrastructure;
- research; and
- monitoring.

7.1 Development of a Management and Administrative Framework

The development of an appropriate management and administrative framework is essential to ensure effective long-term management of the reserves. It consists of the legal, financial, human and administrative activities required to establish and maintain an appropriate framework for marine management. It includes administrative/financial/data management; office and infrastructure costs; human resource management, provision of internal and external advice and licensing and reporting. It also covers the establishment of zoning and mooring schemes, preparation of planning schemes and other activities not covered by the remaining generic management strategies.

For administrative purposes, DEC is divided into regions, which in turn are made up of districts. The reserves are located within the Pilbara Region, with offices in Karratha and Exmouth. The operational responsibility for implementation of the management plan and its management programs rests with the Pilbara Regional Manager. DEC's Marine Policy and Planning Branch has a strategic supporting role in assisting Regional and District offices in the management of marine conservation reserves throughout the State. A number of other specialist DEC branches provide support, direction and assistance in relation to such areas as wildlife management, regulation of industry, licensing of tourism operations, and research and monitoring.

The reserves comprise part of the NRSMPA. The objective of the NRSMPA is to build a system of marine protected areas that will be:

- *Comprehensive* – include marine protected areas in all the major bioregions of Australia;
- *Adequate* – include marine protected areas that are of an appropriate size and configuration to ensure the conservation of biodiversity and the integrity of ecological processes; and
- *Representative* – include the flora, fauna and habitats that are representative of the bioregion.

The implementation of an appropriate zoning scheme is an important strategy for both the conservation of marine biodiversity and the management of human use in the reserves. The partial or total restriction of extractive activities in representative habitats is a key strategy in the long-term maintenance of marine biodiversity values in the reserves. Specifically, the establishment of zones in which extractive activity is not permitted plays a key role in the protection of representative areas of important habitats such as intertidal and subtidal coral reefs, mangroves, macroalgal and seagrass communities, intertidal sand and mudflat habitats and subtidal soft-bottom communities. As well as providing a measure of management 'insurance', these zones provide areas where natural processes can be studied relatively free of significant human influence. These zones also provide the opportunity to improve understanding of the reserves' key ecological processes and to obtain critical baseline data to compare against areas of the reserves where extractive activities are permitted and/or where environmental impacts may be occurring. The zoning scheme assists in minimising any conflicts between activities and provides for specific activities such as for commercial and recreational activities, scientific study and nature appreciation.

Zoning is a flexible management tool that can accommodate evolving use of the reserves. The nature and extent of zoning should be considered within the context of the other generic management strategies of education and interpretation, public participation, patrol and enforcement, management intervention and visitor infrastructure, research, and monitoring (Sections 7.2 – 7.7).

7.1.1 Development of a zoning scheme

Zones are formally established as classified areas under Section 62 of the CALM Act. Section 13B(2) of the CALM Act requires that marine parks be zoned as one or a combination of specific management zones. These are *sanctuary*, *special purpose*, *recreation*, and *general use* zones. In contrast, in marine management areas zones may be created to give effect to the management of the reserve, but this is not a requirement.

Sanctuary zones provide for the maintenance of environmental values and are managed for nature conservation by excluding human activities that are likely to adversely affect the environment. They are used to provide the highest level of protection for vulnerable or specially protected species and to protect representative habitats from human disturbance so that marine life can be seen, appreciated and studied in an undisturbed or largely undisturbed state. Passive recreational activities that do not compromise the maintenance of environmental values may be permitted, but extractive activities including fishing, and traditional fishing and hunting are not. Commercial tourism operations (such as for nature-based tours) are permitted where they do not conflict with other uses and will be regulated under the CALM Act. Sanctuary zones also provide areas for education and scientific study.

Special purpose zones are managed for a particular priority purpose or use, such as a seasonal event (e.g. wildlife breeding, whale watching) or a particular type of commercial activity (e.g. pearling). Uses that are incompatible with the specified priority purpose are not allowed in these zones.

Recreation zones provide for conservation and compatible activities including recreation and recreational fishing. Commercial fishing, pearling, aquaculture, and petroleum exploration and production are not permitted in these zones.

General use zones are all areas of the marine park not included in sanctuary, special purpose or recreation zones. Conservation of natural values remains the priority in general use zones, but activities such as sustainable commercial and recreational fishing, aquaculture, pearling, and petroleum exploration and production are permitted provided they do not compromise the ecological values of the marine park.

The zoning scheme for the reserves was derived primarily through an iterative consultative process with the Advisory Committee for the Proposed Montebello/Barrow Islands Marine Conservation Reserves and key community stakeholder groups, peak bodies and government agencies. Broader community input was facilitated through a number of public comment phases.

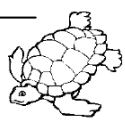
The development of the zoning plan for the reserves was guided by the following principles:

- the zoning scheme should include a system of ‘no-take’ or sanctuary areas that are comprehensive, adequate and representative of the major marine communities;
- the zoning scheme should attempt to separate potentially conflicting uses but are not a mechanism for fish resource allocation between commercial and recreational fishers;
- the zoning scheme should be equitable and where possible, minimise impacts on social values;
- that community support is critical to achieving the strategic objectives of the reserves;
- the zoning scheme should be simple for the public to understand and to facilitate effective compliance with regulations;
- the importance of maintaining both ecological and social values of the reserves; and
- that significant conservation and heritage features (e.g. key breeding areas, areas used by specially protected species, or shipwrecks) should be given a higher level of protection through zoning where possible.

It was also recognised that sanctuary zones provide a critical role in achieving management goals through:

- inclusion of these ‘no-take’ areas as ‘insurance’ against significant long-term impacts of projected usage;
- provision of areas free of significant human impact for research and monitoring; and
- application of the precautionary principle which, in this case, means that a lack of scientific certainty about the location, size or number of no-take areas does not prevent the establishment of no-take areas.

The type, location and size of zones has been based on the need to achieve the various management objectives of the ecological values (e.g. having sanctuary zones in representative areas, and for monitoring and research), while minimising impact on the social values.



Changes to the zoning of the reserves during the life of the management plan can only occur after meeting the statutory public consultation requirements and acquiring the approval of the Minister for the Environment, the Minister for Fisheries and the Minister for Resources.

The Montebello Islands Marine Park is zoned as a combination of sanctuary, recreation, special purpose (benthic protection), special purpose (pearling) and general use zones. The Barrow Island Marine Park is zoned as sanctuary zone. In the Barrow Island Marine Management Area the majority of the reserve is not zoned but there is one specific management zone; the Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection).

The indicative management plan for the reserves indicated that the Barrow Island and Varanus Island ports were included in the marine management area. However, on the basis of legal advice, the ports have now been excluded from the marine management area. It is intended that, during the life of the management plan, the port boundaries be reviewed and amended so that areas of high conservation value can be included into the marine management area. In addition, a large conservation area surrounding Barrow Shoals was included in the zoning scheme of the indicative management plan, but was later removed as a result of conflicts with fishing interests. The lack of high protection zones in the southern and eastern parts of the reserves should be considered in future reviews of the zoning scheme.

The zoning scheme for the reserves is shown in Figures 5-10 and the permitted activities are outlined in Tables 2 and 3. The name, size, purpose and description of each zone are detailed in Section 7.1.2 and 7.1.3.

A summary of the generic administration objectives, strategies and targets are outlined below.

Summary of Generic Administration Objectives, Strategies and Targets

Management objective/s	1. To implement the statutory administrative and management framework for the reserves. 2. To implement collaborative initiatives for the management of the reserves.
Strategies	1. Gazette appropriate notices under the CALM Act and FRM Act to implement the zoning scheme of the reserves (DEC, DoF) **(H-KMS)**. 2. Inform users about the types of zones, reasons for and restrictions on activities in the reserves using signage, information manuals and education programs (DEC, DoF) **(H-KMS)**. 3. MPRA and Conservation Commission to develop an appropriate vesting basis for the management arrangements of the intertidal areas of the reserves (MPRA, Conservation Commission, DEC) **(H-KMS)**. 4. In liaison with stakeholders, develop quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the marine management area (DEC) **(H-KMS)**. 5. In liaison with DPI and port users, rationalise port areas with the aim of including areas of high conservation value currently lying inside the boundaries of Varanus Island and Barrow Island port boundaries, in the marine management area (DEC, DPI) **(H)**. 6. Encourage the completion and implementation of DEC management plans for the island reserves (DEC) **(H)**. 7. Facilitate research on the effectiveness of zoning as an aid to achieving the objectives of the reserves (DEC) **(H)**.
Target	Implementation of management strategies within agreed timeframes (Appendix IV).

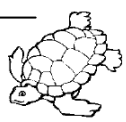


Table 2: Uses permitted in each zone of the Montebello Islands Marine Park and Barrow Island Marine Park

Activity	Sanctuary zone	Recreation zone	Special purpose zone (benthic protection)	Special purpose zone (pearling)	General use zone
COMMERCIAL					
Pearling [bd]	No	No	No	Yes	Assess
Aquaculture [bd]	No	No	No	Assess [e]	Assess
Commercial beche de mer fishing [bd]	No	No	No	Yes [e]	Yes
Commercial trap fishing [bd]	No	No	No	No	Yes
Commercial long line [bd]	No	No	No	No	Yes
Commercial beach seine [bd]	No	No	No	No	Yes
Commercial wetlining [bd]	No	No	Yes (trolling only)	No	Yes
Commercial prawn trawling [bd]	No	No	No	No	No
Commercial crabbing [bd]	No	No	No	No	No
Commercial aquarium collecting [bd]	No	No	No	Yes [e]	Yes
Commercial collection of coral, 'live' sand and 'live' rock [bd]	No	No	No	No	No
Commercial specimen shell collecting [bd]	No	No	No	Yes [e]	Yes
Mineral & petroleum exploration (seismic) [f]	Assess	Assess	Assess	Assess [e]	Assess
Petroleum drilling & mineral development [f]	No	No	Assess	No	Assess
Charter vessels - fishing [bdg]	No	No [h]	Yes (trolling only)	Yes [e]	Yes
Charter vessels - other [cdg]	Yes	Yes	Yes	Yes [e]	Yes
RECREATIONAL					
Boating (motor & non-motorised) [ag]	Yes	Yes	Yes	Yes [e]	Yes
Surface water sports [ag]	Yes	Yes	Yes	Yes [e]	Yes
Recreational rock lobster fishing [b]	No	Yes	No	Yes [e]	Yes
Recreational line fishing [b]	No	Yes	Yes (trolling only)	Yes [e]	Yes
Recreational set and haul netting [b]	No	No	No	No	No
Recreational throw netting [b]	No	Yes	No	Yes	Yes
Spearfishing [b]	No	Yes	No	Yes [e]	Yes
Recreational crabbing [b]	No	Yes	No	Yes [e]	Yes
Recreational aquarium & specimen collecting [b]	No	No	No	No	No
Snorkelling and diving	Yes	Yes	Yes	Yes [e]	Yes
Wildlife interaction [c]	Yes	Yes	Yes	Yes [e]	Yes
Surfing	Yes	Yes	Yes	Yes	Yes
OTHER					
Proposals for marine infrastructure (e.g. moorings) [ad]	Assess	Assess	Assess	Assess [e]	Assess
Pipelines (including dredging for pipelines) [f]	No	No	Assess	No	Assess
Dredging and dredge spoil dumping for shipping activities [d]	No	No	No	No	No
Research [d]	Yes	Yes	Yes	Yes [e]	Yes
Military flight training in restricted airspace R852A & R852B (above 10,000 ft)	Yes	Yes	Yes	Yes	Yes

KEY:

a. Subject to the *Western Australian Marine Act 1982*.
b. Subject to the FRM Act and *Pearling Act 1990*.
c. Subject to the CALM Act and WC Act.
d. Licence required from DEC and/or DoF and/or DoIR and/or EPA.
e. Activities permitted unless the activity is shown to be incompatible with the specified primary purpose of the zone.
f. Subject to the EP Act.
g. Boating and associated activities, and surface water sports may be restricted in specific areas where there is a clear need for such restrictions.
h. Charter vessel fishing is not permitted in the two recreation zones, however unguided recreational fishing by customers of charter operators is permitted in recreation zones.

Assess Proposal will be assessed by relevant agencies in accordance with standard procedures.

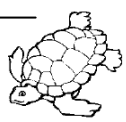


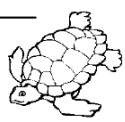
Table 3: Uses permitted in each zone of the Barrow Island Marine Management Area

Activity	Conservation area (benthic fauna/seabird protection)	Unzoned areas
COMMERCIAL		
Pearling [bd]	No	Assess
Aquaculture [bd]	No	Assess
Commercial beche de mer fishing [bd]	No	Yes
Commercial trap fishing [bd]	No	Yes
Commercial long line [bd]	No	Yes
Commercial beach seine [bd]	No	Yes
Commercial wetlining [bd]	No	Yes
Commercial prawn trawling [bd]	No	Yes
Commercial crabbing [bd]	No	No
Commercial aquarium collecting [bd]	No	Yes
Commercial collection of coral, 'live' sand and 'live' rock [bd]	No	No
Commercial specimen shell collecting [bd]	No	Yes
Mineral & petroleum exploration (seismic) [f]	Assess	Assess
Petroleum drilling & mineral development [f]	Assess	Assess
Charter vessels - fishing [bdg]	No	Yes
Charter vessels - other [cdg]	Yes	Yes
RECREATIONAL		
Boating (motor & non-motorised) [ag]	Yes	Yes
Surface water sports [ag]	Yes	Yes
Recreational rock lobster fishing [b]	No	Yes
Recreational line fishing [b]	Yes	Yes
Recreational set and haul netting [b]	No	No
Recreational throw netting [b]	Yes	Yes
Spearfishing [b]	No	Yes
Recreational crabbing [b]	No	Yes
Recreational aquarium & specimen collecting [b]	No	Yes
Snorkelling and diving	Yes	Yes
Wildlife interaction [c]	Yes	Yes
Surfing	Yes	Yes
OTHER		
Proposals for marine infrastructure (e.g. moorings) [ad]	Assess	Assess
Pipelines (including dredging for pipelines) [f]	Assess	Assess
Dredging and dredge spoil dumping for shipping activities [d]	No	Assess
Research [d]	Yes	Yes
Military flight training in restricted airspace R852A & R852B (above 10,000 ft)	Yes	Yes

KEY:

a. Subject to the *Western Australian Marine Act 1982*.
b. Subject to the FRM Act and *Pearling Act 1990*.
c. Subject to the CALM Act and WC Act.
d. Licence required from DEC and/or DoF and/or DoIR and/or EPA.
e. Activities permitted unless the activity is shown to be incompatible with the specified primary purpose of the zone.
f. Subject to the EP Act.
g. Boating and associated activities, and surface water sports may be restricted in specific areas where there is a clear need for such restrictions.

Assess Proposal will be assessed by relevant agencies in accordance with standard procedures.



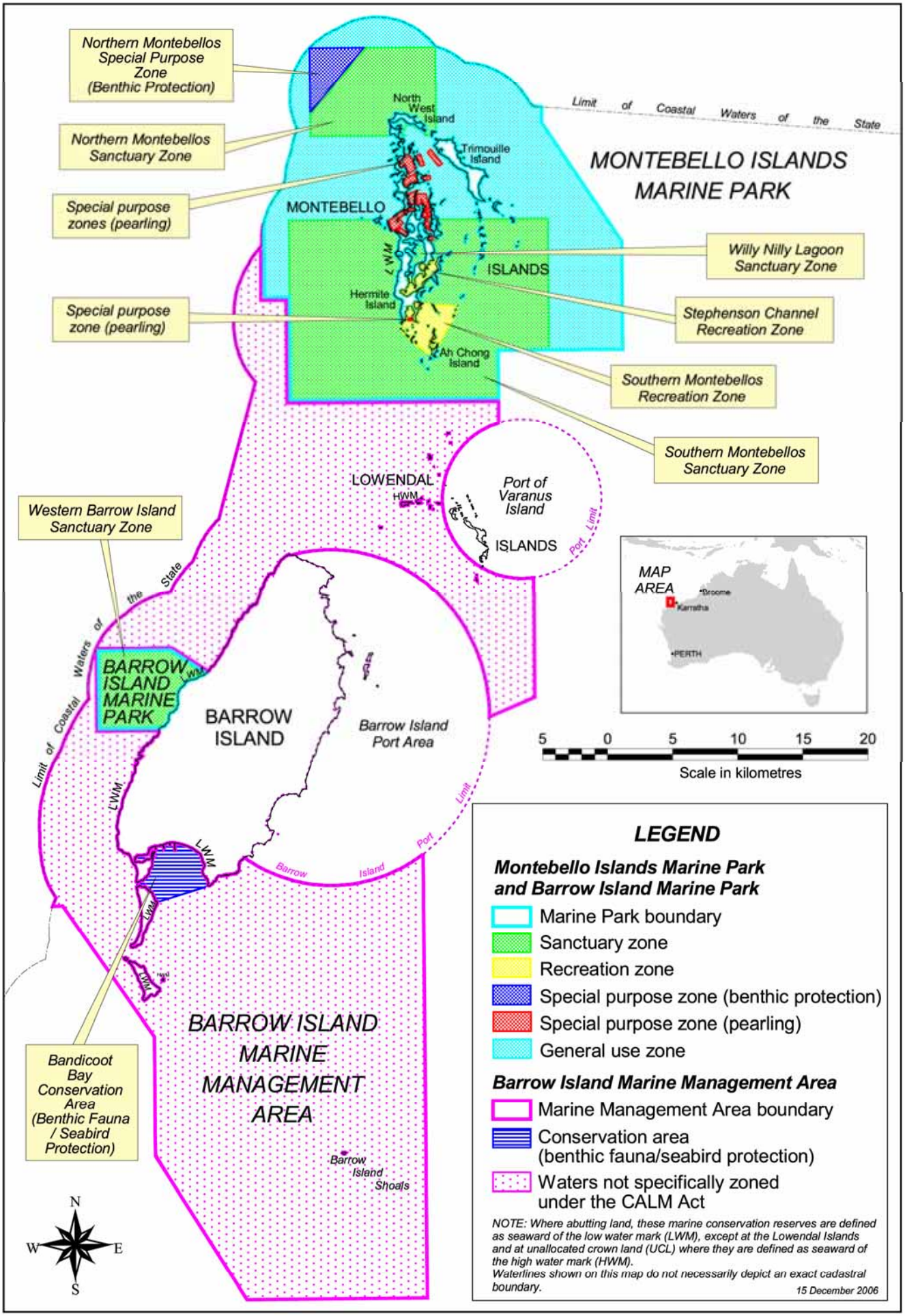


FIGURE 5: Zoning scheme for the Montebello/Barrow islands marine conservation reserves

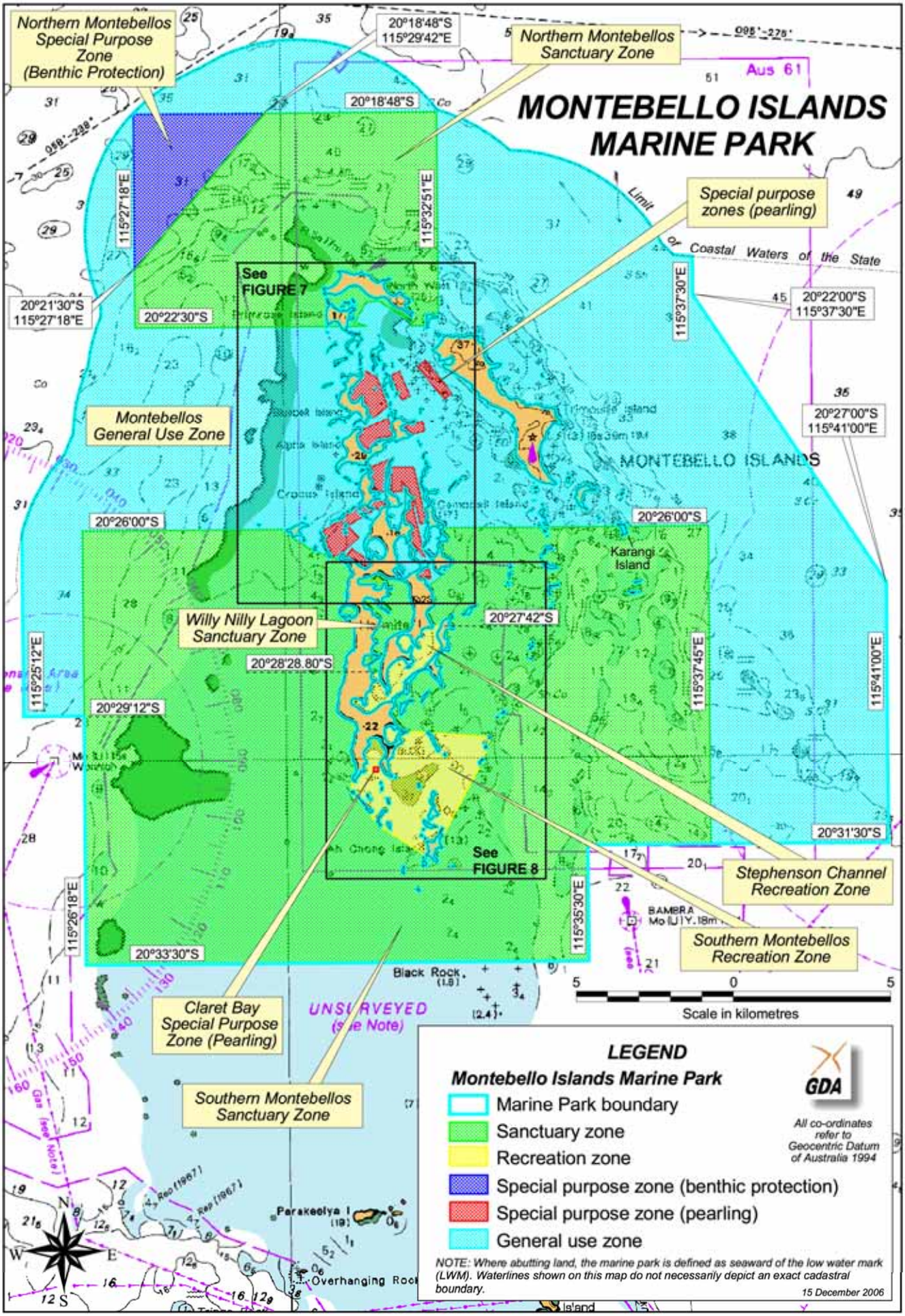


FIGURE 6: Zoning scheme for the Montebello Islands Marine Park

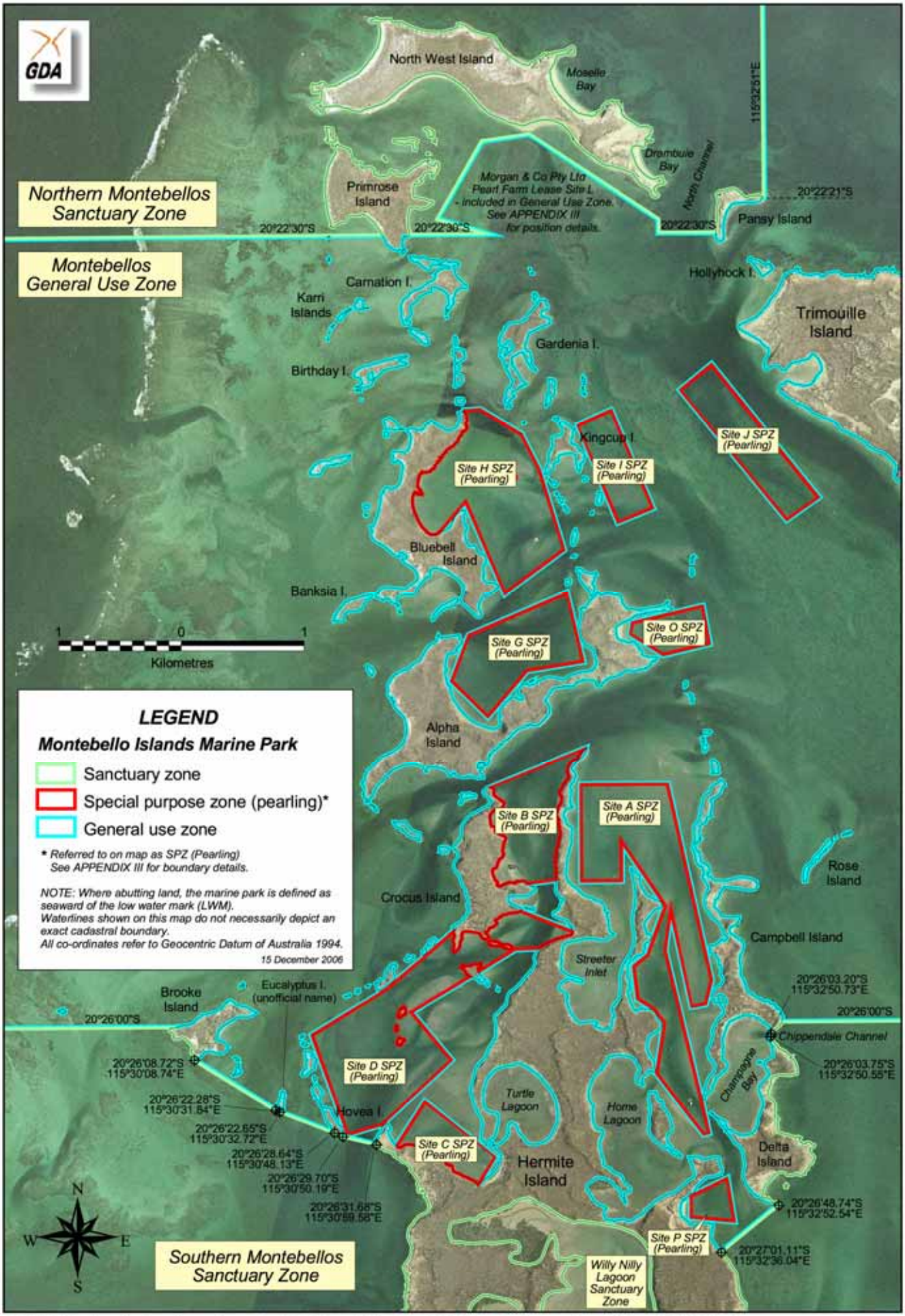


FIGURE 7: Detail of zoning scheme for the Montebello Islands Marine Park - northern Montebello Islands

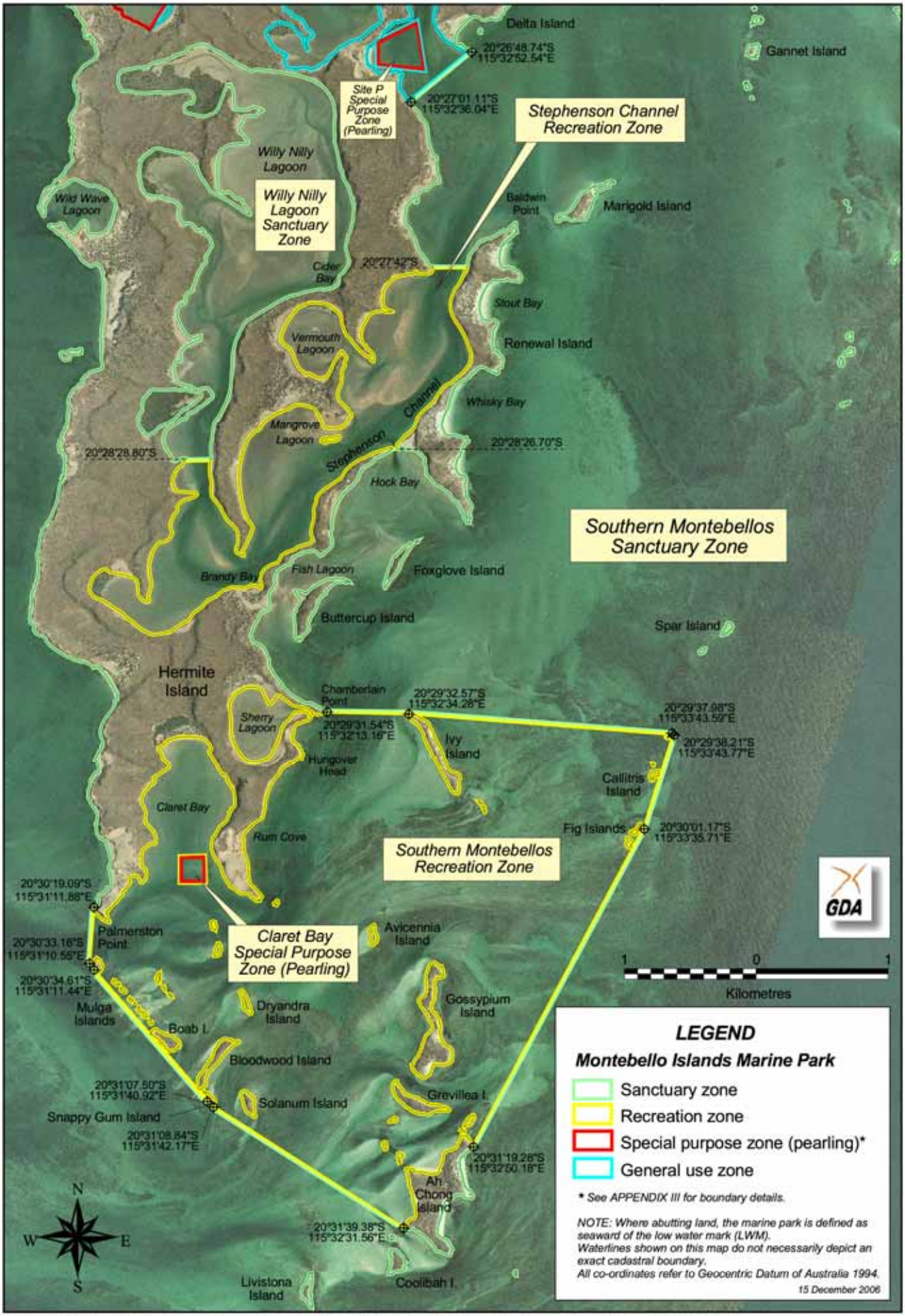


FIGURE 8: Detail of zoning scheme for the Montebello Islands Marine Park - southern Montebello Islands

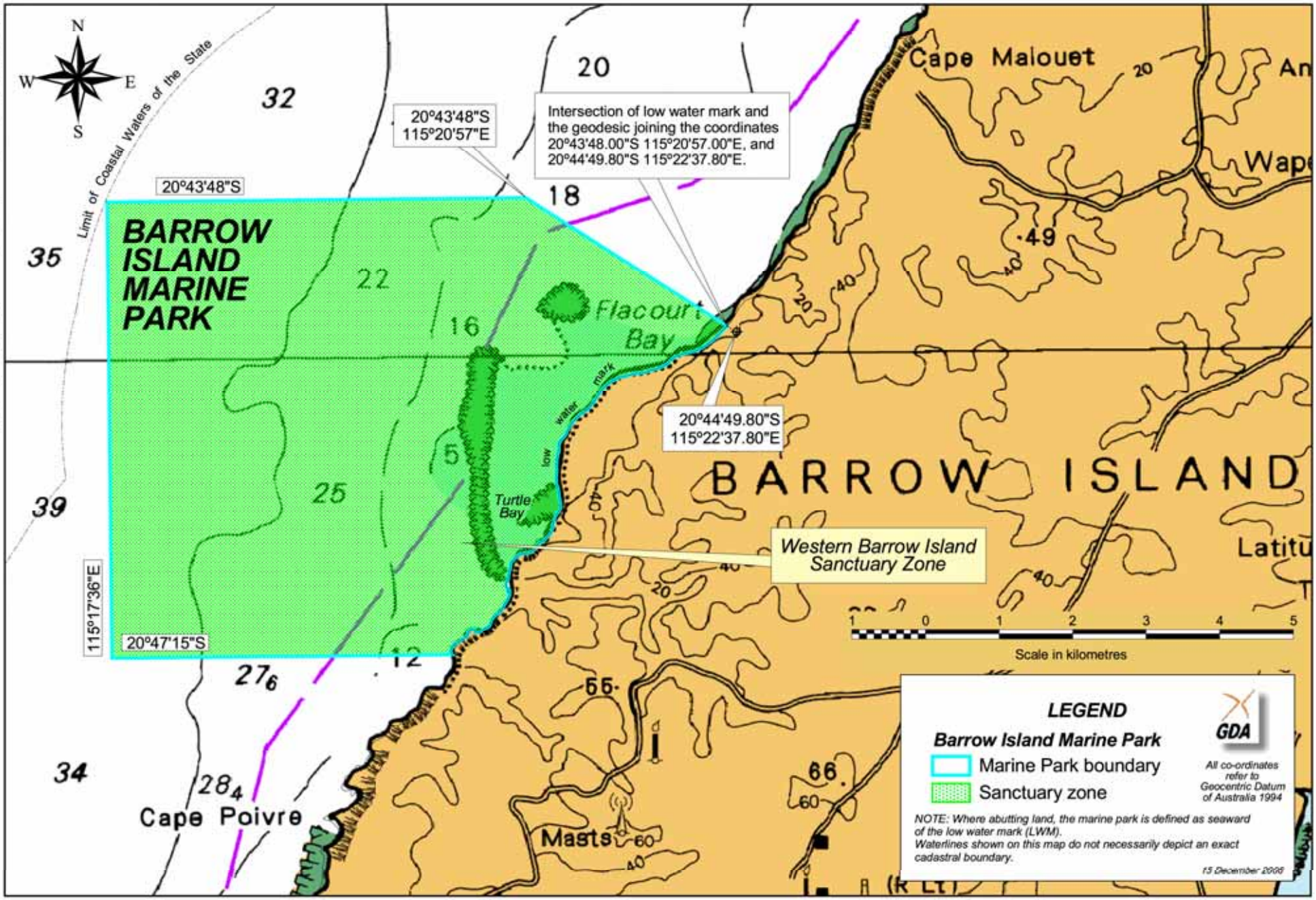


FIGURE 9: Zoning scheme for the Barrow Island Marine Park

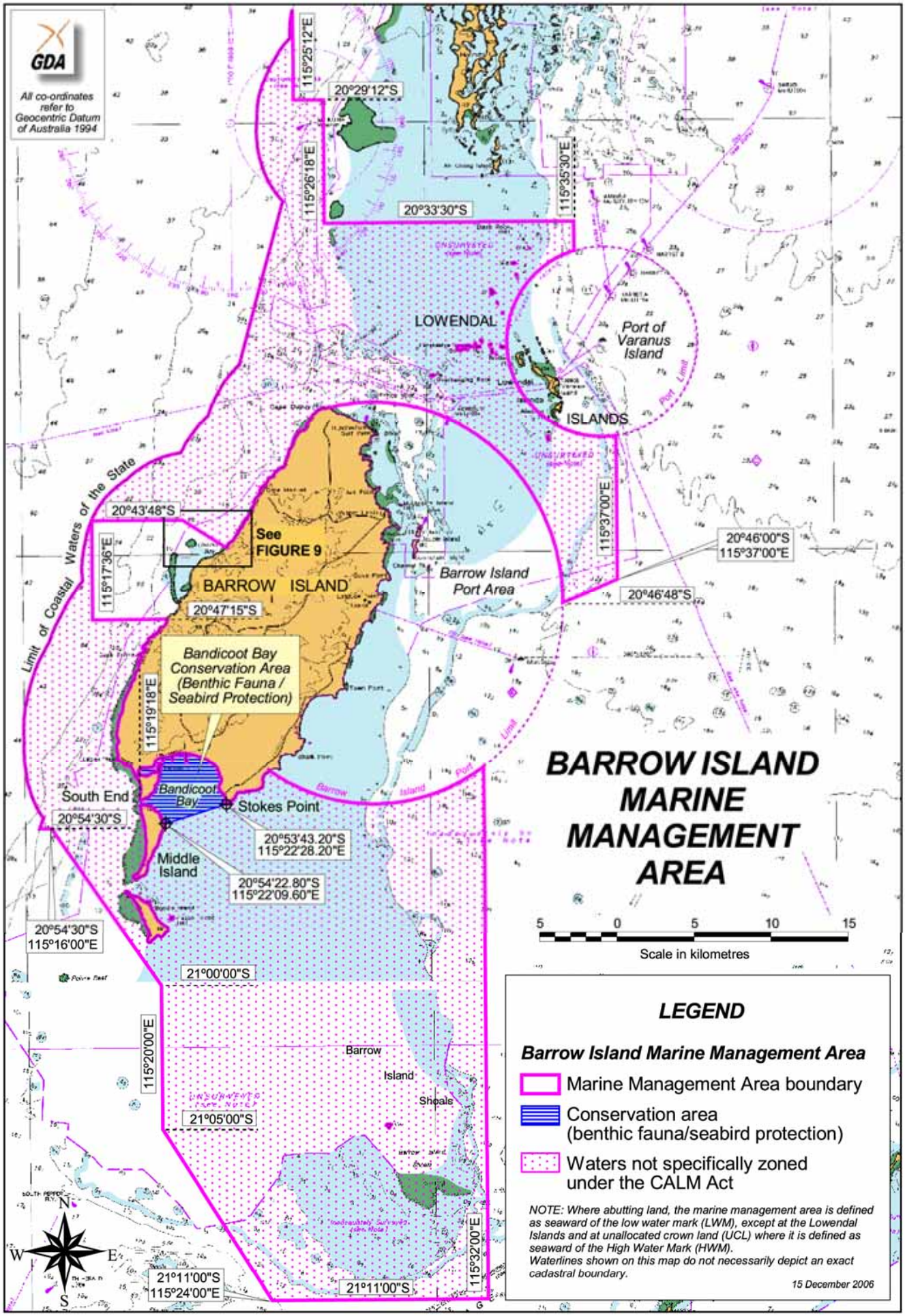


FIGURE 10: Zoning scheme for the Barrow Island Marine Management Area

7.1.2 Zones in the Montebello Islands Marine Park[2]

The zoning of the Montebello Islands Marine Park comprises two sanctuary zones (approximately 28,626 ha or 49% of the marine park), two recreation zones (approximately 1,286 ha or 2% of the marine park), one special purpose zone (benthic protection) (approximately 1,040 ha or 2% of the marine park) and eleven special purpose zones (pearling) (approximately 550 ha or less than 1% of the marine park). All other areas in the marine park not included in sanctuary, recreation or special purpose zones will be zoned as general use (approximately 26,827 ha or 46% of the marine park).

