DRAFT MANAGEMENT PLAN

PROPOSED M10 MARINE PARK

Trigg Island to Burns
including Marmion Reef

Report and Recommendations by the
M10 Marine Park Study Team

Department of Conservation and Environment
Perth, Western Australia

Bulletin 220 September 1985

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This draft management plan is released for public review and comment. All submissions regarding the management plan should be sent or delivered to the below address, to reach the Department by noon, 2 December 1985.

Address submissions to:

The Director
Department of Conservation and Environment
1 Mount Street
PERTH WA 6000

(Attention: M 10 marine park study team)

Release date: 2 October, 1985

ACKNOWLEDGEMENTS

This draft management plan was produced using information and advice from about 120 contributors representing over 65 organisations (Appendix 1). The assistance of all contributors is gratefully acknowledged, including those who allowed the study team access to unpublished observations and data.

It is emphasised, however, that the views expressed in this management plan are those of the M10 marine park study team (Appendix 2) of the Western Australian Department of Conservation and Environment, and are not, necessarily, the views of the external contributors and organisations consulted.

GLOSSARY OF ABBREVIATIONS

The following abbreviations are used in this document.

AMSA	Australian Marine Sciences Association
CALM	Department of Conservation and Land Management
DCE	Department of Conservation and Environment
DMH	Department of Marine and Harbours
EPA	Environmental Protection Authority
ERMP	Environmental Review and Management Program
MRPA	Metropolitan Region Planning Authority
ORV	Off-road vehicle
OTC	Overseas Telecommunications Commission
PWD	Public Works Department
ROS	Regional Open Space
WAWA	Western Australian Water Authority (formerly Metropolitan Water Authority)

RECOMMENDATIONS

Recommendation (1): consideration be given to amending the CALM Act 1984, which at present allows for marine nature reserves and marine parks, to describe a third category of marine protected area for multipurpose use.

Recommendation (2): the waters of the area shown in Figure 3 and Figure 9, up to high water mark* and including the whole part of Little Island, be declared a marine park under the CALM Act 1984, and be vested in the National Parks and Nature Conservation Authority.

* High water mark refers to high water mean of Spring tides (HWM).

Recommendation (3): the marine park, as recommended in Recommendation (2) above, should have the following boundaries

- **from the southernmost part of Trigg Island due west to the limit of waters under Western Australian jurisdiction (that is, due west 3 nautical miles : about 5.4 km);**
- **from a point equidistant between the two Burns Rocks, due east to high water mark and due west to the limit of waters under Western Australian jurisdiction;**
- **the line running approximately north to south which marks the westernmost limit of State waters under Western Australian jurisdiction;**
- **the line running approximately north to south at the high water mark, which is also the western boundary of the proposed foreshore reserves in the greater marine park, and**
- **excluded from above at their outer (seaward) boundaries, the Ocean Reef boat launching facility and the Hillarys Boat Harbour.**

Recommendation (4): the foreshore lands, adjacent to the marine park as described in Recommendations (2) and (3) above (that is those foreshore lands between West Coast Highway/Merrifield Place/Ocean Reef Road and its proposed extension, and high water mark), be the subject of agreements between the Executive Director of CALM and the land owners or vestees, for joint management as part of the greater marine park.

Recommendation (5): all land owned by the State Government (or acquired by the State) in the greater marine park be vested in, or leased to, the appropriate local government authority, for co-operative management by agreement with the Executive Director of CALM as part of the greater marine park.

Recommendation (6): the concept of zoning, for management of the marine park, and foreshore lands to be included in the greater marine park, be endorsed.

Recommendation (7): the following areas be recognised as of particular value and significance for the greater marine park:

(a) **Little Island**
(b) **Boyinaboat Reef, Cow Rocks, Wanneroo Reef, Wreck Rock, Whitford Rock, The Lumps, North Lump**
(c) **Burns Rocks (south)**
(d) **Waterman Marine Reserve**
(e) **part of the Whitford Plain dune system**
(f) **the Pinnacles**
(g) **geological cross-section at Ocean Reef ***
(h) **coastal heath (south of Burns).**

* Preservation of one of the existing geological cross-section faces, or a new face after further earthworks, is suggested.

Recommendation (8): a public education and display area be established in conjunction with a ranger office, in the foreshore component of the greater marine park. An appropriate location for this facility could be in the area proposed for development adjacent to the Hillarys Boat Harbour.

Recommendation (9): that all fish stocks, taken by any means within the marine park, be monitored, and that recreational and professional fishing be allowed and regulated under the Fisheries Act 1905 - 1979 (as amended).

Recommendation (10): monitoring programmes be established to maintain constant assessment of resources and human impacts on resources within the greater marine park, to ensure sustained multipurpose use.

Recommendation (11): the Department of Conservation and Land Management present to State Cabinet for approval a detailed budget, specifying additional funding required to enable the appointment of sufficient, full-time, professionally qualified personnel to undertake the ongoing management, monitoring and public education duties required for effective control of the greater marine park, and to establish and operate the public education display area and greater marine park ranger facility.

Recommendation (12): subject to endorsement of Recommendations (1) - (11) (above) and agreement by Government to allocate appropriate funds to the Department of Conservation and Land Management, that

(a) **the Department of Conservation and Land Management produce the final management plan for the M 10 marine park,**
(b) **the Department of Conservation and Land Management proceed with the declaration of the marine park under the CALM Act 1984, and**
(c) **the Executive Director of CALM enter into agreements with land holders adjacent to the marine park for inclusion of their lands in a non-statutory greater marine park management area.**

CONCERNS

Concern: Educational activities and scientific research be regarded as approved, and necessary, purposes of the greater marine park.

Concern: in addition to commitments made in the ERMP the water quality criteria which should be met within the boat harbour are those in Schedules 1 and 7(c) of the EPA's water quality criteria and which are reproduced in Appendices C and D of the EPA (1985) report. These criteria should be used to assist in setting the objectives of the water quality monitoring and management programme.

Concern: a comprehensive monitoring and management programme be developed by the proponent in consultation with the Department of Conservation and Environment to the satisfaction of the EPA, and that appropriate resources be allocated for the proponent to implement it through the body proposed (EPA, 1985).

Concern: trucks be required to use designated access roads to the site during construction. The designated access roads should be specified by the Shire of Wanneroo in consultation with the proponent.

Concern: a formal management body for the Hillarys Boat Harbour be established comprising the Department of Marine and Harbours, the Shire of Wanneroo, the vestee of the proposed marine park and representatives of the proposed four commercial lessees of the harbour. The points raised in Section 6.4.2 of the EPA (1985) report should be included in the terms of reference for the management body.

Concern: that, as the Hillarys Boat Harbour is likely to affect longshore sand movements and shoreline position, any cost associated with beach restoration should be borne by the proponents, users and operators of the Hillarys Boat Harbour, through the management body (see immediately above).

This concern reflects the EPA's consideration (EPA, 1985, p. 10) that "the boat harbour should not be allowed to contribute to erosion of beaches to the north ...".

Concern: there should be no dredging of Lal Bank.

Concern: during the construction phase of the Hillarys Boat Harbour there should be monitoring of sediment plumes, to determine the area of impact on surrounding marine communities.

Concern: monitoring of the marine communities of Boyinaboat Reef, Cow Rocks, and surrounding areas should be undertaken, to determine the extent and nature of the impact resulting from construction and operation of Hillarys Boat Harbour.

Concern: water quality monitoring, as specified in the ERMP produced by the Public Works Department (1984) and in the EPA report (1985), should be undertaken.

Concern: contingency plans should be drawn up at the earliest possible opportunity, by the Hillarys Boat Harbour management committee, to minimise environmental impacts from any possible spillages of oils, grease, other hydrocarbons, or chemicals, into the waters of the boat harbour.

Concern: the environmental impact of ferry traffic through the marine park should be monitored, and if ferry traffic has a detrimental environmental impact on the marine communities of the park, especially the seagrass meadows, the ferry service should be modified or discontinued to reduce environmental impact to acceptable levels as determined by the EPA.

Concern: that the management committee should report annually to the EPA, detailing identified impacts of the Hillarys Boat Harbour, results of monitoring, any ameliorative actions taken to reduce environmental impacts, and the outcomes of such actions.

Concern: further detailed monitoring and evaluation of nutrient input and nutrient concentration in waters of the study area should be undertaken to:

(i) quantify the ecological effects of the nutrient discharge from the Ocean Reef outfall;

(ii) enable a prediction to be made of the likely levels of nutrients that will discharge at the coast in groundwater; and

(iii) plan necessary or appropriate ameliorative action.

SUGGESTIONS

Suggestion: a management committee including the Shire of Wanneroo and the City of Stirling be established, under the direction of the Department of Conservation and Land Management, to implement the management plans for the marine park and the greater marine park.

Suggestion: Professional fishing be permitted to continue in the marine park.

Suggestion: that the arrangement of zones and the activities permitted in each zone (as described in Figure 9 and Table 4) be adopted.

Suggestion: that the declared zones be reviewed at regular intervals of not more than three years, and that the management committee amend the size and location of zones as appropriate within the boundaries of the greater marine park.

Suggestion: the recommendations concerning access in the City of Stirling (City of Stirling, 1984) and Shire of Wanneroo (Woods, 1984 a,b; 1985) coastal management plans be endorsed.

Suggestion: vehicle use in the onshore component of the park be controlled by the provisions of the Control of Vehicles (Off-Road Areas) Act 1978.

Suggestion: recommendations regarding the Trigg boat ramp in the City of Stirling Coastal Report (City of Stirling, 1984) be endorsed (that is, to maintain the facility as a low-volume boat ramp for launching small boats).

Suggestion: in the vicinity of Mullaloo Point, vehicles be permitted access only to the areas immediately adjacent the boat launching ramp, and access of vehicles to the beach be phased out as the ramps in the Hillarys Boat Harbour become operational.

Suggestion: recommendations regarding the Mullaloo Point boat launching area in Woods (1984, b) be endorsed (that is to maintain the area for launching of small boats without the aid of vehicles).

Suggestion: a water ski pick-up and set-down area be designated north of the Mullaloo Point.

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Suggestion: high protection zones be declared around Little Island and each of the nearshore reefs listed above, for a radius of 250 m from a defined centre point on each reef.

Suggestion: that consideration be given to establishing fixed mooring sites within the high protection zones, to facilitate the entry of people to the high protection zones for non-destructive activities (such as underwater viewing and underwater photography).

Suggestion: that some of these high protection zones be rotated to a medium protection zone for prescribed periods and purposes as determined by the management committee.

Suggestion: that the Waterman Marine Reserve be increased in size, from the existing 400 m radius to 500 m radius.

Suggestion: recreational development of the land component, and allocation of beach space to various user groups between Trigg Island and Beach Road, follow proposals in the City of Stirling Coastal Report (City of Stirling,1984)

Suggestion: allocation of beach space to various user groups between Beach Road and Ocean Reef launching facility basically follow proposals in Woods (1984,b and 1985) with allowance made for the Hillarys Boat Harbour (Figure 9).

Suggestion: recreational development of the Whitford Plain area follow the basic proposals by Scott & Furphy (1979) for the Shire of Wanneroo.

Suggestion: new animal exercise (primarily dog) beaches should be declared between the Marmion Angling and Aquatic Club and Clontarf Road, and opposite the dune preservation unit south of Mullaloo Drive.

Suggestion: the public education/ranger facility consist of

- a ranger's office and marine park information office
- a public education exhibition and display area, and
- a storage/workshop area for rangers' boats and equipment.

Suggestion: a range of pamphlets and public education materials be prepared that contain information about the greater marine park including:

- aims and philosophy of the greater marine park
- access system and explanatory signs
- zoning and activities permitted in each zone, and
- coastal environments and marine life.

Suggestion: a system of onshore (for walkers) and underwater (for snorkellers and SCUBA-divers) nature trails be established.

Suggestion: a review be carried out at the earliest opportunity of research programmes and requirements in the greater marine park.

Suggestion: that trawling or dredging within the marine park should not be permitted.

Suggestion: that recreational fishing by netting within the marine park should not be permitted.

Suggestion: that professional fishing by netting within the marine park be phased out as existing licence holders retire from professional netting in the park area.

Suggestion: line fishing by commercial charter operation be a permitted activity in the low and medium protection zones, by permit only.

Suggestion: other forms of fishing (for example, angling and spearfishing) be permitted in the appropriate protection zone as shown in Table 4 (see Recommendation 9).

Suggestion: collecting of live fish (for aquarium use) or collecting of specimen shells and other marine life be not permitted in the park, other than by permit.

Suggestion: that space be allocated within the Hillarys Boat Harbour precinct for onshore facilities (boat storage areas, clubrooms) for recreational clubs and boating organisations which use the marine park.

Suggestion: angling platforms be built into the outside faces of the breakwaters of Hillarys Boat Harbour: at least four on the southern breakwater and two on the northern breakwater.

Suggestion: a SCUBA diver gearing-up platform be built on the southern breakwater of Hillarys Boat Harbour, immediately opposite Boyinaboat Reef. This platform should have access steps from the breakwater pedestrian walkway to the platform, and from the platform to mean low water level to facilitate entry and exit of SCUBA divers and snorkellers.

Suggestion: no angling be permitted from the southern breakwater of Hillarys Boat Harbour within about 30m of the diver gearing-up platform, to minimise safety hazards to in-water divers.

Suggestion: no anchoring or boat traffic be permitted between Boyinaboat Reef and the southern breakwater of Hillarys Boat Harbour to minimise safety hazards to in-water divers.

Suggestion: consideration be given to providing appropriate wet-mooring sites, loading and off-loading facilities within Hillarys Boat Harbour for commercial fishing vessels, with the intention of eventually restricting the present mooring of commercial fishing vessels near Mullaloo Point.

Suggestion: the monitoring and research programmes currently being undertaken in the marine park by State agencies, CSIRO and tertiary institutions, be co-ordinated by CALM.

Suggestion: no anchoring be permitted within 500m of the OTC cable path, as notified by the Department of Marine & Harbours, **except** at permanent, marked mooring locations to be determined by the marine park management body in consultation with DMH and OTC.

Suggestion: the proper disposal of litter by the public be encouraged through the provision of more collection points, an education programme, and the prohibition of litter disposal in marine park waters.

Suggestion: professional fishermen be encouraged through an education programme to bring all disposable items, including items which biodegrade slowly (plastic materials), ashore for appropriate collection and disposal.