The zoning of the Montebello Islands Marine Park is shown in more detail in Figures 5-8.

Sanctuary Zones

Approximately 49% of the Montebello Islands Marine Park will be protected in two sanctuary zones. These sanctuary zones provide representation of major marine habitats in the reserves as well as the flora and fauna associated with them, and provide protection of unique features of the region's marine environment.

Each of the sanctuary zones contributes to the comprehensive and adequate protection of representative habitats and the species associated with them (the CAR principle). For each sanctuary zone, the description below highlights the zone's contribution to the protection of the environment of the reserves. It also includes information on the marine communities and species found within each zone, the types of activities that occur in the area and, where relevant, the positioning of the sanctuary zone boundaries.

The locations of sanctuary zones in the Montebello Islands Marine Park are shown in Figures 5-8. The permitted activities are shown in Table 2.

Northern Montebellos Sanctuary Zone

The Northern Montebellos Sanctuary Zone (approximately 5,294 ha or 9% of the marine park) includes representative areas of deep water habitats, seaward coral reef communities, macroalgal and seagrass communities, intertidal sand/mudflat communities and rocky shore/intertidal reef platform communities. It encompasses important turtle aggregation areas and has a high diversity of finfish and invertebrate species. The bathymetry in this zone is the most complex in the reserves and thus the area has high habitat diversity and may contain important fish spawning areas. The boundaries of this zone have been placed so as to exclude existing pearling leases to the south. The eastern and north western boundaries of the zone have been placed to avoid impacts to existing commercial mackerel fishing areas and the zone does not overly known high value petroleum areas.

The southern boundary of this sanctuary zone currently adjoins a pearling lease. However, if this lease area is removed during the rationalisation of pearling leases in the Montebello Islands, the intention is to make the southern boundary of this zone a straight line and include part of this lease area in the sanctuary zone.

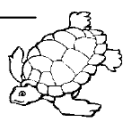
Southern Montebellos Sanctuary Zone

The Southern Montebellos Sanctuary Zone (approximately 23,074 ha or 40% of the marine park) includes representative areas of seaward and leeward coral reef communities, the majority of the internationally significant mangrove communities in the reserves, macroalgal and seagrass communities, intertidal sand/mudflat communities and rocky shore/intertidal reef platform communities. It encompasses turtle aggregation areas, turtle and seabird breeding areas, as well as diverse finfish and invertebrate populations. It includes areas of complex geomorphology and seabed topography, as well as spectacular diving opportunities. The boundaries of this zone have been placed to exclude the existing Wonnich platform, the majority of the Wonnich reservoir to the west and existing pearling leases to the north. There are no known existing high use commercial fishing areas in this sanctuary zone. To provide opportunities for recreational and commercial tourism activities in the southern part of the Montebello Islands, two areas have been excluded from this sanctuary zone and designated recreation zones.

Recreation Zones

There are two recreation zones (approximately 2% of the marine park) in the Montebello Islands Marine Park, located at the Southern Montebellos (approximately 1,036 ha) and Stephenson Channel (approximately 250 ha). The locations of the zones are shown in Figures 5, 6 and 8, and the permitted activities are shown in Table 2.

[2] Area figures are approximate only. There may be significant discrepancies between these areas and the actual areas due to poor quality mapping of low water mark in this region. Figures have been generated using a high water mark coastline that was the best available at the time of printing, which has been used as a surrogate to delineate where the marine conservation reserves abut land.



The Southern Montebellos and Stephenson Channel recreation zones provide opportunities for existing recreational activities and commercial non-extractive tourism activities in this area, including recreational fishing (subject to bag limits and other restrictions from DoF). Due to the relatively sheltered nature of the areas, as well as the existence of mooring sites, the areas are currently utilised for shore and dinghy-based recreational fishing and other recreational activities such as snorkelling, diving and nature appreciation. To protect the values of this zone, charter fishing (which is more intensive) is not permitted in the recreation zone; however unguided recreational fishing by customers of charter operators is permitted. The boundaries of these recreation zones have been devised to encompass the majority of the areas used for recreational activities while not compromising the ecological values of the surrounding sanctuary zone. The recreation zones do not overlap any known high use commercial fishing areas or known petroleum reservoirs.

Special Purpose Zone (Benthic Protection)
There is one special purpose (benthic protection) zone (approximately 1,040 ha or 2% of the marine park) in the Montebello Islands Marine Park. The location of this zone is shown in Figures 5-7 and the permitted activities are shown in Table 2.

The Montebellos Special Purpose (Benthic Protection) Zone includes representative areas of deep water habitat in the north-western area of the marine park. The bathymetry in this area is complex resulting in high habitat diversity. It is in the vicinity of important turtle aggregation areas and whale migration paths and has a high diversity of finfish and invertebrate species. The boundaries of this zone have been placed to allow recreational and commercial trolling to occur. Due to the low level of use it is not considered necessary to prohibit anchoring in this zone. There may be a need however, to restrict this activity if significant damage to benthic communities occurs during the life of this plan.

Special Purpose Zones (Pearling)
Special purpose zones (pearling) (approximately 550 ha or 1% of the marine park) are established for Morgan Pearls Limited's existing pearling leases A, B, C, D, G, H, I, J, O and P, as well as the quarantine site in Claret Bay, to allow pearling to be the priority use of these areas. The locations of all special purpose zones (pearling) are shown in Figures 5-8 and the permitted activities are shown in Table 2.

The other existing pearling leases currently held by Morgan Pearls Limited (i.e. lease areas E, F, K and L) are zoned general use. The owners, in consultation with the MPRA, are undertaking a process of rationalisation of these areas. It is anticipated that this will be completed in the early phase of the management plan. Fantome Pearls' existing pearling leases in the Lowendal Islands are within the unzoned area of the marine management area.

Given that the priority purpose of these zones is pearling, some forms of commercial and recreational fishing, petroleum production and mineral development are not considered compatible (Table 2). All other activities are currently permitted, however if these activities conflict in a significant and unavoidable way with pearling these activities will not be permitted to continue in these zones. It should be noted that the designation of these zones for the primary purpose of pearling does not provide automatic approval for future pearling proposals. Any such proposal will be assessed in accordance with Ministerial Policy Guideline No 8 (DoF, 1998) and only permitted where this use is compatible with the maintenance of the values of the reserves. It should also be noted that this does not preclude a lease being held or created within the general use zone of the marine park or unclassified areas of the marine management area.

General Use Zone
All waters of the Montebello Islands Marine Park not zoned as sanctuary, recreation or special purpose zone are zoned as general use. This area (approximately 26,827 ha or 46% of the marine park) provides for recreational and commercial activities to occur, providing that they are compatible with the overall maintenance of the park's values and undertaken in a sustainable manner.

The location of the general use zones are shown in Figures 5 and 6 and the permitted activities are shown in Table 2.

7.1.3 Zones in the Barrow Island Marine Park[3]

The zoning of the Barrow Island Marine Park comprises one sanctuary zone (approximately 4,169 ha or 100% of the marine park). The location of the Western Barrow Island Sanctuary Zone is shown in Figures 5 and 9 and the permitted activities are shown in Table 2.

Western Barrow Island Sanctuary Zone

The Western Barrow Island Sanctuary Zone includes Biggada Reef, which is one of two examples of significant fringing reef that occur in the reserves, as well as Turtle Bay, a significant aggregation/breeding area for green turtles which, on occasion, is also used by hawksbill and flatback turtles. It also includes representative areas of macroalgal and seagrass communities and deep water habitat. The shoreward boundary of this zone extends to the shoreline to provide protection for marine turtle breeding and resting, and the nearshore habitats. However, the zone has been placed to avoid impacts on future planned pipelines to the north. It should be noted that the boundary of the adjacent Barrow Island Nature Reserve extends to low water mark.

7.1.4 Zones in the Barrow Island Marine Management Area[3]

The zoning of the Barrow Island Marine Management Area comprises one conservation area (benthic fauna/seabird protection) (approximately 1,642 ha or 1% of the marine management area). The remaining area is not zoned (approximately 113,051 ha or 99% of the marine management area). The location of the Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection) is shown in Figures 5 and 10 and the permitted activities are shown in Table 3.

Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection)

The Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection) includes the largest intertidal sand/mudflat community in the reserves, which is known to be high in invertebrate diversity and provides important feeding grounds for migratory birds. This area also encompasses representative areas of macroalgal and seagrass communities, rocky shore/intertidal reef platform communities and turtle aggregation areas. The boundaries of this classified area have been placed so as to encompass the majority of the intertidal sand/mudflat community. This classified area does not overly any known high use commercial fishing areas.

Most extractive activities are excluded from the Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection) (including commercial fishing, specimen collecting, and recreational spearfishing, rock lobster fishing and crabbing). Recreational line fishing, recreational throw-netting, passive nature-based tourism, some recreational activities, boating and approved scientific research are permitted. Proposals for petroleum drilling, mineral development and the installation of pipelines in the Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection) will be assessed by the relevant agencies in accordance with standard procedures.

Unzoned Areas

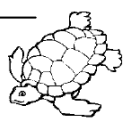
The majority of the marine management area (excluding Bandicoot Bay) is not zoned. This area (approximately 113,051 ha or 99% of the marine management area) provides for recreational and commercial activities to occur, providing that they are compatible with the overall maintenance of the reserves' values.

The zoning for the marine management area is shown in Figures 5 and 10 and the permitted activities are shown in Table 3.

7.1.5 Limitations of the zoning scheme

The zoning scheme considers the ecological and social values of the reserves and the pressure on these values. The zoning scheme, while recognising the importance of the marine ecology of the area, was developed through an iterative community consultative process, which attempted to strike a balance between existing uses and conservation of the flora and fauna of the reserves. The zoning scheme includes few but relatively large sanctuary zones and other protected areas. These highly protected areas provide large representative areas of most of the region's habitats that provide comprehensive opportunities for research and monitoring, and a high degree of ecological insurance against unacceptable impacts of human activities. Zoning in the marine management area does not cover the full range of habitats within the reserve, but provides good protection of benthic habitats in Bandicoot Bay. In particular, the marine habitats to the east of Barrow Island are poorly represented in protected areas. Despite these limitations, the zoning scheme for the reserves protects a range of marine habitats, achieves numerous conservation objectives, and assists in managing human usage by separating potentially conflicting activities.

[3] Area figures are approximate only. There may be significant discrepancies between these areas and the actual areas due to poor quality mapping of low water mark in this region. Figures have been generated using a high water mark coastline that was the best available at the time of printing, which has been used as a surrogate to delineate where the marine conservation reserves abut land.



7.2 Education and Interpretation

Developing community support for the reserves is critical to the effective implementation of reserve management and protection of the area's values. The level of public acceptance and support in relation to management controls in the reserves will be directly related to the level of understanding of the values of the reserves and the reasons for regulation of activities in the reserves. Education programs will initially need to raise awareness of the creation of the reserves and new restrictions on commercial and recreational activities as a result of the implementation of zoning and other management strategies.

Given the remoteness of the Montebello/Barrow islands and the fact that most users are employed by, or access the reserves through, the hydrocarbon, pearling or charter industries, these industries will play a crucial role in providing information and education materials to their staff and/or patrons about the reserves. Specific education strategies are detailed for each ecological and social value in Section 9.

A summary of the generic education and interpretation objectives, strategies and targets is outlined below.

Summary of Generic Education and Interpretation Objectives, Strategies and Targets

Management objective/s	To enhance community understanding of, and support for, the reserves through education and interpretation programs.
Strategies	1. Develop and implement, in collaboration with industry, DoF and other relevant agencies, education and interpretation programs to ensure users of the reserves are aware of and understand the values of the reserves, management zones and regulations and the reasons for these controls (DEC, DoF) **(H-KMS)**. 2. Develop and distribute to the community and visitors a range of education materials about the reserves' values, pressures on these values, strategies, targets, and management, and marine conservation more broadly (DEC, DoF) **(H)**. 3. Assist the hydrocarbon, pearling and charter industries to access and deliver information materials/courses to their staff or patrons (DEC) **(H)**. 4. Provide talks and briefings about the reserves' values, uses and management to user groups (DEC) **(M)**.
Target	1. Implementation of management strategies within agreed timeframes (Appendix IV). 2. 50% of visitors aware of the existence of the reserves, their values and of the restrictions applying to the area within three years of gazettal. 3. 90% of visitors aware of the existence of the reserves, their values and of the restrictions applying to the area within ten years of gazettal.

7.3 Public Participation

Public participation in management can help to generate the community support that is critical for effective implementation of the management plan.

An important early step in the administration of the Montebello/Barrow islands marine conservation reserves is the establishment of a community-based Management Advisory Committee (MAC). The MAC will be established by Ministerial appointment and its main function will be the provision of advice and assistance to DEC and the MPRA. This will provide an ideal forum for information sharing as well as an avenue for dissemination of information to the public. For example, local stakeholders would be able to raise issues with DEC, the MPRA or the Minister in matters relating to the reserves' management, administration, zoning, conflicts of usage and any other management-related issues that arise.

A summary of the generic public participation objectives, strategies and targets is outlined below.

Summary of Generic Public Participation Objectives, Strategies and Targets

Management objective/s	To facilitate on-going community participation in the management of the reserves.
Strategies	1. Establish and maintain a Management Advisory Committee (MAC) (DEC) **(H-KMS)**. 2. Encourage community and local industry involvement in education and interpretation programs (DEC) **(M)**. 3. Encourage community and local industry involvement in monitoring programs (DEC) **(M)**.
Target	Implementation of management strategies within agreed timeframes (Appendix IV).

7.4 Patrol and Enforcement

This management plan includes a range of strategies relating to the management of particular human activities within the reserves. The effectiveness of these strategies depends on the extent to which visitors to the reserves abide by these management measures and controls. The education program is critical to achieving a high level of compliance as in most cases visitors will support controls where they are clearly aware of what they are and why they have been implemented. There will, however, always be a need to monitor the level of compliance and, where visitors continue to undertake illegal activities, take action to stop inappropriate behaviour. Given the remoteness of the reserves and the resources and infrastructure that would be required to have a DEC enforcement presence in the area year round, it is appropriate that the existing users of the area (hydrocarbon, pearling and charter industries) play both a self-regulatory and visitor/user regulation role in the surveillance and enforcement program.

As noted in section 2.2, an MOU has been developed between the Minister for the Environment and the Minister for Fisheries to establish principles of cooperation and integration between DEC and DoF in the management of the State's marine protected areas. Joint working plans will be developed between DEC and DOF to ensure efficient and effective delivery of a range of programs including patrol and enforcement. Specific actions include joint patrols, cross-authorisation of agency staff, improved liaison and reporting arrangements.

A summary of the generic patrol and enforcement objectives, strategies and targets is outlined below.

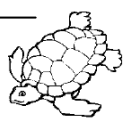
Summary of Generic Patrol and Enforcement Objectives, Strategies and Targets

Management objective/s	Maximise public compliance of regulations related to the ongoing management of the reserves.
Strategies	1. Develop and implement a patrol and enforcement program to ensure an adequate level of compliance with zoning restrictions (DEC, DoF, DPI) **(H-KMS)**. 2. Develop and implement procedures to ensure coordination between Government agencies to maximise efficiency and effectiveness of patrol and enforcement activities (DEC, DoF, DPI) **(H-KMS)**. 3. Facilitate cross authorisation of Government enforcement officers as appropriate (DEC, DoF, DPI) **(H-KMS)**. 4. Facilitate the hydrocarbon, pearling and charter industries, as well as visitors to the reserves, to take an active role in a voluntary surveillance and enforcement program (DEC) **(H)**.
Target	Implementation of management strategies within agreed timeframes (Appendix IV).

7.5 Management Intervention & Visitor Infrastructure

Intervention comprises direct management actions required to achieve conservation outcomes. These can be either proactive (i.e. preventative) or reactive (i.e. restorative) management actions. Intervention includes provision of visitor facilities to reduce site disturbance and environmental impacts (such as moorings and designation of dive trails), rehabilitation of degraded areas and risk management.

Although the majority of the waters in the Montebello/Barrow islands area are in a relatively pristine condition, there may be areas that have suffered some localised disturbance from past or ongoing human use. Anecdotal evidence from current users of the reserves suggests that there may be accumulations of litter in some areas, sediment contamination and impacts on mud crab or finfish stocks. Such localised disturbances may negatively affect the ecological and social values of the area. The management responses in this case would be to identify areas that have been disturbed in the early phase of the management plan and evaluate what, if any, rehabilitation measures should be undertaken. Decisions as to whether it would be appropriate to rehabilitate an area are based



on the ability of an area to recover naturally (i.e. if no further pressure is applied and with no management intervention), the current level of disturbance of the area, ecosystem effects of not carrying out rehabilitation, aesthetic impacts of the disturbance and the cost of rehabilitation.

It is envisaged that human use of the Montebello/Barrow islands area will increase in the future. An increase in visitor numbers may require additional facilities to be provided, so as to protect the ecological values from human disturbance (e.g. moorings or pontoons) and to enhance the visitor experience (e.g. dive trails). The level of use of the reserves and the areas which come under the highest visitor pressure should be monitored and consideration given to provision of visitor facilities where appropriate.

The remote nature of the reserves, combined with shallow submerged reefs, strong ocean currents, high winds and seasonal cyclones, pose a high risk to visitors who may be inexperienced in, or unprepared for, such conditions. Additionally, the rugged island coastlines with undercut cliffs may pose a risk to visitors to the islands. As visitation to the reserves is likely to increase during the life of the management plan, an ongoing visitor risk management program should be undertaken to identify potential hazards and measures implemented to minimise these. Risks to visitors are managed under the framework of DEC's Policy Statement No. 53 *Visitor Risk Management Policy*.

A summary of the generic intervention objectives, strategies and targets is outlined below.

Summary of Management Intervention & Visitor Infrastructure Objectives, Strategies and Targets

Management objective/s	1. To remediate, where necessary, existing human impacts on the ecological and social values of the reserves. 2. To provide visitor facilities that enhance visitor enjoyment of, and minimise environmental impact to, the reserves. 3. To take reasonable steps to minimise visitor risk where possible in the reserves.
Strategies	1. Identify areas of existing human impact in the reserves (DEC) **(M)**. 2. Monitor human use (visitor numbers and high use areas) of the reserves and, consistent with available resources, provide visitor facilities where appropriate (DEC) **(M)**. 3. Implement a program of routine inspections, maintenance and reporting on infrastructure conditions (e.g. zone markers, signage) in the reserves (DEC) **(M)**. 4. Perform assessments of visitor risk in the reserves and, where necessary, implement appropriate measures to minimise visitor risk (DEC) **(M)**.
Target	Implementation of management strategies within agreed timeframes (Appendix IV).

7.6 Research

Developing an understanding of the natural and social environment of the reserves is critical to effective management. Research provides background information on the ecological and social environment and an understanding of what is 'natural' as a benchmark for monitoring programs. As much of this information does not exist at this stage for the reserves, research programs need to focus on establishing the natural state of key ecological values and identifying key processes supporting these values. Research programs should be designed to fill key gaps in current knowledge relevant to management. Licences under the CALM Regulations may be required to conduct research within the reserves. Specific research strategies are detailed for each ecological and social value (section 9) and scientific research as a value of the reserves is outlined in section 9.2.8.

A summary of the generic research objectives, strategies and targets is outlined below.

Summary of Generic Research Objectives, Strategies and Targets

Management objective/s	1. To obtain an appropriate understanding of the biodiversity and key ecological and social processes within the reserves. 2. To promote ecological and social research in the reserves that improves knowledge of the reserves and provides the technical basis for management decisions.
Strategies	1. Develop and progressively implement a coordinated and prioritised research program focussing on key values and processes of the reserves (DEC, DoF) **(H-KMS)**. 2. Develop detailed habitat and wildlife distribution maps for the reserves (DEC, industry) **(H-KMS)**. 3. Develop and maintain a database of human usage and its impacts in the reserves, and use these data to assess the sustainability of marine-based activities in the region (DEC, DoF) **(H-KMS)**. 4. Gather baseline data for values for which insufficient data exist, so changes in values over time can be assessed (DEC) **(H-KMS)**. 5. Identify, prioritise and communicate high priority ecological and social research projects relevant to the management of the reserves and consistent with the prioritised research program to appropriate research organisations (DEC) **(H-KMS)**. 6. Develop and maintain a database of historical and current research in the reserves (DEC) **(H)**. 7. Facilitate scientific and social research in the reserves conducted by research, academic and educational institutions, by providing financial and logistical assistance (where possible) (DEC, DoF) **(H)**. 8. Develop partnerships with stakeholders and the community to implement research programs (DEC) **(H)**.
Target	1. Establishment of priority baselines against which change can be measured. 2. Implementation of management strategies within agreed timeframes (Appendix IV).

7.7 Monitoring

Monitoring the state of the marine environment is essential to the effective management of the reserves. A monitoring program is a key strategy to allow the early detection of detrimental impacts and thereby provide the trigger for management action to mitigate potential impacts before undesirable changes in the reserves values occur. The detection of human-induced changes requires an understanding of what is 'natural' as a benchmark and this information is provided through strategic research programs. Where changes have occurred and remediation measures have been implemented, a monitoring program should determine the rate of recovery of an affected area. Licences under the CALM Regulations may be required to conduct monitoring within the reserves. Specific monitoring strategies are detailed for each ecological and social value (section 9).

A summary of the generic monitoring objectives, strategies and targets is outlined below.

Summary of Generic Monitoring Objectives, Strategies and Targets

Management objective/s	1. To monitor key ecological values at risk and human usage in the reserves. 2. To promote ecological and social monitoring in the reserves that can detect changes to the ecological values. 3. To provide information that supports management decisions.
Strategies	1. Develop and progressively implement a coordinated and prioritised ecological and social monitoring program for the reserves, including community-based monitoring programs, with a particular emphasis on MPRA and DEC audit requirements (DEC, DoF) **(H-KMS)**. 2. Monitor change in key values within the reserves against adequate baseline data (DEC, DoF) **(H-KMS)**. 3. Ensure that proponents of development proposals or activities with the potential to impact on the reserves' values conduct appropriate compliance monitoring programs (DEC) **(H)**.
Target	Implementation of management strategies within agreed timeframes (Appendix IV).

8 DEVELOPMENT PROPOSALS WITHIN THE RESERVES

All development proposals within the marine reserves are subject to the environmental impact assessment requirements of the EP Act and consideration by DEC and the MPRA in the context of the management plan under the CALM Act. During the life of this plan there may be proposals for the installation and construction of marine infrastructure associated with the petroleum industry, pearling or tourism operations and public recreation. These could be major developments such as jetties or pipelines, or minor works such as the installation of moorings or navigation markers. The nature of the development will determine the appropriate level of assessment. Any assessment should review the proposal in terms of its potential impacts on the reserves' ecological and social values and determine whether it is consistent with the targets of the reserves.

In relation to petroleum development in marine conservation reserves, there are agreed assessment procedures and protocols that are set out in a MOU between the EPA and DoIR. The MPRA have endorsed the approach outlined in the MOU. They will be informed of all proposals submitted within the reserves, although the EPA/DoIR will be the primary mechanism for environmental assessment and approvals. There will not be a duplicated approvals process undertaken by the MPRA for petroleum operations. It should be noted that under this arrangement, the MPRA and DEC would still provide input and advice to the EPA on proposals when requested.

Policy Statement No. 59 *Mooring Policy* for marine conservation reserves (CALM & MPRA, 2002) aims to (i) minimise the detrimental impacts of uncontrolled mooring and anchoring; (ii) enhance user safety, access and equity in relation to moorings; and (iii) provide a framework to accommodate present and future mooring usage patterns. Under the Mooring Policy, DEC will seek to designate all marine conservation reserves as 'Mooring Control Areas' under the *Shipping and Pilotage Act 1967* or other legislative mechanism. DEC will further seek appointment as the 'controlling authority', in accordance with the *Shipping and Pilotage (Mooring Control Areas) Regulations 1983*, to facilitate the management and control of mooring control areas in marine conservation reserves. DEC will develop a mooring plan in conjunction with DPI and with appropriate consultation, which will include an assessment of areas in which moorings would be acceptable from an ecological and social perspective and the capacities of these areas. Applications for moorings should be assessed on a case-by-case basis and in relation to criteria established in the Mooring Policy.

A summary of the objectives, strategies and targets for development proposals is outlined below.

Summary of Development Proposals Objectives, Strategies and Targets

Management objective/s	To ensure that the ecological and social impacts of development proposals on the ecological and social values are evaluated through an appropriate level of environmental assessment.
Strategies	1. In the event of new industrial development proposals with the potential to impact on the reserves' values being approved, undertake a risk assessment and revise, as appropriate, management strategies for ecological values that may be impacted (DEC) **(H-KMS)**. 2. Ensure appropriate advice is provided to relevant authorities with regard to proposed marine developments and the relevant ecological targets for the reserves (DEC) **(H)**. 3. Ensure development proposals and activities with the potential to impact on the reserves' values (e.g. the proposed Gorgon gas development), are appropriately assessed and that appropriate conditions are applied (DEC, industry, EPA, DoF, DoIR, Tourism WA) **(H)**. 4. Develop a mooring plan, with appropriate consultation, which will include an assessment of areas in which moorings would be acceptable from an ecological and social perspective and the capacities of these areas (DEC, DPI) **(M)**. 5. Assess mooring applications on a case-by-case basis and in relation to mooring criteria established in the DEC/MPRA Mooring Policy (DEC, MPRA) **(M)**.
Target	Implementation of management strategies within agreed timeframes (Appendix IV).

9 ECOLOGICAL AND SOCIAL VALUES

9.1 Ecological Values

Ecological values are the physical, geological, chemical and biological characteristics of an area. Ecological values are significant in terms of their biodiversity (i.e. representative, rare or unique) and ecosystem integrity role. Ecological values also have a social significance because many social values are functionally dependent on the maintenance of ecological values.

9.1.1 Geomorphology

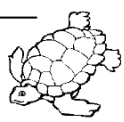
Ecological value	**Geomorphology**: *A complex seabed and island topography consisting of subtidal and intertidal reefs, sheltered lagoons, channels, beaches and cliffs.*

Background	The Montebello/Barrow islands region comprises a complex geomorphological unit that is unique on the Western Australian coast (MPRSWG, 1994). The geomorphology of the reserves has been influenced by geological events over the last 600 million years, including the collision of the Australian and Indonesian continental plates as Australia drifts northwards. The collision of these two tectonic plates resulted in a series of folds occurring along the north-west coast of Australia, one of which forms the backbone on which the Montebello, Barrow, and Lowendal islands are located. The influence of this tectonic plate movement, along with changes in sea levels and more recent oceanic and climatic conditions, has resulted in the complex geomorphology of the area seen today. The complex intertidal and subtidal geomorphology of the area is important as it creates a high diversity of marine habitat types, which support a correspondingly high diversity of species. The Montebello Islands consist of 265 distinct, low-lying islands and islets composed of limestone and cross-bedded sandstones. The islands have convoluted coastlines that form lagoons, channels, intertidal embayments, barrier reefs, intertidal rocky and occasionally sandy shores, and shallow limestone platforms exposed to open ocean conditions. The Lowendal Islands comprise more than 40 limestone islands, islets and rocky stacks. These islands typically have steep shorelines and either support dunes of white sand or are low-lying and rocky with wave cut platforms. The Barrow Island region comprises Barrow Island and nine smaller islands. The western half of Barrow Island is characterised by steep valleys, escarpments and exposed limestone ridges. The topography along the west coast typically comprises weathered rocky cliffs and headlands interspersed with narrow sandy beaches. The eastern coastline is protected with a slight land gradient to the ocean, and is characterised by vegetated sand dunes and expansive intertidal reef flats and shallow pavements which progress to deeper sands offshore. Nearshore limestone or calcarenite pavements are variably covered by sand, gravel and coral. Bare sands overlay limestone pavements in many parts of the area with increased quantities of rubble on exposed pavement where strong water currents are present. Apart from a few locations where hydrocarbon industry pipelines come ashore (east and west sides of Varanus Island and the eastern side of Barrow Island), the geomorphology of the reserves is relatively undisturbed. Development proposals in the area, including new pipelines, are subject to assessment in accordance with the EP Act. The major pressures on the geomorphology of the reserves relate to physical disturbance from the installation of pipelines and dredging and blasting for shipping channels. New port facilities proposed for the east coast of Barrow Island are located in the existing Barrow Island Port and therefore not in the reserves. Management of the reserves' geomorphology includes liaison with industry and other agencies to ensure the importance of the geomorphology is taken into account when proposed developments in the area are assessed.
Current status	The geomorphology is generally in an undisturbed condition, apart from some localised disturbance for pipelines and shipping channels.

Existing and potential uses and/or pressures	• Physical disturbance from: ▪ installation of pipelines; ▪ dredging and blasting of shipping channels; ▪ anchoring/mooring; ▪ installation of markers; ▪ decommissioning of pipelines and platforms; and ▪ aquaculture.
Current major pressure/s	Physical disturbance from development activities, particularly the installation of pipelines and dredging and blasting to create shipping channels.
Management objective/s	1. To ensure the structural complexity of the reserves' geomorphology is not significantly reduced by installation of pipelines, or infrastructure development. 2. To ensure coastal landforms within the reserves are not significantly degraded by installation of pipelines, or infrastructure development.
Strategies	1. Ensure that approvals and the setting of conditions for new coastal and offshore developments and activities are consistent with the management targets for the value of geomorphology and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, EPA, DoIR, DoF, Tourism WA) **(H)**. 2. Ensure effective management of commercial and recreational access to and use of coastal landforms adjacent to the reserves (DEC) **(H)**. 3. Determine the level of existing disturbance/degradation to the geomorphology, to set benchmarks for this value (DEC) **(H)**. 4. Educate users about the ecological importance of the reserves' geomorphology (DEC) **(L)**.

Performance measure/s	1. Area of hard seabed disturbance (ha). 2. Area of coastal disturbance (ha).	**Desired trend/s**	1. Constant or negative. 2. Constant or negative.
Short-term target/s	Not Applicable.		
Long-term target/s	The targets for geomorphology will be as noted below. i. *Sanctuary* and *recreation* zones – no change, as a result of human activity. ii. *General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and the *conservation area* of the *marine management area* – no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% of the total area of these zones. iii. Unzoned areas of the *marine management area*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[§]Quantitative target/s for geomorphology in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.



9.1.2 Sediment quality

Ecological value	**Sediment quality**: *The sediments of the reserves are generally pristine, which is essential to the maintenance of healthy marine ecosystems.*

Background	The sediments of the Montebello/Barrow islands region are generally, with the exception of a few small areas of localised impact, in a pristine condition. High sediment quality is essential for the maintenance of healthy ecosystems. Development and infrastructure proposals that have the potential to significantly impact the State's environment warrant referral to the EPA under the EP Act. The EPA decides whether or not to assess referred proposals. For proposals that are formally assessed, the EPA can recommend that Government apply certain conditions to developments, should approval be granted. These conditions may include those relevant to maintenance of sediment quality. Developments granting conditional Government approval are subsequently regulated by relevant agencies, such as DEC and DoIR. The National Water Quality Management Strategy provides a framework for water and sediment quality management, based on policies and principles that apply nationwide. The national strategy is being given effect in Western Australia through implementation of the State Water Quality Management Strategy (SWQMS) Document No. 6, which was endorsed by State cabinet in 2004. Consistent with SWQMS Document No. 6, the former Department of Environment undertook broad consultation with the community and stakeholders to establish environmental values and objectives for State marine waters off the Pilbara coast, including waters of the reserves. The environmental values and spatially-defined objectives arising from the community consultation (DoE, 2006) have been endorsed by the EPA as 'interim', pending development of a formal policy under the EP Act. The 'interim' environmental values and objectives align with the zoning scheme and KPIs contained in this plan and will be used to guide management and protection of the marine environment from the effects of waste inputs and pollution. In this area, localised impacts on the sediment quality are the result of contamination by drilling fluids and cuttings, which may contain heavy metals and other pollutants. However, these impacts are very small. In areas of high shipping activity, such as loading facilities and channels, the accumulation of tributyl tin in the sediments may have negative effects on ecosystem health. Given the relatively low level of shipping in the reserves, this is not believed to be a major issue. Other industrial wastes (including hydrotest water, sewage, waste chemicals, oil and runoff) also have the potential to cause localised pollution of marine sediments and alter sediment characteristics (sediment size and oxygen concentrations). However, the risk posed by these stressors to the overall sediment quality of the reserves is believed to be low.
Current status	The sediment quality is generally in a pristine condition, apart from some areas of localised disturbance.
Existing and potential uses and/or pressures	• Discharge of toxicants[*] and physical and chemical stressors[†] from: ▪ drilling fluids and cuttings; ▪ tributyl tin accumulation in areas of high shipping activity; ▪ oil contaminated groundwater; ▪ nutrients from sewage discharge; and ▪ waste chemicals, oils etc. • Dredging (e.g. for shipping channels).
Current major pressure/s	Discharge of drilling fluids and cuttings resulting in contamination.
Management objective/s	To facilitate long-term management by accumulating spatial and temporal information about impacts on sediment quality from various activities in the reserves.
Strategies	1. See development proposals strategies in Section 8.0 **(H-KMS)**. 2. Maintain a database of pollutant inputs to sediments (industry, DEC, DoIR) **(H-KMS)**. 3. Minimise impacts on sediments by encouraging, where possible, the use of products that have least impact on the marine biota (DEC, EPA, DoIR) **(H)**.

Performance measure/s	1. Metals and Metalloids. 2. Organic compounds. 3. Ammonia, sulfide and nutrients.	**Desired trend/s**	1. Constant. 2. Constant. 3. Constant.
Short-term target/s	Not Applicable.		
Long-term target/s	The targets for sediment quality will be as noted below. i. *Sanctuary* and *recreation* zones – no change from background[Ω] levels, as a result of human activity. ii. *General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area* – no change from background[Ω] levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% of these zones. iii. Unzoned areas of the *marine management area*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[*] *toxicants* are chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment due to human activity (modified from ANZECC &ARMCANZ, 2000).

[†] *physical and chemical stressors* is used here to describe a number of naturally-occurring physical and chemical stressors that can cause degradation of the marine environment when ambient values are too high or too low as a result of human activity (modified from ANZECC & ARMCANZ, 2000).

[Ω] *background* conditions are determined from an appropriate unimpacted reference site, as per the environmental quality management framework referred to in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000).

[§] Quantitative targets for sediment quality in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.

9.1.3 Water quality (KPI)

Ecological value	**Water quality:** *The waters of the reserves are generally pristine, which is essential to the maintenance of healthy marine ecosystems.*

Background	The majority of the waters of the Montebello/Barrow islands region are in a pristine condition. The broad oceanographic processes and the nature of water circulation in the region influence the transport, dispersal and mixing of sediments, biota and pollutants and, consequently, the water quality of the area. Nearshore water movements and mixing patterns in the Montebello/Barrow islands region are driven primarily by strong currents, large tidal ranges and winds. Wave pumping, seabed topography and the steering effect of islands and reefs also play important roles in water movement and mixing patterns causing rapid flushing in most parts of the Montebello/Barrow islands region. However, some areas, including the lagoons and shallow embayments of the Montebello Islands, are subject to limited flushing and a subsequent low rate of exchange between these waters and the surrounding ocean. Sea surface temperatures around the islands range from 20ºC in winter to about 30ºC in summer, with temperatures sometimes increasing to 33ºC in shallow areas. Temperature and salinity are both constant throughout the water column as a result of tidal stirring. Water clarity varies throughout the reserves, with the reefs and channels on the western side of the Montebello Islands having the highest water clarity, due to their exposure to high currents and strong wave action. Channels within the Montebello Islands have relatively low turbidity, while the lagoons with their fine sediments are more turbid. Water turbidity generally increases towards the south-eastern side of Barrow Island, mainly due to the influence of coastal water discharges that have a high load of fine sediments. The National Water Quality Management Strategy provides a framework for water and sediment quality management, based on policies and principles that apply nationwide. The national strategy is being given effect in WA through implementation of the State Water Quality Management Strategy (SWQMS) Document No. 6, which was endorsed by State cabinet in 2004. Consistent with SWQMS Document No. 6, the former Department of Environment undertook broad consultation with the community and stakeholders to establish environmental values and objectives for State marine waters off the Pilbara coast, including waters of the reserves. The environmental values and spatially-defined objectives arising from the community consultation (DoE, 2006) have been endorsed by the EPA as 'interim', pending development of a formal policy under the EP Act. The 'interim' environmental values and objectives align with the zoning scheme and KPIs contained in this plan and will be used to guide management and protection of the marine environment from the effects of waste inputs and pollution. Sewage discharge from vessels has the potential to increase nutrient levels and cause health problems through direct contact. The impact of sewage discharge from vessels in the reserves will vary spatially and temporally due to environmental parameters (e.g. water circulation) and human usage patterns (e.g. number of vessels). The Strategy for Management of Sewage Discharge from Vessels into the Marine Environment, adopted by Government in 2004, details a framework for the implementation of controls of sewage discharge through designation of high risk areas where discharge is prohibited or where only treated sewage can be discharged from vessels. The strategy outlines a number of guidelines but allows some flexibility in applying the categories in marine conservation reserves. The basis of the policy is that three categories will apply in State waters: • 'Zone 1' – no discharge; • 'Zone 2' – discharge only from approved treatment systems, and more than 20 m from a stationary vessel or person in the water; and • 'Zone 3' – discharge of untreated vessel sewage permitted, except within 500 m of land and within 100 m of a stationary vessel or person in the water. There are currently treated sewage outfalls from the accommodation facilities on both Barrow and Varanus Islands, as well as some discharge from the pearling industry, and recreational and commercial vessels, including houseboats. The quantity of sewage is relatively low from these sources and dispersion is rapid. The risk of impacts due to high nutrients is believed to be low from these sources, and probably localised.

Development and infrastructure proposals that have the potential to impact on water quality in the State are subject to assessment under the EP Act. Conditions are set for water quality and are regulated by DEC and DoIR.

Petroleum industry activities, if not managed appropriately, have the potential to negatively impact on the high water quality of the reserves. By-products of petroleum exploration and production include produced formation water (i.e. water with hydrocarbon contamination), and drill cuttings and fluids. In the reserves, all produced formation water is re-injected rather than being discharged into the marine environment. However, if this were not to happen the area of biological impact of produced formation water could extend up to 900 m from the discharge point, with skewing in the direction of tidal flow (Burns *et al.*, 1999). A separate review on the effects of drilling fluids (which may be water or oil based) on the marine environment has concluded that acute effects are found only at very high concentrations of drilling fluids and are typically observed less than 150 m from the discharge point for short periods after the discharge (Swan *et al.*, 1994). While the effects of drilling operations are relatively localised, there is strong support for techniques such as re-injection of produced formation water to be used in the reserves, to maintain high water quality in the area and avoid localised impacts around discharge points. The frequency of oil spills in the area is low and in the event of a spill, history has shown that the effects are likely to be short-term and acute and high water quality is restored via prevailing flushing and currents. Between 1989 and 2001, there were six oil spills within the reserves, ranging in volume from 20 to 25,000 litres.

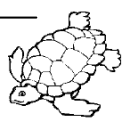
In areas of high shipping activity, the leaching of anti-fouling compounds from vessel hulls and marine structures has the potential to cause localised copper or tributyl tin (TBT) pollution. Deck drainage and runoff from hardstand areas (such as jetties), along with the discharge of ballast and bilge water from loading vessels, may also cause localised pollution of the water column. The proposed Gorgon gas development involves significant dredging and installation of marine infrastructure. Dredging required to create and maintain access channels and berth areas is likely to generate relatively elevated levels of turbidity, potentially resulting in increased sedimentation. These activities are proposed to mainly occur within the Barrow Port, however plumes associated with dredging and dredge spoil dumping may extend into the reserves. These activities will need to be closely managed and designed to minimise impacts on the reserves.

At the current level of recreational and commercial activities in the reserves, no major pressures on the high water quality in the majority of the area have been identified. Management to maintain the water quality of the reserves includes gaining a better understanding of the processes which contribute to the high water quality and development of predictive models in the event of oil spills or shipping accidents. The following sewage discharge scheme will be applied, using three discharge categories (see Figure 11 for additional detail); however during the life of the management plan these categories may be amended if considered necessary:

- all waters in the sanctuary, recreation and special purpose zones (benthic protection) in the Montebello Islands Marine Park and waters within 500 m of these zones are designated ‘Zone 1’ (no discharge);
- waters between the Southern Montebellos Sanctuary Zone and the Northern Montebellos Sanctuary Zone, including the special purpose zones (pearling), are designated ‘Zone 1’ (no discharge). ‘Zone 1’ also extends westwards to 500 m outside the fringing reef and eastwards to 500 m east of islands and rocks;
- the remaining waters of the Montebello Islands Marine Park are designated ‘Zone 2’ (discharge permitted only using approved treatment systems, and more than 20 m from a stationary vessel or person in the water);
- all waters of the Barrow Island Marine Park and waters within 500 m of the boundary of the marine park are designated ‘Zone 1’ (no discharge);
- all waters of the Bandicoot Bay Conservation Area and waters within 500 m of the conservation area are designated ‘Zone 1’ (no discharge); and
- all other waters in the marine management area are designated ‘Zone 3’ (discharge permitted, except discharge is not permitted within 500 m of land or pearling/aquaculture areas, and waters within 100 m of a stationary vessel or person in the water).

Current status	The water quality is generally in a pristine condition, apart from some small areas of localised disturbance.
Existing and potential uses and/or pressures	• Discharge of toxicants[*] and physical and chemical stressors[†] from: ▪ accidental spillage of petroleum products; and ▪ bilge water discharge. ▪ discharge of cooling water; ▪ sedimentation and increased turbidity (e.g. as a result of dredging); ▪ drilling fluids and cuttings; ▪ produced formation water; and ▪ nutrients from sewage discharge. • Introduction of marine pest species from: ▪ ballast water; ▪ aquaculture/pearling activities; and ▪ hull fouling. • Litter.
Current major pressure/s	None.
Management objective/s	To facilitate long-term management by accumulating spatial and temporal information on impacts on water quality of various activities in the reserves.
Strategies	1. Ensure there are appropriate predictive models and specific management plans (given location and weather conditions) for oil spills to assist the State Committee for Combating Oil Pollution in managing any pollution event that occurs (industry, DPI, DEC, DoIR) **(H-KMS)**. 2. Ensure there are adequate management resources available to deal with pollution incidents consistent with the risk of such an event occurring (industry, DPI, DEC, DoIR) **(H)**. 3. Ensure a pollutant inputs database for the reserves is maintained (industry, DEC) **(H)**. 4. Develop an appropriate understanding of the circulation and mixing of the reserves' waters (DEC) **(M)**. 5. Develop an appropriate understanding of the natural variability of the water quality conditions, including those areas of the reserves within the zone of influence of the proposed Gorgon gas development (DEC, DoIR, industry) **(M)**. 6. Encourage a policy of zero discharge where alternatives to discharge exist (DEC, EPA, DoIR) **(M)**. 7. Develop and enforce controls on the discharge of sewage from vessels in the reserves, including the prohibition of discharge in areas designated 'Zone 1' (DPI, DEC) **(M)**. 8. Educate users of the reserves about government policy and regulations on boat sewage disposal (DEC, DPI) **(M)**.

Performance measure/s	1. Nutrients: *Chlorophyll a* and inorganic nitrogen (N) conc. in seawater. 2. Toxicants: conc. in seawater. 3. Pathogens: Faecal coliform conc. in seawater. 4. Litter: Mass (kg) of litter at selected monitoring sites. 5. Other measures will be developed as necessary.	**Desired trend/s**	1. Constant or negative. 2. Constant or negative. 3. Constant or negative. 4. Constant or negative.
Short-term target/s (KPI)	Not Applicable.		



Long-term target/s (KPI)	The targets for water quality will be as noted below. i. *Sanctuary* and *recreation* zones – no change from background[Ω] levels, as a result of human activity. ii. *General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area* – no change from background[Ω] levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% (by area) of these zones. iii. Unzoned areas of the *marine management area*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.

[*] *toxicants* are chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment due to human activity (modified from ANZECC &ARMCANZ, 2000).

[†] *physical and chemical stressors* is used here to describe a number of naturally-occurring physical and chemical stressors that can cause degradation of the marine environment when ambient values are too high or too low as a result of human activity (modified from ANZECC & ARMCANZ, 2000).

[Ω] *background* conditions are determined from an appropriate unimpacted reference site, as per the environmental quality management framework referred to in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000).

[§] Quantitative targets for water quality in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan.

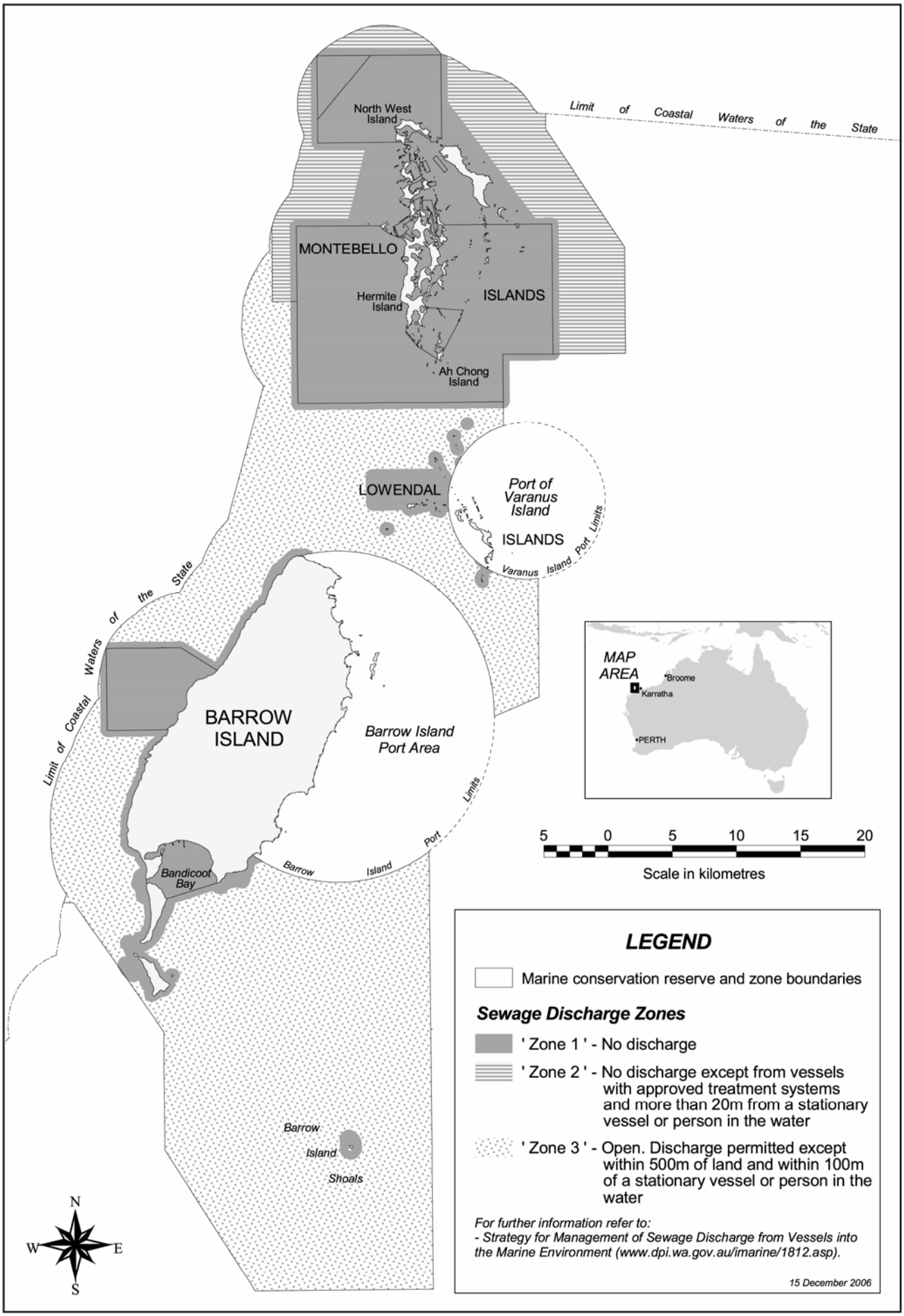


FIGURE 11: Controls on sewage discharge in the Montebello/Barrow islands marine conservation reserves

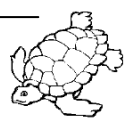
9.1.4 Coral reef communities (KPI)

Ecological value	**Coral reef communities:** *Undisturbed intertidal and subtidal coral reefs and bommies with a high diversity of hard corals.*

Background	Coral reef communities occur throughout the reserves. The best developed coral reef communities in the reserves are in the relatively clear water and high energy conditions of the fringing reefs to the west and south-west of the Montebello Islands, and bommies and patch reefs in the more turbid and lower energy waters along the eastern edge of the Montebello Islands. The most significant coral reefs around Barrow Island are Biggada Reef on the west coast, Dugong Reef and Batman Reef off the south-east coast and along the edge of the Lowendal Shelf on the east side of Barrow Island. The reserves have a high diversity of hard corals with at least 150 species (54 genera) of hard corals recorded to date, from limited surveys (Berry, 1993). Species diversity and community structure vary with different environmental conditions such as exposure to wave action, currents and water clarity. Corals are important primary producers that provide food, substrate and shelter for a wide variety of marine life, including sponges, sea stars, sea urchins, crustaceans, molluscs, worms and fishes, some of which are targeted by recreational and commercial fishers. They also protect coastlines from wave erosion. The coral reef communities in the reserves are currently in good condition with no significant human impacts reported. Corals can currently be collected legally throughout the State under the FRM Act for commercial purposes, by five fishers who hold a Marine Aquarium Managed Fishery Licence with an endorsement to take corals. In July 2001, DoF imposed an interim 12 month prohibition on recreational collection of coral in WA, and recreational coral collection continues to be prohibited in the Pilbara/Kimberley region. In addition to the collection of corals, development activities such as installation of petroleum pipelines may impact on corals through direct physical disturbance. In many cases these impacts can be avoided by appropriate placement of such facilities. Major, long-term impacts of seabed disturbance on coral communities can occur from direct removal of substrates with attached corals, such as from dredging or blasting of vessel access channels, and installation of infrastructure on the seabed. Construction activities in the marine environment, particularly dredging and drilling, may also temporarily affect corals, through smothering from deposited sediments and shading by finer sediments suspended in the water. Spilled liquid hydrocarbons can adversely affect coral communities by direct contact at low tide, through the dispersal of oil into the shallow subtidal areas or by dissolution of toxic hydrocarbons into the water column. The extent to which a spill will affect corals in any area depends on a complex suite of interacting physical, chemical and biological factors. The probability of a large leak or spill is very low. Detailed contingency planning is in place to reduce the risk of a significant spill and substantial oil spill response capacity is currently maintained at the Port of Dampier and on the islands of the north-west shelf, including Barrow Island. The major pressures on coral reef communities in the reserves are physical disturbance from installation of pipelines and accidental spillage of petroleum products. Mooring and anchoring are potential pressures on coral reef communities in the reserves. They are carried out mainly by commercial tender and charter boat operators, and to lesser extent recreational vessels, that use the area. Anecdotal reports from users indicate that mooring and anchoring occurs predominantly on sand areas and as a result has had minimal impact on coral reef communities in the past. However, as nature-based tourism grows, the use of sensitive coral reefs is likely to increase and controls may be required. A key management approach to protect coral reef communities is the establishment of a zoning scheme. This helps provide a degree of ecological insurance against potential impacts and allows for monitoring of areas relatively free of human impact. Other management controls include prohibitions on both commercial and recreational coral collecting, and a mooring and anchoring program may be initiated where appropriate.
Current status	Coral reef communities are generally in an undisturbed condition.

Existing and potential uses and/or pressures	• Physical disturbance from: ▪ installation of pipelines; ▪ drilling; ▪ dredging and trenching; ▪ mooring and anchoring; and ▪ commercial coral collecting. • Discharge of toxicants* and other physical and chemical stressors† from : ▪ accidental spillage of petroleum products; ▪ sedimentation (e.g. as a result of drilling, dredging and trenching); ▪ discharge of cooling water; and ▪ nutrients from sewage discharge. • Introduction of marine pest species from: ▪ ballast water; ▪ aquaculture/pearling activities; and ▪ hull fouling.
Current major pressure/s	• Accidental spillage of petroleum products. • Physical disturbance from pipeline installation.
Management objective/s	To ensure coral reef communities are not significantly impacted by accidental spillage of petroleum products or physical disturbance from development activities.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. See development proposal strategies detailed in Section 8.0 **(H-KMS)**. 3. Assess the nature, level and potential impacts of human activities on coral reef communities within the reserves and implement an appropriate monitoring program (DEC) **(H-KMS)**. 4. Ensure all existing and new moorings meet specified environmentally acceptable standards where these moorings are located in sensitive coral habitats (DEC, DPI) **(H)**. 5. Ensure that approvals and the setting of conditions for new petroleum, nature-based tourism, pearling and aquaculture operations are consistent with the management targets for coral reef communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, EPA, DoIR, DoF, Tourism WA) **(H)**. 6. Prohibit the commercial and recreational collection of coral within the reserves (DoF, DEC) **(H)**. 7. Ensure activities that are potentially detrimental to successful coral reproduction are not carried out during and immediately after the major period of coral spawning (industry, DEC, DoIR) **(H)**. 8. Educate users of the reserves about the ecological importance of coral reef communities and the potential detrimental effects of indiscriminate reef walking, collecting, anchoring and boating on coral reef communities (DEC) **(M)**. 9. Ensure the hydrocarbon industry is informed of relevant management objectives and targets for coral reef communities (DEC, DoIR) **(M)**. 10. Ensure the State Committee for Combating Oil Pollution has access to data relevant to the management of oil spills (DEC, DPI) **(M)**.

Performance measure/s	1. Diversity. 2. Biomass.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s (KPI)	Not Applicable.		



Long-term target/s (KPI)	1. No loss of coral reef community diversity as a result of human activity in the reserves. 2. The abundance[Ø] targets for coral reef communities will be as noted below. i. *Sanctuary* and *recreation* zones – no change due to human activity. ii. *General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area* – no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. iii. Unzoned areas of the *marine management area*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.

[*] *toxicants* are chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment due to human activity (modified from ANZECC & ARMCANZ, 2000).

[†] *physical and chemical stressors* is used here to describe a number of naturally-occurring physical and chemical stressors that can cause degradation of the marine environment when ambient values are too high or too low as a result of human activity (modified from ANZECC & ARMCANZ, 2000).

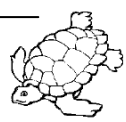
[Ø] In this context a loss or change in *abundance* or *biomass* excludes losses of a minor, transient or accidental nature.

[§] Quantitative targets for coral reef communities in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.

9.1.5 Mangrove communities (KPI)

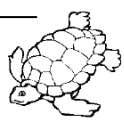
Ecological value	**Mangrove communities:** *Six species of mangrove are found in the reserves, with the Montebello Islands' mangrove communities considered globally unique as they occur in lagoons of offshore islands.*

Background	There are six species of mangrove found in the reserves, these being the white mangrove (*Avicennia marina*), ribbed-fruit orange mangrove (*Bruguiera exaristata*), yellow-leaf spurred mangrove (*Ceriops tagal*), red mangrove (*Rhizophora stylosa*), club mangrove (*Aegialitis annulata*) and river mangrove (*Aegiceras corniculatum*). The majority of mangrove communities in the reserves occur in the Montebello Islands. The largest mangrove community (approximately 15 ha) is found in Stephenson Channel on Hermite Island, where individual trees can reach 5 m in height. Mangroves also occur on Barrow Island, with restricted areas of stunted *Avicennia marina* occurring in narrow fringing strips in embayments. These include at Mattress Point, south of the Chevron camp, near the airstrip, at Stokes Point and near Pelican Island on the western side of Bandicoot Bay. In the Lowendal Islands there are mangroves on less than 0.1% of the coastline. Due to the unusual and scientifically important combination of lagoonal mangrove assemblages occurring in oceanic islands, the mangrove communities at the Montebello Islands are considered to be globally unique (Semeniuk, 1997). The mangrove communities in the reserves are important primary producers, with decomposing leaves providing food for microscopic organisms, which in turn provide food for a variety of other animals. Mangrove leaves also provide a food source for larger animals such as turtles. Mangals (mangrove forests) support a range of associated animal species, many of which are restricted to that environment. Common mangal fauna include burrowing infauna such as peanut worms (sipunculids), mud crabs (*Scylla serrata*), and mud lobsters (*Thallasina*) and epifauna such as gastropods, mud skippers and crabs. Some littorine whelks and barnacles are restricted to living on mangrove trees. Ospreys (*Pandion haliaetus*) and white-bellied sea eagles (*Haliaeetus leucogaster*) roost in mangroves, while brahminy kites (*Haliastur indus*) and a range of smaller birds nest in them. The small mangal in Square Bay at Barrow Island has an associated population of red fiddler crabs (*Uca* sp.). These communities also provide valuable nursery areas for juvenile fishes and crustaceans, some of which are targeted by recreational and commercial fishers, and may provide shelter for other species such as juvenile turtles. Mangroves are generally of high conservation significance and are protected throughout the State under the WC Act. In addition, development proposals that may impact on mangrove communities are subject to an environmental impact assessment by DEC/EPA in accordance with the *Guidance Statement for Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline* (EPA, 2001). This guidance statement, which has its basis in the EP Act, indicates that the EPA's environmental objective in regard to tropical arid zone mangroves of the Pilbara coastline, habitats and dependent habitats is "*…to maintain ecological function and sustainability"* (EPA, 2001). Due to their remote and largely inaccessible location, there are few pressures on mangrove communities in the reserves and, as a result, the mangrove communities are currently in a relatively undisturbed condition. The current pressure that impacts on mangrove communities in the Montebello Islands is that of physical disturbance to the mangroves by fishing for mud crabs in these habitats. The long-term indirect effects of this activity on mangrove ecology are unknown but direct impacts, such as trampling of aerial roots and damage to individual trees are apparent. Pressures on mangrove communities in the Barrow Island area include some physical disturbance for development of industry facilities and infrastructure. Given that physical disturbance and extraction of a major component of the community are the most significant threats to mangrove communities, management arrangements include protecting these communities in sanctuary zones. This will alleviate pressure on the mangrove communities from mud crabbing activity and, given that mud crabs are also found outside mangrove areas, it will still allow opportunities to take mud crabs from the reserves. It should be noted that, as many of the island conservation reserves extend to the low water mark, some of the mangrove communities may be located in the terrestrial island conservation reserves. The intent is to afford these communities the same level of protection as the rest of the marine conservation reserves. To assist this, the MPRA will work with the Conservation Commission



	to achieve integrated management of these mangrove areas, which will include applying DoF restrictions, across the whole intertidal community as appropriate.
Current status	The mangrove communities are generally in an undisturbed condition with some localised areas of disturbance.
Existing and potential uses and/or pressures	• Removal of mud crabs. • Physical disturbance from: ▪ mud crabbing; ▪ recreational fishing; ▪ clearing for facilities; and ▪ installation of infrastructure and pipelines. • Discharge of toxicants* and other physical and chemical stressors† from: ▪ accidental spillage of petroleum products; ▪ use of dispersants; ▪ tributyl tin from ship hulls; and ▪ nutrients from sewage. • Litter (e.g. ropes). • Introduction of marine pest species from: ▪ ballast water; ▪ aquaculture/pearling activities; and ▪ hull fouling. • Dust from land-based activities. • Sedimentation from construction, installation of pipelines, dredging and drill cuttings.
Current major pressure/s	Over exploitation of mud crabs and physical disturbance of mangroves from mud crabbing.
Management objective/s	To ensure that mangrove communities are not significantly impacted by physical disturbance or mud crabbing in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. See development proposal strategies detailed in Section 8.0 **(H-KMS)**. 3. Educate users of the reserves about the ecological importance of mangroves in the reserves and, in particular, the impacts of physical disturbance and mud crabbing on mangrove communities (DEC) **(H-KMS)**. 4. Assess the nature, level and potential impacts of human activities on mangrove communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**. 5. Ensure the hydrocarbon and nature-based tourism industries are informed of relevant management objectives and targets for mangrove communities within the reserves (DEC, DoIR) **(H)**.

Performance measure/s	1. Diversity. 2. Biomass (extent in ha).	**Desired trend/s**	1. Constant. 2. Constant or positive.
Short-term target/s (KPI)	Not Applicable.		
Long-term target/s (KPI)	1. No loss of mangrove community diversity as a result of human activity in the reserves. 2. The abundance^{Ø} targets for mangrove communities will be as noted below. i. *Sanctuary* and *recreation* zones – no change due to human activity. ii. *General use, special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area* – no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. iii. Unzoned areas of the *marine management area*§ - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		



[*] ***toxicants*** are chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment due to human activity (modified from ANZECC & ARMCANZ, 2000).

[†] ***physical and chemical stressors*** is used here to describe a number of naturally-occurring physical and chemical stressors that can cause degradation of the marine environment when ambient values are too high or too low as a result of human activity (modified from ANZECC & ARMCANZ, 2000).

[Ø] In this context a loss or change in ***abundance*** or ***biomass*** excludes losses of a minor, transient or accidental nature.

[§] Quantitative targets for mangrove communities in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.

9.1.6 Macroalgal and seagrass communities (KPI)

Ecological value	**Macroalgal and seagrass communities**: *Extensive subtidal macroalgal and seagrass communities are important primary producers and refuge areas for fishes and invertebrates.*

Background	Seagrass and macroalgae are important components of shallow tropical marine environments. Macroalgae in particular are important primary producers and significantly contribute to the productivity of the region. In addition to providing energy and nutrients for detrital grazing food webs, seagrasses and macroalgae provide food for protected animals such as dugongs (*Dugong dugon*) and green turtles (*Chelonia mydas*). Dense seagrass and macroalgal meadows enhance the habitat value of abiotic benthic habitats by increasing structural diversity and by stabilising soft substrates. Seagrass and macroalgae habitats in the reserves vary seasonally in response to water temperature, day length, reproductive cycles, physical disturbance and regrowth. Macroalgal meadows are the most extensive benthic habitat of the reserves and make the major contribution to primary production. Macroalgae are important primary producers, trapping light energy from the sun and making it available to the ecosystem. They also provide important habitat for molluscs, sea urchins, sea stars, crabs and fishes. These communities are most commonly found on shallow limestone pavement in depths of 5 to 10 m. The macroalgal assemblage is typically dominated by species of brown algae, particularly of the genera *Sargassum*, *Turbinaria* and *Pandina*. Green algae from the genera *Caulerpa*, *Cladophora* and *Rhodophyta* are also quite common, with the latter being an important food source for the green turtle. Other abundant taxa include *Halimeda, Dictyopterus, Dictyota, Cystoseira, Codium* and *Laurencia*. Some species are known only from Barrow Island as systematic collections have not been undertaken for other north-west sites. For example, *Boergesenia forbessii, Yamadaella caenomyce, Halimeda velasquezii, Neomeris vanboseae, Gracillaria urvillei,* and *Valoniopsis pachynema* have only been recorded in Western Australia during surveys for the proposed Gorgon gas development. Seagrasses appear not to form extensive meadows in the reserves but rather, are sparsely interspersed between the macroalgae. A total of seven seagrass species have been recorded to date, these being *Cymodocea angustata*, *Halophila ovalis*, *Halophila spinulosa*, *Halodule uninervis*, *Thalassia hemprichi, Thalassodendron ciliatum* and *Syringodium isoetifolium*. However, the level of knowledge on seagrass distribution in the reserves is low. *Halophila* spp. are known to be the most common seagrasses on shallow soft substrates and sand veneers throughout the area. They extend from the intertidal zone to approximately 15m water depth. The ephemeral seagrasses typically found in the area are likely to be the preferred food source for resident dugongs, while turtles feed on both seagrasses and macroalgae. Given the ability of macroalgal and ephemeral seagrass communities in the reserves to recover from human impact where water quality and substrate are not diminished, no major pressures on these communities have been identified. Pressures on macroalgal and seagrass communities in the Barrow Island area may include physical disturbance for industry development facilities and infrastructure, and associated impacts through increased levels of sedimentation and turbidity. Management controls for macroalgal and seagrass communities emphasise maintenance of areas free of human impact for monitoring as well as areas that provide a degree of ecological insurance against impacts in the future. Development proposals that may impact on macroalgal and seagrass communities are subject to an environmental impact assessment by DEC/EPA.
Current status	The macroalgal and seagrass communities are generally in an undisturbed condition.