CONTENTS

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1 INTRODUCTION

1.1 Background

The System 6 Committee (Department of Conservation and Environment, 1981) made the following recommendations for the metropolitan location M 10 (offshore reefs - Ocean Reef to Trigg; Figure 1):

> **M10.1 The Environmental Protection Authority (EPA) should commission a study of the Sorrento-Mullaloo reefs with the aim of recommending the establishment of an Aquatic Reserve.**
>
> **M10.2 Marine life should be conserved through revision of regulations to prevent any fishing except by line.**

The EPA reviewed those recommendations and, in late 1983 (EPA, 1983), made the following recommendations:

> **M10.1 That our general recommendations on planning and management of Regional Parks be applied to this area.**
>
> **M10.2 That a study of the area be commissioned by the Environmental Protection Authority with the aim of establishing a marine reserve to be managed for the purposes of scientific research, education, conservation and recreation.**
>
> **M10.3 That, subject to the implementation of M10.2, a management plan be prepared for the Reserve.**

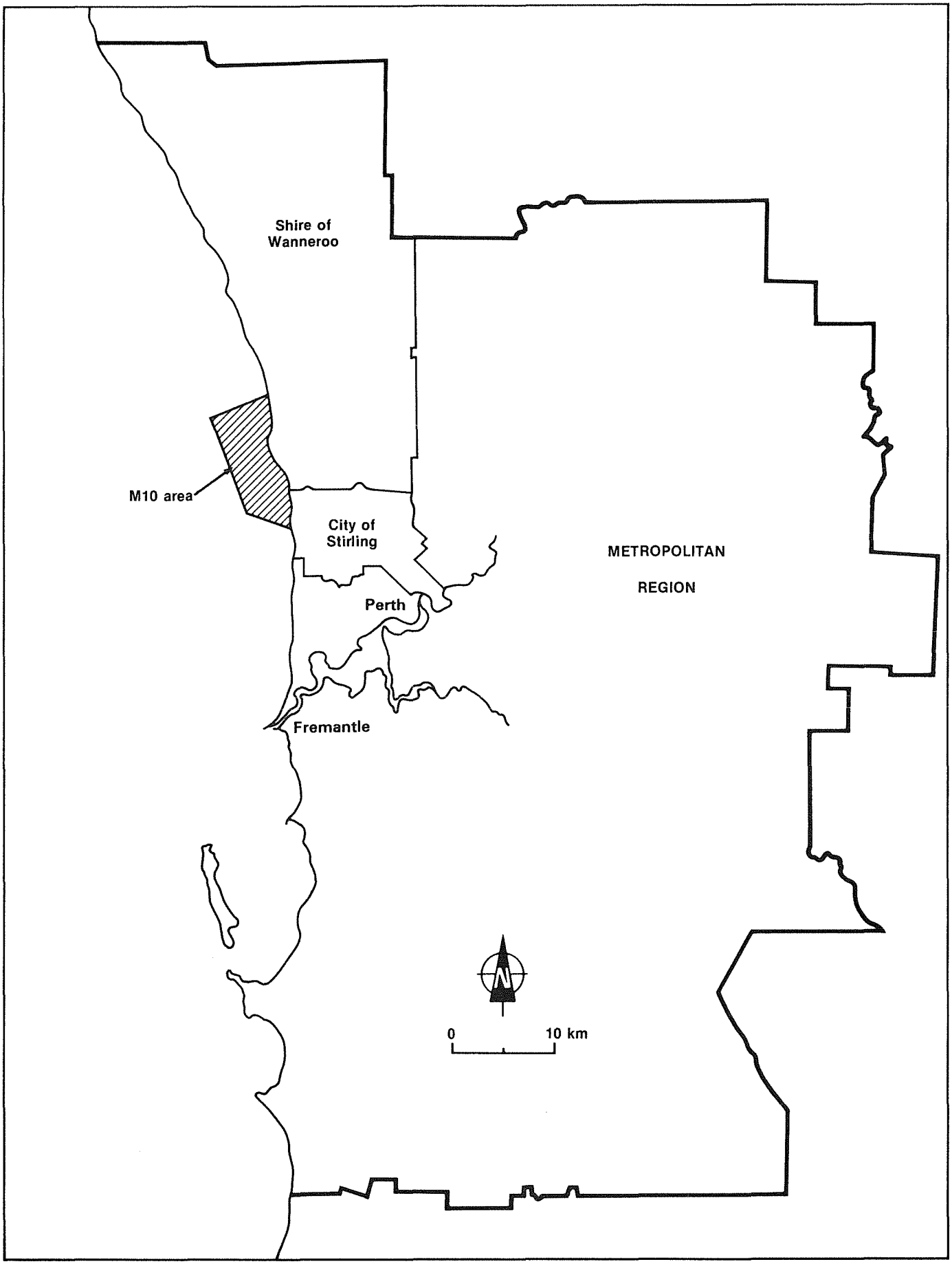


Figure 1 Location of the area covered by the M10 recommendation (DCE, 1981).

In February 1985, the Department of Conservation and Environment (DCE) in response to a Government directive commenced a study to comply with these recommendations of the EPA. The M10 study team was given the following terms of reference:

(i) to characterise and describe the marine environments and marine communities of the area, and produce a report on the findings of the study,

(ii) to identify and evaluate present and future impacts on the proposed M10 marine reserve, and

(iii) after consideration of (i) and (ii) above, and in consultation with representatives of the user-groups with interests in the proposed M10 marine reserve area, to frame a management plan for the proposed reserve, with respect to scientific research, education, conservation and recreation.

This draft management plan partially fulfils the terms of reference (ii) and (iii) above, and has been produced in consultation with representatives from over 65 organisations and user-groups (Appendix 1). Since the announcement on June 11, 1985, by State Government that the Hillarys Boat Harbour construction would proceed, the study team has not considered further a management plan for the study area without this boat harbour. This document is intended for discussion and comment by those organisations and members of the general public. Comments received will be taken into consideration during production of the final management plan.

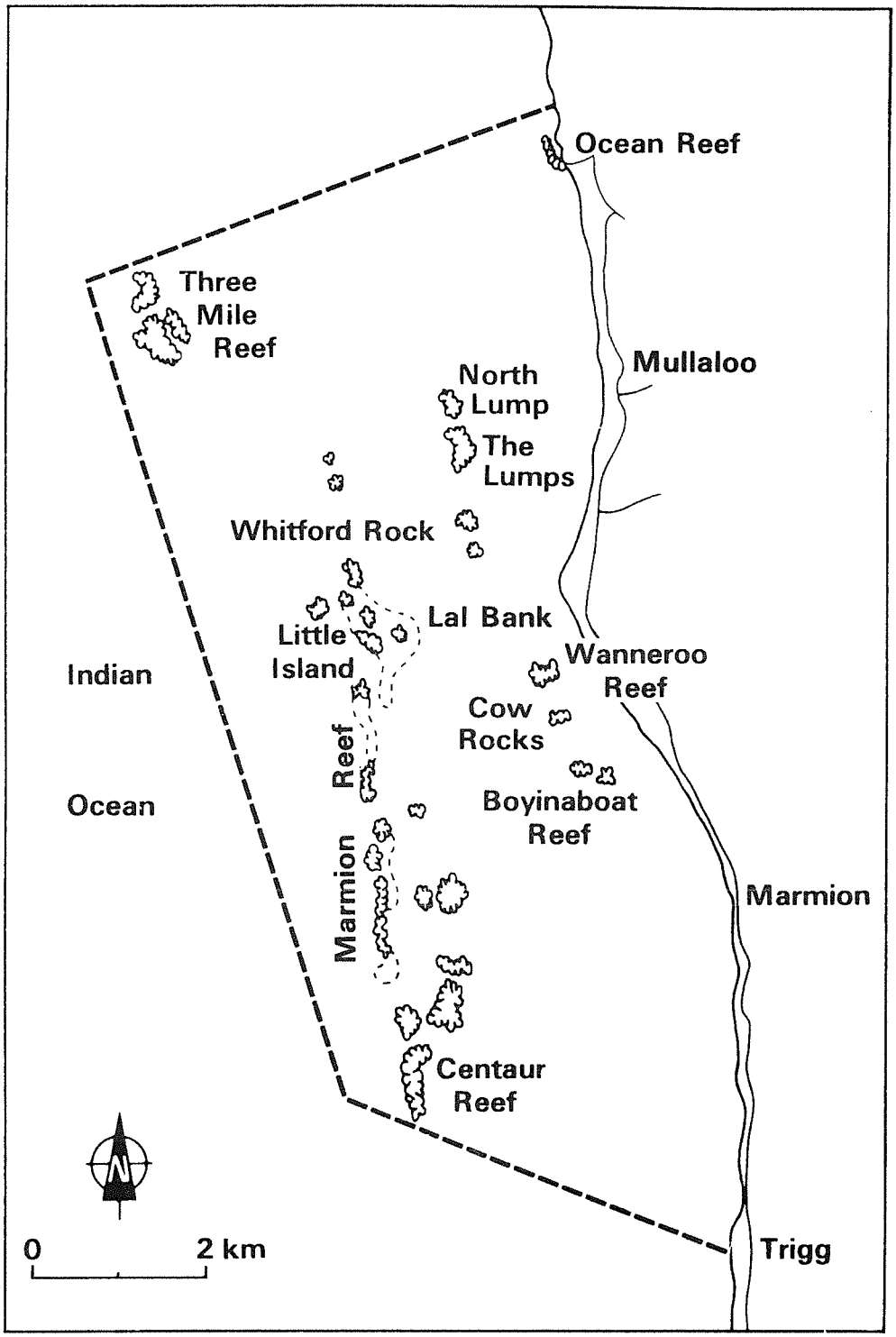


Figure 2 Boundaries of the marine reserve as proposed by the EPA (1983) – Recommendation M10.

1.2 Study Area

The M 10 area as proposed in the System 6 Report (1983) lies between Trigg and Ocean Reef, and extends offshore about 5 km from high water mark (Figure 2). It covers about 60 km^2, and includes intertidal reef platforms (onshore reefs) and coastal sand beaches, a series of small, high limestone reefs about 1 km from the coast (nearshore reefs), the Centaur Reef to Three Mile Reef system (Marmion Reefs) about 4 km from the coast (offshore reefs) and complex assemblages of seafloor communities including seagrass meadows, algal/limestone pavement communities, and crevice animal associations.

Between high water mark and West Coast Highway, which approximately parallels the coast adjacent to the M 10 area, the land is generally reserved Regional Open Space (ROS) and is, or will be, vested in the local authorities for parks and recreation. As major boat access to the M 10 area is through the Regional Open Space, which also serves as a major recreation reserve, it would be logical to consider planning and management of the coastal land together with that of the adjoining M 10 area.

Therefore, for the purposes of this management plan, the **M10 study area** will be defined as the waters and island described in the System 6 Report (EPA, 1983) M 10 recommendations, adjacent State waters between Trigg and Burns, and all the land between the West Coast Highway/Merrifield Place/Ocean Reef Road and its proposed extension, and the sea (Figure 3).

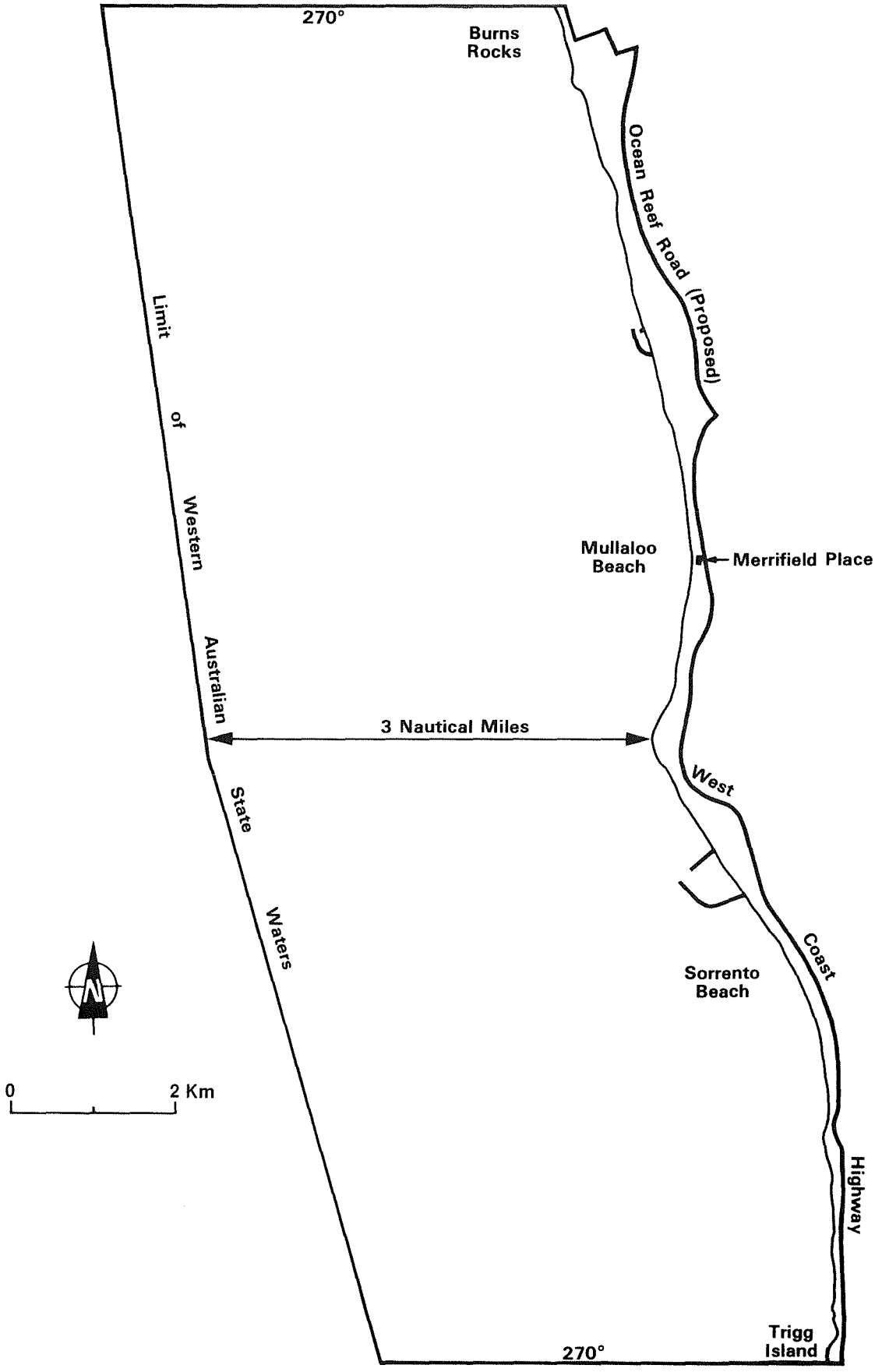


Figure 3 The Study Area which includes all State waters between Trigg Island and Burns Rocks (south) and adjacent land west of West Coast Highway/ Merrifield Place/Ocean Reef Road and its proposed extension.

1.3 Purpose of Study

The purposes of this management plan are to implement the EPA (1983) M10 recommendations, and to recommend long term management strategies for the study area which protects the area for the purposes of scientific research, conservation, education and recreation, and where possible accommodate the various demands on the area in a rational, co-ordinated manner.

The M10 Study Team has therefore:

- reviewed existing knowledge of the terrestrial and marine environments and discussed limitations on theiruse;
- considered the past, present and future extent, impact and implications of human pressures on the marine and terrestrial environments;
- identified issues that require resolution or need to be addressed in management of the area; and
- formulated this management plan, which includes objectives, recommendations, concerns and suggestions, to provide a guide for sustained multipurpose use of the study area.

The philosphy of sustained multipurpose use of the environment and natural resources is consistent with the State Government's commitment, made by State Cabinet on February 4, 1985, to the National Conservation Strategy.

1.4 Nomenclature

The EPA (1983) recommended that the M10 area become a **marine reserve** managed for the purposes of scientific research, education, conservation and **recreation.** The term marine reserve was not defined in the EPA (1983) document. Under the Conservation and Land Management (CALM) Act 1984, the purposes of a **marine nature reserve** do not include recreation, but are defined to conserve aquatic or terrestrial flora and fauna and their habitats generally and/or specifically. Under the same Act, a **marine park** may include all of the purposes of a marine nature reserve as well as **recreation.** The view of the EPA, that recreation should be a permitted use of the M10 area, was endorsed at a workshop in June 1985 which was attended by about 80 delegates representing over 38 organisations and user-groups. While there was some strong dissension, the majority of delegates concluded that the area should be managed primarily for the purposes of **recreation and conservation** but taking into account **education, scientific research** and **commercial fishing.**

These last three purposes are not mentioned specifically in the CALM Act 1984 as permitted in either a **marine nature reserve** or a **marine park.** A third category of marine protected area seems warranted therefore under the CALM Act 1984, to accommodate multipurpose use as envisaged by the EPA. This would also be consistent with the philosophy of management applied to other marine parks in Australia, such as the Great Barrier Reef Marine Park. However, for the purposes of this document, and to comply with the intention of the EPA recommendations that recreation should be permitted in the M10 area, the CALM Act 1984, and the majority view of representatives at the M10 workshop, the study area

will be referred to as a **marine park** and that nomenclature will be used therefore in this management plan.

Recommendation (1): consideration be given to amending the CALM Act 1984, which at present allows for marine nature reserves and marine parks, to describe a third category of marine protected area for multipurpose use.

1.5 Format of Report

The format of this document is summarised in Figure 4.

Section 1 introduces the subject, the purpose of the report and defines the study area.

Section 2 briefly documents the physical and biological character of the study area's natural environment. Some aspects are covered in greater detail in separate DCE technical reports.

Section 3 documents the human environment including current and proposed uses, existing facilities, land-use zoning, land tenure, and existing management and planning controls. Use pressures are identified and discussed in terms of existing and potential impacts on the study area.

Section 4 summarises the data contained in Sections 2 and 3, and discusses these in the context of resources and opportunities for use, and the constraints that limit use.

Sections 5 and 6 present the management proposals including a number of objectives.

Recommendations, concerns and suggestions are made that provide a guide for future planning and management, and address specific issues. These three terms are defined below.

1.6 Definitions

Recommendations are the strongest level of statement made in this management plan. It is considered that the recommendations are essential for implementation of this management plan for the M10 marine park.

Concerns are areas or matters which the study team believes should be addressed as highest priority by the park management committee.

Suggestions are specific management matters which are brought to the attention of the park management committee, for consideration as time and resources permit.

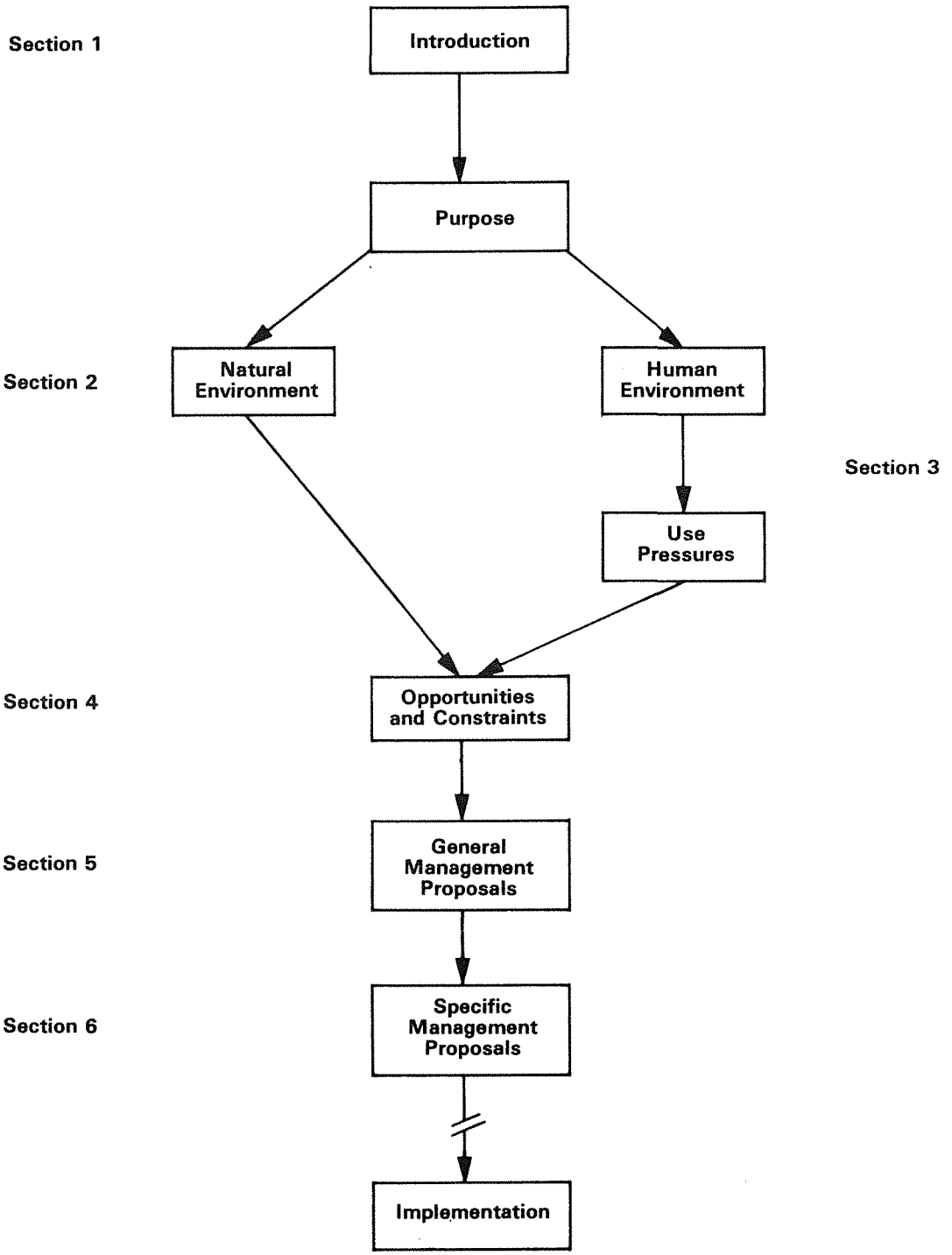


Figure 4 Format of report.

2 NATURAL ENVIRONMENT

The natural environment comprises the structure, and form and dynamics of the land and waters (that is, geology, geomorphology and hydrology), the climatic and oceanographic processes that determine structure and form, and the biota that occupy the land and waters.

Descriptions of various aspects of the natural environment in the study area are contained in separate technical reports, in preparation by DCE. Summaries of presently available data can be found in the City of Stirling Coastal Report (City of Stirling, 1984), reports on the Wanneroo Coast (Woods, 1984 a,b), the Environmental Review and Management Programme (ERMP) for the Sorrento Boat Harbour (PWD, 1985) which is now known as the Hillarys Boat Harbour, and in the EPA's assessment of the Sorrento Boat Harbour ERMP (EPA, 1985). Only sufficient detail is provided here to summarise aspects of the natural environment in terms of relevance to the area as a whole.

2.1 Geology

The study area is underlain by Tamala Limestone, which is covered partially by yellow quartz sand and the younger carbonate-rich Becher and Safety Bay Sands. Tamala Limestone was deposited during the Pleistocene (that is 100,000 years ago and before) as a series of parallel beach and dune sand ridges. Since deposition, these sediments have been cemented into a porous limestone that incorporates solution pipes and dense hard capstone layers. The Becher and Safety Bay Sands were deposited during the Holocene, which covers the period of the last 10,000 years. The upper Safety

Bay Sand, which comprises beach, beach ridge and dune sediments, formed in the subaerial environment. The underlying Becher Sand formed beneath seagrass cover.

The stratigraphy and age structure of the Holocene sequence has been determined (Semeniuk and Searle, 1985).

2.2 Geomorphology

The study area is characterised by a series of limestone ridges, the largest of which forms the mainland coast. Offshore, three lower ridges form broken chains of islands and reefs that are separated by linear depressions. South of Sorrento and north of Mullaloo the mainland ridge has been eroded to form cliffs and wave-cut platforms (the onshore reefs), with rocky headlands separating small sandy bays. Offshore, the limestone ridges form two chains of reefs which display numerous, complex underwater structures including cliffs, caves, solution pipes and platforms. The nearshore reefs are about 1 km from the coast, with the offshore reefs about 4 km offshore.

Superimposed on the limestone basement are a number of landforms associated with the younger sandy sediments. Between Sorrento and Mullaloo, a submarine bank (Lal Bank) has partitioned the nearshore depression into two discrete marine basins or lagoons (Marmion lagoon to the south and Whitford lagoon to the north). Adjacent to Lal Bank, the mainland ridge is covered partially by a veneer of transgressive dunes which are stabilised by vegetation. The bank itself is partially covered by a prograded beach ridge plain (Whitford

Plain), which is roughly triangular in shape, and which protrudes about 1.2 km beyond the general seaward margin of the mainland coast. The southern half of the plain, which is fronted by a narrow beach and steep dune cliff, is covered by stabilised transgressive dunes. In contrast, the northern half of the plain is lower and beach ridges which mark successive shoreline positions during growth of the plain are plainly visible from the ground and from aerial photographs. A wide sandy beach exists between Mullaloo Point and Mullaloo.

2.3 Hydrology

2.3.1 Groundwater

Potable groundwater is found within an unconfined aquifer in the Tamala Limestone. The limestone is very permeable and consequently the water table gradient is low. Allen (1981) estimated that the groundwater is moving towards the coast at a rate of 90 m/year. It is probable that the limestone aquifer is contiguous with that found in the Safety Bay Sand beneath the Whitford Plain.

As the aquifer is located under an area of increasing urbanisation, and recharged from rainfall, it is susceptible to changes in surface runoff and to pollution from nutrients, pesticides, hydrocarbons and other chemicals. The aquifer is used extensively for irrigation of domestic gardens and municipal reserves. Nitrate concentrations in groundwaters within the study area have been found to be 2 - 5 times higher than concentrations in groundwaters further north where no urban development has taken place (Johannes, 1980).

2.3.2 Marine water

Between June 1979 and June 1982, seawater temperature, salinity and nutrient data were collected on an approximately monthly basis from about 20 stations within the study area (Pearce et al, 1984).

Mean monthly seawater temperatures in the study area peak at 21-22°C between January and April, and fall to a minimum of about 17°C during the period July to September. There can be a significant drop in seawater temperature very close inshore during early winter, because of direct loss of heat to the atmosphere.

Annual seawater salinity ranges from 36.1 g/litre in late summer to 35.3 g/litre in late winter. The salinity peaks and troughs closely coincide with those of annual seawater temperature fluctuations. Within a few hundred metres of the shore, there is local lowering of salinity due to submarine groundwater discharge. Under calm conditions, a low salinity surface layer, extending further offshore, is formed.

Dissolved nutrient concentrations, in the waters of the study area, are presently low and in the range of concentrations generally reported for temperate coastal waters (Pearce et al, 1984). Dense phytoplankton blooms have not been observed (Johannes & Hearn, 1983), except for blooms of the blue-green alga Trichodesmium (Creagh, 1985). Nevertheless, nitrate concentrations in groundwater, discharging into the study

area, are two orders of magnitude greater than ambient concentrations in the receiving seawater. The nitrogen load from groundwater discharge to the Marmion lagoon is estimated to be about half of the requirement for the observed growth of the lagoon's macrophytes (Johannes & Hearn, 1983). Whitford lagoon receives nutrients from groundwater discharge, and also from the Beenyup (Ocean Reef) secondary treated effluent outfall, located about 1.6 km offshore from the Ocean Reef boat launching facility. The effects of nutrients from both sources have not yet been fully investigated.

2.4 Climate and Oceanography

The study area experiences hot, dry summers and mild wet winters. Air temperatures are similar to those in Perth, where mean daily maximum temperatures vary from 30.3°C in summer to 17.6°C in winter. Mean daily minimum temperatures are 18.6°C in summer and 9.1°C in winter. Rainfall is moderate (about 880 mm/year) and falls mainly in May to October. Evaporation in the region is high (about 1980 mm/year).

2.4.1 Winds

The dominant climatic factor is the wind, which generates waves, induces water circulation and transports sand inland. The wind regime in the study area is similar to that at Fremantle (Steedman & Craig, 1979, 1983). A diurnal wind variation persists throughout the year, but intensifies during summer. In winter, winds are predominantly to offshore at

night and in the morning, and to onshore in the afternoon. In summer the sea breeze/land breeze pattern is stronger, and acts additionally to a persistent southerly airstream, so that the resultant wind blows from the southeast at night and in the morning and from the southwest in the afternoon. The passage of low pressure systems, in winter, bring northwest winds and gales that back to the west and southwest; the strongest winds blow from the southwest.