Existing and potential uses and/or pressures	• Discharge of toxicants* and other physical and chemical stressors† from:
	  ▪ accidental spillage of petroleum products;
	  ▪ nutrients from sewage discharge; and
	  ▪ tributyl tin from ship hulls.
	• Physical disturbance from:
	  ▪ trenching;
	  ▪ dredging;
	  ▪ drilling; and
	  ▪ bottom towing of pipelines.
	• Shading from marine infrastructure.

	• Introduction of marine pest species from:
	  ▪ ballast water;
	  ▪ aquaculture/pearling activities; and
	  ▪ hull fouling.
	• Sedimentation from drilling and dredging.
	• Commercial trawling.

Current major pressure/s	None.
Management objective/s	To gain an increased understanding of the macroalgal and seagrass communities in the reserves to facilitate long-term management.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. See development proposal strategies detailed in Section 8.0 **(H-KMS)**. 3. Initiate research and mapping programs to provide a more comprehensive assessment of the seagrass communities in the reserves (DEC) **(H-KMS)**. 4. Ensure that approvals and the setting of conditions for new petroleum, nature-based tourism, pearling, aquaculture and commercial fishing operations are consistent with the management targets for macroalgal and seagrass communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, industry, DoIR, EPA, DoF, Tourism WA) **(H)**. 5. Ensure reserve users are informed of relevant management objectives and targets for macroalgal and seagrass communities (DEC, DoIR) **(H)**. 6. Assess the nature, level and potential impacts of human activities on macroalgal and seagrass communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**. 7. Educate users of the reserves about the ecological importance of macroalgal and seagrass communities and the potential impacts of their activities on these habitats (DEC) **(L)**.

Performance measure/s	1. Diversity. 2. Biomass.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s (KPI)	Not Applicable.		

Long-term target/s (KPI)	1. No loss of macroalgal and seagrass community diversity as a result of human activity in the reserves.
	2. The abundance[Ø] targets for macroalgal and seagrass communities will be as noted below.
	  i. *Sanctuary* and *recreation* zones – no change due to human activity.
	  ii. *General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area* – no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones.
	  iii. Unzoned areas of the *marine management area*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[*] *toxicants* are chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment due to human activity (modified from ANZECC & ARMCANZ, 2000).

[†] *physical and chemical stressors* is used here to describe a number of naturally-occurring physical and chemical stressors that can cause degradation of the marine environment when ambient values are too high or too low as a result of human activity (modified from ANZECC & ARMCANZ, 2000).

[Ø] In this context a loss or change in *abundance* or *biomass* excludes losses of a minor, transient or accidental nature.

[§] Quantitative targets for macroalgal and seagrass communities in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.

9.1.7 Rocky shore/intertidal reef platform communities

Ecological value	**Rocky shore/intertidal reef platform communities**: *Rocky shores predominate on most of the islands of the reserves and provide habitat for a variety of intertidal organisms, which in turn provide food for shorebirds.*

Background	The majority of the island shores within the reserves are primarily composed of rocky limestone cliffs and horizontal rock platforms. Most of the limestone cliffs are approximately one to two metres above the level of high water. However, on the west coast of Barrow Island the cliffs are up to 30 m high. The moderately large tidal ranges within the reserves result in pronounced horizontal zonation of plants and animals such as algae, oysters, barnacles, crabs and molluscs. Beneath the undercut cliffs, intertidal limestone rock platforms extend seaward for up to 100 m. In areas of low wave action, such as the east coasts of the islands of the reserves, a layer of mud or sand often covers the platforms. In more exposed areas, platforms are covered with an algal turf and corals may grow on the outer edges. This habitat supports a myriad of marine animals, whose distribution is controlled by the action of the tides. Bivalve shells, snails, crabs, worms and small fish can seek refuge from desiccation in shallow rock pools at low tide, while larger fish and other marine animals come in to feed on these organisms when the tide is high. Offshore intertidal reefs in the reserves are surrounded by coral reef communities and support coralline algae and a range of invertebrates. The abundance of invertebrate life on rocky shores provides a valuable food source for shorebirds and these areas contribute significantly to the variety of habitats and therefore the biological diversity of the reserves. Given the low level of human usage of the reserves, there are no current major pressures on the rocky shore/intertidal reef platform communities. Management of these communities in the reserves will relate to the use of zoning to provide for areas of no impact in which monitoring can be undertaken, as well as education of users of the reserves about the importance of this value. Under the FRM Act, DoF is responsible for the management of the recreational and commercial take of invertebrate species from rocky shore/intertidal reef platform communities. Any development proposals that may impact on rocky shore/intertidal reef platforms would be subject to assessment under the EP Act. It should be noted that, as many of the island conservation reserves extend to the low water mark, some of the rocky shore/intertidal reef platform communities may be located in the terrestrial island conservation reserves. The intent is to afford these communities the same level of protection as the rest of the marine conservation reserves. To assist this, the MPRA will work with the Conservation Commission to achieve integrated management of these rocky shore/intertidal reef platform areas, which will include applying DoF restrictions, across the whole intertidal community as appropriate.
Current status	The rocky shore/intertidal reef platform communities are generally in an undisturbed condition.

Existing and potential uses and/or pressures	• Physical disturbance from:
	  ▪ human activity; and
	  ▪ infrastructure development.
	• Litter.
	• Nutrients from sewage discharge.
	• Transition zone seismic.
	• Overfishing, including collecting, by recreational and commercial fishers.
	• Accidental spillage of petroleum products.
	• Introduction of marine pest species from:
	  ▪ ballast water;
	  ▪ aquaculture/pearling activities; and
	  ▪ hull fouling.

Current major pressure/s	None.
Management objective/s	To gain an increased understanding of the rocky shore/intertidal reef platform communities in the reserves to facilitate long-term management.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. See development proposal strategies detailed in Section 8.0 **(H-KMS)**. 3. Assess the nature, level and potential impacts of human activities on rocky shore/intertidal reef platform communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**. 4. Ensure that approvals and the setting of conditions for new petroleum, nature-based

	tourism, pearling, aquaculture and commercial fishing operations are consistent with the management targets for rocky shore/intertidal reef communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, industry, DoIR, EPA, DoF, Tourism WA) **(H)**. 5. Initiate research programs to characterise the flora and fauna of selected rocky shore/intertidal reef platform communities within the reserves (DEC) **(M)**. 6. Educate users of the reserves about the detrimental effects of human activities on rocky shore/intertidal reef platform communities (DEC) **(M)**. 7. Ensure the hydrocarbon industry considers appropriate methods when performing transition zone seismic activities in these areas (DEC, EPA, DoIR) **(M)**.

Performance measure/s	1. Diversity. 2. Abundance of indicator species.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	Not Applicable.		
Long-term target/s	1. No loss of rocky shore/intertidal reef platform community diversity as a result of human activity in the reserves. 2. The abundance[Ø] targets for rocky shore/intertidal reef platform communities will be as noted below. i. <u>*Sanctuary* and *recreation* zones</u> – no change due to human activity. ii. <u>*General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area*</u> – no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. iii. <u>Unzoned areas of the *marine management area*[§]</u> - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[Ø]In this context a loss or change in *abundance* or *biomass* excludes losses of a minor, transient or accidental nature.

[§]Quantitative targets for rocky shore/intertidal reef platform communities in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.

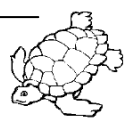
9.1.8 Intertidal sand/mudflat communities

Ecological value	**Intertidal sand/mudflat communities:** *The intertidal sand/mudflat communities are primary producers with an abundant invertebrate fauna, which provides a valuable food source for shorebirds.*

Background	Intertidal sand/mudflat communities consist of sand, mud or silt and occur in sheltered, relatively low energy marine environments that result in depositional conditions. The intertidal sand/mudflat communities in the reserves occur predominantly in the Montebello Islands area and to a lesser extent, along the eastern and southern shores of Barrow Island. While not as extensive as other benthic communities in the reserves, the intertidal sand/mudflat communities are extremely important from a biodiversity conservation perspective, because of the high diversity of infauna (particularly molluscs) found in these habitats. Although typically bare of vegetation, some of the more protected northern sand flats at Barrow Island support seagrasses, macroalgae, and soft coral species with lower exposure tolerance such as *Sarcophyton* and *Lobophyton.* Intertidal sand/mudflats are covered with a surface film of micro-organisms, which are a rich source of food for the high diversity of invertebrates they support. This includes bivalve shells, lamp shells or brachiopods, worms, crabs and sea urchins. These invertebrates are found both living on the surface of the sand or mud and burrowing into the substrate, where their burrowing activities regularly turn over the sediment. The abundance of invertebrate life found on intertidal sand/mudflat communities provides a valuable food source for resident and migratory shorebirds. At high tide, the intertidal sand flats provide a foraging habitat for many larger species such as shovelnose rays and sharks. Pressures on intertidal sand/mudflat communities in the reserves include physical disturbance from bottom towing of pipelines and the laying of pipelines on the seabed surface by the hydrocarbon industry, digging for bait, fossicking and construction activities. Given the relatively low usage of the area these activities do not pose a significant risk at this time. Management of the intertidal sand/mudflat communities in the reserves includes the implementation of zones to provide areas of intertidal sand/mudflat communities free of physical disturbance, to allow for monitoring and to provide an appropriate level of ecological insurance against future impacts. Development proposals that may impact on intertidal sand/mudflat communities are subject to an environmental impact assessment by DEC/EPA. It should be noted that, as many of the island conservation reserves extend to the low water mark, some of the intertidal sand/mudflat communities may be located in the terrestrial island conservation reserves. The intent is to afford these communities the same level of protection as the rest of the marine conservation reserves. To assist this, the MPRA will work with the Conservation Commission to achieve integrated management of these intertidal sand/mudflat areas, which will include applying DoF restrictions, across the whole intertidal community as appropriate.
Current status	The intertidal sand/mudflat communities in the reserves are generally in an undisturbed condition, apart from some localised disturbance at Barrow Island.

Existing and potential uses and/or pressures	• Physical disturbance from:
	  ▪ bottom towing and laying of pipelines;
	  ▪ fossicking and digging for bait; and
	  ▪ construction, e.g. groynes.
	• Discharge of toxicants* and other physical and chemical stressors† from:
	  ▪ accidental spillage of petroleum products; and
	  ▪ nutrients from sewage discharge.
	• Overfishing from bait and live shell collecting.
	• Introduction of marine pest species from:
	  ▪ ballast water;
	  ▪ aquaculture/pearling activities; and
	  ▪ hull fouling.
	• Tributyl tin from ship hulls.

Current major pressure/s	Physical disturbance from development activities.
Management objective/s	To ensure that intertidal sand/mudflat communities are not significantly impacted by development activities in the reserves.



Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. See development proposal strategies detailed in Section 8.0 **(H-KMS)**. 3. Liaise with the hydrocarbon industry to ensure that development proposals have minimal impact on intertidal sand/mudflat communities (DEC, industry, DoIR) **(H-KMS)**. 4. Ensure that approvals and the setting of conditions for new petroleum, nature-based tourism, pearling and aquaculture operations are consistent with the management targets for intertidal sand/mudflat communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, industry, EPA, DoF, DoIR, Tourism WA) **(H)**. 5. Assess the nature, level and potential impacts of human activities on intertidal sand/mudflat communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**. 6. Ensure users of the reserves are informed of the management objectives and targets for intertidal sand/mudflat communities within the reserves (DEC) **(M)**. 7. Educate users of the reserves abut the ecological importance of intertidal sand/mudflat communities and the potential impacts of their activities on these habitats (DEC) **(L)**.

Performance measure/s	1. Diversity. 2. Abundance of indicator species.	**Desired trend/s**	1. Constant. 2. Constant or positive.
Short-term target/s	Not Applicable.		
Long-term target/s	1. No loss of intertidal sand/mudflat community diversity as a result of human activity in the reserves. 2. The abundance[Ø] targets for intertidal sand/mudflat communities will be as noted below. i. *Sanctuary* and *recreation* zones – no change due to human activity. ii. *General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area* – no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. iii. Unzoned areas of the *marine management area*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[*] *toxicants* are chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment due to human activity (modified from ANZECC & ARMCANZ, 2000).

[†] *physical and chemical stressors* is used here to describe a number of naturally-occurring physical and chemical stressors that can cause degradation of the marine environment when ambient values are too high or too low as a result of human activity (modified from ANZECC & ARMCANZ, 2000).

[Ø] In this context a loss or change in *abundance* or *biomass* excludes losses of a minor, transient or accidental nature.

[§] Quantitative targets for intertidal sand/mudflat communities in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.

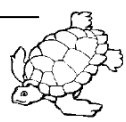
9.1.9 Subtidal soft-bottom communities

Ecological value	***Subtidal soft-bottom communities:*** *Subtidal sand and silt habitats support a variety of fauna including burrowing invertebrates and filter-feeding communities.*

Background	Subtidal sand and silt habitats, which are typically unvegetated, support a rich and diverse fauna. Silt habitats are commonly associated with sheltered areas, such as nearshore waters adjacent to mangroves, while sand habitats more typically occur offshore. These habitats offer little structural diversity and are dominated by detrital-based faunal food webs. Their habitat value is generally dependent on oxygenation levels through the sediment profile, particle size, wave energy and the amount of organic matter in the sediments. Silt sediments in particular may be organically enriched and support a high density of organisms that exploit this nutrient source. Burrowing organisms, such as polychaetes, molluscs and crustaceans, live within these sediments, while often complex assemblages of species live on the surface. Surface dwelling species range from very small crustaceans and molluscs to larger echinoderms and a range of sessile organisms, such as sponges, corals, sea whips and sea squirts. Small and/or juvenile fishes may aggregate where the structure of these benthic communities offer protection, while larger animals, such as rays, dugongs and turtles feed on invertebrates in these habitats. Soft sediment habitats are widespread in deeper offshore areas throughout the region and these fine sands, silts and clays are expected to support diverse infaunal assemblages. The east coast of Barrow Island is characterised by less stable, coarser sediments. These sediments are affected by wave energy and currents and tend to be relatively mobile. Pavement habitats between Barrow Island and the mainland are covered by a sediment veneer that appears to periodically move, exposing areas of pavement reef. Sessile benthic organisms that require hard substrates for attachment, such as gorgonians, are frequently seen emerging through a shallow veneer of sand. These mobile sand sheets are generally of lower habitat value to infauna and are less likely to support diverse infaunal assemblages. Current pressures on subtidal soft-bottom communities derive primarily from commercial activities in the area. These include physical disturbance from anchoring, trawling, pipe-laying, dredging and dredge spoil dumping. The communities are also susceptible to the toxic effects of a range of discharges and the development of infrastructure. The management of subtidal soft-bottom communities includes zoning to provide representative, undisturbed areas of soft-bottom habitat to provide 'reference' sites for monitoring, research, education and for an appropriate level of ecological insurance against future impacts. Other strategies include increasing awareness and knowledge among visitors about the nature of these communities, and the potentially detrimental impacts of human activities, and liaison with industry and other agencies during the assessment of proposed developments in the area.
Current status	The subtidal soft-bottom communities are generally in an undisturbed condition.

Existing and potential uses and/or pressures	• Discharge of toxicants[*] and other physical and chemical stressors[†] from:
	  ▪ accidental spillage of petroleum products;
	  ▪ nutrients from sewage discharge;
	  ▪ tributyl tin from ship hulls.
	• Physical disturbance from:
	  ▪ trenching;
	  ▪ dredging;
	  ▪ drilling;
	  ▪ bottom towing of pipelines; and
	  ▪ anchoring.
	• Sedimentation from drilling and dredging.
	• Introduction of marine pest species from:
	  ▪ ballast water;
	  ▪ aquaculture/pearling activities; and
	  ▪ hull fouling.
	• Shading from marine infrastructure.

Current major pressure/s	Physical disturbance from development activities.



Management objective/s	To ensure that subtidal soft-bottom communities are not significantly impacted by physical disturbance in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. See development proposal strategies detailed in Section 8.0 **(H-KMS)**. 3. Map the location of different types of subtidal soft-bottom communities within the reserves (DEC) **(K-HMS)**. 4. Initiate research programs to quantify the floral and faunal diversity, and natural variability of subtidal soft-bottom communities in the reserves (DEC) **(H)**. 5. Assess the nature, level and potential impacts of human activities on subtidal soft-bottom communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**. 6. Ensure that approvals and the setting of conditions for petroleum, commercial fishing, pearling, aquaculture and nature-based tourism operations are consistent with the management targets for subtidal soft-bottom communities and that where appropriate monitoring conditions are applied to ensure these outcomes are achieved (DoIR, EPA, industry, DoF, Tourism WA, DEC) **(H)**. 7. Prevent damage to soft-bottom communities through controls on anchoring and the installation of moorings where necessary (DEC, DPI) **(H)**. 8. Educate users of the reserves about the potential detrimental impacts of human activity on subtidal soft-bottom communities (DEC) **(M)**.

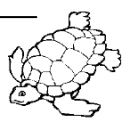
Performance measures	1. Diversity. 2. Abundance of indicator species.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	Not Applicable.		
Long-term target/s	1. No loss of subtidal soft-bottom community diversity as a result of human activity in the reserves. 2. The abundance[Ø] targets for subtidal soft-bottom communities will be as noted below. ii. *Sanctuary* and *recreation* zones – no change due to human activities. iii. *General use*, *special purpose (benthic protection)* and *special purpose (pearling)* zones of the *Montebello Islands Marine Park* and *conservation areas* of the *marine management area* – no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. iv. Unzoned areas of the *marine management area*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[*] *toxicants* are chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment due to human activity (modified from ANZECC & ARMCANZ, 2000).

[†] *physical and chemical stressors* is used here to describe a number of naturally-occurring physical and chemical stressors that can cause degradation of the marine environment when ambient values are too high or too low as a result of human activity (modified from ANZECC & ARMCANZ, 2000).

[Ø] In this context a loss or change in *abundance* or *biomass* excludes losses of a minor, transient or accidental nature.

[§] Quantitative targets for subtidal soft-bottom communities in the unzoned areas of the marine management area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to more accurately define the extent of marine habitats.



9.1.10 Marine mammals

Ecological value	**Marine mammals**: *Ten species of cetaceans are recorded from the reserves, with the humpback whale passing through the area during its annual migration. Dugongs are found in the shallow warm waters*.

Background	Whale species that may occasionally visit the Montebello/Barrow islands region include the humpback whale (*Megaptera novaeangliae)*, short-finned pilot whale *(Globicephala macrorhynchus)*, false killer whale (*Pseudorca crassidens)*, killer whale *(Orcinus orca)*, minke whale *(Balaenoptera acutorostrata)*, Bryde's whale (*Balaenoptera edeni)*, sei whale (*Balaenoptera borealis*), pygmy blue whale (*Balaenoptera musculus brevicauda*), fin whale (*Balaenoptera physalus)*, melon-headed whale *(Peponocephala electra*), sperm whale (*Physeter macrocephalus)* and the blue whale (*Balaenoptera musculus musculus)*. Of these, only the humpback whale is a regular visitor to the area. The migration path of the humpback whale passes through the reserves (Figure 12) during the annual migration north to the warm tropical waters off the Pilbara and Kimberley coasts in June and July, where females give birth and suckle their young. It is understood that an area of sheltered water to the west of Trimouille Island in the Montebello group is used as a resting area for female humpback whales and their young calves during their southerly migration to feeding grounds in Antarctica. However, anecdotal evidence on the importance of this area is varied. There is less understanding of the occurrence, population and migratory characteristics of blue whales in Western Australian waters. However, the period in which blue whales are likely to migrate through the region extends from April/May through to November. Bottlenose dolphins (*Tursiops truncatus)* and Indo-Pacific humpback dolphins (*Sousa chinensis*) have resident populations within the shallow waters of the inner Rowley Shelf, including the Barrow Island area. Spinner dolphins (*Stenella longirostris*), common dolphins (*Delphinius delphis*), and striped dolphins (*Stenella caeruleoalba)* are also abundant in the waters around Barrow Island. These are generally oceanic species and are likely to be most abundant on the west coast of the island. Less common inhabitants may include Risso's dolphins *(Grampus griseus*), spotted dolphins (*Stella attenuata*) and rough-toothed dolphins (*Steno bredanensis*). Three rough-toothed dolphins stranded on Barrow Island in 1971. The dugong (*Dugong dugon*) occurs throughout the tropical and subtropical Indo-West Pacific but has been reduced to relict populations separated by large areas in which it is extinct or close to extinction. In the reserves, dugongs are frequently found in the shallow, warm waters in the vicinity of the Montebello Islands, Lowendal Islands and Barrow Shoals, though not in the comparatively large or dense concentrations seen further south in Exmouth Gulf and Shark Bay. Current knowledge of the size, distribution and migratory habits of dugong populations in the region is limited. A survey by Prince (2001) of dugong numbers in the Pilbara estimated a Pilbara population of approximately 2000 individuals. The seagrass beds around the Lowendal Islands are thought to provide a valuable food source for these animals. Annually recruiting seagrasses in areas of soft bottom habitat, especially those of the genera *Halophila* and *Halodule* are prime foraging resources for dugongs in the reserves. The dugong is a long-lived mammal with a lifespan of 50-60 years and a minimum pre-reproductive period of 9-10 years for both sexes. Dugongs are believed to calve predominantly in August to September and produce one calf every three to seven years. All marine mammals are protected under the WC Act and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The humpback whale is a threatened species of baleen whale that is declared to be specially protected under the WC Act, due to over-exploitation during the whaling era. The blue whale is also listed as a threatened species under the EPBC Act and both are listed as migratory species under the Bonn Convention. The dugong is specially protected under the WC Act and is listed as threatened (vulnerable) under the EPBC Act. Due to the low level of human usage, there are no current major pressures on the marine mammal populations in the reserves. Shipping activity and noise have the potential to disturb individual animals, particularly dugongs. Management of the reserves will focus on undertaking further research to determine the importance of the area for marine mammals in the reserves

	and educating users of the reserves about marine mammals.
Current status	Whales and dolphins – populations are generally considered to be stable in the reserves. Dugongs - population status is unknown in the reserves.

Existing and potential uses and/or pressures	• Physical disturbance from:
	  ▪ visitors and fishers in the reserves;
	  ▪ seismic survey; and
	  ▪ shipping activity.
	• Entanglement in fishing gear and litter.
	• Accidental spillage of petroleum products.

Current major pressure/s	None.
Management objective/s	To gain an increased understanding of marine mammals in the reserves to facilitate long-term management.
Strategies	1. Undertake research to ascertain the regional importance of the Montebello/Barrow islands area for dugongs and the relative importance of areas within the reserves (DEC) **(H-KMS)**. 2. Ensure relevant industry activities are undertaken at times and places that do not conflict with humpback whale migration through the reserves (DEC, EPA, DoIR, DoF) **(H-KMS)**. 3. Ensure that offshore developments do not have significant impacts on marine mammals through the provision of advice to the EPA (DEC) **(M)**. 4. Educate users of the reserves on the possible detrimental impacts of human activities on marine mammals (DEC) **(M)**. 5. Maintain records of the incidence of entanglement, boat collisions and stranding of marine mammals in the reserves (DEC) **(L)**.

Performance measure/s	1. Diversity. 2. Abundance.	**Desired trend/s**	1. Constant or positive 2. Constant or positive
Short-term target/s	To be developed.		
Long-term target/s	1. No loss of marine mammal diversity as a result of human activity in the reserves. 2. No loss in marine mammal abundance[Ø] as a result of human activity in the reserves.		

[Ø]In this context a loss or change in *abundance* or *biomass* excludes losses of an accidental nature.

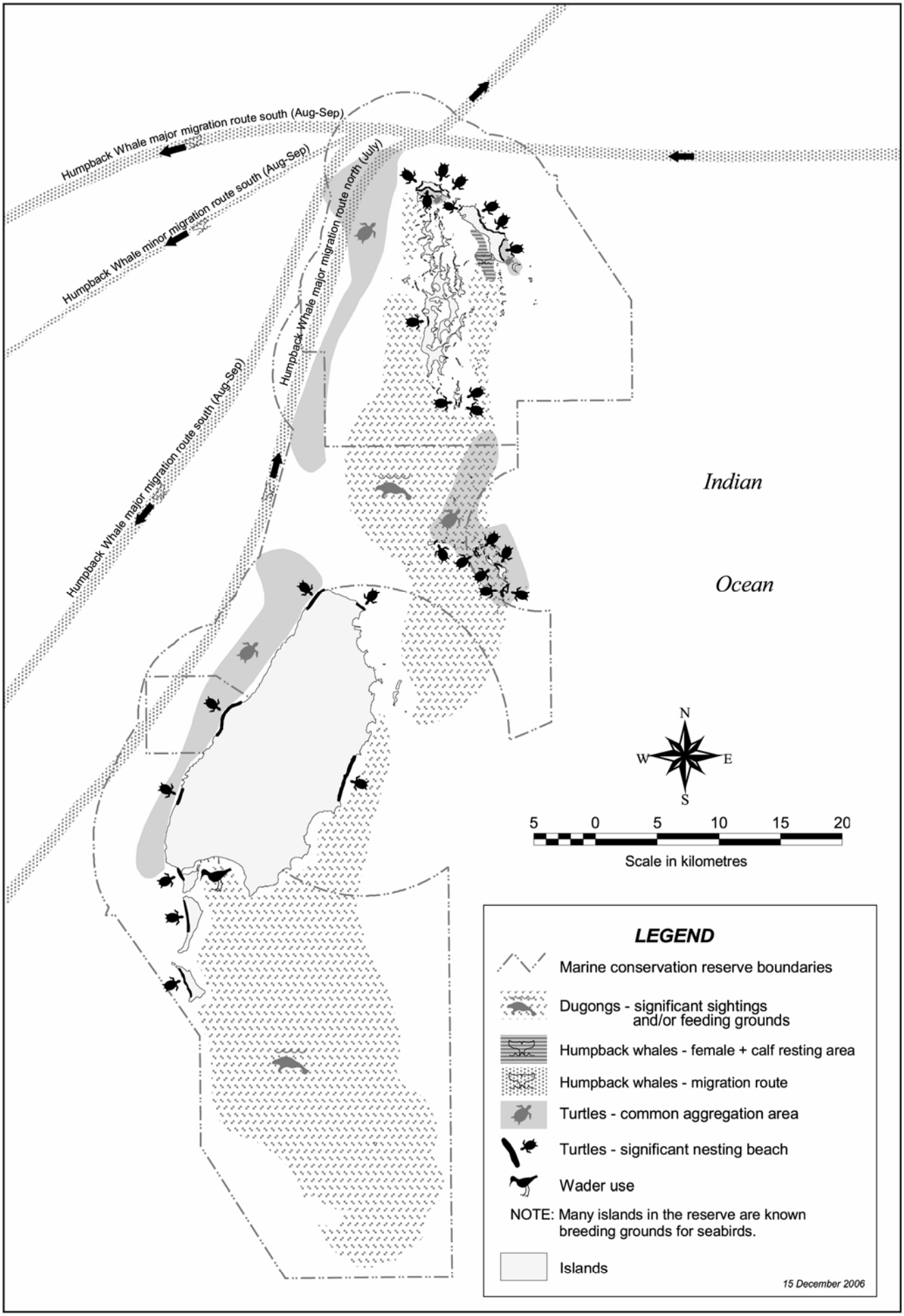


FIGURE 12: Significant wildlife distributions of the Montebello/Barrow islands

9.1.11 Turtles (KPI)

Ecological value	**Turtles**: *Green, flatback, hawksbill, loggerhead and leatherback turtles are found in the reserves, with the Western Australian hawksbill population being the largest remaining in the Indian Ocean. Four species use sandy beaches in the reserves for nesting.*

Background	Australia is one of the few countries in the world still to have relatively intact turtle populations and the Montebello/Barrow islands region provides important habitat and relatively undisturbed nesting areas for these populations. Five species of marine turtle are known from the Montebello/Lowendal/Barrow Island region, these being the green (*Chelonia mydas*), flatback (*Natator depressus*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) turtles. The Western Australian populations of the hard-shelled turtle species are the only remaining populations of these species in the south-eastern Indian Ocean. Of the species that do occur in the reserves, the green, hawksbill and flatback regularly use the sandy beaches in the reserves for breeding, while occasional nesting by loggerheads has been recorded. The majority of the Western Australian hawksbill breeding population nest on island beaches off the Pilbara Coast and so the reserves are of great importance for conservation of hawksbill turtles in the south-eastern Indian Ocean. The largest proportion of hawksbill tracks occur within the Montebello Islands (53%) with fewer in the Lowendal (37%) and Barrow Island groups (10%) (Pendoley, 2006). Flatback turtles nest on sandy beaches on the mid-eastern coast of Barrow Island, as well as similar sheltered sandy beaches in the Montebello and Lowendal islands. The highest density of flatback turtle nesting occurs on five central beaches on the east coast of Barrow Island with Bivalve Beach recorded as having the highest density (Pendoley, 2006). The eastern coast of Barrow Island is also significant for nesting flatback turtles in terms of number of turtles nesting, with these beaches being at the south western extent of the nesting range for this species. Barrow Island is also an important nesting location for green turtles, which predominantly use exposed sandy beaches on the west coast. They can, however, be found nesting from Boodie Island north to the Montebello Islands. Beaches in the reserves appear to be at the northern limit of the breeding range for loggerhead turtles so nesting visits are generally irregular and few in number. Breeding aggregations of turtles occur in the Montebello Islands along the western edge of the archipelago, south of North West Island, and north of Trimouille Island. Evidence suggests that substantial mating populations of green turtles are also found in the waters of north-western Barrow Island. In addition to these breeding aggregations, the reserves have a large year round resident marine turtle population, comprising many species. Large aggregations of these non-breeding resident turtles can often be found seaward of the 20 to 50m isobath, off the north-western sector of Barrow Island. The waters around Barrow Island provide a feeding ground for green turtles and appear to provide feeding grounds and juvenile habitat for flatback turtles. While most adult green turtles migrate away from the area after the summer breeding season, some appear to be resident, remaining near Barrow Island during winter, and feeding year-round on algae-covered rocky intertidal and subtidal platforms off the west coast of Barrow Island. Feeding grounds for hawksbill turtles have been identified to the south of the Barrow Shoals. While the location of flatback turtle feeding grounds off Barrow Island have not been identified, there is some evidence that juvenile flatback turtles are using the Barrow Island region as a developmental habitat. The rocky intertidal/subtidal platforms that are a common feature of west coast beaches in the reserves are also an important inter-nesting and foraging habitat for marine turtles. Resident turtles browse on the nearshore macroalgal dominated reef platforms. These platforms are often broken up by rock pools and these pools and reefs are used by post-nesting marine turtles. On low tide, females leaving the beach after nesting can be found with anything from their head to their entire body submerged in the rock pools. As populations of marine turtles continue to decline in other regions of the world due to direct and indirect impacts and a lack of strong conservation measures, the Montebello/Barrow islands, which provide areas relatively free of human impact, will increase in significance in

	terms of their value to turtle populations. The National Recovery Plan for Marine Turtles in Australia (Environment Australia, 2003) identifies Barrow Island and all waters within a 20 km radius of the island as critical habitat to the survival of green turtles, the Montebello Islands and all waters within a 20 km radius as critical habitat to the survival of flatback and hawksbill turtles, and the Lowendal Islands and all waters within a 20 km radius as critical habitat to the survival of hawksbill turtles. Green, flatback, hawksbill and leatherback turtles are threatened species declared to be vulnerable under the Commonwealth EPBC Act and the loggerhead and olive ridley are threatened species declared to be endangered under this Act. Green, flatback, hawksbill, loggerhead and leatherback turtles are threatened species declared to be specially protected under the WC Act. All Australian marine turtles are also listed migratory species protected under the Bonn Convention. The current major pressure on turtles in the reserves relates to the impact of lights and flares from hydrocarbon industry and pearling operations on hatchlings. Turtle hatchlings use the lighter horizon over the ocean to orientate themselves to head out to sea when they emerge from the nest. Lights and flares attract the hatchlings so, not only do they become misoriented (i.e. move towards the light instead of towards the ocean), they become vulnerable to attack from predators such as gulls, which are also attracted to the lights. Adult females may also suffer misorientation after nesting by moving towards a light source rather than returning to the ocean. Hatchlings may also become disoriented, when they are trapped by a light field and run in circles. Recent studies (Pendoley, 2004, 2006) indicate that the lights least disruptive to marine turtles are the flares and sodium vapour lights. Under certain conditions however, these lights can still be disruptive to hatchlings, particularly if the light source is within 200 m of where the hatchlings emerge from their nest. Development proposals that involve lighting need to take account of these findings to minimise impacts on turtles. Management of the reserves will include the use of zoning for protection of turtle nesting and aggregation sites, as well as regulation of the use of appropriate lighting by existing and future industry in the region.
Current status	The turtle populations are considered to be stable in the reserves; however trends are unclear.