Dissipating tropical cyclones can affect the coast during summer, bringing wind gusts up to 70 knots (35 m/s) from any direction. Though these cyclonic events are of short duration, associated winds and high energy waves can have a marked effect on the coast.

2.4.2 Waves

The study area is subject to a prevailing, refracted, long period (8-12 s) southwest-west swell that is continually generated by storms in the 'Roaring Forties' and the Indian Ocean. The swell is further refracted, reflected and diffracted as it passes through the reef chains.

Superimposed on the swell are locally generated, short period (4-6 s) wind waves. During summer, southwest waves are generated by the reinforced sea breeze; during winter, high energy waves are generated during northwest and westerly gales. The occasional summer cyclone may also generate waves from the north, west or south.

As swell and waves interact with the complex seabed topography, wave energy is expended before reaching the coast (Steedman & Associates, 1976). Depending on the prominence of the adjacent islands and reefs, wave energy reaching the coast may vary markedly from place to place, with different parts of the coast being subject to swell, waves, swell and waves, or waves with damped swell.

The prominent reefs off Mullaloo Point have had a marked influence on the swell, with the result that the area behind the reef complex has been the site of major accumulation of Holocene sands.

2.4.3 Circulation

Water movement on the inner continental shelf off Perth is driven mainly by wind stress; the presence of a regional current is also evident during calmer periods. Water generally flows northward in summer and southward in winter. In the shallow, nearshore waters of the study area, the local wind-driven currents become more dominant relative to the regional water movements. Mean current speeds in the range of 0.05 - 0.1 m/s are typical (Steedman & Associates, 1976).

The complex reef chains within and adjacent to the study area act as partial barriers, restricting exchange between inshore and offshore waters. Under stable wind conditions, local circulation patterns are established as a result of the interaction between the wind stress forcing, and seafloor

topography. For example, during prolonged easterly winds, shallow water over Lal Bank is driven westward, inducing circulation that replaces nearshore water with offshore water (Hearn, 1983). Wind-induced circulation is an important flushing mechanism for the study area, and may also affect the water temperature regime experienced by reef-dwelling communities. During prolonged calm periods, some flushing of the area is still maintained by the regional current.

Water replacement time in the Marmion lagoon is estimated to be of the order of one day (Hearn, 1983), although under extended calm conditions, replacement may take up to four or five days.

2.4.4 Sea Level Changes

The Wanneroo coast generally experiences one astronomic tide per day, though barometric pressure, prevailing wind direction and seasonal changes are also responsible for changes in water level. The normal tidal range is about 0.5 m, though the range in water levels, during a year due to all factors, is of the order of 1 m.

2.5 Coastal Processes

The following processes operate in the study area:

- swell-induced onshore transport, in a complex zone of swell wave interference behind the Marmion reefs. This has led to major movement of sediment from the reefs to the mainland

coast, to form Lal Bank, Whitford Plain and the transgressive dunes that overlay the mainland ridge. At present, minor onshore transport is evident as a thin plume of sand moving across the seagrass covered bank.

- swell-induced longshore transport in the surf zone, which moves sand towards the zone of onshore transport behind the Marmion reefs. This has minimised longshore sediment losses from within the study area and has been dominant in maintaining the triangular shape of Whitford Plain.

- local wave-induced longshore transport in the surf zone which moves sediment:

    a) northwards in summer, especially along the shore between Sorrento and Mullaloo Point, and along the rocky coast immediately north of Mullaloo;

    b) southwards during winter, especially between Mullaloo Point and Mullaloo where the coast erodes each winter, with sand transported south to Sorrento.

Due to the dominance of the summer wind-wave regime there is a net movement of sediment northwards. This has led to modification of the swell-controlled shape of the Whitford Plain.

- wind transport which blows sand inland on coasts exposed to

south-west and westerly winds. With the exception of the 'little desert' north of Mullaloo there is, at present, little wind transport except in areas where human activity has degraded dune vegetation or the dune scarp behind the beach. The presence of large vegetated and stabilised transgressive dunes, however, is evidence of previous periods of major wind transport.

- seasonal recycling of beach and foredune material to an offshore bar, especially along the sandy coast between Sorrento and Mullaloo.

- longer-term (hundreds of years) changes in coastal processes and sand supply, which have led to periods of erosion or stability during the long-term progradation of the Whitford Plain. Whether these changes are cyclical or random is not clear, nor are the periods between each change.

- long-term evolution of the sandy coastal landforms, which is leading to gross changes in shoreline position. It is evident that the sandy Whitford Plain prograded, until about 1000 years ago, when the southern flank commenced eroding. As this is probably related to a long-term decline in sand supply, this process is likely to continue. Although this process is slow, it must, as demonstrated by beach erosion at Sorrento, be taken into account in planning for coastal structures which have design lives of a decade or more.

2.6 Marine Biota

Marine biota and marine communities are described in detail in a separate DCE technical report and in the proceedings of the M10 workshop. There is high habitat diversity in the study area due to the variation in geomorphology, substrate, water depth, exposure to wave energy and light.

These habitats may be classified into five broad categories which are listed below. The following information on the benthic marine communities is derived from DCE field surveys and from a submission by the Western Australian Museum. Information on habitat preferences of common fish species was collated from interviews conducted with amateur fishing groups, and supplied as part of the submission by the Fisheries Department.

2.6.1 Benthic Communities

(i) Lagoon Subtidal Sandy Seafloor

The predominant substrates in this habitat consist of calcareous sand plains, stabilised by seagrasses interspersed with areas of bare sand. The seagrass meadows (mainly Posidonia sinuosa, Amphibolus antarctica and Halophila ovalis) support a diverse assemblage of animals, and are important as a food source and refuge for echinoderms, molluscs, crustacea and fish.

(ii) Lagoon Subtidal Limestone Pavement

This habitat occurs in the less sheltered areas of the Marmion and Mullaloo lagoons, with limestone pavement and

consolidated sand substrates. The seagrasses (Amphibolus antarctica, Posidonia sinuosa, Halophila ovalis) occur, but are less extensive than in the more sheltered areas. Attached seaweeds, especially the macrophytes (for example Caulerpa cactoides, Ecklonia radiata, and Hypnea episcopalis) are common on the limestone pavement.

(iii) **Lagoon Intertidal Nearshore Reefs and Little Island**

Isolated patch reefs occur in the lagoons (for example Wanneroo Reef). The reef tops have areas of essentially bare rock populated with small gastropods, limpets, coralline algae/Haliotis associations, or a mixed algal assemblage which is determined in part by the reef height relative to low tide level and the aspect of the reef. Vertical faces of these reefs are covered with the macroalgae Ecklonia radiata and Sargassum spp. Overhangs, shaded walls and the roofs of caves are covered densely with a diverse sponge/ascidian/gorgonian/bryozoan assemblage, grazed by molluscs and several species of starfish. The large baler shell, Melo miltonis, occurs in the sand adjacent to the undercut caves. These predatory molluscs feed on other molluscs buried in the sand, but also emerge to feed on the abalone Haliotis roei.

Hard corals (Order : Scleractinia) such as Montipora, Favia, Favites, Goniastrea, Plesiastrea and Symphyllia occur on the reefs around Cow Rocks and Wreck Rock, while Pocillopora damicornis is moderately common on outer reefs near Little Island (Figure 2). Pelagic fish species such as herring, skipjack, trevally and buff bream are common near these reefs

as well as many species of wrasse. Little Island provides a resting site for seabirds (gulls, terns, cormorants and others) and sea lions, and bridled terns may breed there occasionally.

(iv) **Nearshore Reefs and Intertidal Onshore Rock Platforms**

Attached macrophytes are dominant on these reefs with red algae (Dictymenia sonderi, Hypnea episcopalis, and Vidalia spiralis) and brown algae (Ecklonia radiata, Lobospira bicuspidata) being most common. The abalone, Haliotis roei, and the turban shell, Turbo torquatus are both common in these habitats.

(v) **Offshore Shallow Limestone Reefs**

This habitat is found on the seaward slopes of the Marmion Reef/Three Mile Reef complex. It is characterised by marked algal zonation related to water depth. In the shallower region, algae adapted to high illumination, such as Sargassum, are common. Below about 2 m, dense stands of kelp, Ecklonia radiata, and an associated sub-canopy of encrusting coralline algae, dominate. The density of kelp plants decreases with depth down to 25 m, at which point epilithic seagrass (Thallassodendron sp.), red algae and sponges predominate.

2.6.2 Fish

The common fish species caught in the study area, and their habitats, are shown in Table 1.

TABLE 1:Fish species commonly caught in the study area and their preferred habitats (from Fisheries Department submission)

Fish	Habitat
Garfish	Coastal waters over seagrass
Western school whiting	Sandy bottoms in surf zone and offshore
Tailor	Juveniles school in surf zones Larger fish around offshore reefs
Australian herring	Around coastal reefs - over seagrass
Skipjack trevally	Coastal reef areas
Yellowtail scad	Surf zone to offshore reefs. Active at night
Wrasses (several species)	Mostly in association with coastal reefs
Cobbler	Coastal reef and weed areas Juveniles associated with nearshore drift macrophytes. Adults feed in the surf zone mainly during winter evenings
Blue-spotted flathead	Inshore sandy bottoms
Sea trumpeter	Adults in seagrass beds. Juveniles associated with shoreline drift macrophytes
Western sand whiting	Surf zone sand, particularly around reefs
Red mullet	Sand/seagrass areas
Buffalo bream	Around coastal reefs
Yellow-eye mullet	Surf zone
Leatherjacket (several species)	Common over seagrass beds
Blowfish	Inshore sandy bottoms, but also seagrass and reef areas
Snook	Offshore weed beds
Shark species	Offshore roving species throughout the water column
Westralian dhufish	Around reef areas
Sea mullet - migratory	Just off surf zone
Australian salmon - migratory	School around offshore reefs and surf zone
Western rock lobster	Around reef areas

2.7 Terrestrial Flora and Fauna

A description of vegetation in the coastal zone between Trigg Island and Beach Road (City of Stirling/Shire of Wanneroo boundary) is contained in the City of Stirling Coastal Report (City of Stirling, 1984). The Environmental Review and Management Programme (ERMP) for Sorrento Boat Harbour (PWD, 1985) contains a description of the vegetation in the general area. Vegetation in the coastal zone within the study area is similar to that found elsewhere along the Perth metropolitan coast. Little is known about past or present wildlife in the area, although enquiries of Government agencies and interested organisations indicate that the area does not appear to contain any known rare or endangered species.

It is now recognised that within the metropolitan area coastal habitats are rapidly diminishing and there are good reasons to conserve representative examples of these in sufficiently large areas to ensure viability of their fauna and flora. There are several areas within the study area that are large enough to warrant conservation.

2.8 Summary

A feature of the west coast of Western Australia is the extensive system of marine limestone reefs that is approximately parallel to and within a few kilometres of the shore. These reefs protect the coast from oceanic swells, and create sheltered inshore lagoons. The lagoons in the study area, which are protected by the chain of offshore reefs from Centaur Reef northwards to Three Mile Reef (including the Marmion Reefs), contain also an inner chain of nearshore reefs (Figure 2). This presents a diversity of marine

environments which, probably, is not matched near any other metropolitan area of the major Australian cities.

The study area also contains a wide range of habitats, supporting diverse communities. This, taken together with the caves, archways, solution pipes and collapsed sections of the reef platforms, provides a spectacular underwater landscape for snorkellers or SCUBA divers. Because of the accessibility of these reefs, human pressures, including fishing of all forms and shell collecting (especially of cowries including the highly prized endemic dwarf form of Cyprea venusta) have, according to anecdotal reports, depleted some of the fauna. The rarity of sea urchins, turbo shells (Turbo torquatus) and attractive gastropods, especially on easily accessible reefs from Trigg to Marmion, possibly reflects the impact of collecting on edible species or on the other species valued by collectors. In addition, although the baler shell and the giant conch (Syrinx aruanus) were probably never abundant, both are now rarely seen in the more accessible localities, again possibly because of human predation. Similarly, many species of edible reef fish, and the western rock lobster, are now rarely observed in parts of the study area.

The shore in the study area contains a wide variety of geomorphological features, ranging from stable cliff-backed rocky coasts to more mobile, dune-backed sand beaches. These features are of high recreational, education and aesthetic value.

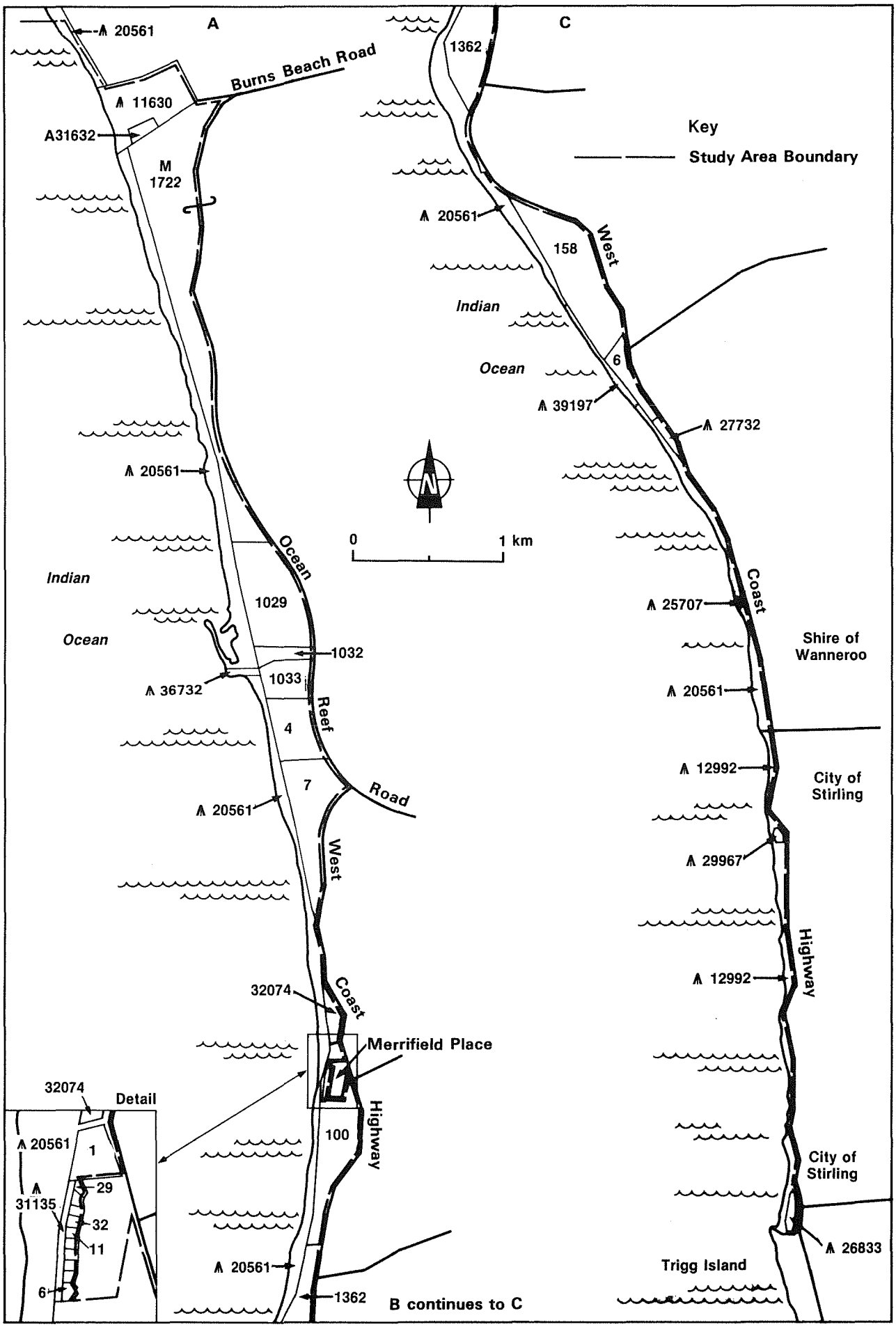


Figure 5 Land tenure (see Table 2).