Existing and potential uses and/or pressures	• Lighting and flares causing:
	  ▪ misorientation of adults and hatchlings;
	  ▪ disorientation of hatchlings; and
	  ▪ increased predation of hatchlings.
	• Accidental spillage of petroleum products.
	• Entanglement in fishing nets.
	• Vessel strike.
	• Physical disturbance from:
	  ▪ people on foot, vehicles on or near beaches and people in the water;
	  ▪ dredging;
	  ▪ seismic surveys; and
	  ▪ sand extraction and other physical disturbances to nesting beaches.
	• Litter resulting in entanglement and ingestion.
	• Dredging resulting in habitat loss or change.

Current major pressure/s	Lighting and flares causing misorientation of adults and hatchlings and increased predation of turtle hatchlings.
Management objective/s	To ensure no loss of species diversity and abundance of turtles in the reserves, particularly in relation to the potential impacts of lights and flares on hatchlings.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. See development proposal strategies detailed in Section 8.0 **(H-KMS)**. 3. Ensure that licences for pearling, aquaculture, nature-based tourism and hydrocarbon operations contain conditions to minimise the impacts of lights and flares on turtle hatchlings (DEC, EPA, DoIR, DoF, Tourism WA) **(H-KMS)**. 4. Determine the impacts of lights on hatchling survival (due to misorientation and predation by silver gulls) (DEC, industry) **(H-KMS)**. 5. In liaison with industry and other stakeholders, investigate the need for seasonal closures of areas to protect breeding aggregations of marine turtles, and implement these where

	appropriate (DEC) **(H-KMS)**. 6. Manage human activities such that mating aggregations and nesting activities of turtles are not significantly disturbed by recreational boating, nature-based tourism, pearling, aquaculture and hydrocarbon operations (DEC, EPA, DoF, Tourism WA) **(H)**. 7. Monitor turtle nesting activities to determine the relative importance of nesting beaches and to assess long term changes in abundance and usage of sites (DEC, industry) **(M)**. 8. Facilitate research applicable to the management of turtles in the reserves (DEC) **(M)**. 9. Educate users of the reserves on the possible detrimental impacts of human activities on turtles in the reserves (DEC) **(M)**. 10. Maintain a database of turtle mortality and incidents of entanglement in the reserves (DEC) **(L)**.

Performance measure/s	Number of nesting females (by species) on individual beaches.	**Desired trend/s**	Constant or positive.
Short-term target/s (KPI)	Not Applicable.		
Long-term target/s (KPI)	1. No loss of turtle diversity as a result of human activity in the reserves. 2. No loss of turtle abundance[Ø] as a result of human activity in the reserves.		

[Ø]In this context a loss or change in *abundance* or *biomass* excludes losses of an accidental nature.

9.1.12 Seabirds

Ecological value	**Seabirds**: *The reserves provide important feeding and resting areas for migrating shorebirds. Islands within the reserves provide nesting areas for at least 15 species of seabirds.*

Background	The seabird assemblage of the Montebello/Barrow islands region comprises at least 67 species, including 25 species of migratory shorebirds and 20 resident shorebirds. The assemblage of marine species listed under the EPBC Act (section 248) includes 14 seabird species and 25 wetland/littoral species. At least 61 islands in the Montebello group are used by nesting seabirds. The region contains significant rookeries of at least 15 species of seabirds, with the largest breeding colony of roseate terns (*Sterna dougallii*) in Western Australia being located in the Montebello Islands. Wedge-tailed shearwaters (*Puffinus pacificus*), crested terns (*Sterna bergii*) and bridled terns (*Sterna anaethetus*) also have large nesting populations on a number of North West Shelf islands. The reserves are also an important resource for a variety of resident and migratory shorebird species that feed on the worms, bivalves and other invertebrates in the sand and mudflats. Seabird and shorebird colonies which breed on the island conservation reserves and rocky outcrops that are scattered throughout the area are protected from ground predators, such as foxes and feral cats, which have been introduced on the mainland. Introduced black rats, which may eat seabird eggs and chicks, have been eradicated from both Barrow and the Montebello Islands. As well as being of ecological significance, these seabird colonies are one of the attractions for people who visit these islands. Under the Ramsar Convention, an area is recognised as an internationally-significant littoral avifauna site if it supports greater than one percent of a species' population. Barrow Island meets this Ramsar criterion for six trans-equatorial migratory species: grey-tailed tattler (*Tringa brevipes*), ruddy turnstone (*Arenaria interpres*), red-necked stint (*Caladrius ruficollis*), sanderling (*Calidris alba*), greater sand plover (*Charadrius leschenaultia*) and lesser sand plover (*Charadrius mongolus*). It is also significant for two non-migratory birds: fairy tern (*Sterna nereis*) and the northern race of the sooty oystercatcher (*Haematopus fuliginosus opthalmicus*). This high abundance of migratory waders results in a rank of equal tenth for Barrow Island, amongst 147 sites in Australia that have been identified as important for migratory shorebirds. For the grey-tailed tattler and ruddy turnstone, it is the fifth and fourth-most important site in Australia, respectively. The migration route of the migratory sea and shorebirds within the reserves typically occurs along the East Asian-Australasian Flyway. These avifauna are covered by the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) and are specially protected under the WC Act. Many of these birds (such as the wedge-tailed shearwater and the bridled tern) are also protected under the EPBC Act. Studies indicate that Barrow Island is unusual compared with other sites in the north-west of Australia in effectively acting as a terminus for migratory species. While the region is used as a staging site during southward migrations, it is also used through the summer non-breeding season by migrant species and during the winter by at least some birds. Migratory shorebird abundances increase on the island as the birds arrive from the north during September to December. The abundances of some migratory shorebirds continue to increase in January and February, suggesting local movements of birds from the mainland to Barrow Island. Abundances decrease as the migratory species leave the region to return north at the end of summer. On Barrow Island, the highest abundances of shorebirds are associated with the extensive tidal mudflats of the south-eastern and southern coasts, such as Bandicoot Bay. Due to the low level of usage, there are no current major pressures on seabirds in the reserves. Proposed hydrocarbon industry developments on Barrow Island have the potential to disturb shorebird foraging sites and these impacts on seabirds will need to be assessed and managed appropriately to minimise any impacts. Wedge-tailed shearwaters, which nest on a number of islands, are reported to be tolerant of disturbance from human activities close to their breeding colonies, but juveniles are sometimes attracted to lights and may be injured or killed by flying into buildings or other structures.

	Terns, pelicans and cormorants are susceptible to disturbance during nesting. Adults will fly off the nest when approached by people, vessels or aircraft exposing the chicks to predators. Silver gull numbers have increased in the reserves in recent years, mainly due to an increase in food sources provided by the presence of people on the islands. Silver gulls can aggressively displace other species of seabird, such as terns, taking over nesting and feeding areas. Disturbance of seabird rookeries on the islands in the region will be addressed under a separate management plan for these terrestrial reserves. Management of seabirds in the reserves will include implementation of zoning to provide protection to seabird nesting and roosting areas.
Current status	Seabird populations are generally considered to be stable in the reserves.
Existing and potential uses and/or pressures	• Physical disturbance from: ▪ visitation including boats and helicopters near nesting colonies; ▪ future industry development; ▪ future nature-based tourism operations; ▪ visitors reef/rock fishing; and ▪ removal or disturbance to habitat by construction. • Accidental spillage of petroleum products. • Entanglement in litter. • Displacement by silver gulls.
Current major pressure/s	None.
Management objective/s	To gain an increased understanding of the seabirds of the reserves to facilitate long-term management.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. Minimise the increase in silver gull numbers by: • discouraging feeding of silver gulls by workers and visitors though education programs; • liaising with industry regarding lighting to reduce night-time feeding opportunities for silver gulls; and • liaising with industry and local government regarding rubbish disposal and freshwater sources (DEC, industry) **(M)**. 3. Ensure that important seabird and shorebird breeding and feeding areas are not significantly affected by human activities (DEC, industry) **(M)**. 4. Educate users of the reserves on the ecological significance of the reserves' seabird and shorebird populations and the potential detrimental impacts of human disturbance (DEC) **(L)**.

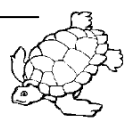
Performance measure/s	To be developed.	**Desired trend/s**	To be developed.
Short-term target/s	Not Applicable.		
Long-term target/s	1. No loss of seabird and shorebird diversity as a result of human activity in the reserves. 2. No loss of seabird and shorebird abundance[Ø] as a result of human activity in the reserves.		

[Ø]In this context a loss or change in *abundance* or *biomass* excludes losses of an accidental nature.

9.1.13 Finfish (KPI)

Ecological value	**Finfish**: *A rich finfish fauna with at least 456 species.*

Background	The Montebello/Barrow islands region supports a higher species richness of marine fish than most other parts of tropical Western Australia. A total of 456 fish species from 75 families were recorded from the Montebello Islands during a 1993 Western Australian Museum survey (Allen, 2000). While a small number of these species are found only in the north-west of the State, most of the species have relatively wide distributions throughout the Indo-West Pacific region. Two of the pipefish species recorded, *Doryrhamphus multiannulatis* and *Phoxocampus belcheri,* represent new records for Australia. The Commonwealth Department of Environment and Heritage (DEH) database indicates that Barrow Island lies within the general distribution area of 30 species of pipefish and seahorse that are included as listed marine species under the EPBC Act (section 248). However, only two of these species, *Hippocampus hystrix* and *P. belcheri*, have been recorded from Barrow Island. The majority of the fish species found in the area have eggs or larvae that are dispersed in the water column. It is therefore likely that recruitment is supplemented from elsewhere, such as the Dampier Archipelago, Rowley Shoals and outer reefs upstream in the Leeuwin Current. It is also likely that the reserves are an important source of recruits for more southerly destinations along the Western Australian coast. Some of the fish species found within the reserves are important to commercial and recreational fishers. These include sharks, north-west snapper (*Lethrinus* spp.), Spanish mackerel (*Scoberomorus* spp.), red emperor (*Lutjanus sebae*), coral trout (*Plectropomus* spp.), sea perch (*Lutjanus* spp.), golden trevally (*Gnathanodon speciocus*) and cod (*Epinephelus* spp. and *Cephalopholis* spp.). Under the FRM Act, DoF is responsible for the management of the recreational and commercial take of finfish species. Under this Act, the potato cod (*Epinephelus tukula*) and the hump head maori wrasse (*Cheilinus undulatus*), which occur in the reserves, are totally protected. The whale shark (*Rhincodon typus*) is also protected under the FRM Act and the WC Act and occurs along the northern Western Australian coast, including the islands of the Montebello/Barrow Island region. Other EPBC Act-listed species, such as the great white shark, are occasional visitors to the Barrow Island area. Grey nurse sharks (*Carcharias taurus)* are regionally widespread and are believed to be in the waters surrounding the Montebello/Barrow Islands. The grey nurse shark is listed as Vulnerable under the EPBC Act and on the IUCN Red List of Threatened Animals worldwide. This species is also specially protected under the WC Act. Their life-history and reproductive strategies, such as their preference for inshore rocky reef habitats and their tendency to aggregate, make them particularly vulnerable to human-induced pressures. Given the low level of commercial and recreational fishing in the reserves, it is considered that there are no current major pressures on finfishes. Physical disturbance from future industry developments may impact upon fish habitat sites and these impacts need to be considered when assessing proposed developments. The management of exploited finfish species needs to consider the population viability of these species in the context of maintaining the values of the reserves. Fisheries management scales are rarely reconciled with the spatial scales of marine conservation reserves and, as such, populations of some species in the reserves could become locally depleted even though the fishery is being managed on a sustainable basis at the broader scale. To overcome this potential problem, consideration is required as to the appropriateness of recreational and/or commercial extraction of target species and whether specific finfish species should be protected in part or all of the reserves. This decision would be based on a number of factors including species distribution, abundance, life history and an assessment of the ecological and social importance of the species in the context of the reserves (e.g. "icon" species). Species for which take is considered appropriate will be managed by DoF, in accordance with ecologically sustainable development principles. In particular, management will focus on maintaining targeted species diversity throughout the reserves by maintaining sustainable levels of extraction and protecting important habitats, maintaining or increasing finfish abundance by maintaining sustainable levels of extraction, and maintaining or recovering age structure in sanctuary zones representing that found in unexploited populations. The remaining species will be protected throughout the



	reserves using appropriate legislation. Given the potential for pressure to increase through possible increases in the scale of recreational fishing, priority species to monitor include those that are long-lived, change sex, aggregate to spawn and/or have limited home ranges.
Current status	Finfish populations are considered to be in a stable condition, apart from some localised impacts on selected site-attached species.

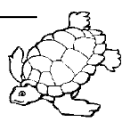
Existing and potential uses and/or pressures	• Recreational fishing.
	• Commercial fishing.
	• Accidental spillage of petroleum products.
	• Introduction of marine pest species from:
	  ▪ ballast water;
	  ▪ aquaculture/pearling activities; and
	  ▪ hull fouling.
	• Habitat disturbance from industry development.

Current major pressure/s	None.
Management objective/s	To gain an increased understanding of the finfish diversity and abundance throughout the reserves to facilitate long-term management.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. Identify finfish species that can be taken by recreational and commercial fishers in the reserves and, in liaison with DoF, provide the necessary legislation to provide protection for species that will not be extracted (DEC, DoF) **(H)**. 3. Review the need for special conditions (e.g. bag limits and possession limits) for target finfish species in the reserves (DoF) **(H)**. 4. Undertake research programs to characterise finfish diversity and abundance in the reserves (DEC, DoF) **(M)**. 5. Develop and implement monitoring programs for priority species (DEC, DoF) **(M)**. 6. Educate users of the reserves on the conservation issues associated with finfish populations, the potential detrimental impacts of human activity on finfish, as well as appropriate behaviours and conduct to minimise potential impacts (DEC) **(M)**.

Performance measure/s	1. Abundance. 2. Diversity.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s (KPI)	No loss[Ø] of finfish species abundance in the *sanctuary zones* in the *marine parks* as a result of human activity within the reserves.		
Long-term target/s (KPI)	1. No loss of finfish diversity as a result of human activity in the reserves. 2. No loss in protected finfish species abundance[Ø] as a result of human activity in the reserves. 3. Abundance and size composition of finfish species in *sanctuary zones* of the *marine parks* to be at natural[‡] levels. 4. Management targets for abundance of targeted finfish species in all other areas to be determined in consultation with Department of Fisheries and peak bodies.		

[Ø]In this context a loss or change in *abundance* or *biomass* excludes losses of a minor, transient or accidental nature.

[‡]*'Natural'* in this context refers to the abundance that would occur in areas that are undisturbed and/or unexploited by human activities.



9.1.14 Invertebrates

Ecological value	**Invertebrates**: *A diverse marine invertebrate fauna comprising mostly tropical species.*

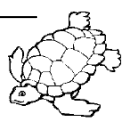
Background	Marine invertebrates are those marine animals without a backbone and include such animals as corals, sponges, rock lobster, crabs, squid, cuttlefish, molluscs, jellyfishes, seastars, anemones and marine worms. The reserves have a high diversity and abundance of invertebrate species, which is attributed to the wide range of habitats. The invertebrate fauna comprises tropical species, which are common throughout the Indo-West Pacific region, as well as north-western Australian endemic species and northern Australian inshore species, some of which are rare. The invertebrate fauna is a food source for fishes and migratory birds. Several invertebrate species, including oysters, squid, sea cucumbers, crabs, rock lobsters and shells are targeted by commercial and recreational fishers and collectors. Knowledge of the invertebrate fauna of the reserves is incomplete, although some survey work has been undertaken in the Montebello and Barrow islands. Data from these limited surveys indicate that the Montebello Islands region is home to one of the highest number (633 species) of molluscs recorded from Western Australian tropical reef systems, and is the type locality of a number of species (Wells *et al*., 1993). The echinoderm fauna of the Montebello Islands is rich in species compared with most other areas in Western Australia, with a total of 170 species of echinoderms recorded in the region. Some of the recorded echinoderm species are thought to be undescribed species and several are thought to be new records for Australia (Marsh, 1993b). Sea stars, sand dollars, heart urchins and sea cucumbers are found in soft bottom and/or reef habitats. Invertebrate assemblages of the western and northern shores of Barrow Island are typical of the Pilbara offshore marine bioregion. Invertebrate assemblages of the eastern and southern shores are more similar to assemblages in the Pilbara nearshore marine bioregion along the mainland coast. Of the 316 species of mollusc recorded from the shores of Barrow Island, less than a third occur on both the east and west coasts. Differences in the molluscan assemblage between the two sides of Barrow Island relate to the higher proportion of bivalve species in the muddier habitats on the east coast and the presence of more coral reef gastropod species on the west coast. The first sighting of the giant clam *Tridacna derasa* in Western Australia was recorded during recent marine surveys. It is only known from two locations on Barrow Island and one on the mainland near Dampier and should be considered as an evolutionary significant unit until its wider distribution can be confirmed. Crown-of-thorns seastars (*Acanthaster planci*) have been observed at low densities in coral areas east of Barrow Island. Under the FRM Act, DoF is responsible for the management of the recreational and commercial take of invertebrate species. No marine invertebrates from the region have specific legislative protection. The gastropod *Amoria macandrewi* is endemic to sandbars within the Montebello/Lowendal/Barrow Island region and is of high conservation significance. Because of the low level of commercial and recreational fishing in the reserves, it is considered that there are no current major pressures on invertebrates. The management of exploited invertebrate species needs to consider the population viability of these species in the context of maintaining the values of the reserves. Fisheries management scales are rarely reconciled with the spatial scales of marine conservation reserves and, as such, populations of some species in the reserves could become locally depleted even though the fishery is being managed on a sustainable basis at the broader scale. To overcome this potential problem, consideration is required as to the appropriateness of recreational and/or commercial extraction of target species and whether specific invertebrate species should be protected in part or all of the reserves. This decision would be based on a number of factors including species distribution, abundance, life history and an assessment of the ecological and social importance of the species in the context of the reserves (e.g. "icon" species). Species for which take is considered appropriate will be managed by DoF, in accordance with ecologically sustainable development principles. In particular, management will focus on maintaining targeted species diversity throughout the reserves by maintaining sustainable levels of extraction and protecting important habitats, maintaining or increasing finfish abundance by maintaining sustainable levels of extraction, and maintaining or recovering age structure in sanctuary zones representing that found in

	unexploited populations. Non-target species will be protected throughout the reserves using appropriate legislation and through research and monitoring programs.
Current status	Invertebrate populations are considered to be in a stable condition.
Existing and potential uses and/or pressures	• Recreational and commercial fishing for invertebrates, e.g. shell, bait and beche de mer collecting. • Accidental spillage of petroleum products. • Introduction of marine pest species from: ▪ ballast water; ▪ aquaculture/pearling activities; and ▪ hull fouling. • Physical disturbance from proposed hydrocarbon developments.
Current major pressure/s	None.
Management objective/s	To gain an increased understanding of the invertebrate diversity and abundance throughout the reserves to facilitate long-term management.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. Identify invertebrate species that can be taken by recreational and commercial fishing in the reserves and, in liaison with DoF, provide the necessary legislation to provide protection for species that will not be extracted (DEC, DoF) **(H)**. 3. Prohibit recreational shell collecting in the reserves (DoF, DEC) **(H)**. 4. Review the need for special conditions (e.g. bag limits and possession limits) for target invertebrate species in the reserves (DoF) **(H)**. 5. Undertake research programs to characterise invertebrate diversity and abundance in the reserves (DEC, DoF) **(M)**. 6. Develop and implement monitoring programs for priority species (DEC, DoF) **(M)**. 7. Educate users of the reserves on the conservation issues associated with invertebrate populations, the potential detrimental impacts of human activity on invertebrates, as well as appropriate behaviours and conduct to minimise potential impacts (DEC) **(M)**.

Performance measure/s	1. Diversity. 2. Abundance.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	No loss[Ø] of invertebrate species abundance in the *sanctuary zones* in the *marine parks* and in the *conservation area* in the *marine management area* as a result of human activity in the reserves.		
Long-term target/s	1. No loss of invertebrate diversity as a result of human activity in the reserves. 2. No loss in protected invertebrate species abundance[Ø] as a result of human activity in the reserves. 3. Abundance and size composition of invertebrate species in *sanctuary zones* of the *marine parks* and the *conservation area* in the *marine management area* to be at natural[‡] levels. 4. Management targets for abundance of targeted invertebrate species in all other areas to be determined in consultation with Department of Fisheries and peak bodies.		

[Ø]In this context a loss or change in *abundance* or *biomass* excludes losses of a minor, transient or accidental nature.

[‡]*'Natural'* in this context refers to the abundance that would occur in areas that are undisturbed and/or unexploited by human activities.



9.2 Social Values

Social values are those cultural, aesthetic, recreational and economic characteristics for which an area is significant or well known. These can include heritage, commercial and recreational usage, science and education. Striking a balance between protecting the environment for current and future generations and facilitating ongoing recreational and commercial opportunities is the primary purpose of this management plan. It should be noted that DEC's Policy Statement No. 18 *Recreation, Tourism and Visitor Services* provides a framework for the "provision of world class recreation and tourism opportunities, services and facilities for visitors to the public conservation estate while maintaining in perpetuity Western Australia's natural and cultural heritage". Recreation and tourism will be managed in light of this policy.

9.2.1 Hydrocarbon exploration and production industry

Social value	**Hydrocarbon exploration and production industry**: *The Montebello/Barrow islands region is within the State's most productive petroleum area (for both oil and gas).*

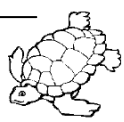
Background	Western Australia's petroleum industry began more than 40 years ago and was worth $15,210 million in 2005/2006, making it the State's most valuable commodity. The North West Shelf is the State's most productive petroleum area with approximately 59% of the State's oil and 93% of the State's gas production. The value of petroleum production from the Montebello/Barrow Islands area alone was worth $515 million in 2005/2006. At the time of publication, there are two major petroleum projects within the reserves, these being the Barrow Island Project and the Harriet and East Spar projects on Varanus Island (Figure 13). The Barrow Island Project operated by Chevron Texaco Australia Pty. Ltd. is one of the State's largest oil producing projects, with approximately 3.3% of the total State production. Over 300 million barrels of oil have been produced (to mid 2006), from 30 reservoirs and 12 producing horizons, and a total of 800 wells have been drilled on the Island. The oil field has an estimated production life of a further 25 years. Apache Energy operates the Harriet and East Spar projects on Varanus Island that produce gas condensate and oil. The two projects produce approximately 7% of the State's oil production and 6.5% of domestic gas production, with gas, condensate and oil being produced from over 50 wells. The projects comprise the East Spar, Harriet, Agincourt, Albert, Artereus, Bambra, Double Island, Endymion, Gipsy, Gudrun, Hoover, Linda, Little Sandy, Mohave, Monet, North Alkimos, North Pedirka, Rose, Simpson, Sinbad, South Plato, Tanami, Victoria and Wonnich fields, all of which are linked to the Varanus Island facilities. There are other petroleum resources within the reserves that are yet to be developed, and due to the presence of east-west faults with the potential to trap oil and gas, the area is considered to be highly prospective. The Greater Gorgon area, situated 130 km off the north-west coast of Western Australia (approximately 70 km from Barrow Island), comprises the largest gas resource discovered to date in Australia. Development proposals have been put forward to recover gas from the Gorgon and Jansz fields. Chevron Australia is the operator and proponent for the proposed Gorgon field development and Mobil Exploration and Production Australia (MEPA) is the operator and proponent for the Jansz field. The proposed development of the Gorgon field will require a range of infrastructure to extract the gas and transport it to Barrow Island for processing and delivery to market. Proposed developments include subsea infrastructure (including pipelines) for the production and transport of the gas to Barrow Island, and a gas processing facility at Town Point on the east coast of Barrow Island. Liquefied Natural Gas produced at the gas processing facility will be shipped from Barrow Island and, if commercially viable, gas will also be exported by pipeline to the mainland for domestic use. Associated infrastructure will include administration and accommodation facilities, a materials lay down area, a materials off-loading facility, a carbon dioxide injection facility and a conventional loading jetty. The Barrow Island Joint Venture operates a port facility on the east coast of the island. The port was constructed to support Barrow Island's oil field that began production in 1967 and consists of a sub-sea pipeline, and an offshore tanker mooring and load out facility. Apache Energy also operates a port facility surrounding Varanus Island. The port was constructed in 1986 and supports Apache Energy's operations to the north-east, south-west and west of the island. Like the Barrow Island Port Facility, the Varanus Island facility consists of a sub-sea pipeline, and an

offshore tanker mooring and load out facility. Both ports have a materials handling barge-landing facility.

DoIR is responsible for management of petroleum activities carried out in State waters and is responsible for the assessment, evaluation and approval of petroleum operation proposals in Western Australia (Department of Minerals and Energy, 2000). This responsibility comes via the legislative framework of the *Petroleum (Submerged Lands) Act 1982*, which controls marine based petroleum operations, and the *Petroleum Pipelines Act 1969*, which governs the construction, operation and maintenance of petroleum pipelines. The *Barrow Island Bill 2003* ratifies an agreement between the State Government and Gorgon joint venturers relating to a proposal to undertake offshore production of natural gas and other petroleum products and a gas processing and infrastructure project on Barrow Island. Petroleum proposals may also be subject to assessment by the EPA under the EP Act and, where proposals may impact on matters of national environmental significance, under the EPBC Act, by DEH. The standard approvals process for the petroleum industry, which currently includes referral of petroleum development proposals to a variety of bodies, continues to apply in the reserves. There will not be a duplicated environmental approvals process for petroleum development proposals within the reserves. Conditions and regulations for proposals will continue to be set, monitored and managed by DEC and DoIR. The MPRA will be informed of all petroleum development proposals in the reserves and would be expected to provide advice where proposals are formally assessed by the EPA. The MPRA's advice will relate to whether the proposal is consistent with the management plan (i.e. targets for the ecological values and management objectives for the social values). To facilitate such an approach DEC will work towards development of appropriate ecological management targets for all values.

The petroleum industry has the potential to impact on the ecological and other social values of the reserves, with the most likely scenario of greatest public concern being that of a major oil spill or shipping accident. While the effects of such an incident could be widespread, the historical frequency has been low. Between 1989 and 2001, there were six oil spills within the petroleum permit areas over the reserves during production and exploration activities. Four of these spills were of crude oil and two were of diesel and ranged in volume from 20 to 25,000 litres. However, after investigation of the most recent incident by DoIR and the former DoE, it was concluded that there had been no significant shoreline contact with spilled oil or impact of spilled oil on any of the Montebello/Lowendal islands (DoE, 1999). This was probably due to the volatility of the products and the prevailing weather/current conditions, which resulted in the spill evaporating quickly. Other potential impacts on the ecological values of the reserves include potential negative effects of seismic surveys on marine animals, impacts from produced formation water and drilling fluids, smothering of marine life by drill cuttings and from dredging, and possible misorientation and increased predation of turtle hatchlings as a result of the artificial lights which are used at hydrocarbon production facilities. These impacts can be mitigated through application of best practice techniques and implementation of appropriate conditions and regulations.

The primary role of reserve management in relation to hydrocarbon exploration and production is, in liaison with DoIR and the EPA, to ensure that hydrocarbon exploration and production activities in the reserves are ecologically and socially sustainable and to ensure equitable access to the reserves for the industry. Subject to environmental assessment, drilling for petroleum exploration or production, petroleum pipelines (and associated dredging and dredge spoil dumping) can be permitted in the general use zones and special purpose zone (benthic protection) of the Montebello Islands Marine Park and in the marine management area. Under the CALM Act, drilling for petroleum exploration or production is not permitted in sanctuary and recreation zones. In special purpose zones these activities may be permitted where this activity is compatible with the primary purpose of the zone. In respect to the specific case of the special purpose zones (pearling) in the Montebello Islands Marine Park, drilling for petroleum exploration or production, petroleum pipelines and dredging and dredge spoil dumping for shipping activities are not considered compatible. This is due to the requirements for very high water quality for pearl culture and the presence of infrastructure (pearl lines, production facilities etc) in these relatively small leased areas. Another consideration is that these zones are located in shallow waters, which are not accessible for shipping, and are generally too shallow to permit drilling activities. Seismic exploration can occur in any area of the reserves subject to



	environmental assessment. The permitted activities within each zone of the reserves are outlined in Tables 2 and 3.
Requirements	Equitable access to the reserves.
Management objective/s	1. To ensure that, in collaboration with the hydrocarbon industry and DoIR, hydrocarbon industry activities in the reserves are managed in a manner that is consistent with maintaining the reserves values. 2. Cooperate with the industry and DoIR in the maintenance of a viable hydrocarbon exploration and production industry in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 (H-KMS). 2. Ensure a coordinated approach to industry assessment and reporting requirements in the reserves (DEC, EPA, DoIR, industry) (H). 3. Ensure the conditions applied to approved petroleum industry projects are consistent with the management plan and they include: • appropriate environmental performance measures; • desired trends; • short-term and long-term management targets; and • monitoring and reporting requirements (DEC, EPA, DoIR) **(H)**. 4. Ensure that environmental research and monitoring undertaken by industry is coordinated and maximise opportunities for collaboration to increase understanding and knowledge of the area (DEC, DoIR, industry) (H). 5. Ensure that due consideration is given to activities which would unnecessarily restrict future petroleum industry opportunities in appropriate areas in the reserves (DEC) (M).

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes (Appendix IV).

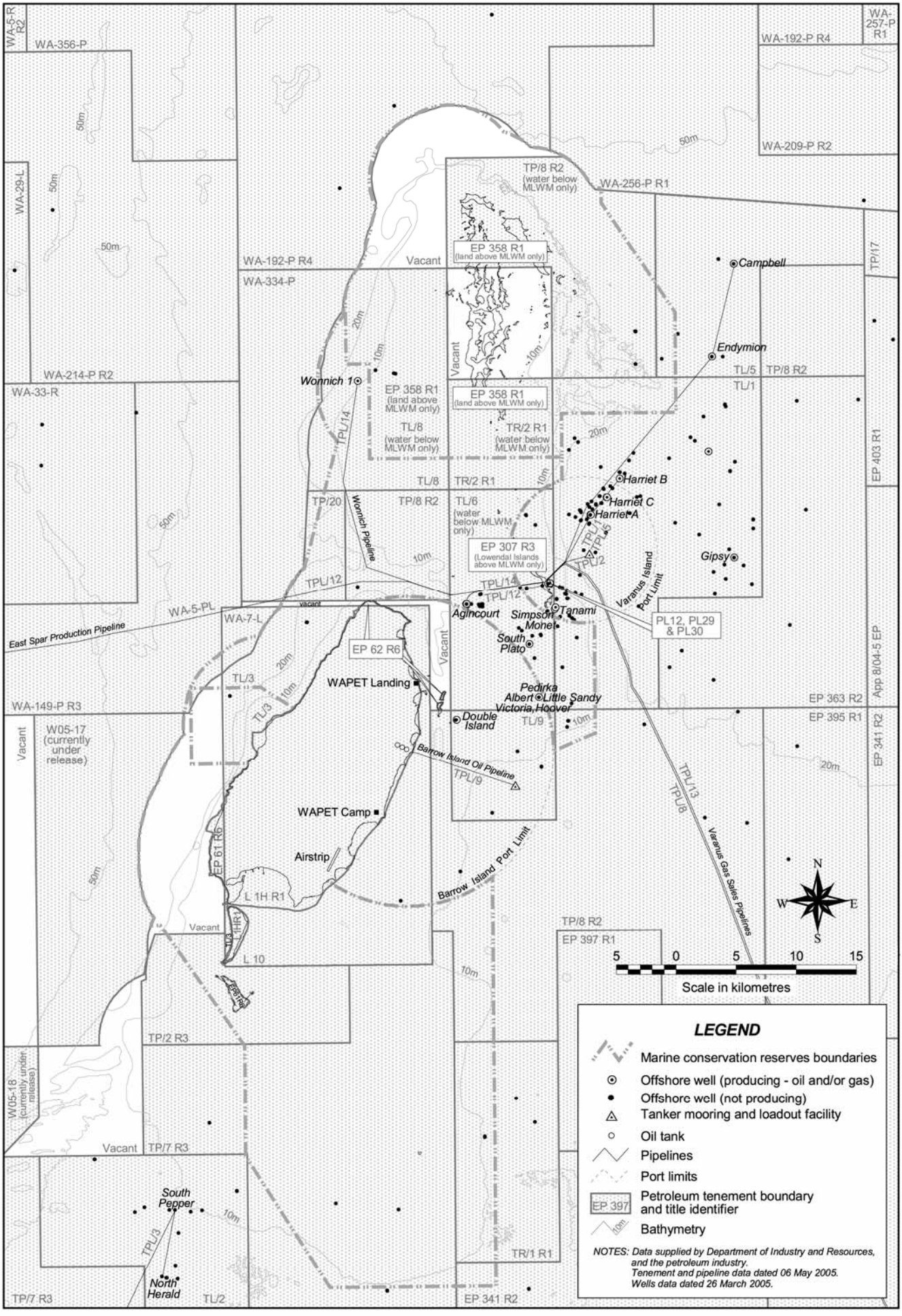


FIGURE 13: Petroleum tenements, petroleum infrastructure, and port limits of the Montebello/Barrow islands

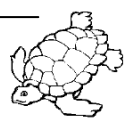
9.2.2 Pearling

Social value	**Pearling**: *The warm pristine waters of the reserves provide optimal conditions for production of high quality pearls by the existing pearling operations.*

Background	Pearling is the production of pearls from the oyster species *Pinctada maxima*, which are either collected from the wild or grown in hatcheries. The warm water temperatures, high nutrient levels, protection from wave damage, clear sandy bottoms and relatively shallow water of the reserves make them one of the best areas in the world for pearl production. There are currently two pearling leaseholders in the reserves, these being Morgan Pearls Limited and Fantome Pearls Pty. Ltd. (formerly Cossack Pearls Pty. Ltd.) (Figure 14). As of November 2006, Morgan Pearls Limited hold 14 lease areas in the Montebello Islands, covering approximately 550 ha. They also have a quarantine site in Claret Bay, which is used for any shell which is imported from outside the DoF pearling zone. The Morgan Pearls Limited operation makes an important contribution to the industry, with annual production worth many millions of dollars. Fantome Pearls has one pearl lease of approximately 1,231 ha to the north of Parakeelya Island in the Lowendal Islands. Pearling in Western Australia is managed by DoF under the *Pearling Act 1990* through the granting of licences, quotas and size limits on the collection of wild oysters, restrictions on hatchery production and restrictions on allowable distances between leases to minimise disease transfer. Ministerial Policy Guideline Number 8 *Assessment of applications for authorisations for Aquaculture and Pearling in coastal waters of Western Australia* (DoF, 1998) sets out guidelines for the assessment of pearling proposals. Pearling is permitted in marine management areas and in general use and appropriate special purpose zones of marine parks. Proposals for new pearling activities involve the referral of the application to DEC/EPA, the MPRA and a range of other government, community and industry groups. The approval of the Minister for the Environment is also required. Where the establishment of a marine nature reserve or exclusion zone in a marine park is claimed to have reduced the commercial value of a pearling licence or lease, the licensee or lessee may be eligible for compensation under the *Fishing and Related Industries Compensation (Marine Reserves) Act 1997.* In 2003, the Northern Pearl Oyster Fishery was accredited under the EPBC Act as an ecologically sustainable fishery. In addition, a review of environmental impacts of pearling (Enzer Marine Environmental Consulting, 1998) concluded, *"…in general the industry is environmentally benign, producing a high value product with a minimum of environmental disruption."* However, if not carefully sited and managed, activities associated with pearling could have localised negative impacts on the ecological and social values of the reserves. This could include impacts from anchoring, shading of benthic fauna by grow out panels or floating infrastructure, sewage discharge, waste disposal, introduction of marine pest species, loss of visual amenity, and perceptions of loss of access by tourism, recreational and other users. The management of human activities that affect the ecological values (i.e. high water quality and healthy habitats) that are critical requirements of the industry is a key issue for pearling. The primary role of management in relation to pearling in the reserves is to ensure pearling activities are socially and ecologically sustainable and to help maintain the natural values of the reserves on which the industry depends. Activities associated with the pearling industry, such as vessel movement, cleaning of shell and landing of seaplanes will not be unnecessarily restricted within the reserves. Special purpose zones (pearling) will be established for pearling leases A, B, C, D, G, H, I, J, O and P, as well as the quarantine site in Claret Bay (see Figure 14), to provide priority use of these areas. The other existing pearling leases currently held by Morgan Pearls Limited (i.e. lease areas E, F, K and L), as well as Fantome Pearl's lease areas in the Lowendal Islands will be zoned general use. The owners, in consultation with the MPRA, are undertaking a process of rationalisation of these areas. It is anticipated that this will be completed in the early phase of the management plan. It should be noted that this does not preclude a lease being held or created within a general use zone of the reserves. Pearling is not permitted in sanctuary and recreation zones of marine parks. It is also not permitted in the special purpose zone (benthic protection) of the Montebello Islands Marine

	Park or the Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection) in the marine management area. Pearling is permitted in the general use and the special purpose zones (pearling) of the Montebello Islands Marine Park and in unzoned areas of the marine management area. The permitted activities within each zone of the reserves are outlined in Tables 2 and 3.
Requirements	• High water quality. • Equitable access to locations suitable for pearl production in appropriate zones of the reserves (including seaplane access and access between leases for pearl culture vessels). • Detailed knowledge of ecological processes to assist pearling planning and monitoring programs.
Management objective/s	1. To ensure that, in collaboration with the industry and DoF, the pearling industry in the reserves is managed in a manner that is consistent with maintaining the reserves' values. 2. To maintain the ecological values of the reserves that are important to the pearling industry. 3. Cooperate with the industry and DoF in the maintenance of a viable pearling industry in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. Ensure pearling licences are consistent with the management plan and they include: • conditions requiring environmental monitoring to the satisfaction of DEC; and • conditions relating to lighting, navigational marking and site utilisation to the satisfaction of DPI and DoF (DoF, DEC, EPA, DPI) **(H-KMS)**. 3. In liaison with the MPRA and pearl producers, review pearling lease areas in the reserves (in particular E, F, K and L leases) and rationalise these areas where appropriate (DEC, DoF) **(H)**. 4. In collaboration with the Pearl Producers' Association and DoF, assess the need for Codes of Practice for pearling in the reserves to ensure social and ecological sustainability (DEC, DoF, PPA) **(H)**. 5. Ensure that proposals for petroleum and nature-based tourism operations do not affect the key ecological requirements for pearling operations (e.g. high water quality) (DEC, EPA, Tourism WA) **(H)**. 6. Ensure that due consideration is given to activities which would unnecessarily restrict future pearling activities in appropriate areas in the reserves (DEC) **(M)**. 7. Provide formal advice to DoF and EPA (as appropriate) in relation to the environmental assessment of proposed pearling activity in the reserves (DEC) **(M)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes (Appendix IV).



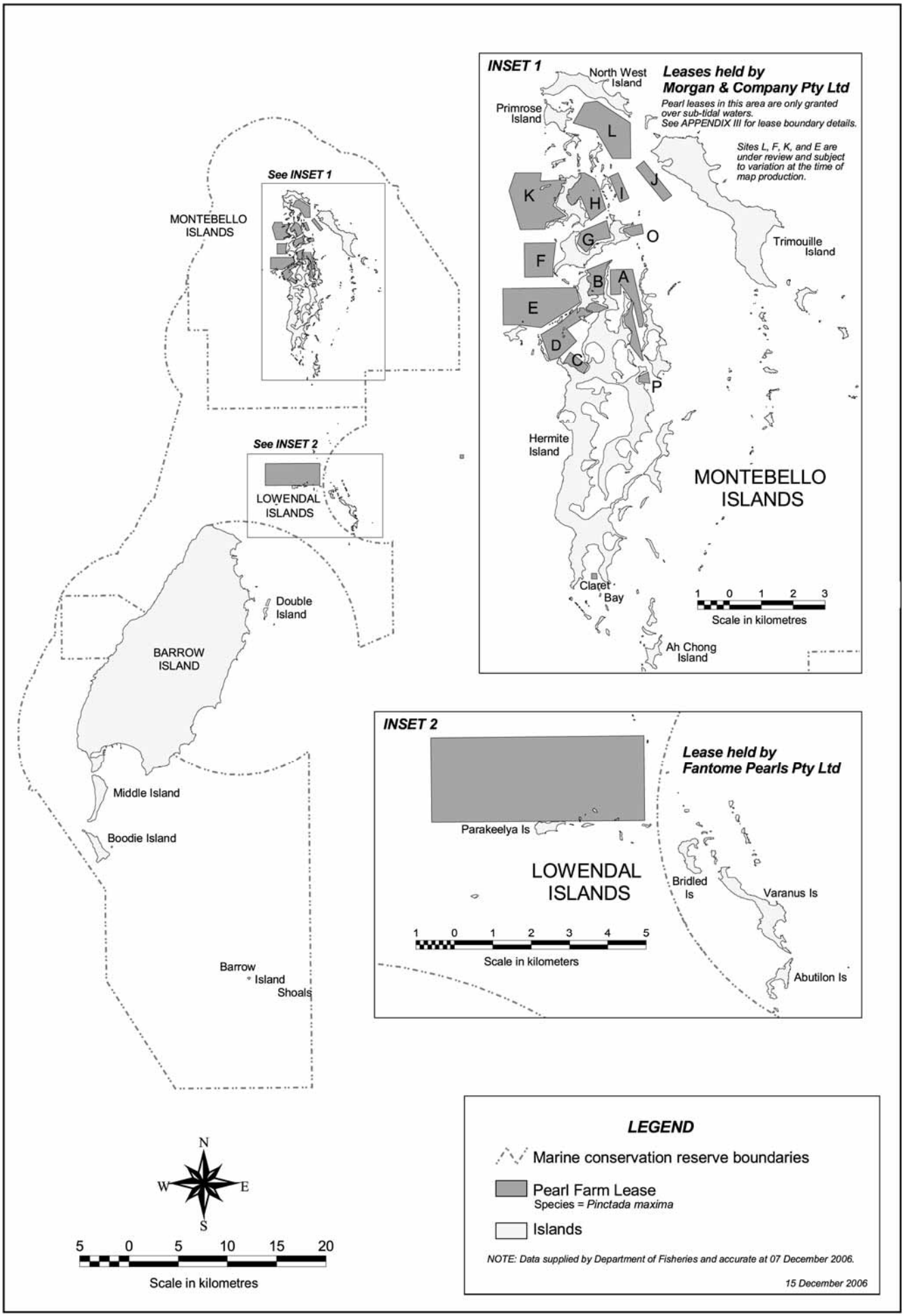


FIGURE 14: Pearling leases of the Montebello/Lowendal/Barrow islands

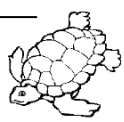
9.2.3 Nature-based tourism

Social value	**Nature-based tourism**: *The reserves are developing rapidly as an important area for the nature-based tourism industry, with charter boats taking visitors to the Montebello Islands to participate in activities such as fishing, diving, wildlife viewing, island exploring and surfing.*

Background	The wide variety of wildlife and the wild, natural appearance of the land and seascapes within the reserves have the potential to support an increasing nature-based tourism industry. This high nature-based tourism potential was identified in the Pilbara Development Commission's ecotourism management strategy for the Pilbara offshore islands (PDC, 1995). In 2004/2005, a total of 339,000 tourists visited the Pilbara region, spending approximately $225 million (Tourism Western Australia, 2006). The percentage of these tourists who visited the reserves is unknown, but is likely to have been small. At present, nature-based tourism in the reserves is limited to a small seasonal charter vessel industry. Charter vessels usually visit the reserves between April and November. The majority of these visits centre on the Montebello Islands, with activities around Barrow Island being rare. Charter vessel passengers participate in SCUBA diving, snorkelling, fishing, mud crabbing, wildlife appreciation, island exploring and a limited amount of surfing. The area of the Montebello Islands visited depends on the activity being undertaken and charter operators have preferred areas of operation. Despite the presence of infrastructure from the hydrocarbon and pearling industries, an attraction for visitors to the Montebello Islands is the sense of isolation and remoteness that can be found in some areas due to the absence of man-made structures and the small number of visitors to the area. These characteristics should be considered when activities or developments are proposed, to maintain this feature of the area where possible. DEC manages commercial tourism activities within marine conservation reserve under the framework of Policy Statement No. 18 *Recreation, Tourism and Visitor Services* and through licences. Under Section 101 of the CALM Act, all commercial activities on land and waters vested in the MPRA or Conservation Commission and managed by DEC require a licence. Human interactions with wildlife are also controlled through the WC Act and codes of conduct. DoF managed charter fishing activities through a system of fishing tour operator licences and aquatic eco-tourism licences. Nature-based tourism has the potential to make an important contribution to protecting the region's ecosystems by fostering a greater understanding of the environment. However, unless carefully manage, visitation has the potential to cause environmental damage, particularly as the numbers of visitors continues to increase. This includes increases in litter, impacts on fish stocks due to fishing, damage to coastal and marine areas, as well as disturbance to seabirds, marine mammals and nesting turtles. Issues for the industry raised by charter operators include disposal of rubbish, equity of access and the current low level of promotion of the area for nature-based tourism. Of greatest concern among the majority of operators were the impacts on some populations due to fishing, especially mud crabs. The management goals of the reserves' management in relation to nature-based tourism are to manage these activities in a manner that is consistent with maintaining the reserves' values, to maintain the values of the reserves on which the nature-based tourism industry depends, and to assist in maintaining a viable nature-based industry in the reserves. Non-extractive tourism activities are permitted in all zones of the marine parks. However, in sanctuary and special purpose zones there may be restrictions on activities that are shown to be incompatible with the zone. Extractive tourism activities (i.e. charter fishing) are permitted in accordance with the permitted uses in various management zones (see Tables 2 and 3).

Requirements	• High water quality. • Equitable access to the natural values of the reserves. • Healthy benthic communities. • High aesthetic quality of the marine environment. • Provision of 'undisturbed' areas for nature appreciation.
Management objective/s	1. To manage nature-based tourism in the reserves in a manner that is consistent with maintaining the reserves' values. 2. To maintain the ecological values of the reserves that are important to the nature-based tourism industry. 3. Cooperate in maintaining a viable nature-based tourism industry in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. License all nature-based tourism operators within the reserves with appropriate conditions (DEC) **(H)**. 3. Develop Codes of Practice for nature-based tourism operations in the reserves including: • performance measures; • desired trends; • short-term and long-term management targets; and • monitoring and reporting requirements (DEC, Tourism WA) **(M)**. 4. Ensure equitable access for nature-based tourism within appropriate zones in the reserves (DEC) **(M)**.

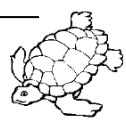
Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes (Appendix IV).



9.2.4 Commercial fishing

Social value	**Commercial fishing**: *The reserves are used by commercial fishers targeting a variety of finfish, sharks and beche de mer*.

Background	A number of commercial fisheries are permitted in the reserves, including the Pilbara Trap Managed Fishery, the North Coast Shark Fishery, Onslow Prawn Managed Fishery, wetline, beche de mer and tropical rock lobster fisheries, and shell, coral and aquarium fish collecting. However, many of these fisheries do not operate in the reserves, rarely fish, or fish only on the extremities of the reserves. The Pilbara Trap Managed Fishery has a total of 6 licences issued and was worth $1.9 million with a total catch of 395 tonnes in 2004 (Penn *et al.*, 2005). Any fisher with a Western Australian Fishing Boat Licence can potentially fish in the Montebello/Barrow island area (in 2003 there were 1,200 licences in operation). However, a very small proportion of these actually fish in the area. The total line fishing catch in the Pilbara region in 2004 was 217 tonnes worth $1 million, comprising mainly goldband snapper, red emperor, scarlet perch and spangled emperor (Penn *et al.*, 2005). Commercial line fishers also troll for spanish mackerel in waters of 20 m depth or more. Commercial boats operating in Commonwealth managed fisheries such as tuna longliners can access the waters of the reserves but are currently not active in the region. The nine licensed operators in the North Coast Shark Fishery have access to the reserves and in 2003/2004 landed approximately 591 tonnes worth about $1.7 million (Penn *et al.*, 2005). Hook and line techniques are used by this fishery, including drop lines and long lines, and a wide range of species including sandbar, black tip, spot tail, tiger, hammerhead and lemon sharks, and a variety of whalers are targeted. Zones 2 and 3 of the Onslow Prawn Managed Fishery fall within the Montebello/Barrow islands region. Even though there are 31 licensed operators, prawn trawling is generally restricted to inshore areas near the mainland coast, so operators do not currently use the reserves. The level of collection of beche de mer in the reserves is currently unknown, although there are seven licences in Western Australia that permit collection by hand of these animals. There is a closed area for tropical rock lobsters between Onslow and Cape Preston that includes the Montebello Islands, however the fishery has access to waters west of Barrow Island. Two commercial operators have licences to take tropical rock lobsters for aquarium display purposes only. There are 33 commercial shell collecting and 13 aquarium fish collecting licences issued by DoF throughout the State but the levels of collection in the reserves are unknown. Commercial fishing in Western Australian is managed by DoF under the FRM Act. A range of management strategies is used including limitations on fishing gear, closed areas, limits to the number of licences issued and the monitoring of catch and stock levels. In June 2002, a prohibition was imposed under the FRM Act on commercial fishing for mud crabs south of King Sound. The Pilbara Trap Managed Fishery has been regulated since 2000 by the allocation of time/gear units, which is currently one fish trap used for one day. In 2004, 5,867 trap days were allocated for the entire fishery although an estimated 5,377 days were used (Penn *et al.*, 2005). Commercial line fishing is currently unrestricted throughout the reserves. No trawling for finfish is carried out in the reserves as they lie in a DoF trawling exclusion area. Where the establishment of a marine nature reserve or exclusion zone in a marine park is claimed to have reduced the commercial value of a fishing licence, the licensee may be eligible for compensation under the *Fishing and Related Industries Compensation (Marine Reserves) Act 1997*. Potential habitat damage and impacts on fish stocks are the major considerations in regard to commercial fishing in the reserves. However, given the low level of usage of the reserves for commercial fishing and the types of gear used, the potential for impacts from these activities is low. The primary roles of management within the reserves in relation to commercial fishing are to help maintain the natural values of the reserves on which the industry depends and, in liaison with DoF, to ensure that commercial fishing activities are ecologically and socially sustainable. In addition, the creation of no-take areas within the reserves provides research and monitoring opportunities through which the impacts of commercial fishing on the reserves' values can be assessed. Commercial fishing is not permitted in sanctuary, recreation or special purpose zones (pearling) of the marine parks or the Bandicoot Bay Conservation Area (Benthic Fauna/Seabird



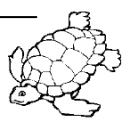
	Protection) of the marine management area. Commercial trolling is permitted in the special purpose zone (benthic protection) of the Montebello Islands Marine Park. Commercial coral collection will be prohibited throughout the reserves. Other forms of commercial fishing are permitted in the unzoned area of marine management area and the general use zone of the Montebello Islands Marine Park. The permitted activities within each zone of the reserves are outlined in Tables 2 and 3.
Requirements	• High water quality. • Maintenance of key habitat (e.g. nursery grounds, areas of high primary productivity). • Equitable access to fishing grounds (in appropriate areas). • Maintenance of target fish stocks.
Management objective/s	1. To ensure that, in collaboration with the industry and DoF, commercial fishing activities in the reserves are managed in a manner consistent with maintaining the reserves' values. 2. To maintain the ecological values of the reserves that are important to commercial fisheries. 3. Cooperate with the industry and DoF in the maintenance of a viable commercial fishing industry in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. Quantify the levels and effects of commercial fishing activity in the reserves and review management controls where required (DoF, DEC) **(H)**. 3. Monitor and report on commercial fishing catch/effort within the reserves (DoF) **(H)**. 4. Ensure commercial fishers are aware of the zoning scheme and any restrictions that may apply to their operations (DoF, DEC) **(M)**. 5. Liaise with the MPRA in regard to proposed new fisheries and major changes to existing fisheries within the reserves (DoF) **(M)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes (Appendix IV).

9.2.5 Recreational fishing

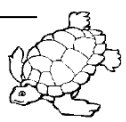
Social value	**Recreational fishing**: *Excellent shore and boat-based recreational fishing opportunities targeting a variety of pelagic and reef finfish species, mud crabs and other edible invertebrates.*

Background	The productive coral reefs in the reserves support an abundance of prized table fishes, but due to the remoteness of the area, very few of Western Australia's approximately 540,000 recreational fishers currently visit the reserves. Those recreational fishers who do visit the area target spangled emperor (*Lethrinus nebulosus*), red emperor (*Lutjanus sebae*), spanish mackerel (*Scomberomorus* spp), coral trout (*Plectropomus* spp), mangrove jacks (*Lutjanus argentimaculatus*), oysters, mudcrabs, rock lobsters and squid. The areas of highest recreational fishing activity are reported to be off the north-eastern end of Trimouille Island and in the waters south of the Montebello group. Medium intensity recreational fishing is reported to be carried out in the vicinity of the small islands to the south of Trimouille Island. Employees and contractors working on Barrow and Varanus islands and offshore platforms undertake recreational fishing in the reserves, mainly around these islands. Recreational fishing is managed by DoF through a variety of management tools that aim to limit catches to sustainable levels. These tools include bag and size limits, gear restrictions, seasonal restrictions and licensing, while potato cod, whale sharks and hump-headed maori wrasse are fully protected in all State Waters. DoF undertook a survey on the regional boat-based recreational fishing effort in the Pilbara in 1999-2000. New bag, size and possession limits came into effect on 1 January 2006 on a number of species targeted by recreational fishers (DoF, 2006a). The review also addressed issues of research, resource sharing and protection of vulnerable species. These changes do not preclude further management changes for the Montebello/Barrow islands area if there are sustainability concerns that could be addressed by changes to management controls. In July 2001, DoF imposed an interim 12 month prohibition on recreational collection of coral in WA, and recreational coral collection continues to be prohibited in the Pilbara/Kimberley region. The main issues in regard to recreational fishing in the reserves are impacts on target species due to fishing, including localised depletion, and associated impacts on the ecological values, for example, from litter or trampling of sensitive habitat. Mud crabbing was identified as the major pressure on mangrove communities in the reserves. However, given the current low level of usage of the reserves for recreational fishing, the overall potential for impacts from this activity is probably low. The primary role of the reserves' management in relation to recreational fishing is to help maintain the natural values of the reserves on which this activity depends and, in liaison with DoF, to ensure that recreational fishing activities in the reserves are ecologically and socially sustainable. In addition, the creation of no-take areas within the reserves provides research and monitoring opportunities through which the impacts of recreational fishing on the reserves' values can be assessed. Recreational fishing is not permitted in sanctuary zones of the marine parks. Certain types of recreational fishing are permitted in special purpose (benthic protection) and special purpose (pearling) zones in the Montebello Islands Marine Park, and in the Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection) in the marine management area. Recreational shell collecting will be prohibited in the reserves. While throw netting is permitted in specified zones of the reserves, haul and set netting are not permitted in the region under the FRM Act. Charter vessel fishing is not permitted in the two recreation zones; however unguided recreational fishing by customers of charter operators is permitted in recreation zones. All other forms of recreational fishing are permitted in general use and recreation zones of the Montebello Islands Marine Park and unzoned areas of the marine management area. The permitted activities within each zone of the reserves are outlined in Tables 2 and 3.
Requirements	• High water quality. • Maintenance of target species' habitat. • Equitable access to fishing grounds (in appropriate areas). • Maintenance of recreational fish stocks in the reserves.
Management	1. To ensure that, in collaboration with the community and DoF, recreational fishing in the



objective/s	reserves is managed in a manner consistent with maintaining the reserves' values. 2. To maintain the ecological values of the reserves that are important to recreational fishing. 3. To cooperate with the community and DoF in maintaining quality recreational fishing opportunities in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. Ensure recreational fishers are aware of the zoning scheme and of restrictions that apply to their activities in the reserves (DoF, DEC, industry) **(H)**. 3. Evaluate the sustainability of existing recreational fisheries in the reserves (DoF) **(H)**. 4. Formulate performance measures and targets for key recreational species for the maintenance of the quality of recreational fishing in the reserves (DoF) **(M)**. 5. Determine the effects of recreational fishing activities in the reserves and review management controls as required (DoF, DEC) **(M)**. 6. Monitor recreational fishing catch/effort within the reserves (DoF) **(M)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes (Appendix IV).

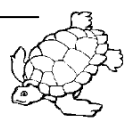


9.2.6 Water sports

Social value	**Water sports:** *The natural values, climate, and scenic values provide the basis for a wide range of recreational activities.*

Background	The warm climate, stunning island and ocean vistas, abundant wildlife and relatively undisturbed environment of the reserves provides the opportunity for a variety of marine recreation activities. Recreational boating, diving, snorkelling, surfing and wildlife observation (e.g. of whales, dolphins, dugongs, turtles and birds) all occur within the reserves. However, due to the area's isolation from major mainland centres and a lack of visitor facilities, visitation remains at a low level. Boating is a popular recreational activity in Western Australia with 57,000 private vessels registered with DPI. In 2004, approximately 2,100 of these were registered to owners residing in the towns of Karratha, Dampier, Point Samson, Roebourne, Onslow and Exmouth. Despite Pilbara coastal towns having the highest rate of boat ownership per capita in Western Australia, anecdotal reports from charter boat operators indicate only about 20 private yachts and 10 other private vessels visit the reserves each year for recreational activities. In addition, petroleum and pearling industry workers based in the region use the reserves for water sports. There is very little use of the reserves for surface water sports such as sea-kayaking and windsurfing, although surfing is becoming more popular. DPI is responsible for all boating regulations including licensing, safety standards, marker buoys, moorings and jetties. Mooring controls can be delegated to other management agencies, and DEC would seek to become the 'controlling authority' in respect of the reserves. Wildlife viewing is controlled by codes of conduct, which include minimum approach distances, maximum boat speeds and use of lights in the vicinity of wildlife. Whales, dolphins, dugongs, turtles, birds and whale sharks are fully protected under the WC Act and it is an offence to disturb these animals. Increases in boating in the future have the potential to negatively impact on the ecological values of the reserves through an increase in the disposal of effluent and rubbish, as well as through inappropriate anchoring and installation of inappropriate moorings in sensitive habitats. The goals of the reserves' management in relation to water sports are to manage recreational use in the reserves in a manner that is consistent with maintaining the reserves' values, to maintain the values of the reserves important to water sports, and to ensure water sports are carried out in an equitable manner. Boating is permitted in all areas of the reserves. Speed and area restrictions may be necessary where use of boats and personal water craft (e.g. jet skis) is shown to be incompatible with the ecological or social values. Any restrictions would be developed in consultation with key stakeholders. Diving, snorkelling and surfing are permitted in all zones of the reserves.
Requirements	• High water quality. • Equity of access to appropriate areas in the reserves. • Separation of incompatible recreational activities.
Management objective/s	1. To ensure water sports are managed in a manner that is consistent with maintaining the reserves' ecological values. 2. To maintain the ecological values of the reserves that are important to recreational users. 3. To manage recreational activities in a manner that minimises conflict between users of the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. In collaboration with user groups, develop Codes of Conduct to minimise environmental impacts of recreational activities, as appropriate (DEC) **(M)**. 3. Determine the nature, spatial patterns, compatibility and potential environmental impacts of all existing water sports in the reserves (DEC) **(M)**. 4. Implement restrictions on boating and use of personal water craft (e.g. speed/area closures), in consultation with key stakeholders, if these activities are shown to be impacting on the ecological and social values of the reserves (DPI, DEC) **(L)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes (Appendix IV).



9.2.7 European history/maritime heritage

Social value	**European history/maritime heritage**: *The Montebello Islands have a history of European contact dating from 1622, which includes pearling, whaling, fishing for turtles and, more recently, British atomic testing.*

Background	The Montebello/Barrow islands have a long history of European contact, which began with the wreck of the English East India Company vessel, the *Tryal* on Tryal rocks (outside the reserves). The 46 survivors from the wreck who landed on the Montebello Islands are the first Europeans recorded landing on the islands. Since then, the *Wild Wave* was wrecked at the Montebello Islands in 1872, an unidentified boat was lost in 1893 and the *Marietta* was wrecked in 1905. In addition, it is believed that there are a number of uncharted wrecks within the reserves, including pearling luggers lost over the years during cyclones. The natural resources of the reserves have been harvested for many years. American and British whalers are believed to have worked in the region as early as the late 1800's, while fishing for turtles was carried out from the late 1870s until 1973. Cultured pearl farming in the Montebello Islands began in 1902 and continues today. The Montebello Islands also have a history of military use, with a total of three British atomic weapons tests being conducted there during 1952 and 1956. The 1952 test, called Operation Hurricane, saw a 25 kiloton device exploded inside the hull of the *HMS Plym*, a frigate anchored in 12 metres of water, 400 metres off Trimouille Island. The explosion left a saucer shaped crater on the sea-floor that is 6 metres deep and 300 metres across. During Operation Mosaic, in 1956, a 15 kiloton device was exploded on Trimouille Island and a 98 kiloton device was exploded on Alpha Island. The area has been described as being destroyed after the tests, with the device exploded at Alpha Island being the largest atomic weapon tested on Australian soil. Remains of the military activities including scrap steel, disused roadways and the foundations of former British operational headquarters can still be found on some islands Pre-1900 shipwrecks are protected under the *Maritime Archaeology Act 1973* (State legislation) and the *Historic Shipwrecks Act 1976* (Commonwealth legislation). The Western Australian Maritime Museum has statutory responsibility for management of these wrecks. In regard to European history/maritime heritage, the goal of management within the reserves is to prevent significant human impacts on important historic sites by education of reserves users.
Requirements	• Protection of heritage and historical sites.
Management objective/s	To ensure that, in collaboration with the Western Australian Museum, human activities do not significantly impact on historic sites in the reserves.
Strategies	1. Distribute educational material to enhance awareness of the maritime heritage of the reserves (WAMM, DEC) **(L)**. 2. Advise reserve users of the relevant regulations under the *Heritage of Western Australia Act 1990*, the *Maritime Archaeology Act 1973* and the Commonwealth *Historic Shipwrecks Act 1976*, where appropriate (WAMM, DEC) **(L)**. 3. Determine and maintain appropriate levels of access to heritage sites (DEC) **(L)**. 4. Monitor maritime heritage sites to ensure maintenance of values (WAMM) **(L)**.

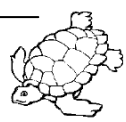
Performance measure/s	To be developed as required.	**Desired trend/s**	To be developed as required.
Short-term target/s	To be developed as required.		
Long-term target/s	To be developed as required.		

9.2.8 Scientific research

Social value	**Scientific research**: *The undisturbed nature and wide variety of habitats and communities within the reserves provide unique opportunities for scientific research.*

Background	The marine biodiversity of the reserves is broadly representative of the Pilbara Offshore marine bioregion. The region is a significant and important source of larval recruitment to reefs further south and this, coupled with high habitat and species diversity, unusual habitats and species assemblages, mangrove communities of global significance and the undisturbed nature of the region, make the area of particular interest and value for scientific research. Despite the wide range of natural features and history of commercial use of the reserves, the level of knowledge about environmental processes and existing pressures on the reserves' values is relatively limited. There is expected to be an increase in the amount of scientific research being conducted in the region, particularly once the reserves are created. Research and monitoring are also important generic management tools used as a management strategy for many other values. This is discussed further in sections 7.6 and 7.7. All research within the reserves requires the appropriate research permit issued under the CALM Act, WC Act or the FRM Act. Most scientific research programs have relatively benign sampling methods, but the combined effect of many research projects has the potential to impact adversely on the ecological values of the marine environment. Conflicts with other human activities can also be an issue for management as scientific research has specific access requirements, e.g. access to representative areas free of major human influence for 'scientific sites' and areas covering the range of major human activities for 'impact sites'. Management strategies for scientific research within the reserves include the implementation of a zoning scheme to provide for the monitoring and assessment of key ecological processes and the level of human impact as well as equitable access to appropriate zones. Another management strategy is to ensure that proponents of scientific research obtain and comply with appropriate DEC and DoF permits. Scientific research is permitted in all areas of the marine parks and the marine management area, subject to the appropriate permit.
Requirements	• Access to sites free of major human influences for 'scientific reference' sites. • Access to representative sites covering the range of major human activities in the park for 'impact' sites. • Equitable access to the reserves for ecological and social research opportunities in appropriate zones.
Management objective/s	To ensure the reserves' value for scientific research is not diminished as a result of human activities in the reserves.
Strategies	1. See the zoning strategies detailed in Section 7.1 **(H-KMS)**. 2. Identify and communicate high priority scientific and social research projects relevant to the management of the reserves to appropriate research organisations (DEC) **(H)**. 3. Facilitate scientific and social research in the reserves by research, academic and educational institutions by providing financial and logistical assistance (where possible) (DEC, industry) **(M)**. 4. Liaise with the petroleum industry to coordinate industry and DEC research programs with the aim of maximising priority research outcomes for the area (DEC) **(M)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes (Appendix IV).



10 PERFORMANCE ASSESSMENT

The effectiveness of the management plan for the reserves will be periodically reviewed through a formal auditing and review process. This will be undertaken through an annual assessment carried out by DEC and a formal audit by the MPRA every three years. The audits will include reports on the status of the key ecological and social values of the reserves and an assessment of the effectiveness of current management strategies, which will provide feedback to reserve managers.

Overall management performance will be reviewed by the MPRA via a performance assessment report, which assesses compliance against the stated key ecological and social management targets (i.e. outcome-based approach) and against progress regarding implementation of the key management strategies (i.e. activity-based approach) as outlined in Sections 7-9. Management targets of selected key ecological and social values of the reserves are used as *key performance indicators* of the effectiveness of the reserves' management. These are identified in Section 9 by the symbol KPI. The KPIs reflect both the conservation priorities and the management imperatives of the MPRA, DEC and the community. The KPIs for the reserves will be the management targets for water quality, coral reef communities, mangrove communities, macroalgal and seagrass communities, turtles and finfish. *Key management strategies* (KMS) are identified in Sections 7-9 by the symbol H-KMS.

10.1 Performance assessment by the Department of Environment and Conservation

The prioritised strategies outlined in Sections 7-9 of the management plan will be built into annual works programs of DEC's Pilbara Region, which will be responsible for the day to day management of the reserves. Progress against the KPIs, KMSs and the remaining management targets and strategies will form the basis of an annual performance assessment report on the reserves prepared by DEC's Pilbara Region for the MPRA and DEC's Corporate Executive.

10.2 Audit by the MPRA

Progress against the KPIs and KMSs will form the basis of a formal MPRA audit of the reserves every three years. Following gazettal of the reserves, DEC will provide annual status reports to the MPRA, which will enable monitoring of DEC's implementation of the management plan. The adequacy of the range of selected KPIs and KMSs will be reviewed following each MPRA audit and they will be amended if appropriate.

Given the key values and pressures on the area, the KPIs for the reserves will be based on the management targets for water quality, coral reef communities, mangrove communities, macroalgal and seagrass communities, turtles and finfish.

10.3 Review of the Management Plan

After its approval, the management plan will guide the management of the reserves for a period of 10 years, or until such time as the statutory review of the management plan is undertaken and a new management plan is prepared.

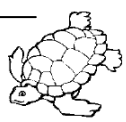
The plan will be reviewed after 10 years with full public consultation, re-submitted to the MPRA and then submitted to the Minister for the Environment, the Minister for Fisheries and the Minister for Resources for approval. The CALM Act specifies that, in the event of such a revision not occurring by the end of the plan's specified lifespan, the plan will remain in force in its original form until a new plan is approved or it is revoked by the Minister.

10.4 Links with State Environment Reporting

The first Western Australian State of the Environment Report was prepared in 1992 and a second report was published in 1998 (Government of Western Australia, 1998b). These reports provided an overview of the key marine and terrestrial environmental issues in the state. The EPA will be responsible for ongoing State of the Environment reporting building on the framework contained within the 1998 report. Relevant marine issues covered by this framework are the implementation of a statewide system of marine conservation reserves, biodiversity, degradation of marine habitats, contamination of the marine environment, the introduction of exotic marine species and tourism, recreational fishing, and commercial activities including fisheries and the mining and petroleum industries. The performance assessment of the marine parks and marine management area, as described above, is broadly consistent with the State of the Environment reporting framework.