3 HUMAN ENVIRONMENT

3.1 Existing Planning and Management Controls

3.1.1 Land Use/Tenure

The land component of the study area lies within the Shire of Wanneroo and City of Stirling. The land is generally reserved Regional Open Space (ROS) under :

(i) Shire of Wanneroo Town Planning Scheme No 1

(ii) City of Stirling District Planning Scheme

(iii) Metropolitan Region Scheme

A narrow foreshore reserve is vested in the local authorities for parks and recreation. East of this, the land includes unvested and vested Crown reserves, freehold land, and land owned by the Metropolitan Regional Planning Authority (MRPA) and the Water Authority of Western Australia (WAWA). Negotiations by State agencies are currently underway to acquire freehold land west of West Coast Highway/Merrifield Place/Ocean Reef Road.

Crown Reserves in the study area are listed in Table 2 and shown in Figure 5.

TABLE 2: Crown Reserves in the study area

Reserve or Lot Number	Purpose	Vesting or Proprietor	Power to lease
CROWN RESERVES			
11630	camping, park and recreation	Shire of Wanneroo	21 years
12992	Recreation	City of Stirling	yes
20561	recreation and purposes incidental thereto	Shire of Wanneroo	21 years
23563	recreation and national fitness	Recreation Camps and Reserves Board	no
25707	club and club premises	Crown Grant in trust to Marmion Angling and Aquatic Club	not applicable
26833	recreation and purposes incidental thereto	City of Stirling	yes
27732	recreation	Shire of Wanneroo	no
29967	marine aquarium and research laboratory	Minister for Fisheries and Fauna	no
31135	recreation	Not vested	not applicable
31632	caravan park	Shire of Wanneroo	21 years
32074	recreation and parking	Shire of Wanneroo	no
36732	breakwater and sewer outfall facilities	Water Authority of Western Australia	no
39197	harbour purposes	Minister for Transport	no
OTHER LANDS			
1	-	Shire of Wanneroo	-
4	-	Ocean Reef Pty Ltd	-
6	-	Metropolitan Region Planning Authority	-
7	-	Metropolitan Region Planning Authority	-
6-11, 29-32	-	Shire of Wanneroo	-
100	-	Crown land	-
158	-	Pattara Pty Ltd (to MRPA)	-
1029	-	Shire of Wanneroo	-
1032, 1033	-	Water Authority of Western Australia	-
1362	-	Whitfords Beach Estate Pty Ltd	-
M1722	-	Roman Catholic Archbishop of Perth	-
32074	recreation and parking	Crown land vested in Shire of Wanneroo	-

3.1.2 Land Management

The Shire of Wanneroo and the City of Stirling are responsible for day to day management of vested Crown reserves within the study area. The City of Stirling Coastal Report (City of Stirling, 1984) and the Wanneroo Coastal Study (Woods, 1984 a,b) provide management guidelines and specific management recommendations for land in the study area. The MRPA is responsible for development control of land under MRPA ownership.

The Water Authority of Western Australia and private land owners are responsible for managing their own land.

3.1.3 Marine Management

Management of living marine resources in the area is currently the responsibility of the Fisheries Department. The department's main functions are the administration and regulation of professional and amateur fishing; however, due to limited departmental resources commercial fisheries receive most attention.

A small fisheries reserve has been declared adjacent to the Waterman Marine Laboratory, in which no consumptive activity other than line fishing from the shore is permitted.

The City of Stirling and Shire of Wanneroo both have bylaws which prohibit or restrict certain activities in specific areas of the coast, including exercising of animals, nude bathing, water-skiing, spearfishing, and use of off-road vehicles.

The Department of Marine and Harbours is responsible for boating activity in the Ocean Reef boat launching facility and in navigable waters of the study area. It is also responsible for general safety of coastal marine traffic, and will be responsible for boat activity in and around the proposed Hillarys Boat Harbour. Fremantle Port Authority has jurisdiction over waters in the southern part of the study area.

3.1.4 **Relevant Legislation**

There are a number of Acts of Parliament which may have a direct bearing on establishment and administration of the proposed marine park. Summaries below relate only to the relevance of Acts to the study area.

(i) Conservation and Land Management (CALM) Act 1984.

This Act provides for conservation of flora and fauna and their habitats, and for management of certain land and waters. The Act also enables proclamation of marine nature reserves and marine parks, and describes procedures for preparing management plans.

(ii) Fisheries Act 1905 - 1979 (as amended)

This Act provides, principally, for the regulation of professional and amateur fisheries, but also includes provision for establishment and regulation of aquatic reserves.

(iii) Local Government Act 1960 - 1981 (as amended)

This Act enables Local Councils to regulate various activities along the coast through bylaws. A list of relevant bylaws is given in the City of Stirling Coastal Report 1984 (p. 48).

(iv) Marine and Harbours Act 1981

This Act makes provision concerning the functions of the Department of Marine and Harbours and to provide for the advancement of efficient and safe shipping and effective boating and port administration through the provision of certain facilities and services, and for incidental and connected purposes.

(v) Western Australian Marine Act 1982

This Act provides for regulation of navigation and shipping.

(vi) Fremantle Port Authority Act 1902 - 1969

This Act provides for regulation of commercial shipping and oil spills. Regulation of small craft in the area covered by this Act is delegated to the Department of Marine and Harbours.

The following Acts (summarised in the City of Stirling Coastal Report 1984, p. 83) also have force in the area:

- Town Planning and Development Act 1928 - 1980 (as

amended)

- Public Works Act 1902 - 1979 (as amended)
- Environmental Protection Act 1971 - 1980 (as amended)
- Land Act 1933 - 1980 (as amended).

3.2 Existing Facilities

All existing facilities are shown on Figure 6.

3.2.1 Access

The study area is serviced by roads and tracks, providing easy access to much of the coast. The only area lacking formal road access lies immediately south of Ocean Reef launching facility, where West Coast Highway swings inland from the coast.

3.2.2 Car Parks

Formal car parks are located along the coast adjacent to the developed areas from Trigg to Sorrento, at Mullaloo Point and at Mullaloo Beach. There is also a large car park at the Ocean Reef launching facility. Informal parking occurs along the length of the West Coast Highway, in the sand dunes between Sorrento and Mullaloo, and on either side of the Ocean Reef launching facility.

3.2.3 Pedestrian Access

Controlled pedestrian access is limited to the developed coast between Trigg and Sorrento, and at Mullaloo where fenced paths and/or steps are provided in association with car parks.

3.2.4 Boat Launching

The Ocean Reef launching facility provides for the launching and retrieval of up to 500 trailer-mounted boats per day. At present, there are eight boat ramps operating, with provision for additional ramps when required in the future. The Shire of Wanneroo operates the ramps on a user-pays basis.

A small boat ramp is located immediately north of Trigg Island, though lack of space restricts parking of cars. Launching of small boats also occurs from the beach at Mullaloo Point, where a small informal car park has been developed in the sand dunes.

3.2.5 Angling Facilities

A short fishing platform, located at North Beach, is well-used by anglers. This is the only platform or jetty-type structure in the study area. The three groynes at Sorrento, and the seawalls of the Ocean Reef launching facility, are also used extensively by anglers.

3.2.6 Overseas Telecommunications Commission (OTC) Cable

In December 1984, OTC sent the EPA a Notice of Intent to lay a submarine telephone cable through the study area. In early June, 1985, the 100 mm diameter armoured cable was laid in a series of gentle curves around the high reefs to make landfall at Whitford Beach.

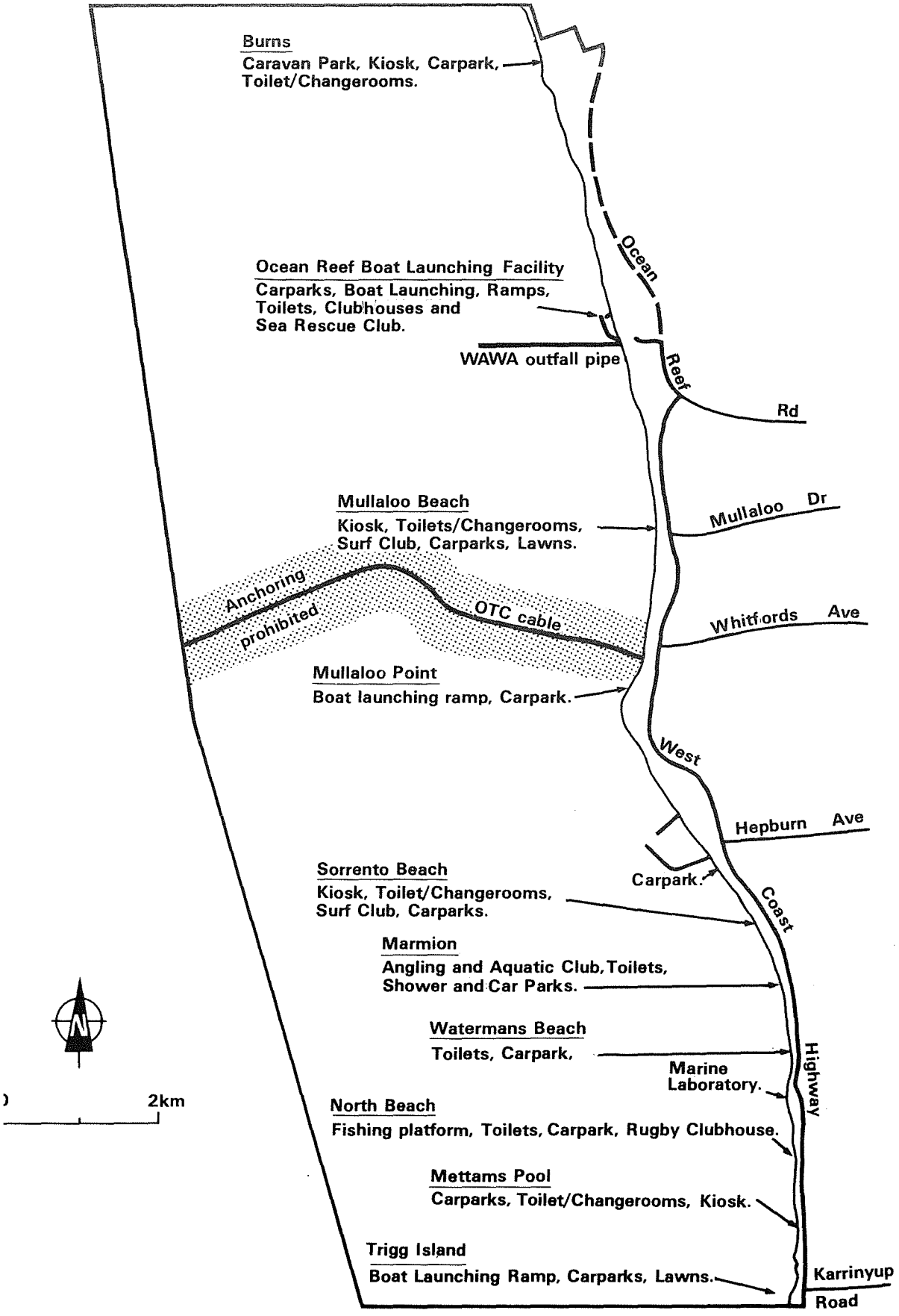


Figure 6 Existing facilities.

3.2.7 Ocean Reef Secondary Treated Effluent Outfall

Domestic liquid waste from the northern metropolitan area is treated at the Beenyup plant. The secondary treated effluent is then discharged at a rate of about 35 million litres/day, through a submarine pipe, 1.6 kilometres offshore from Ocean Reef.

3.2.8 Other Facilities

Grassed picnic areas are provided at Trigg Island and Mullaloo. Toilets, change rooms and kiosks are located at major beaches.

3.3 Use Pressures

Pressures have been identified for the use of coastal land and the adjacent offshore waters in the study area. Demand for use of the resources in the area is unlikely to diminish. Rather, it is likely to grow steadily as the population of Perth increases, especially in the northern coastal suburbs. This section provides a description of present use of the study area, and a discussion of probable future use pressures.

3.3.1 Population Increase

Coastal suburbs adjacent to the southern section of the study area are virtually fully-developed, while in the north are mostly undeveloped. Information supplied by the City of Stirling indicates that 60 - 70% of total beach use in the City of Stirling is undertaken by local residents.

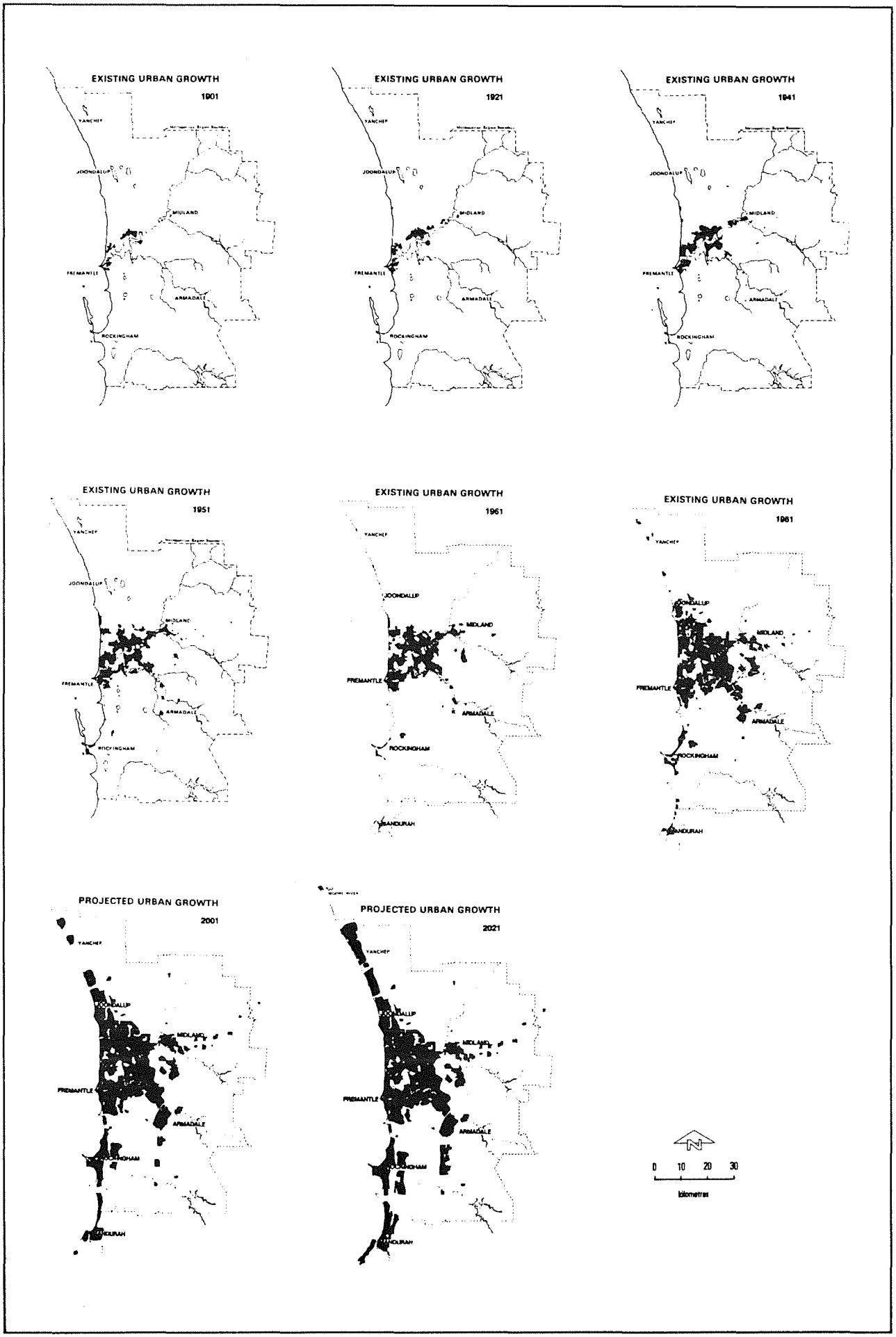


Figure 7 Perth Metropolitan Region: Urban Growth, 1901-2021 (Perth Towards 2001, Carr, 1983)

As a result of residential development of the northern coastal suburbs, the local population adjacent to the study area is increasing. In 1971 the North West Corridor held 2300 people. In 1993 the corridor is expected to contain about 130,000 people (MRPA, 1977), with most of the growth between Wanneroo Road and the coast (Figure 7). The ultimate population of the corridor could reach 330,000 people.

Coincident with this will be a general increase in population in the inner suburbs of Perth, and further development of major road systems in the northern suburbs. All these factors, taken together, indicate that there will be rapidly increasing pressure from people using the beaches and waters of the study area.

3.3.2 Access

3.3.2.1 Onshore

Access to the beaches between Trigg and Sorrento and at Mullaloo is convenient; elsewhere it is inadequate, due largely to the tenure of land which has limited the provision of public access. This situation, however, is likely to change in the near future when the State acquires the coastal lands in the study area. At present, the distribution of beach users reflects to a large degree the proximity of road access, the distribution of car parks and the presence or absence of facilities such as change rooms and kiosks. Several surveys show that beach users congregate in the vicinity of developed beach sites.

As it is inevitable that there will be growing demand for recreational use of the extensive sandy beach north of Sorrento, there will be a need to provide more facilities and better access (for example car parks, paths, cycleways) along this part of the coast.

3.3.2.2 **Offshore**

The ramps at the Ocean Reef launching facility allow safe launching and retrieval of trailer craft, and expansion of this facility is likely in the near future. Small craft and yachts launch from the beach at Mullaloo Point and from a ramp at Trigg. Although the Trigg ramp is unlikely to be expanded, many more craft could be launched at Mullaloo Point if facilities were improved. Marmion Angling and Aquatic Club operates a private ramp at Marmion. It is also expected that deep-keeled craft will have access to waters of the study area from the Hillarys Boat Harbour, which will also have four launching ramps for trailer craft.

A study carried out by P.A. Management Australia (1981) indicates that boat ownership will stabilise at around 55 boats per 1000 people by 1990. To indicate the likely future demand for boat launching facilities Woods (1984a) states that 'with a projected increase in population in the North West Corridor, the number of boats now in that area will rise to 7000 in 1993 and to 18,000 when the corridor is fully populated; the latter figure being equal to the present total number of registered boats in the metropolitan area north of

Perth". Thus, it can be expected that there will be increasing demand for launching facilities on the northern coast of the metropolitan area.

3.3.3 Conservation

The study area has been recognised as having high conservation value by various authorities and groups. Impetus to conserve the area originated from a submission in 1972 by the Australian Marine Sciences Association to the System 6 Committee (DCE, 1981).

In 1983, the EPA stated in the System 6 Report (EPA, 1983) that:

The reefs are biologically rich and are unsurpassed locally as an underwater spectacle. Because the reefs have been heavily exploited, and as the area has education value, it is considered essential that they be reserved and protected to conserve the marine communities, including a rare species of cowrie shell which is much sought by collectors.

The area has high recreational value because the sheltered water provides safe boating, diving, swimming and fishing conditions.

The recommended area constitutes open space of regional significance because of its high conservation, education and recreation values. Any management plan for the area should have these values as primary management objectives.

A number of terrestrial features has also been considered worthy of conservation. Hill & Mann (1974) suggested protection of areas of relatively undisturbed coastal heath south of Burns. Another report (Scott & Furphy, 1981) recognised that the dunes and vegetation on the Whitford Plain are rare in the metropolitan region, and with

construction of the Hillarys Boat Harbour pressure will increase to conserve the remaining major dune areas.

As discussed in Woods (1984 a,b) two other features are worthy of conservation. The first is the area of Pinnacles north of Mullaloo, which the Shire of Wanneroo has already fenced off in order to protect it. The second is the geological cross-sections in the side of the WAWA excavation at Ocean Reef. The sections, which expose a rare example of a raised beach on a calcreted platform, are visited by tertiary and secondary students.

Little Island is the only location in the study area where a range of seabird species (gulls, terns, cormorants and others) and sea lions can be seen at once. The island is not an important breeding colony for any of these species, but could, nevertheless, be regarded as an important resource for education (for example, for field studies in wildlife biology).

With increasing development of the foreshore land, and growing recreational activity in the area, these features will be subject to increasing pressure.

3.3.4 **Recreation**

The study area is a recreational resource of both local and regional significance. The area has become popular since the early 1970's when West Coast Highway was extended to Mullaloo and the launching ramp at Mullaloo Point was

constructed. In 1979, the Ocean Reef launching facility was developed and since then recreational pressure in the study area has increased markedly.

The variety of geomorphological features in the area offers opportunities for a wide range of recreational activities. The coastal management plans for the Shire of Wanneroo and City of Stirling both emphasise the need to cater for the increasing recreational demand in the area.

3.3.4.1 **Shore-based Activities (including Little Island)**

Beaches and shallow, nearshore waters in the study area are used for a variety of activities (described below), with frequency of use along the coast varying from very light to regularly intense.

(a) **Passive Beach Activities**

Most of the sandy beaches within the study area are used for relaxation, walking, sunbathing, picnicking, beachcombing, bathing in shallow water, and swimming. South of Sorrento these activities are restricted mostly to small sandy coves situated between rocky headlands. The extensive sandy beaches to the north of Sorrento are highly suited to these activities, although poor access has led to concentration of beachgoers at Sorrento and Mullaloo beaches. There is potential, therefore, to accommodate many more beachgoers between Sorrento and Mullaloo.

(b) **Beach Angling**

Beach angling has been carried out along the entire coast of the study area since at least the 1930's. This coast is a popular fishing area and currently supports two angling clubs (Marmion Angling and Aquatic Club, and the Whitfords Sea Sports Club).

Anecdotal information, supplied by anglers to DCE, suggests that dhufish and blue groper up to 10 kg and more were caught regularly at Trigg Island and other onshore reef platforms until the early 1950's. Since then, the numbers of these fish have apparently declined in particular areas. This is probably related to increased human activity.

(c) **Animal Exercise**

At present there are two designated dog beaches between Trigg and Sorrento. The dog beaches are small, but have the advantage of being enclosed by rocky headlands and, therefore, are readily defined; hence, these beaches may be avoided easily by people wishing to do so. A survey carried out by geographers from the University of Western Australia found that the total number of people exercising dogs, on any week day or on any weekend day is low. Nevertheless, it is likely that demand for this activity will increase.

There is an animal exercise beach south of Mullaloo Point that is extensively used by people to exercise dogs, and also horses. There is likely to be continued demand for animal

exercise beaches from residents in the developing Wanneroo Shire and the adjacent suburbs. Though presently there is little conflict between animal owners (and their pets) with other users of the beaches, experience at other metropolitan beaches (for example Cottesloe) indicates that dog beaches must be well defined and policed if conflict is to be avoided.

(d) **Abalone Collecting**

The collection of abalone by amateurs is currently a seasonal activity, confined mainly to the onshore intertidal reef platforms. During the open season, October 1 - March 1, the more accessible reef platforms are heavily exploited, with up to 50 people at any one time collecting abalone; however, the abalone on these parts of the onshore reefs represent a small proportion of the total abalone stock in the study area (Fisheries Department submission).

(e) **Onshore Spearfishing**

In 1971, spearfishing within 50 m of another person was prohibited along the coast controlled by the City of Stirling. In 1973, the taking of western rock lobster with a pointed implement, such as a spear, was prohibited by the Fisheries Department. Anecdotal information from a DCE survey indicates that larger reef fish (such as dhufish, blue groper and baldchin groper), smaller edible reef fish, and western rock lobster were considered abundant in the study area before 1960, and were speared in large numbers. By 1965, however, large edible reef fish were reportedly rarely observed at

particular onshore reefs, and, by about 1975, western rock lobster were also rarely seen on those onshore reefs. In addition, the numbers of small reef fish, observed by divers had reportedly declined. Many of the people interviewed believe human activities are responsible for this apparent decline, but anecdotal information cannot be regarded as conclusive, and there are few scientific data on the changes before 1970.

(f) **Organised Sporting Activity**

Sporting clubs located in the study area include:

- Marmion Angling and Aquatic Club
- Mullaloo Surf Life Saving Club
- Sorrento Surf Life Saving Club
- Whitfords Bay Sailing Club
- Whitfords Sea Sports Club

There is pressure from other clubs to construct facilities west of West Coast Highway and this is bound to increase with expansion of the northwestern suburbs, and development of other major beaches and the Hillarys Boat Harbour.

(g) **Off-road Vehicles (ORVs)**

Most ORV activity occurs along the coast north of Mullaloo Beach where informal sandy tracks have been cut to provide access to sandy coves, fishing spots, and to Burns Beach. This section of the coast is stable, and presently there is little conflict between ORVs and other user groups. The question of

formalising ORV access on this part of the coast is currently the subject of a report to Wanneroo Shire Council (Woods, 1985).

Other ORV activity, associated with small boat launching, takes place at Mullaloo Point and beaches to the north. Given the lack of a suitable ramp at Mullaloo Point, the desire to drive onto the beach will remain. With increasing use of the beaches, and provision of launching ramps elsewhere to cater for trailer craft, the presence of ORVs on popular family beaches will become untenable, eventually necessitating prohibition except within designated areas.

(h) **Observation of Wildlife**

Seabirds are common throughout the study area, on the coast, nearshore reefs, Little Island, and on the sea. Seagull populations are increasing as a result of the increasing human population and present habits of food and garbage disposal; the effects of people on the behaviour and numbers of other seabird populations are, mostly, not known. Marine mammals (sea lions, dolphins and rarely whales) can be seen occasionally.

Little Island is the only location in the study area where, normally, a range of seabirds (gulls, terns, cormorants and others) and sea lions can be seen at once. Numbers of people visiting the island have, reportedly, increased markedly in recent years, commensurate with the increasing population in

the northern suburbs, the increased access to the coast, and the increased popularity of small craft, such as windsurfers, surf skis and surfboards, which can land visitors easily. Some people go to Little Island specifically to observe the birds and sea lions; other visit to picnic, sunbathe, swim, dive, or for the exercise of paddling small craft to the island and back. It seems quite likely that the frequency of people visiting the island will continue to increase, probably to the point where the level of disturbance deters some of the animals from using the island to rest or breed. It is a value judgement whether Little Island should be regarded as, primarily, a refuge and resting place for wildlife or an offshore recreation resource for people.

3.3.4.2 **Water Based Activities**

Sheltered waters, combined with attractive reef areas, provide opportunities for the full range of offshore recreational activities in the study area.

Most offshore activities take place from boats, with most boat access to the area from Ocean Reef launching facility and Mullaloo Point, and to a lesser extent from ramps at the Marmion Angling and Aquatic Club and Trigg Island.

(a) **Boat Angling**

The area is very popular for boat angling; however, there are no data on the numbers of anglers using the area privately or as club members.

Table 1 lists the common fish species caught in the area.