10.5 Links with National Environment Reporting

At a national level, there are two major reporting mechanisms relevant to marine conservation reserves. These are the national State of the Environment Report and the performance assessment framework for the NRSMPA. The national State of the Environment Report, which has been published in 1996, 2001 and 2006, is prepared by an independent committee to provide an assessment of the Australian environment (Australian State of the Environment Committee, 2006). A range of performance assessment criteria are being developed to assess whether the goals of the NRSMPA are being achieved. The performance assessment framework of this plan is broadly consistent with the performance assessment criteria being developed for the NRSMPA.



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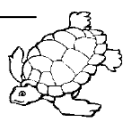

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13 APPENDICES

Appendix I: List of Acronyms

ANZECC	Australian and New Zealand Environment and Conservation Council
CALM	Department of Conservation and Land Management
CALM Act	*Conservation and Land Management Act 1984*
CAMBA	China-Australia Migratory Bird Agreement
CAR	Comprehensive, Adequate and Representative
DEC	Department of Environment and Conservation
DEH	Department of Environment and Heritage (Commonwealth)
DoE	Department of Environment
DoF	Department of Fisheries
DoIR	Department of Industry and Resources
DPI	Department for Planning and Infrastructure
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*
FRM Act	*Fish Resources Management Act 1994*
H	High priority management strategy
HWM	High water mark
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IUCN	The World Conservation Union
JAMBA	Japan-Australia Migratory Bird Agreement
KMS	Key management strategy
KPI	Key performance indicator
L	Low priority management strategy
LWM	Low water mark
M	Medium priority management strategy
MAC	Management Advisory Committee
MOU	Memorandum of Understanding
MPRA	Marine Parks and Reserves Authority
MPRSWG	Marine Parks and Reserves Selection Working Group
NRSMPA	National Representative System of Marine Protected Areas
PDC	Pilbara Development Commission
PIO	Pilbara offshore marine bioregion
PPA	Pearl Producers' Association
TBT	Tributyl tin
WAFIC	Western Australian Fishing Industry Council
WAM	Western Australian Museum
WAMM	Western Australian Maritime Museum
WC Act	*Wildlife Conservation Act 1950*

Appendix II: Technical description of reserve and zone boundaries

MONTEBELLO/BARROW ISLANDS MARINE CONSERVATION RESERVES TECHNICAL DESCRIPTION of MARINE RESERVES GAZETTED UNDER THE *CONSERVATION AND LAND MANAGEMENT ACT 1984*

Class 'A' Marine Reserve No. 9
Montebello Islands Marine Park Boundary

Situated in the Indian Ocean, the Montebello Islands Marine Park comprises Western Australian waters, the airspace above those waters, the seabed below those waters, and the subsoil to a depth of 200 metres below that seabed that are -

a) contained within and bounded by a line:
   i) commencing west of the Montebello Islands at the intersection of longitude 115º25'12" east and the seaward limit of the coastal waters of the State (3 nautical miles seaward of the territorial sea baseline); and
   ii) extending south along longitude 115º25'12" east to latitude 20º29'12" south;
   iii) thence east along latitude 20º29'12" south to longitude 115º26'18" east;
   iv) thence south along longitude 115º26'18" east to latitude 20º33'30" south;
   v) thence east along latitude 20º33'30" south to longitude 115º35'30" east;
   vi) thence north along longitude 115º35'30" east to latitude 20º31'30" south;
   vii) thence east along latitude 20º31'30" south to longitude 115º41'00" east;
   viii) thence north along longitude 115º41'00" east to latitude 20º27'00" south;
   ix) thence north-westerly along the geodesic to the intersection of latitude 20º22'00" south and longitude 115º37'30" east;
   x) thence north along longitude 115º37'30" east to the seaward limit of the coastal waters of the State;
   xi) thence generally north-westerly, south-westerly, and southerly along the seaward limit of the coastal waters of the State to the point of commencement; and

b) seaward of the low water mark that is the boundary of Reserve 42197 as shown on Deposited Plan 240365.

The marine reserve area excludes all allocated land, and all unallocated land landward of the high water mark.

NOTES:

1) All geographic coordinates are expressed in terms of the Geocentric Datum of Australia 1994 ("GDA94").
2) "Western Australian waters" means all waters -
   a) that are within the limits of the State; or
   b) that are "coastal waters of the State".
3) "coastal waters of the State" has the meaning given to that term in the *Off-shore (Application of Laws) Act 1982* section 2.
4) Low water mark (L.W.M.) is the ordinary (mean of) low water mark at spring tides.
5) High water mark (H.W.M.) is the ordinary (mean of) high water mark at spring tides as defined in the *Land Administration Act 1997* section 3.

Class 'A' Marine Reserve No. 10
Barrow Island Marine Park Boundary

Situated in the Indian Ocean, the Barrow Island Marine Park comprises Western Australian waters, the airspace above those waters, the seabed below those waters, and the subsoil to a depth of 200 metres below that seabed that are contained within and bounded by a line:

i) commencing west of Barrow Island at the intersection of latitude 20º43'48" south and longitude 115º17'36" east; and

ii) extending south along longitude 115º17'36" east to latitude 20º47'15" south;

iii) thence east along latitude 20º47'15" south to the western shore of Barrow Island at the intersection of that latitude and the low water mark on Barrow Island that is the boundary of Reserve 11648 (Barrow Island Nature Reserve) as shown on Deposited Plan 91514;

iv) thence generally north-easterly along the low water mark of Barrow Island to the intersection of the low water mark and the geodesic joining the coordinates latitude 20º44'49.80" south longitude 115º22'37.80" east on Barrow Island, and latitude 20º43'48" south longitude 115º20'57" east west of Barrow Island;

v) thence north-westerly along that geodesic to latitude 20º43'48" south longitude 115º20'57" east;

vi) thence west along latitude 20º43'48" south to the point of commencement.

The marine reserve area excludes all allocated land, and all unallocated land landward of the high water mark.

NOTES:

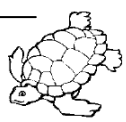
1) All geographic coordinates are expressed in terms of the Geocentric Datum of Australia 1994 ("GDA94").

2) "Western Australian waters" means all waters -
   a) that are within the limits of the State; or
   b) that are "coastal waters of the State".

3) "coastal waters of the State" has the meaning given to that term in the *Off-shore (Application of Laws) Act 1982* section 2.

4) Low water mark (L.W.M.) is the ordinary (mean of) low water mark at spring tides.

5) High water mark (H.W.M.) is the ordinary (mean of) high water mark at spring tides as defined in the *Land Administration Act 1997* section 3.



Class 'A' Marine Reserve No. 11
Barrow Island Marine Management Area Boundary

Situated in the Indian Ocean, the Barrow Island Marine Management Area comprises Western Australian waters, the airspace above those waters, the seabed below those waters, and the subsoil to a depth of 200 metres below that seabed that are -

a) contained within and bounded by a line:
   i) commencing west of the Montebello Islands at the intersection of longitude 115º25'12" east and the seaward limit of the coastal waters of the State (3 nautical miles seaward of the territorial sea baseline); and
   ii) extending generally southerly along the seaward limit of the coastal waters of the State to latitude 20º54'30" south;
   iii) thence east along latitude 20º54'30" south to longitude 115º16'00" east;
   iv) thence south-easterly along the geodesic to the intersection of latitude 21º00'00" south and longitude 115º20'00" east;
   v) thence south along longitude 115º20'00" east to latitude 21º05'00" south;
   vi) thence south-easterly along the geodesic to the intersection of latitude 21º11'00" south and longitude 115º24'00" east;
   vii) thence east along latitude 21º11'00" south to longitude 115º32'00" east;
   viii) thence north along longitude 115º32'00" east to the limit of the Barrow Island Port Area;
   ix) thence generally south-westerly and north-westerly along the limit of the Barrow Island Port Area to the low water mark on the eastern shore of Barrow Island that is the boundary of Reserve 11648 (Barrow Island Nature Reserve) as shown on Deposited Plan 91514;
   x) thence generally south-westerly, north-westerly, and north-easterly along the low water mark of Barrow Island to the intersection of low water mark and latitude 20º47'15" south;
   xi) thence west along latitude 20º47'15" south to longitude 115º17'36" east;
   xii) thence north along longitude 115º17'36" east to latitude 20º43'48" south;
   xiii) thence east along latitude 20º43'48" south to longitude 115º20'57" east;
   xiv) thence south-easterly along the geodesic joining the coordinates latitude 20º43'48" south longitude 115º20'57" east west of Barrow Island, and latitude 20º44'49.80" south longitude 115º22'37.80" east on Barrow Island, to the intersection of that geodesic with the low water mark on the western shore of Barrow Island that is the boundary of Reserve 11648;
   xv) thence generally north-easterly along the low water mark of Barrow Island to the limit of the Barrow Island Port Area at the northern end of Barrow Island;
   xvi) thence generally easterly and south-easterly along the limit of the Barrow Island Port Area to latitude 20º46'48" south;
   xvii) thence north-easterly along the geodesic to the intersection of latitude 20º46'00" south and longitude 115º37'00" east;
   xviii) thence north along longitude 115º37'00" east to the limit of the Port of Varanus Island;
   xix) thence generally westerly, north-westerly, and north-easterly along the limit of the Port of Varanus Island to longitude 115º35'30" east;
   xx) thence north along longitude 115º35'30" east to latitude 20º33'30" south;

xxi) thence west along latitude 20º33'30" south to longitude 115º26'18" east;

xxii) thence north along longitude 115º26'18" east to latitude 20º29'12" south;

xxiii) thence west along latitude 20º29'12" south to longitude 115º25'12" east;

xxiv) thence north along longitude 115º25'12" east to the point of commencement; and

b) seaward of the low water mark that is the boundary of Reserve 38728 (Boodie Island and Middle Island) as shown on Deposited Plan 91515; and

c) seaward of the low water mark that is the boundary of Reserve 33831 (Great Sandy Islands Nature Reserve) as shown on Deposited Plan 240184.

The marine reserve area excludes all allocated land, and all unallocated land landward of the high water mark.

NOTES:

1) All geographic coordinates are expressed in terms of the Geocentric Datum of Australia 1994 ("GDA94").

2) "Western Australian waters" means all waters -

   a) that are within the limits of the State; or

   b) that are "coastal waters of the State".

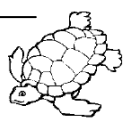
3) "coastal waters of the State" has the meaning given to that term in the *Off-shore (Application of Laws) Act 1982* section 2.

4) Low water mark (L.W.M.) is the ordinary (mean of) low water mark at spring tides.

5) High water mark (H.W.M.) is the ordinary (mean of) high water mark at spring tides as defined in the *Land Administration Act 1997* section 3.

6) "Barrow Island Port Area" means the area described as the Barrow Island Port Area in the Schedule to the proclamation under the *Marine and Harbours Act 1981* section 9 published in the *Government Gazette of Western Australia* of 5 February 1982 at page 410 (as varied by the proclamation under that section published in the *Government Gazette of Western Australia* of 19 February 1982 at page 584).

7) "Port of Varanus Island" means the area described as the Port of Varanus Island in the Schedule to the proclamation under the Shipping and Pilotage Act 1967 section 10(2) published in the Government Gazette of Western Australia of 18 April 1986 at page 1431.



MONTEBELLO/BARROW ISLANDS MARINE CONSERVATION RESERVES

TECHNICAL DESCRIPTION of MANAGEMENT ZONING CLASSIFIED UNDER THE *CONSERVATION AND LAND MANAGEMENT ACT 1984* Section 62

These technical descriptions should be read in conjunction with the technical descriptions for the outer boundaries of the marine conservation reserves.

Class 'A' Marine Reserve No. 9
Montebello Islands Marine Park Management Zoning

Sanctuary Areas

Northern Montebellos Sanctuary Zone

All that portion of Montebello Islands Marine Park that is contained within and bounded by a line:

i) commencing north-west of the Montebello Islands at the intersection of latitude 20º18'48" south and longitude 115º29'42" east; and

ii) extending east along latitude 20º18'48" south to longitude 115º32'51" east;

iii) thence south along longitude 115º32'51" east to latitude 20º22'21" south;

iv) thence west along latitude 20º22'21" south to the low water mark on Pansy Island that is the boundary of Reserve 42197 as shown on Deposited Plan 240365;

v) thence generally north-westerly and southerly along the low water mark of Pansy Island to latitude 20º22'30" south;

vi) thence west along latitude 20º22'30" south to Morgan & Co Pty Ltd Pearl Farm Lease Site L as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C;

vii) thence north, north-westerly, south-westerly, and south-easterly along the boundary of Morgan & Co Pty Ltd Pearl Farm Lease Site L to latitude 20º22'30" south;

viii) thence west along latitude 20º22'30" south to the low water mark on Primrose Island that is the boundary of Reserve 42197;

ix) thence generally northerly, westerly, southerly and easterly along the low water mark of Primrose Island to latitude 20º22'30" south;

x) thence west along latitude 20º22'30" south to longitude 115º27'18" east;

xi) thence north along longitude 115º27'18" east to latitude 20º21'30" south;

xii) thence north-easterly along the geodesic to the point of commencement.

Southern Montebellos Sanctuary Zone

All that portion of Montebello Islands Marine Park that is contained within and bounded by a line:

i) commencing west of the Montebello Islands at the intersection of latitude 20º26'00" south and longitude 115º26'18" east; and

ii) extending east along latitude 20º26'00" south to the western side of Brooke Island at the intersection of that latitude and the low water mark on Brooke Island that is the boundary of Reserve 42197 as shown on Deposited Plan 240365;

iii) thence generally south-westerly and south-easterly along the low water mark of Brooke Island to the southernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º26'08.72" south longitude 115º30'08.74" east on Brooke Island, and latitude

20º26'22.28" south longitude 115º30'31.84" east on the unnamed island west of Hovea Island (unofficially named Eucalyptus Island);

iv) thence south-easterly along that geodesic to the south-westernmost point of the unnamed island west of Hovea Island at the intersection of that geodesic and the low water mark on that island that is the boundary of Reserve 42197;

v) thence generally south-easterly along the low water mark of the unnamed island west of Hovea Island to the southernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º26'22.65" south longitude 115º30'32.72" east on that island, and latitude 20º26'28.64" south longitude 115º30'48.13" east on Hovea Island;

vi) thence south-easterly along that geodesic to the southern point of Hovea Island at the intersection of that geodesic and the low water mark on Hovea Island that is the boundary of Reserve 42197;

vii) thence generally south-easterly along the low water mark of Hovea Island to the southernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º26'29.70" south longitude 115º30'50.19" east on Hovea Island, and latitude 20º26'31.68" south longitude 115º30'59.58" east on Hermite Island;

viii) thence south-easterly along that geodesic to the western point of Hermite Island at the intersection of that geodesic and the low water mark on Hermite Island that is the boundary of Reserve 42197;

ix) thence generally southerly down the western side of Hermite Island along the low water mark to the southern end of that island near Palmerston Point at the intersection of low water mark and the geodesic joining the coordinates latitude 20º30'19.09" south longitude 115º31'11.88" east on Hermite Island, and latitude 20º30'33.16" south longitude 115º31'10.55" east on the north-westernmost island of the Mulga Islands;

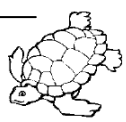
x) thence southerly along that geodesic to the westernmost point of the north-westernmost island of the Mulga Islands at the intersection of that geodesic and the low water mark on the north-westernmost island of the Mulga Islands that is the boundary of Reserve 42197;

xi) thence generally south-easterly along the low water mark of the north-westernmost island of the Mulga Islands to the south-western point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º30'34.61" south longitude 115º31'11.44" east on the north-westernmost island of the Mulga Islands, and latitude 20º31'07.50" south longitude 115º31'40.92" east on Snappy Gum Island;

xii) thence south-easterly along that geodesic to the western point of Snappy Gum Island at the intersection of that geodesic and the low water mark on Snappy Gum Island that is the boundary of Reserve 42197;

xiii) thence generally south-easterly along the low water mark of Snappy Gum Island to the southernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º31'08.84" south longitude 115º31'42.17" east on Snappy Gum Island, and latitude 20º31'39.38" south longitude 115º32'31.56" east on Ah Chong Island;

xiv) thence south-easterly along that geodesic to the south-westernmost point of Ah Chong Island at the intersection of that geodesic and the low water mark on Ah Chong Island that is the boundary of Reserve 42197;



xv) thence generally south-easterly and north-easterly along the low water mark of Ah Chong Island to the north-easternmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º31'19.28" south longitude 115º32'50.18" east on Ah Chong Island, and latitude 20º30'01.17" south longitude 115º33'35.71" east on the northernmost island of the Fig Islands;

xvi) thence north-easterly along that geodesic to the easternmost point of the northernmost island of the Fig Islands at the intersection of that geodesic and the low water mark on the northernmost island of the Fig Islands that is the boundary of Reserve 42197;

xvii) thence generally northerly along the low water mark of the northernmost island of the Fig Islands to the geodesic joining the coordinates latitude 20º30'01.17" south longitude 115º33'35.71" east on the northernmost island of the Fig Islands, and latitude 20º29'38.21" south longitude 115º33'43.77" east on the third unnamed island north of Callitris Island;

xviii) thence north-easterly along that geodesic to the easternmost point of the third unnamed island north of Callitris Island at the intersection of that geodesic and the low water mark on the third unnamed island north of Callitris Island that is the boundary of Reserve 42197;

xix) thence generally north-westerly along the low water mark of the third unnamed island north of Callitris Island to the northernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º29'37.98" south longitude 115º33'43.59" east on the third unnamed island north of Callitris Island, and latitude 20º29'32.57" south longitude 115º32'34.28" east on Ivy Island;

xx) thence westerly along that geodesic to the northernmost point of Ivy Island at the intersection of that geodesic and the low water mark on Ivy Island that is the boundary of Reserve 42197;

xxi) thence generally westerly along the low water mark of Ivy Island to the geodesic joining the coordinates latitude 20º29'32.57" south longitude 115º32'34.28" east on Ivy Island, and latitude 20º29'31.54" south longitude 115º32'13.16" east on Hermite Island;

xxii) thence westerly along that geodesic to Chamberlain Point on Hermite Island at the intersection of that geodesic and the low water mark on Hermite Island that is the boundary of Reserve 42197;

xxiii) thence generally north-westerly and north-easterly along the low water mark of Hermite Island to the narrow channel between Stephenson Channel and Hock Bay at the intersection of low water mark and latitude 20º28'26.70" south on Hermite Island;

xxiv) thence east along latitude 20º28'26.70" south to the westernmost point of Renewal Island at the intersection of that latitude and the low water mark on Renewal Island that is the boundary of Reserve 42197;

xxv) thence generally south-easterly, northerly, and south-westerly around Renewal Island along the low water mark to the point on the western side of that island near the entrance to Stephenson Channel at the intersection of low water mark and latitude 20º27'42" south;

xxvi) thence west along latitude 20º27'42" south to the western point of Hermite Island at the intersection of that latitude and the low water mark on Hermite Island that is the boundary of Reserve 42197;

xxvii) thence generally northerly along the low water mark of Hermite Island to the point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º27'01.11" south

longitude 115º32'36.04" east on Hermite Island, and latitude 20º26'48.74" south longitude 115º32'52.54" east on Delta Island;

xxviii) thence north-easterly along that geodesic to the southern point of Delta Island at the intersection of that geodesic and the low water mark on Delta Island that is the boundary of Reserve 42197;

xxix) thence generally northerly around the eastern side of Delta Island along the low water mark to the northernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º26'03.75" south longitude 115º32'50.55" east on Delta Island, and latitude 20º26'03.20" south longitude 115º32'50.73" east on Campbell Island;

xxx) thence north-easterly across Chippendale Channel along that geodesic to the south-easternmost point of Campbell Island at the intersection of that geodesic and the low water mark on Campbell Island that is the boundary of Reserve 42197;

xxxi) thence north-easterly along the low water mark of Campbell Island to the point on the eastern side of Campbell Island at the intersection of low water mark and latitude 20º26'00" south;

xxxii) thence east along latitude 20º26'00" south to the western point of Karangi Island at the intersection of that latitude and the low water mark on Karangi Island that is the boundary of Reserve 42197;

xxxiii) thence generally south-easterly, southerly, north-easterly, and north-westerly along the low water mark of Karangi Island to the point on the western side of that island at the intersection of low water mark and latitude 20º26'00" south;

xxxiv) thence east along latitude 20º26'00" south to longitude 115º37'45" east;

xxxv) thence south along longitude 115º37'45" east to latitude 20º31'30" south;

xxxvi) thence west along latitude 20º31'30" south to longitude 115º35'30" east;

xxxvii) thence south along longitude 115º35'30" east to latitude 20º33'30" south;

xxxviii) thence west along latitude 20º33'30" south to longitude 115º26'18" east;

xxxix) thence north along longitude 115º26'18" east to the point of commencement.

Willy Nilly Lagoon Sanctuary Zone

All that portion of Montebello Islands Marine Park that is contained within and bounded by a line:

i) commencing south of Willy Nilly Lagoon from the eastern point of the western arm of Stephenson Channel at the intersection of latitude 20º28'28.80" south and the low water mark on Hermite Island that is the boundary of Reserve 42197 as shown on Deposited Plan 240365; and

ii) extending generally westerly, northerly, easterly and southerly around Willy Nilly Lagoon along the low water mark of Hermite Island to the point on the eastern side of Stephenson Channel at the intersection of low water mark and latitude 20º28'28.80" south;

iii) thence west along latitude 20º28'28.80" south to the point of commencement.

Recreation Areas

Stephenson Channel Recreation Zone

All that portion of Montebello Islands Marine Park that is contained within and bounded by a line:

i) commencing south of Willy Nilly Lagoon from the eastern point of the western arm of Stephenson Channel at the intersection of low water mark on Hermite Island that is the boundary of Reserve 42197 as shown on Deposited Plan 240365, and latitude 20º28'28.80" south; and

ii) extending east along latitude 20º28'28.80" south to the eastern side of the western arm of Stephenson Channel at the intersection of that latitude and the low water mark on Hermite Island;

iii) thence generally southerly, northerly, and north-easterly around Stephenson Channel along the low water mark of Hermite Island to the eastern point of that island on the western side of the entrance to Stephenson Channel at the intersection of low water mark and latitude 20º27'42" south;

iv) thence east along latitude 20º27'42" south to the eastern side of the entrance to Stephenson Channel at the intersection of that latitude and the low water mark on Renewal Island that is the boundary of Reserve 42197;

v) thence generally southerly along the low water mark of Renewal Island to the westernmost point of that island at the intersection of low water mark and latitude 20º28'26.70" south;

vi) thence west across the narrow channel between Stephenson Channel and Hock Bay along latitude 20º28'26.70" south to the intersection of that latitude and the low water mark on Hermite Island that is the boundary of Reserve 42197;

vii) thence generally northerly, south-westerly, and northerly along the low water mark of Hermite Island to the point of commencement.

Southern Montebellos Recreation Zone

All that portion of Montebello Islands Marine Park that is contained within and bounded by a line:

i) commencing from Chamberlain Point on Hermite Island at the intersection of the low water mark of Hermite Island that is the boundary of Reserve 42197 as shown on Deposited Plan 240365, and the geodesic joining the coordinates latitude 20º29'31.54" south longitude 115º32'13.16" east on Hermite Island, and latitude 20º29'32.57" south longitude 115º32'34.28" east on Ivy Island; and

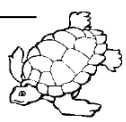
ii) extending easterly along that geodesic to the northernmost point of Ivy Island at the intersection of that geodesic and the low water mark on Ivy Island that is the boundary of Reserve 42197;

iii) thence generally westerly, south-easterly, northerly and north-westerly around Ivy Island along the low water mark to the northernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º29'32.57" south longitude 115º32'34.28" east on Ivy Island, and latitude 20º29'37.98" south longitude 115º33'43.59" east on the third unnamed island north of Callitris Island;

iv) thence easterly along that geodesic to the northernmost point of the third unnamed island north of Callitris Island at the intersection of that geodesic and the low water mark on that island that is the boundary of Reserve 42197;

v) thence generally south-westerly, south-easterly, and north-easterly around the third unnamed island north of Callitris Island along the low water mark of that island to the intersection of low water mark and the geodesic joining the coordinates latitude 20º29'38.21" south longitude 115º33'43.77" east on the third unnamed island north of Callitris Island, and latitude 20º30'01.17" south longitude 115º33'35.71" east on the northernmost island of the Fig Islands;

vi) thence south-westerly along that geodesic to the easternmost point of the northernmost island of the Fig Islands at the intersection of that geodesic and the low water mark on that island that is the boundary of Reserve 42197;



vii) thence generally north-westerly, south-westerly, south-easterly, and north-easterly around the northernmost island of the Fig Islands along the low water mark of that island to the intersection of low water mark and the geodesic joining the coordinates latitude 20º30'01.17" south longitude 115º33'35.71" east on the northernmost island of the Fig Islands, and latitude 20º31'19.28" south longitude 115º32'50.18" east on Ah Chong Island;

viii) thence south-westerly along that geodesic to the north-easternmost point of Ah Chong Island at the intersection of that geodesic and the low water mark on Ah Chong Island that is the boundary of Reserve 42197;

ix) thence generally north-westerly and south-westerly along the low water mark of Ah Chong Island to the south-westernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º31'39.38" south longitude 115º32'31.56" east on Ah Chong Island, and latitude 20º31'08.84" south longitude 115º31'42.17" east on Snappy Gum Island;

x) thence north-westerly along that geodesic to the southernmost point of Snappy Gum Island at the intersection of that geodesic and the low water mark on Snappy Gum Island that is the boundary of Reserve 42197;

xi) thence generally north-easterly, north-westerly, and southerly along the low water mark of Snappy Gum Island to the western point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º31'07.50" south longitude 115º31'40.92" east on Snappy Gum Island, and latitude 20º30'34.61" south longitude 115º31'11.44" east on the north-westernmost island of the Mulga Islands;

xii) thence north-westerly along that geodesic to the south-western point of the north-westernmost island of the Mulga Islands at the intersection of that geodesic and the low water mark on the north-westernmost island of the Mulga Islands that is the boundary of Reserve 42197;

xiii) thence generally south-easterly, northerly and south-westerly along the low water mark of the north-westernmost island of the Mulga Islands to the westernmost point of that island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º30'33.16" south longitude 115º31'10.55" east on the north-westernmost island of the Mulga Islands, and latitude 20º30'19.09" south longitude 115º31'11.88" east on Hermite Island;

xiv) thence northerly along that geodesic to the southern end of Hermite Island near Palmerston Point at the intersection of that geodesic and the low water mark on Hermite Island that is the boundary of Reserve 42197;

xv) thence generally south-easterly and north-easterly along the low water mark of Hermite Island around Claret Bay, Rum Cove, Hungover Head and Sherry Lagoon to the point of commencement.

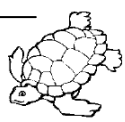
Special Purpose Areas

Northern Montebellos Special Purpose Zone (Benthic Protection)

All that portion of Montebello Islands Marine Park that is contained within and bounded by a line:

i) commencing north-west of the Montebello Islands at the intersection of latitude 20º18'48" south and longitude 115º27'18" east; and

ii) extending east along latitude 20º18'48" south to longitude 115º29'42" east;



iii) thence south-westerly along the geodesic to the intersection of latitude 20º21'30" south and longitude 115º27'18" east;

iv) thence north along longitude 115º27'18" east to the point of commencement.

Site A Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site A as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site B Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site B as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site C Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site C as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site D Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site D as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site G Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site G as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site H Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site H as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site I Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site I as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site J Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site J as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site O Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site O as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Site P Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease Site P as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-193-01C and 911-193-02C.

Claret Bay Special Purpose Zone (Pearling)
All that portion of Montebello Islands Marine Park that is contained within and bounded by Morgan & Co Pty Ltd Pearl Farm Lease in Claret Bay as shown on Department of Fisheries Pearl Farm Lease Site Plan 911-217-

01.

General Use Areas

Montebellos General Use Zone

All that portion of Montebello Islands Marine Park that is not sanctuary area, recreation area or special purpose area.

NOTES:

6) All geographic coordinates are expressed in terms of the Geocentric Datum of Australia 1994 ("GDA94").

7) Low water mark (L.W.M) is the ordinary (mean of) low water mark at spring tides.

Class 'A' Marine Reserve No. 10
Barrow Island Marine Park Management Zoning:

Sanctuary Areas

Western Barrow Island Sanctuary Zone

All of Barrow Island Marine Park.

Class 'A' Marine Reserve No. 11
Barrow Island Marine Management Area Management Zoning:

Conservation Areas

Bandicoot Bay Conservation Area (Benthic Fauna/Seabird Protection)

All that portion of Barrow Island Marine Management Area that is contained within and bounded by a line:

i) commencing from South End on Barrow Island at the intersection of longitude 115º19'18" east and the low water mark on Barrow Island that is the boundary of Reserve 11648 (Barrow Island Nature Reserve) as shown on Deposited Plan 91514; and

ii) extending generally north-easterly, westerly, northerly, easterly and south-easterly around Bandicoot Bay along the low water mark to Stokes Point on Barrow Island at the intersection of low water mark and the geodesic joining the coordinates latitude 20º53'43.20" south longitude 115º22'28.20" east on Barrow Island, and latitude 20º54'22.80" south longitude 115º20'09.60" east on Middle Island;

iii) thence south-westerly along that geodesic to the easternmost point of Middle Island at the intersection of that geodesic and the low water mark on Middle Island that is the boundary of Reserve 38728 as shown on Deposited Plan 91515;

iv) thence generally north-westerly and westerly along the low water mark of Middle Island to the intersection of low water mark and longitude 115º19'18" east;

v) thence north along longitude 115º19'18" east to the point of commencement.

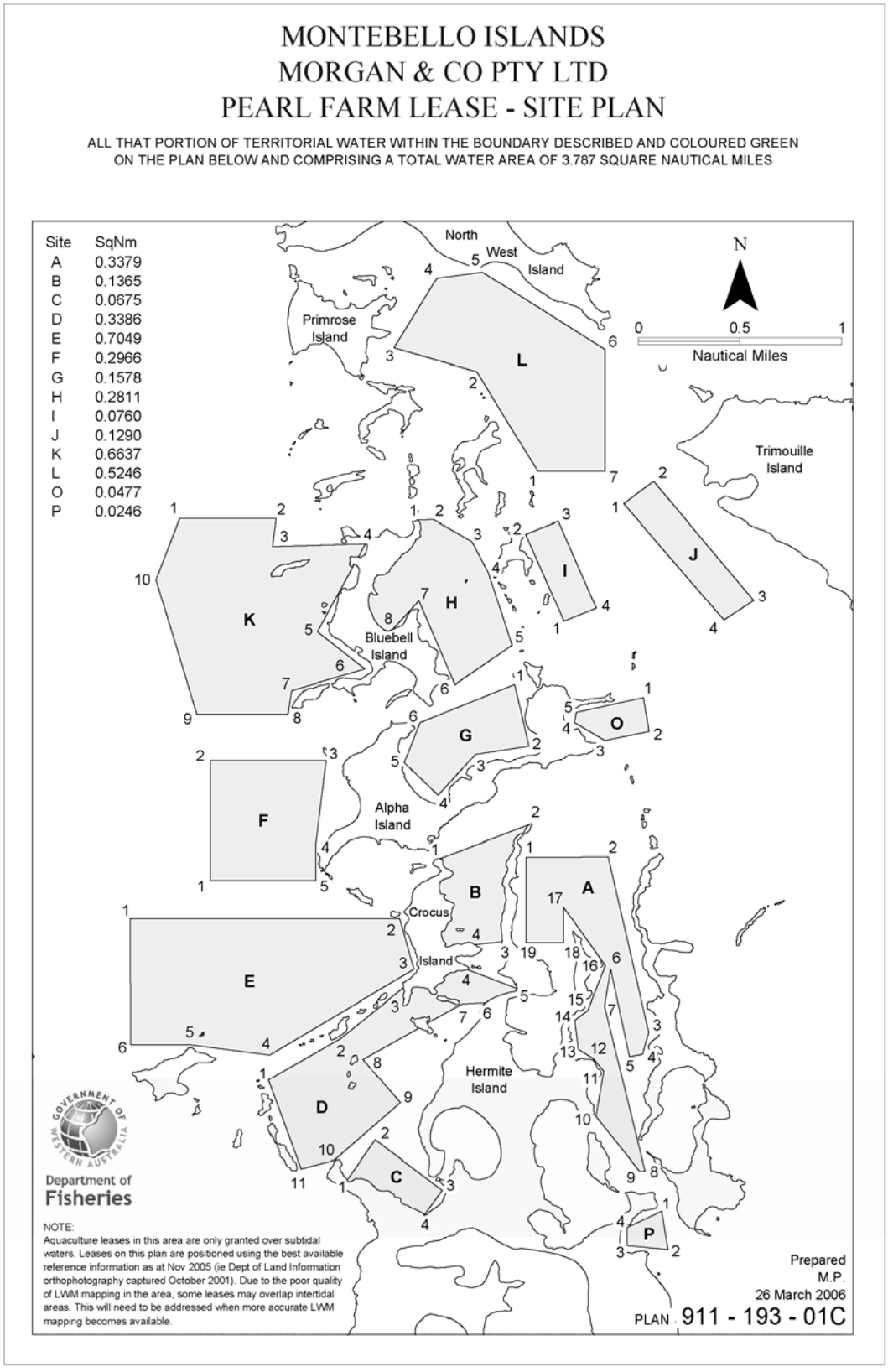
NOTES:

8) All geographic coordinates are expressed in terms of the Geocentric Datum of Australia 1994 ("GDA94").

9) Low water mark (L.W.M) is the ordinary (mean of) low water mark at spring tides.