Prior to 1975, boat anglers fished the nearshore and offshore reefs for dhufish, blue groper and baldchin groper. Currently some anglers travel up to 30 km offshore to fish for these species, since very few are now caught or seen in the study area. Other anglers, with smaller boats, still catch large numbers of garfish, whiting, skipjack trevally and herring at many locations throughout the study area.

Before about 1975, tailor and spanish mackerel were common and caught in large numbers. Anecdotal evidence from fishermen interviewed by DCE (Appendix 1), suggests that the numbers of these fish, in the study area, have declined since then due possibly to increased local fishing pressure. It is noted, however, that variation in abundance of pelagic and migratory species in any particular area is unlikely to be caused by fishing pressure in that immediate area. Fisheries regulations should, if enforced, be sufficient to maintain stocks at levels adequate for recreational fishing.

(b) **Rock Lobster Potting**

The Fisheries Department estimates that the amateur rock lobster catch in the study area is about 4000 kg

annually, which is about 4 - 5% of the professional catch (Fisheries Department submission).

Amateurs are limited to 2 pots per licensed person, with a bag limit of 8 rock lobsters per day. If there are two or more licence holders on any boat, a maximum of 4 pots may be pulled per boat per day. Amateurs usually fish reef areas (Norton, 1981) which are readily accessible from boat ramps. Reefs in the study area are subject to substantial pressure from amateurs, and this is likely to increase as the adjacent land area becomes urbanised.

(c) **Netting**

Currently amateur fishermen netting in the study area use mainly set nets. This type of fishing is largely non-selective. At the M10 workshop there was support for banning netting from the study area. Wilson, Hancock & Chittleborough (1979) imply that netting and other human pressures may have reduced fish stocks in the Swan River during the early development of Perth, but there appears to be no detailed scientific study on the impacts of net fishing in the inshore coastal waters of Western Australia.

(d) **Diving**

Recreational diving commenced in Australia primarily as a sport for adventurous males who wished to

spearfish, catch rock lobsters, or collect marine life for personal use or profit. In recent years the emphasis has moved away from hunting and collecting to more social and less destructive activities such as marine nature appreciation, recreational study of marine life and underwater photography. Diver training organisations, dive shops and education groups now offer many courses aimed at increasing diver appreciation and enjoyment of marine environments and marine communities, and increasing recreational diver safety and skills. Specialist courses are also available in underwater navigation, search and recovery, wreck diving, night diving and marine archaeology. As yet, there are no wrecks or sites of archaeological interest in the study area, but the other recreational diver activities can be undertaken there from shore or boat.

A considerable amount of spearfishing currently occurs among the many reefs in the study area. As well as individuals, three clubs are active in it. With a growing population, and provision of more boat launching ramps, there does not appear to be any reason why spearfishing will not increase in popularity. It can be expected therefore that there will be pressure on areas that offer targets, and without effective management a possible reduction in numbers of large reef fish.

Divers may be categorised into two groups : those who

consume resources in the area and those who do not. Submissions and the anecdotal information received from interviews with SCUBA divers and spearfishermen, suggest that there has been a significant impact on the reef-dwelling fish, lobster and shell stocks as a result of diving activities in the study area.

(i) **Spearfishing (Fin Fish)**

There are few quantitative scientific data on the impact of spearfishing on fish populations. Pollard and Scott (1968), however, blamed excessive spearfishing for the denudation of reef fish populations along inshore areas of the NSW coast. Divers interviewed by the study team attributed the reported decline in many fish populations in the study area to spearfishing. This applied especially to the larger reef fish (for example, dhufish, blue groper and baldchin groper) which were considered to be once common around the nearshore and offshore reefs and abundant at Three Mile Reef, and are now rarely seen. Throughout the last 30 years there has been also, reportedly, a decline in abundance of the smaller, edible reef fish.

According to divers interviewed (Appendix 1), there has been a minimal decline of the larger pelagic fin fish species, which are speared only infrequently. Overall, according to the divers interviewed, spearfishing

appears to have had the greatest impact on the reef dwelling fish, especially on the larger, more sluggish species.

(ii) **Spearfishing (Western Rock Lobster)**

Anecdotal information suggests that, prior to about 1965, rock lobsters, some very large, were abundant around the onshore, nearshore and offshore reefs in the study area. At present, rock lobsters are rarely observed on the onshore and nearshore reefs, but are still common on the offshore reefs. Many factors other than human activities can cause fluctuations in the abundance of a species in a particular area; however, in this instance, many divers interviewed (Appendix 1) suggested that spearfishing and hand collecting have had an effect.

(iii) **Collecting**

A variety of attractive shell species occur in the study area and have been intensively collected in the past, notably:

- cowrie — Cypraea venusta, forma sorrentensis
  C. friendii friendii
  C. marginata
- conch — Syrinx aruanus
- southern baler — Melo miltonis
- turban — Turbo torquatus

Small, cryptic gastropods are abundant throughout the

area on reefs and on the sand habitats. Extensive shell collecting on accessible reefs has led to localised depletion of the more attractive shell species, especially cowries including Cypraea venusta. The conch, baler and turban shells were probably never common in the area, and are now rarely seen in accessible localities.

The rarity of sea urchins, ascidians, starfish and other large, reef fauna on easily accessible onshore and nearshore reefs, from Trigg to Marmion, possibly reflects collecting pressure from casual beachcombers on attractive species. As with spearfishing, collecting results in preferential reduction of particular species, and it can be expected that, with time, there will be a continued decline in the abundance of attractive species.

(iv) **Passive diving activities**

In contrast to spearfishing and shell collecting, SCUBA-diving and snorkelling for observation, underwater photography or diving-skill exercises such as underwater navigation, are not destructive activities. The many sheltered reefs, and wide diversity of biota in the study area, already attract many divers. Passive diving activities have minimal deleterious impact on marine environments, and should be encouraged in the marine park. Underwater trails through protected reef

areas, such as the very popular underwater trail at Green Island in Queensland, would be educational and entertaining.

(e) **Sailing**

The Whitfords Bay Sailing Club organises sailing activities from Mullaloo Point. The most popular craft are small dinghies and catamarans. To a lesser extent, individuals launch trailer yachts from Ocean Reef launching facility. The recent decision to construct the Hillarys Boat Harbour will mean the provision of wet moorings for up to 1000 deep-keeled craft. Thus, it can be expected that there will be increased sailing activity in the study area, as well as increased demand for adequate facilities for beach launching of small craft at Mullaloo Point.

(f) **Windsurfing**

This activity is rapidly increasing in popularity in the metropolitan area. Mullaloo Point is particularly popular for launching windsurfers, since there is a car park, a launching ramp and ready access to calm waters and the offshore reefs.

(g) **Surfing and Waveskiing**

Nearshore waters adjacent to the coast south of Sorrento, and areas in the north of the study area, are popular surfing and waveskiing locations. Surf-breaks

around Little Island and parts of the Marmion Reef are also popular locations.

(h) **Powerboating**

Currently, powerboat owners utilise the study area for pleasure cruising, fishing and water skiing. Most launching takes place at Ocean Reef launching facility, with other launching at Mullaloo Point, the Trigg Island ramp and the Marmion Angling and Aquatic Club ramp. The main setdown area for water skiing is a sandy beach north of Mullaloo Point. With development of the Hillarys Boat Harbour and possible expansion of launching capacity at Ocean Reef launching facility, powerboating activity is likely to increase in the study area. Given this increase, there is likely to be increasing conflict between powerboating and other activities, especially nearshore in the vicinities of the Hillarys Boat Harbour, north of Mullaloo Point, and near Little Island.

3.3.5 Professional Fishing

Fisheries resources in the study area, of importance to professional fishermen, are the western rock lobster, Roe's abalone and various fin fish species (Fisheries Department submission). Professional fishermen are regulated by the Fisheries Department, and while there may be little likelihood that the professional catch will increase (Wilson, Hancock & Chittleborough, 1979), there will be increasing competition for

the fish resources from the increasing level of recreational fishing.

Professional fishermen recognise that it is in the best interests of their industry to maintain fishing catches at maximum sustainable yields, and accept regulation to achieve this. Amateur fishing, however, is more difficult to control, and, particularly with people not associated with recreational fishing clubs, potentially more likely to lead to overfishing or taking of undersize fish by angling, netting, spearing or hand-collecting.

As indicated above (Section 1.4), at the M10 workshop, there were strong opinions expressed that all forms of professional fishing should be banned from the study area, and that the area should be reserved exclusively for non-commercial activities such as personal recreation, education, conservation and scientific research. It should be noted, however, that while a minority of delegates were representing the professional fishing industry, most delegates considered that the fish resources of the proposed marine park could and should be managed to allow the continuation of both recreational and professional fishing.

It was recognised, however, that although professional fishing could be accommodated now, it was likely that, without comprehensive management of recreational fishing, there would be a decline in the professional catch as the

recreational catch increased. This could force professional fishermen out of the area through economic factors.

(a) **Western Rock Lobster (Panulirus cygnus)**

The study area covers about 30% of the 0-10 fathoms (0-18 m) depth area in transects 315 and 316 of the western rock lobster fishery. Therefore, the study area currently supplies about 80,000 kg of rock lobsters annually, worth approximately one million dollars annually at present prices. This represents about 0.7% of the total Western Australian catch. Some 30 boats fish the area during the peak of season, with 10 boats remaining all year (Fisheries Department submission).

(b) **Roe's Abalone (Haliotis roei)**

The stocks in the Trigg to Marmion area are capable of supporting an annual professional catch of 15 to 20 tonnes, which at $4/kg live weight, is worth $60,000 to $80,000. For Western Australia, this constitutes approximately 20% of the total annual catch of Roe's abalone (Fisheries Department submission).

(c) **Fin Fish**

Thirty four species of fin fish are listed in the 1983-84 (Australian Bureau of Statistics) commercial catch data for Block 3114, which encloses the study area. No specific figures are available for professional fin fishing catches in the study area; however, netting of sea mullet, and to a lesser extent

yellow-eye mullet, has occurred in the study area, annually between January and July, since about 1940. Currently about six professional netters fish the area (Fisheries Department submission). These mullet species are migratory, and caught mainly by beach seining, which is very selective.

From anecdotal reports, it seems that the sea mullet catches may have exceeded one tonne per week until the late 1960's. Anecdotal reports also suggest that maximum weekly catches in recent years are less than half the former quantity caught. The decrease has been attributed to increased onshore and nearshore activity, which deters the schools of migratory fin fish from coming close to the shore.

(d) **Trawling**

Trawling is currently forbidden within 800 m of the coast.

3.3.6 Education and Scientific Research

Demand for educational use of the study area is high. Ongoing educational use of the area including rocky shores, intertidal platforms, offshore reefs and their biota, and the dunes of the Whitford Plain, has been confirmed by various institutions, including the Education Department. There have been submissions made regarding the high value of the study area for scientific research. There are demands to set aside protected areas specifically for education and scientific research purposes.

3.3.7 Beach Litter

Litter is common on metropolitan beaches. Some types of litter can be a safety hazard (for example, glass bottles), some can harm or interfere with marine life (uncut bait-box straps, discarded fishing line or fishing nets), and all is aesthetically displeasing. Complaints from members of the public made to Fisheries Department (Fins Vol.16(2),1983; 17(2),1984; 18(4),1985) or DCE, regarding beach litter, are not uncommon. A DCE survey of beach litter indicated that up to 18 kg of litter (145-637 individual items) could be collected per 100 m of beach. About 70% of this beach litter could be attributed to recreational beach users, and about 30% came from professional fishermen. The quantity of litter from professional fishermen is unlikely to increase, while that from recreational users may well do.

3.3.8 Secondary Treated Effluent and Groundwater Discharge

The Beenyup sewage treatment plant discharges secondary treated effluent, containing nutrients, 1.6 km offshore from Ocean Reef, at a rate of about 35 million litres per day. This effluent includes 1750 kg/day of combined nitrogen and 440 kg/day combined phosphorus. The estimated discharge rate, for the year 2000, is 100 million litres per day. To date, there does not appear to have been any major impact detected on the surrounding ecosystem, though no detailed ecological investigation has been conducted.

Nutrients from this source add to those associated with groundwater, from beneath adjacent urban areas, which discharges along the coast (Section 2.3). Although nutrients from discharging groundwater can be detected up to a few hundred metres offshore, the general nutrient levels in the waters of the study area are not elevated (Pearce et al, 1984).

Nevertheless, groundwater presently delivers about 110 kg/day of combined nitrogen to waters of the study area, and, within the Marmion lagoon, the nitrogen load from groundwater is considered equal to about half the requirements for calculated growth of macrophytes. It should be noted, however, that

(i) nitrate and silicate concentrations in groundwater are two orders of magnitude higher than ambient concentrations in the receiving seawaters

(ii) nutrient concentrations in groundwater are likely to rise with the increasing urbanisation of the hinterland, and

(iii) groundwater is moving seawards at an estimated rate of 90 m/year (Allen, 1981).

It may be many years before the full impact of urbanisation, on groundwater discharging at the coast, is realised, at which time, reversal of the trend would be virtually impossible. Under present policies of the Water Authority of Western Australia, increasing urbanisation of the adjacent hinterland will inevitably lead to discharge of increasing volumes of secondary treated effluent, containing nutrients, to the coastal waters. Changes are being made, however, to the

processing of sewage received at Beenyup which will reduce significantly the combined nitrogen levels in the secondary treated effluent (WAWA submission).

Thus, increasing wastewater effluent discharge, and the increasing concentration of nutrients in seaward-moving groundwater, may contribute to elevated nutrient levels in the waters of the study area, which in turn, would increase the likelihood of algal blooms and eutrophication in the Whitford lagoon and adjacent marine areas.

3.3.9 Summary

Surveys of recreational use of the study area, carried out by Elliott et al (1985) and DCE, indicate that use of coastal land and nearshore waters is influenced largely by the nature of the coastline and access.

South of Sorrento, the small pocket beaches and associated car parks reach saturation during summer. Between Sorrento and Mullaloo, use of the sand beach is largely dependent on access and facilities. At any one time, up to about 300 people per 250 m of beach are found at Sorrento and Mullaloo on a normal summer day. With provision of upgraded access and car parks many more beachgoers could be accommodated between these two beaches. A rough estimate of the potential number of people that could be accommodated between Sorrento and Mullaloo (allowing for the construction of the Hillarys Boat Harbour) is in the order of 5000 at any one

time. This implies that there will be a demand for car parks, grassed picnic areas, kiosks, toilets, change rooms and pedestrian paths in coastal land to the west of West Coast Highway, especially between Sorrento and Mullaloo. As the population of the northern coastal suburbs increase, there will be growing potential for conflict amongst different user groups and increasing competition for space in the limited land area along the coast.