Appendix III: Description of the pearl leases in the Montebello Islands Marine Park

(courtesy of Department of Fisheries)



THE COORDINATES LISTED RELATE TO THE
GEOCENTRIC DATUM OF AUSTRALIA 1994 (GDA94)

Boundary Corner Co-ordinates: Site A

Pnt	Longitude	Latitude
1	115° 31.970'	-20° 24.944'
2	115° 32.375'	-20° 24.944'
3	115° 32.574'	-20° 25.809'
4	115° 32.546'	-20° 25.916'
5	115° 32.480'	-20° 25.928'
6	115° 32.387'	-20° 25.498'
7	115° 32.358'	-20° 25.680'
8	115° 32.558'	-20° 26.491'
9	115° 32.531'	-20° 26.494'
10	115° 32.315'	-20° 26.224'
11	115° 32.354'	-20° 25.999'
12	115° 32.303'	-20° 25.937'
13	115° 32.229'	-20° 25.891'
14	115° 32.211'	-20° 25.748'
15	115° 32.276'	-20° 25.699'
16	115° 32.362'	-20° 25.481'
17	115° 32.157'	-20° 25.192'
18	115° 32.157'	-20° 25.369'
19	115° 31.971'	-20° 25.369'

Boundary Corner Co-ordinates: Site B

Pnt	Longitude	Latitude
1	115° 31.544'	-20° 24.952'
2	115° 31.992'	-20° 24.784'
3	115° 31.852'	-20° 25.363'
4	115° 31.719'	-20° 25.378'

Boundary Corner Co-ordinates: Site C

Pnt	Longitude	Latitude
1	115° 31.090'	-20° 26.539'
2	115° 31.229'	-20° 26.338'
3	115° 31.558'	-20° 26.585'
4	115° 31.471'	-20° 26.710'

Boundary Corner Co-ordinates: Site D

Pnt	Longitude	Latitude
1	115° 30.703'	-20° 26.041'
2	115° 31.057'	-20° 25.838'
3	115° 31.367'	-20° 25.589'
4	115° 31.683'	-20° 25.500'
5	115° 31.926'	-20° 25.593'
6	115° 31.774'	-20° 25.663'
7	115° 31.657'	-20° 25.667'
8	115° 31.167'	-20° 25.942'
9	115° 31.353'	-20° 26.156'
10	115° 31.027'	-20° 26.439'
11	115° 30.865'	-20° 26.482'

Boundary Corner Co-ordinates: Site E

Pnt	Longitude	Latitude
1	115° 30.023'	-20° 25.248'
2	115° 31.349'	-20° 25.250'
3	115° 31.419'	-20° 25.500'
4	115° 30.709'	-20° 25.920'
5	115° 30.319'	-20° 25.870'
6	115° 30.025'	-20° 25.870'

Boundary Corner Co-ordinates: Site F

Pnt	Longitude	Latitude
1	115° 30.416'	-20° 25.060'
2	115° 30.416'	-20° 24.470'
3	115° 30.986'	-20° 24.470'
4	115° 30.936'	-20° 24.880'
5	115° 30.936'	-20° 25.060'

Boundary Corner Co-ordinates: Site G

Pnt	Longitude	Latitude
1	115° 31.915'	-20° 24.094'
2	115° 31.986'	-20° 24.397'
3	115° 31.723'	-20° 24.437'
4	115° 31.539'	-20° 24.640'
5	115° 31.370'	-20° 24.479'
6	115° 31.450'	-20° 24.280'

Boundary Corner Co-ordinates: Site H

Pnt	Longitude	Latitude
1	115° 31.438'	-20° 23.282'
2	115° 31.516'	-20° 23.279'
3	115° 31.706'	-20° 23.389'
4	115° 31.787'	-20° 23.544'
5	115° 31.902'	-20° 23.901'
6	115° 31.622'	-20° 24.096'
7	115° 31.443'	-20° 23.684'
8	115° 31.315'	-20° 23.823'

Boundary Corner Co-ordinates: Site I

Pnt	Longitude	Latitude
1	115° 32.158'	-20° 23.784'
2	115° 31.970'	-20° 23.353'
3	115° 32.130'	-20° 23.288'
4	115° 32.318'	-20° 23.719'

Boundary Corner Co-ordinates: Site J

Pnt	Longitude	Latitude
1	115° 32.452'	-20° 23.202'
2	115° 32.600'	-20° 23.090'
3	115° 33.093'	-20° 23.681'
4	115° 32.945'	-20° 23.778'

Boundary Corner Co-ordinates: Site K

Pnt	Longitude	Latitude
1	115° 30.265'	-20° 23.273'
2	115° 30.741'	-20° 23.273'
3	115° 30.723'	-20° 23.414'
4	115° 31.179'	-20° 23.400'
5	115° 30.944'	-20° 23.836'
6	115° 31.177'	-20° 24.018'
7	115° 30.818'	-20° 24.124'
8	115° 30.799'	-20° 24.240'
9	115° 30.349'	-20° 24.240'
10	115° 30.150'	-20° 23.578'

Boundary Corner Co-ordinates: Site L

Pnt	Longitude	Latitude
1	115° 32.029'	-20° 23.040'
2	115° 31.729'	-20° 22.550'
3	115° 31.321'	-20° 22.433'
4	115° 31.533'	-20° 22.088'
5	115° 31.757'	-20° 22.058'
6	115° 32.359'	-20° 22.440'
7	115° 32.359'	-20° 23.040'

Boundary Corner Co-ordinates: Site O

Pnt	Longitude	Latitude
1	115° 32.550'	-20° 24.158'
2	115° 32.577'	-20° 24.324'
3	115° 32.360'	-20° 24.370'
4	115° 32.209'	-20° 24.280'
5	115° 32.219'	-20° 24.230'

Boundary Corner Co-ordinates: Site P

Pnt	Longitude	Latitude
1	115° 32.640'	-20° 26.690'
2	115° 32.670'	-20° 26.880'
3	115° 32.470'	-20° 26.860'
4	115° 32.470'	-20° 26.770'

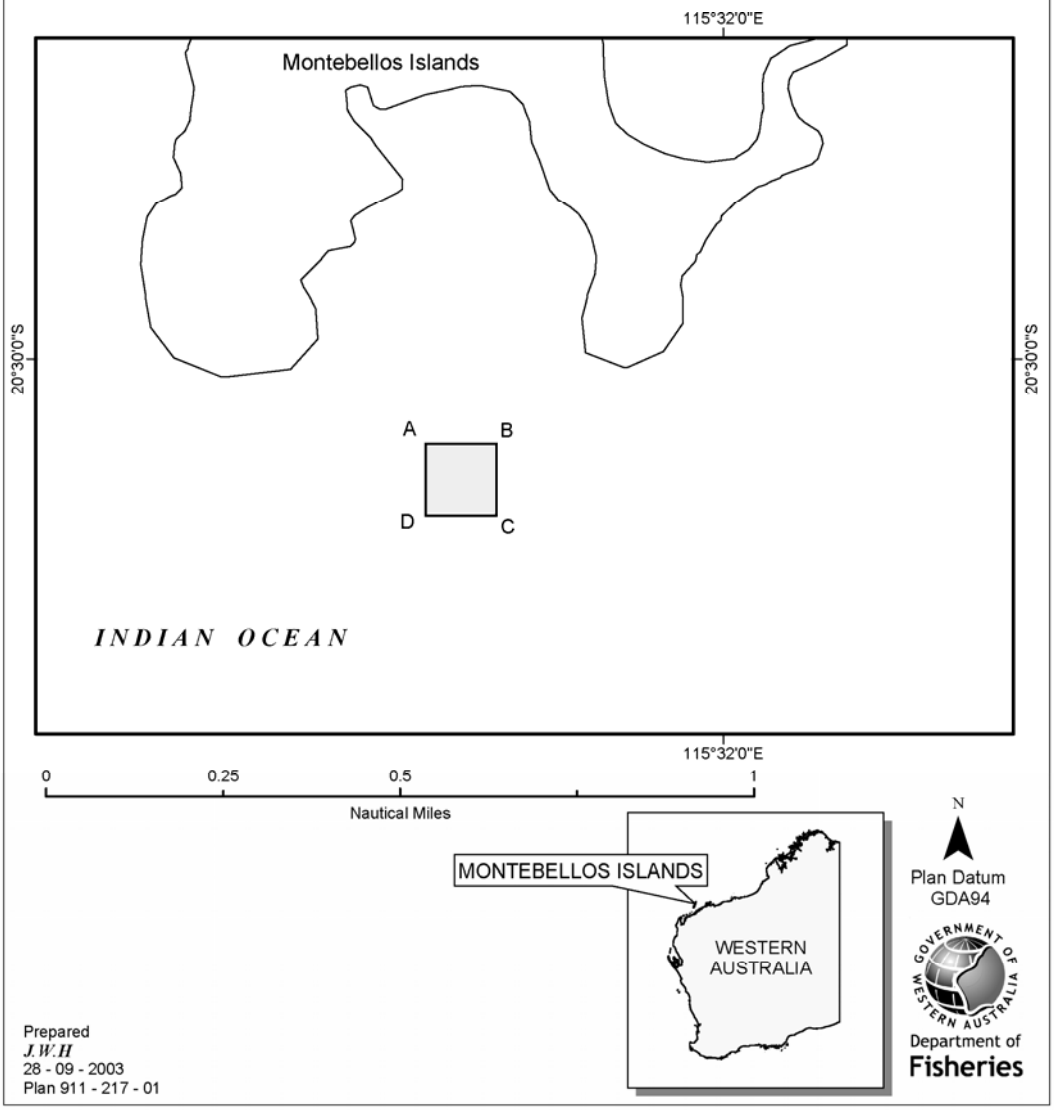
GOVERNMENT OF WESTERN AUSTRALIA
Department of
Fisheries

PLAN 911 - 193 - 02C

MONTEBELLOS ISLANDS - CLARET BAY
PEARL FARM LEASE - SITE PLAN
MORGAN & COMPANY PTY LTD

ALL THAT PORTION OF TERRITORIAL WATER WITHIN THE BOUNDARY DESCRIBED AND COLOURED GREEN ON THE PLAN BELOW COMPRISING A TOTAL WATER AREA OF 0.0094 SQUARE NAUTICAL MILES

Boundary Coordinates: Datum GDA94			Boundary Coordinates: Datum AGD84		
Point	Longitude	Latitude	Point	Longitude	Latitude
A	115° 31.5796'	-20° 30.1205'	A	115° 31.5000'	-20° 30.2000'
B	115° 31.6796'	-20° 30.1205'	B	115° 31.6000'	-20° 30.2000'
C	115° 31.6796'	-20° 30.2206'	C	115° 31.6000'	-20° 30.3000'
D	115° 31.5796'	-20° 30.2206'	D	115° 31.5000'	-20° 30.3000'



Appendix IV: Timetable for Implementation of Management Strategies

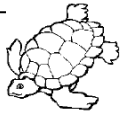
VALUE	MANAGEMENT STRATEGY	Year									
ECOLOGICAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Geomorphology (EV 7.1.1)	1. Ensure that approvals and the setting of conditions for new coastal and offshore developments and activities are consistent with the management targets for the value of geomorphology and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, EPA, DoIR, DoF, Tourism WA) **(H)**.										
	2. Ensure effective management of commercial and recreational access to and use of coastal landforms adjacent to the reserves (DEC) **(H)**.										
	3. Determine the level of existing disturbance/degradation to the geomorphology, to set benchmarks for this value (DEC) **(H)**.										
	4. Educate users about the ecological importance of the reserves' geomorphology (DEC) **(L)**.										
Sediment quality (EV 7.1.2)	2. Maintain a database of pollutant inputs to sediments (industry, DEC, DoIR) **(H-KMS)**.										
	3. Minimise impacts on sediments by encouraging, where possible, the use of products that have least impact on the marine biota (DEC, EPA, DoIR) **(H)**.										
Water quality * (EV 7.1.3)	1. Ensure there are appropriate predictive models and specific management plans (given location and weather conditions) for oil spills to assist the State Committee for Combating Oil Pollution in managing any pollution event that occurs (industry, DPI, DEC, DoIR) **(H-KMS)**.										
	2. Ensure there are adequate management resources available to deal with pollution incidents consistent with the risk of such an event occurring (industry, DPI, DEC, DoIR) **(H)**.										
	3. Ensure a pollutant inputs database for the reserves is maintained (industry, DEC) **(H)**.										
	4. Develop an appropriate understanding of the circulation and mixing of the reserves' waters (DEC) **(M)**.										
	5. Develop an appropriate understanding of the natural variability of the water quality conditions, including those areas of the reserves within the zone of influence of the proposed Gorgon gas development (DEC, DoIR, industry) **(M)**.										
	6. Encourage a policy of zero discharge where alternatives to discharge exist (DEC, EPA, DoIR) **(M)**.										
	7. Develop and enforce controls on the discharge of sewage from vessels in the reserves, including the prohibition of discharge in areas designated 'Zone 1' (DPI, DEC) **(M)**.										
	8. Educate users of the reserves about government policy and regulations on boat sewage disposal (DEC, DPI) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
ECOLOGICAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Coral reef communities * (EV 7.1.4)	3. Assess the nature, level and potential impacts of human activities on coral reef communities within the reserves and implement an appropriate monitoring program (DEC) **(H-KMS)**.										
	4. Ensure all existing and new moorings meet specified environmentally acceptable standards where these moorings are located in sensitive coral habitats (DEC, DPI) **(H)**.										
	5. Ensure that approvals and the setting of conditions for new petroleum, nature-based tourism, pearling and aquaculture operations are consistent with the management targets for coral reef communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, EPA, DoIR, DoF, Tourism WA) **(H)**.										
	6. Prohibit the commercial and recreational collection of coral within the reserves (DoF, DEC) **(H)**.										
	7. Ensure activities that are potentially detrimental to successful coral reproduction are not carried out during and immediately after the major period of coral spawning (industry, DEC, DoIR) **(H)**.										
	8. Educate users of the reserves about the ecological importance of coral reef communities and the potential detrimental effects of indiscriminate reef walking, collecting, anchoring and boating on coral reef communities (DEC) **(M)**.										
	9. Ensure the hydrocarbon industry is informed of relevant management objectives and targets for coral reef communities (DEC, DoIR) **(M)**.										
	10. Ensure the State Committee for Combating Oil Pollution has access to data relevant to the management of oil spills (DEC, DPI) **(M)**.										
Mangrove communities * (EV 7.1.5)	3. Educate users of the reserves about the ecological importance of mangroves in the reserves and, in particular, the impacts of physical disturbance and mud crabbing on mangrove communities (DEC) **(H-KMS)**.										
	4. Assess the nature, level and potential impacts of human activities on mangrove communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**.										
	5. Ensure the hydrocarbon and nature-based tourism industries are informed of relevant management objectives and targets for mangrove communities within the reserves (DEC, DoIR) **(H)**.										

VALUE	MANAGEMENT STRATEGY	Year									
ECOLOGICAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Macroalgal and seagrass communities * (EV 7.1.6)	3. Initiate research and mapping programs to provide a more comprehensive assessment of the seagrass communities in the reserves (DEC) **(H-KMS)**.										
	4. Ensure that approvals and the setting of conditions for new petroleum, nature-based tourism, pearling, aquaculture and commercial fishing operations are consistent with the management targets for macroalgal and seagrass communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, industry, DoIR, EPA, DoF, Tourism WA) **(H)**.										
	5. Ensure reserve users are informed of relevant management objectives and targets for macroalgal and seagrass communities (DEC, DoIR) **(H)**.										
	6. Assess the nature, level and potential impacts of human activities on macroalgal and seagrass communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**.										
	7. Educate users of the reserves about the ecological importance of macroalgal and seagrass communities and the potential impacts of their activities on these habitats (DEC) **(L)**.										
Rocky shore/intertidal reef platform communities (EV 7.1.8)	3. Assess the nature, level and potential impacts of human activities on rocky shore/intertidal reef platform communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**.										
	4. Ensure that approvals and the setting of conditions for new petroleum, nature-based tourism, pearling, aquaculture and commercial fishing operations are consistent with the management targets for rocky shore/intertidal reef communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, industry, DoIR, EPA, DoF, Tourism WA) **(H)**.										
	5. Initiate research programs to characterise the flora and fauna of selected rocky shore/intertidal reef platform communities within the reserves (DEC) **(M)**.										
	6. Educate users of the reserves about the detrimental effects of human activities on rocky shore/intertidal reef platform communities (DEC) **(M)**.										
	7. Ensure the hydrocarbon industry considers appropriate methods when performing transition zone seismic activities in these areas (DEC, EPA, DoIR) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
ECOLOGICAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Intertidal sand/mudflat communities (EV 7.1.7)	3. Liaise with the hydrocarbon industry to ensure that development proposals have minimal impact on intertidal sand/mudflat communities (DEC, industry, DoIR) **(H-KMS)**.										
	4. Ensure that approvals and the setting of conditions for new petroleum, nature-based tourism, pearling and aquaculture operations are consistent with the management targets for intertidal sand/mudflat communities and that appropriate monitoring conditions are applied to ensure these outcomes are achieved (DEC, industry, EPA, DoF, DoIR, Tourism WA) **(H)**.										
	5. Assess the nature, level and potential impacts of human activities on intertidal sand/mudflat communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**.										
	6. Ensure users of the reserves are informed of the management objectives and targets for intertidal sand/mudflat communities within the reserves (DEC) **(M)**.										
	7. Educate users of the reserves about the ecological importance of intertidal sand/mudflat communities and the potential impacts of their activities on these habitats (DEC) **(L)**.										
Subtidal soft-bottom communities (EV 7.1.9)	3. Map the location of different types of subtidal soft-bottom communities within the reserves (DEC) **(K-HMS)**.										
	4. Initiate research programs to quantify the floral and faunal diversity, and natural variability of subtidal soft-bottom communities in the reserves (DEC) **(H)**.										
	5. Assess the nature, level and potential impacts of human activities on subtidal soft-bottom communities within the reserves and implement an appropriate monitoring program (DEC) **(H)**.										
	6. Ensure that approvals and the setting of conditions for petroleum, commercial fishing, pearling, aquaculture and nature-based tourism operations are consistent with the management targets for subtidal soft-bottom communities and that where appropriate monitoring conditions are applied to ensure these outcomes are achieved (DoIR, EPA, industry, DoF, Tourism WA, DEC) **(H)**.										
	7. Prevent damage to soft-bottom communities through controls on anchoring and the installation of moorings where necessary (DEC, DPI) **(H)**.										
	8. Educate users of the reserves about the potential detrimental impacts of human activity on subtidal soft-bottom communities (DEC) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
ECOLOGICAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Marine mammals (EV 7.1.10)	1. Undertake research to ascertain the regional importance of the Montebello/Barrow islands area for dugongs and the relative importance of areas within the reserves (DEC) **(H-KMS)**.										
	2. Ensure relevant industry activities are undertaken at times and places that do not conflict with humpback whale migration through the reserves (DEC, EPA, DoIR, DoF) **(H-KMS)**.										
	3. Ensure that offshore developments do not have significant impacts on marine mammals through the provision of advice to the EPA (DEC) **(M)**.										
	4. Educate users of the reserves on the possible detrimental impacts of human activities on marine mammals (DEC) **(M)**.										
	5. Maintain records of the incidence of entanglement, boat collisions and stranding of marine mammals in the reserves (DEC) **(L)**.										
Turtles * (EV 7.1.11)	3. Ensure that licences for pearling, aquaculture, nature-based tourism and hydrocarbon operations contain conditions to minimise the impacts of lights and flares on turtle hatchlings (DEC, EPA, DoIR, DoF, Tourism WA) **(H-KMS)**.										
	4. Determine the impacts of lights on hatchling survival (due to misorientation and predation by silver gulls) (DEC, industry) **(H-KMS)**.										
	5. In liaison with industry and other stakeholders, investigate the need for seasonal closures of areas to protect breeding aggregations of marine turtles, and implement these where appropriate (DEC) **(H-KMS)**.										
	6. Monitor human activities such that mating aggregations and nesting activities of turtles are not significantly disturbed by recreational boating, nature-based tourism, pearling, aquaculture and hydrocarbon operations (DEC, EPA, DoF, Tourism WA) **(H)**.										
	7. Monitor turtle nesting activities to determine the relative importance of nesting beaches and to assess long term changes in abundance and usage of sites (DEC, industry) **(M)**.										
	8. Facilitate research applicable to the management of turtles in the reserves (DEC) **(M)**.										
	9. Educate users of the reserves on the possible detrimental impacts of human activities on turtles in the reserves (DEC) **(M)**.										
	10. Maintain a database of turtle mortality and incidents of entanglement in the reserves (DEC) **(L)**.										



VALUE	MANAGEMENT STRATEGY	Year									
ECOLOGICAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Seabirds (EV 7.1.12)	2. Minimise the increase in silver gull numbers by: • discouraging feeding of silver gulls by workers and visitors though education programs; • liaising with industry regarding lighting to reduce night-time feeding opportunities for silver gulls; and • liaising with industry and local government regarding rubbish disposal and freshwater sources (DEC, industry) (M).										
	3. Ensure that important seabird and shorebird breeding and feeding areas are not significantly affected by human activities (DEC, industry) (M).										
	4. Educate users of the reserves on the ecological significance of the reserves' seabird and shorebird populations and the potential detrimental impacts of human disturbance (DEC) (L).										
Finfishes * (EV 7.1.13)	2. Identify finfish species that can be taken by recreational and commercial fishers in the reserves and, in liaison with DoF, provide the necessary legislation to provide protection for species that will not be extracted (DEC, DoF) **(H)**.										
	3. Review the need for special conditions (e.g. bag limits and possession limits) for target finfish species in the reserves (DoF) **(H)**.										
	4. Undertake research programs to characterise finfish diversity and abundance in the reserves (DEC, DoF) **(M)**.										
	5. Develop and implement monitoring programs for priority species (DEC, DoF) **(M)**.										
	6. Educate users of the reserves on the conservation issues associated with finfish populations, the potential detrimental impacts of human activity on finfish, as well as appropriate behaviours and conduct to minimise potential impacts (DEC) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
ECOLOGICAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Invertebrates (EV 7.1.14)	2. Identify invertebrate species that can be taken by recreational and commercial fishing in the reserves and, in liaison with DoF, provide the necessary legislation to provide protection for species that will not be extracted (DEC, DoF) **(H)**.										
	3. Prohibit recreational shell collecting in the reserves (DoF, DEC) **(H)**.										
	4. Review the need for special conditions (e.g. bag limits and possession limits) for target invertebrate species in the reserves (DoF) **(H)**.										
	5. Undertake research programs to characterise invertebrate diversity and abundance in the reserves (DEC, DoF) **(M)**.										
	6. Develop and implement monitoring programs for priority species (DEC, DoF) **(M)**.										
	7. Educate users of the reserves on the conservation issues associated with invertebrate populations, the potential detrimental impacts of human activity on invertebrates, as well as appropriate behaviours and conduct to minimise potential impacts (DEC) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
SOCIAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Hydrocarbon exploration and production industry (SV 7.2.1)	2. Ensure a coordinated approach to industry assessment and reporting requirements in the reserves (DEC, EPA, DoIR, industry) (H).										
	3. Ensure the conditions applied to approved petroleum industry projects are consistent with the management plan and they include: • appropriate environmental performance measures; • desired trends; • short-term and long-term management targets; and • monitoring and reporting requirements (DEC, EPA, DoIR) **(H)**.										
	4. Ensure that environmental research and monitoring undertaken by industry is coordinated and maximise opportunities for collaboration to increase understanding and knowledge of the area (DEC, DoIR, industry) **(H)**.										
	5. Ensure that due consideration is given to activities which would unnecessarily restrict future petroleum industry opportunities in appropriate areas in the reserves (DEC) **(M)**.										
Pearling (SV 7.2.2)	2. Ensure pearling licences are consistent with the management plan and they include: • conditions requiring environmental monitoring to the satisfaction of DEC; and • conditions relating to lighting, navigational marking and site utilisation to the satisfaction of DPI and DoF (DoF, DEC, EPA, DPI) (H-KMS).										
	3. In liaison with the MPRA and pearl producers, review pearling lease areas in the reserves (in particular E, F, K and L leases) and rationalise these areas where appropriate (DEC, DoF) **(H)**.										
	4. In collaboration with the Pearl Producers' Association and DoF, assess the need for Codes of Practice for pearling in the reserves to ensure social and ecological sustainability (DEC, DoF, PPA) **(H)**.										
	5. Ensure that proposals for petroleum and nature-based tourism operations do not affect the key ecological requirements for pearling operations (e.g. high water quality) (DEC										
	6. Ensure that due consideration is given to activities which would unnecessarily restrict future pearling activities in appropriate areas in the reserves (DEC) **(M)**.										
	7. Provide formal advice to DoF and EPA (as appropriate) in relation to the environmental assessment of proposed pearling activity in the reserves (DEC) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
SOCIAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Nature-based tourism (SV 7.2.3	1. License all nature-based tourism operators within the reserves with appropriate conditions (DEC) **(H)**.										
	2. Develop Codes of Practice for nature-based tourism operations in the reserves including: • performance measures; • desired trends; • short-term and long-term management targets; and • monitoring and reporting requirements (DEC, Tourism WA) **(M)**.										
	3. Ensure equitable access for nature-based tourism within appropriate zones in the reserves (DEC) **(M)**.										
Commercial fishing (SV 7.2.4)	1. Quantify the levels and effects of commercial fishing activity in the reserves and review management controls where required (DoF, DEC) **(H)**.										
	2. Monitor and report on commercial fishing catch/effort within the reserves (DoF) **(H)**.										
	3. Ensure commercial fishers are aware of the zoning scheme and any restrictions that may apply to their operations (DoF, DEC) **(M)**.										
	4. Liaise with the MPRA in regard to proposed new fisheries and major changes to existing fisheries within the reserves (DoF) **(M)**.										
Recreational fishing (SV 7.2.5)	1. Ensure recreational fishers are aware of the zoning scheme and of restrictions that apply to their activities in the reserves (DoF, DEC, industry) **(H)**.										
	2. Evaluate the sustainability of existing recreational fisheries in the reserves (DoF) **(H)**.										
	3. Formulate performance measures and targets for key recreational species for the maintenance of the quality of recreational fishing in the reserves (DoF) **(M)**.										
	4. Determine the effects of recreational fishing activities in the reserves and review management controls as required (DoF, DEC) **(M)**.										
	5. Monitor recreational fishing catch/effort within the reserves (DoF) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
SOCIAL		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Water sports (SV 7.2.6)	1. In collaboration with user groups, develop Codes of Conduct to minimise environmental impacts of recreational activities, as appropriate (DEC) **(M)**.										
	2. Determine the nature, spatial patterns, compatibility and potential environmental impacts of all existing water sports in the reserves (DEC) **(M)**.										
	3. Implement restrictions on boating and use of personal water craft (e.g. speed/area closures), in consultation with key stakeholders, if these activities are shown to be impacting on the ecological and social values of the reserves (DPI, DEC) **(L)**.										
European history/maritime heritage (SV 7.2.7)	1. Distribute educational material to enhance awareness of the maritime heritage of the reserves (WAMM, DEC) **(L)**.										
	2. Advise reserve users of the relevant regulations under the *Heritage of Western Australia Act 1990*, the *Maritime Archaeology Act 1973* and the Commonwealth *Historic Shipwrecks Act 1976*, where appropriate (WAMM, DEC) **(L)**.										
	3. Determine and maintain appropriate levels of access to heritage sites (DEC) **(L)**.										
	4. Monitor maritime heritage sites to ensure maintenance of values (WAMM) **(L)**.										
Scientific research (SV 7.2.8)	1. Identify and communicate high priority scientific and social research projects relevant to the management of the reserves to appropriate research organisations (DEC) **(H)**.										
	2. Facilitate scientific and social research in the reserves by research, academic and educational institutions by providing financial and logistical assistance (where possible) (DEC, industry) **(M)**.										
	3. Liaise with the petroleum industry to coordinate industry and DEC research programs with the aim of maximising priority research outcomes for the area (DEC) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
Generic		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Administration	1. Gazette appropriate notices under the CALM Act and FRM Act to implement the zoning scheme of the reserves (DEC, DoF) **(H-KMS)**.										
	2. Inform users about the types of zones, reasons for and restrictions on activities in the reserves using signage, information manuals and education programs (DEC, DoF) **(H-KMS)**.										
	3. MPRA and Conservation Commission to develop an appropriate vesting basis for the management arrangements of the intertidal areas of the reserves (MPRA, Conservation Commission, DEC) **(H-KMS)**.										
	4. In liaison with stakeholders, develop quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the marine management area (DEC) **(H-KMS)**.										
	5. In liaison with DPI and port users, rationalise port areas with the aim of including areas of high conservation value currently lying inside the boundaries of Varanus Island and Barrow Island port boundaries, in the marine management area (DEC, DPI) **(H)**.										
	6. Encourage the completion and implementation of DEC management plans for the island reserves (DEC) **(H)**.										
	7. Facilitate research on the effectiveness of zoning as an aid to achieving the objectives of the reserves (DEC) **(H)**.										
Education and Interpretation	1. Develop and implement, in collaboration with industry, DoF and other relevant agencies, education and interpretation programs to ensure users of the reserves are aware of and understand the values of the reserves, management zones and regulations and the reasons for these controls (DEC, DoF) **(H-KMS)**.										
	2. Develop and distribute to the community and visitors a range of education materials about the reserves' values, pressures on these values, strategies, targets, and management, and marine conservation more broadly (DEC, DoF) **(H)**.										
	3. Assist the hydrocarbon, pearling and charter industries to access and deliver information materials/courses to their staff or patrons (DEC) **(H)**.										
	4. Provide talks and briefings about the reserves' values, uses and management to user groups (DEC) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
Generic		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Public Participation	1. Establish and maintain a Management Advisory Committee (MAC) (DEC) **(H-KMS)**.										
	2. Encourage community and local industry involvement in education and interpretation programs (DEC) **(M)**.										
	3. Encourage community and local industry involvement in monitoring programs (DEC) **(M)**.										
Patrol and Enforcement	1. Develop and implement a patrol and enforcement program to ensure an adequate level of compliance with zoning restrictions (DEC, DoF, DPI) **(H-KMS)**.										
	2. Develop and implement procedures to ensure coordination between Government agencies to maximise efficiency and effectiveness of patrol and enforcement activities (DEC, DoF, DPI) **(H-KMS)**.										
	3. Facilitate cross authorisation of Government enforcement officers as appropriate (DEC, DoF, DPI) **(H-KMS)**.										
	4. Facilitate the hydrocarbon, pearling and charter industries, as well as visitors to the reserves, to take an active role in a voluntary surveillance and enforcement program (DEC) **(H)**.										
Management Intervention and Visitor Infrastructure	1. Identify areas of existing and emerging human impact in the reserves (DEC) **(M)**.										
	2. Monitor human use (visitor numbers and high use areas) of the reserves and, consistent with available resources, provide visitor facilities where appropriate (DEC) **(M)**.										
	3. Implement a program of routine inspections, maintenance and reporting on infrastructure conditions (e.g. zone markers, signage) in the reserves (DEC) **(M)**.										
	4. Perform assessments of visitor risk in the reserves and, where necessary, implement appropriate measures to minimise visitor risk (DEC) **(M)**.										

VALUE	MANAGEMENT STRATEGY	Year									
Generic		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Research	1. Develop and progressively implement a coordinated and prioritised research program focussing on key values and processes of the reserves (DEC, DoF) **(H-KMS)**.										
	2. Develop detailed habitat and wildlife distribution maps for the reserves (DEC, industry) **(H-KMS)**.										
	3. Develop and maintain a database of human usage and its impacts in the reserves, and use these data to assess the sustainability of marine-based activities in the region (DEC, DoF) **(H-KMS)**.										
	4. Gather baseline data for values for which insufficient data exist, so changes in values over time can be assessed (DEC) **(H-KMS)**.										
	5. Identify, prioritise and communicate high priority ecological and social research projects relevant to the management of the reserves and consistent with the prioritised research program to appropriate research organisations (DEC) **(H-KMS)**.										
	6. Develop and maintain a database of historical and current research in the reserves (DEC) **(H)**.										
	7. Facilitate scientific and social research in the reserves conducted by research, academic and educational institutions, by providing financial and logistical assistance (where possible) (DEC, DoF) **(H)**.										
	8. Develop partnerships with stakeholders and the community to implement research programs (DEC) **(H)**.										
Monitoring	1. Develop and progressively implement a coordinated and prioritised monitoring program for the reserves, including community-based monitoring programs, with a particular emphasis on MPRA and DEC audit requirements (DEC, DoF) **(H-KMS)**.										
	2. Monitor change in key values within the reserves against adequate baseline data (DEC, DoF) **(H-KMS)**.										
	3. Ensure that proponents of development proposals or activities with the potential to impact on the reserves' values conduct appropriate compliance monitoring programs (DEC) **(H)**.										

VALUE	MANAGEMENT STRATEGY	Year									
Generic		**1**	**2**	**3†**	**4**	**5**	**6†**	**7**	**8**	**9**	**10‡**
Development proposals	1. In the event of new industrial development proposals with the potential to impact on the reserves' values being approved, undertake a risk assessment and revise, as appropriate, management strategies for ecological values that may be impacted (DEC) **(H-KMS)**.										
	2. Ensure appropriate advice is provided to relevant authorities with regard to proposed marine developments and the relevant ecological targets for the reserves (DEC) **(H)**.										
	3. Ensure development proposals and activities with the potential to impact on the reserves' values (e.g. the proposed Gorgon gas development), are appropriately assessed and that appropriate conditions are applied (DEC, industry, EPA, DoF, DoIR, Tourism WA) **(H)**.										
	4. Develop a mooring plan, with appropriate consultation, which will include an assessment of areas in which moorings would be acceptable from an ecological and social perspective and the capacities of these areas (DEC, DPI) **(M)**.										
	5. Assess mooring applications on a case-by-case basis and in relation to mooring criteria established in the DEC/MPRA Mooring Policy (DEC, MPRA) (M).										

Key:
* = Key Performance Indicator
† MPRA Audit
‡ MPRA Audit and Management Plan Review