The coastal waters of the study area, adjacent to an expanding metropolitan population, provide a varied resource for many user groups. Some of the users consume resources; others do not. In view of the inevitable increasing demand on the area, it is clear that unless non-consumptive uses (such as swimming, boating and photography) are encouraged, and consumptive uses (such as fishing and shell collecting) are properly managed, there will be a decline in the biological resources. It is also clear that some uses conflict with others and that, unless incompatible user groups are separated by zoning of permitted activities, there will be conflicts.

4 OPPORTUNITIES AND CONSTRAINTS

The study area has certain characteristics which make it attractive.These characteristics are summarised below as opportunities and resources; however, it must be recognised and emphasised that natural environments have a limited capacity to absorb use pressure before they degrade. This capacity for regeneration sets limits on the types and levels of use that are permissible. These limits are summarised below as constraints. In order to plan for use of any natural system, the opportunities and resources that exist, and the constraints that limit use, must be appreciated.

4.1 Opportunities and Resources

The study area has the following opportunities and resources:

- outstanding examples of natural features and biotic assemblages, that are easily accessible from Perth;
- a large body of relatively protected water, between the outer reefs and the coast, and especially in the vicinity of Mullaloo Point;
- a stable rocky coast, with numerous small sandy coves between Trigg and Sorrento, and north from Mullaloo;
- a protected, sand beach stretching 5 km between Sorrento and Mullaloo;
- a coastal dune system, which is mostly stabilised by vegetation;
- space between the coast road and the beach north of Sorrento, to allow for natural coastal processes and for provision of recreational facilities;

- attractive scenery, and coastal panoramas visible from the coastal highways;
- a recreation resource for the Perth metropolitan area, and especially the rapidly growing northern suburbs;
- existing convenient access and potential access to all beaches and the rocky headlands along the coast;
- developed beach sites between Trigg and Sorrento, and at Mullaloo, with surf lifesaving clubs and other facilities;
- an eight ramp boat launching facility at Ocean Reef, with extensive car and trailer parking area and boat washing facilities;
- small boat launching ramps at Trigg, Marmion and Mullaloo Point;
- edible marine life, particularly fin fish, rock lobster and abalone;
- use patterns that are not well entrenched, especially north of Sorrento;
- a boat harbour under development at Hillarys, which will hold 1000 deep-keeled craft, provide four ramps for launching small boats, and increase boating and angling opportunities.

There is time and space to provide for a number of other uses that could take advantage of the natural attractions of the study area (for example, glass-bottomed boat tours around the nearshore high reefs).

4.2 Constraints

The study area has the following constraints, which will limit use and should be considered before development is approved:

- relatively small areas of high reef, which are easily affected by uncontrolled human pressures (fishing, collecting, anchoring damage);
- sandy parts of the coast which are liable to major changes in shoreline position through natural processes (for example, Mullaloo Point);
- a coast which is subject to onshore and offshore winds which are capable of transporting sand, especially if the natural vegetation cover or the dune scarp between Sorrento and Mullaloo Point are disturbed;
- an open landscape, which could be degraded easily, either by poorly sited or by poorly constructed developments;
- the existing locations of West Coast Highway and Ocean Reef Road, and the immediately adjacent urban areas zoned for urban residential development, which have set narrow limits on the width of Regional Open Space, especially south of Sorrento;
- current community expectations regarding the appropriate future uses of the Whitford Regional Open Space, local beaches and rocky shores;
- the presence of the OTC intercontinental telecommunications cable on the seabed in the vicinity of Mullaloo Point, which has necessitated the Department of Marine and Harbours prohibiting anchoring in a 1 km wide strip from west to east across the study area;

- Water Authority of Western Australia submarine outfall, discharging secondary treated effluent containing nutrients.
- considerably increased boat traffic (especially yachts) in the vicinity of Hillarys Boat Harbour, which will require management to avoid safety and environmental problems.

The greatest constraint is that the physical and biological resources of the study area are limited, and, in order to ensure sustainable use, careful planning and careful management are needed.

5 GENERAL MANAGEMENT PROPOSALS

5.1 Introduction

The area covered by the M10 recommendations and the adjacent coastal land has been acknowledged as being of high regional significance. Subsequently, the EPA (1983) recommended that the area be declared a marine reserve to be managed for scientific research, education, conservation and recreation.

As discussed in Sections 2 and 3 of this document, the investigations of the M10 study team, and the consensus views reached at the M10 workshop, in June 1985, support the EPA (1983) recommendations. In addition, there is argument for allowing some professional fishing to continue. Clearly, there is a great awareness of the area's ecological significance for the growing population of Perth, and of the area's limitations in terms of consumable resources. There are, therefore, sound reasons to endorse the EPA (1983) recommendations to declare the area a multipurpose marine protected area for the purposes of scientific research, education, conservation, recreation, and additionally, for restricted professional fishing. As discussed in Section 1.4, the CALM Act 1984 does not make provision for a marine protected area for multipurpose use such as implied in the System 6 Report (EPA, 1983); however, the Act does allow for the declaration of **marine nature reserves** and **marine parks.**

5.1.1 Vesting and Control of the Park

The Conservation and Land Management (CALM) Act 1984, in Sections 13(1) - 13(3), states:

> **13(1) Subject to section 14, the Governor may by order published in the Gazette, reserve any part of Western Australian waters as a** marine nature reserve **or a** marine park.
>
> **13(2) The reservation of a** marine nature reserve **shall be for the conservation of -**
> **(a) aquatic or terrestrial flora and fauna generally and their habitats;**
> **(b) marine and freshwater flora and fauna generally; or**
> **(c) any specified marine or freshwater -**
> **(i) animal, or**
> **(ii) plant life,**
>
> **or class thereof, or a combination of any of those purposes.**
>
> **13(3) The reservation of a** marine park **shall be for one or more of the purposes described in subsection (2) as well as for the purpose of public recreation.**

Section 6 of the Act states that marine parks will comprise all waters reserved under Section 13 as a marine park and all land reserved under Section 29 of the Land Act 1933 as a part of the marine park.

The onshore component of the study area includes land reserved under Section 29 of the Land Act 1933 (that is, the foreshore reserve and other reserves listed in Table 2), as well as privately and publicly owned land.

Sections 16(1) - 16(3) of the CALM Act 1984 state:

> **16(1) The Executive Director may enter into agreements with the owner, lessee or licensee of any land for the management of the land by the Department as a State forest, timber reserve, national park or nature reserve or as part of a marine nature reserve or marine park under this Act.**
>
> **16(2) The Executive Director shall not enter into any agreement under this section with the lessee or licensee of any land unless the owner, and any person occupying the land with the consent of the owner, has given approval in writing to the agreement.**
>
> **16(3) An agreement shall not be made under this section so as to bind the Executive Director to do anything in relation to any land which is inconsistent with or contrary to a management plan for that land or with the provision of section 56 relevant to land of the category to which that land belongs.**

Under this section of the CALM Act 1984, it would be possible to include the foreshore component of the study area within the marine park, if that was deemed desirable.

It would also be possible for the foreshore component to be jointly vested in the National Parks and Nature Conservation Authority and the two local authorities, for several purposes including that of a marine park.

Subject to the provisions of Section 16, a management plan shall be prepared, which under Sections 55 and 56, shall contain a statement of the policies or guidelines proposed to be followed, and a summary of the operations to be

undertaken, which will have the objective of achieving or promoting the purpose for which the land (and waters) are vested.

Therefore, the Act allows not only the waters below high water mark to be vested in the National Parks and Nature Conservation Authority and managed by CALM, but also the adjacent land to be included in a marine park and managed by CALM, subject to the Executive Director of CALM reaching agreement with owners on a management plan. In this instance, both lands and waters of the study area would be included in a marine park as defined by the Act.

Alternatively, the waters only of the study area could be declared a marine park under the Act, with the land component included by agreement in **a non-statutory management area,** which in this document will be referred to as **a greater marine park.** In this instance, the Executive Director of CALM would reach an agreement with the owners or vestees of adjacent land on an appropriate management strategy and then the marine park and adjacent lands would be managed accordingly. The owners or vestees of the land would retain control of these foreshore lands and would be responsible for management of their land. This alternative would enable the two local government authorities to continue their present management functions with respect to their foreshore lands. In view of the effective management by the two local government authorities, this option seems most appropriate.

Hence, it is proposed that the waters of the study area be declared a **marine park** under the CALM Act 1984 and vested in the National Parks and Nature Conservation Authority. It is also proposed that the adjacent lands, to the west of West Coast Highway/Merrifield Place/Ocean Reef Road, and its proposed extension be included, by agreement between the Executive Director of CALM and the owners or vestees, in a non-statutory management area referred to as **the greater marine park.**

5.1.2 Boundaries

The System 6 Report (EPA, 1983) shows the boundary of the proposed marine park between Trigg Island and Ocean Reef launching facility, and enclosing Three Mile Reef and Centaur Reef. Apart from Trigg Island, which is easily discerned, the other three corner points are related only loosely to physical features. Therefore, it is proposed that Trigg Island be used as the southern reference point.

As discussed in Section 1.2, it would be logical to include in the greater marine park adjacent coastal land, from which most demands on the park originate and where most facilities, associated with use of the park, are located. Extension of the park to Burns would include onshore reefs similar to those between Trigg and Sorrento, as well as Burns Rocks, and an area of land recommended by the MRPA (and endorsed by the EPA) to be reserved for parks and recreation. This land includes a diverse coastal environment (EPA, 1983) including

an area of coastal heath noted in Woods (1984b) as having significant conservation value. Extension of the marine park to Burns would maintain options for regulating use of terrestrial and marine resources in this area.

Therefore, it is proposed that Burns Rocks, and the onshore reefs and sandy beaches north to Burns be included in the marine park, with the northern reference point being Burns Rocks. Hence, it is proposed that the eastern boundary follow West Coast Highway, Merrifield Place, Ocean Reef Road and its northern extension to Burns, so that all land to the west which is generally reserved Regional Open Space, and which incorporates land referred to in System 6 Report Recommendation M2 (EPA, 1983), is included in the greater marine park.

Recommendation (2): the waters of the area shown in Figure 3 and Figure 9, up to high water mark* and including the whole part of Little Island, be declared a marine park under the CALM Act 1984, and be vested in the National Parks and Nature Conservation Authority.

* High water mark refers to high water mean of Spring tides (HWM).

Recommendation (3): the marine park, as recommended in Recommendation (2) above, should have the following boundaries

- **from the southernmost part of Trigg Island due west to the limit of waters under Western Australian jurisdiction (that is, due west 3 nautical miles : about 5.4 km);**

- from a point equidistant between the two Burns Rocks, due east to high water mark and due west to the limit of waters under Western Australian jurisdiction;
- the line running approximately north to south which marks the westernmost limit of State waters under Western Australian jurisdiction;
- the line running approximately north to south at the high water mark, which is also the western boundary of the proposed foreshore reserves in the greater marine park, and
- excluded from above at their outer (seaward) boundaries, the Ocean Reef boat launching facility and the Hillarys Boat Harbour.

Recommendation (4): the foreshore lands, adjacent to the marine park as described in Recommendations (2) and (3) above (that is those foreshore lands between West Coast Highway/Merrifield Place/Ocean Reef Road and its proposed extension, and high water mark), be the subject of agreements between the Executive Director of CALM and the land owners or vestees, for joint management as part of the greater marine park.

5.1.3 Name of the Marine Park

Several names have been suggested, including Hillarys, Marmion, Mettams, Mullaloo, Ocean Reef, Sorrento and Whitford. One of the original developments in the area was the Marmion whaling station which stood on the ground now occupied by the caravan park at Sorrento, and after which, presumably, the suburb Marmion, the Marmion lagoon and the Marmion Reefs were named. The name Marmion therefore has a longstanding, readily identifiable, geographical

association with the area, and, hence, is suggested as an appropriate name for the marine park.

5.2 External Consultation

5.2.1 Scientific Advice

In view of the importance of the park, to residents of Perth specifically, and to Western Australians in general, it would be appropriate that scientific expertise be obtained from bodies such as AMSA, CSIRO, DCE, Fisheries Department, tertiary institutions, and the Western Australian Museum:

(a) to provide independent scientific and technical advice;

(b) to advise on appropriate scientific studies and monitoring programmes within the marine park;

(c) to assist with interpretation of the results of these scientific studies and monitoring programmes; and

(d) to assist with review of the monitoring programmes and management policies for the marine park.

5.2.2 User-Group Advice

At the M10 workshop, it was evident that many local user groups have a strong interest in providing a positive, informed contribution to management of the marine park. The existence of groups such as Sorrento and Mullaloo Surf Life Saving Clubs, the Whitfords Sea Rescue Group, the Whitfords Sea Sports Club, and the Marmion Angling and Aquatic Club, indicates that the philosophy of self-management and self-support is present in the community, and that, in practice, it succeeds.

In view of the demonstrated interest of these largely self-supporting groups, and other informed community groups, in the future of the marine park, it seems logical that they be involved in its planning and management.

5.3 Management Committee

Establishment of the Department of Conservation and Land Management provides an agency which can assume sole responsibility for co-ordinating the planning and management of marine parks. The greater marine park comprises land and waters, within which various organisations and statutory authorities have interests through vesting, lease and ownership, or have statutory control over aspects of planning and management.

As previously stated, existing planning and management of the land component of the greater marine park is primarily the responsibility of the Shire of Wanneroo and the City of Stirling. The Department of Fisheries, the Department of Marine and Harbours and the Fremantle Port Authority have responsibility over various aspects of the water component. The MRPA and WAWA also have statutory responsibilities in the area.

The two local government authorities presently provide effective management over the land component of the study area. These two local authorities have a commitment to, and experience in, coastal management, and have strong vested interests in future planning and proper management of the foreshore components of the greater marine park.

Suggestion: a management committee including the Shire of Wanneroo and the City of Stirling be established, under the direction of the Department of Conservation and Land Management, to implement the management plans for the marine park and the greater marine park.

The committee could consist of representatives from

- Department of Conservation and Land Management
- Department of Marine and Harbours
- Fisheries Department
- Fremantle Port Authority
- City of Stirling
- Shire of Wanneroo
- Department of Sport and Recreation

A suggested management structure is shown in Figure 8.

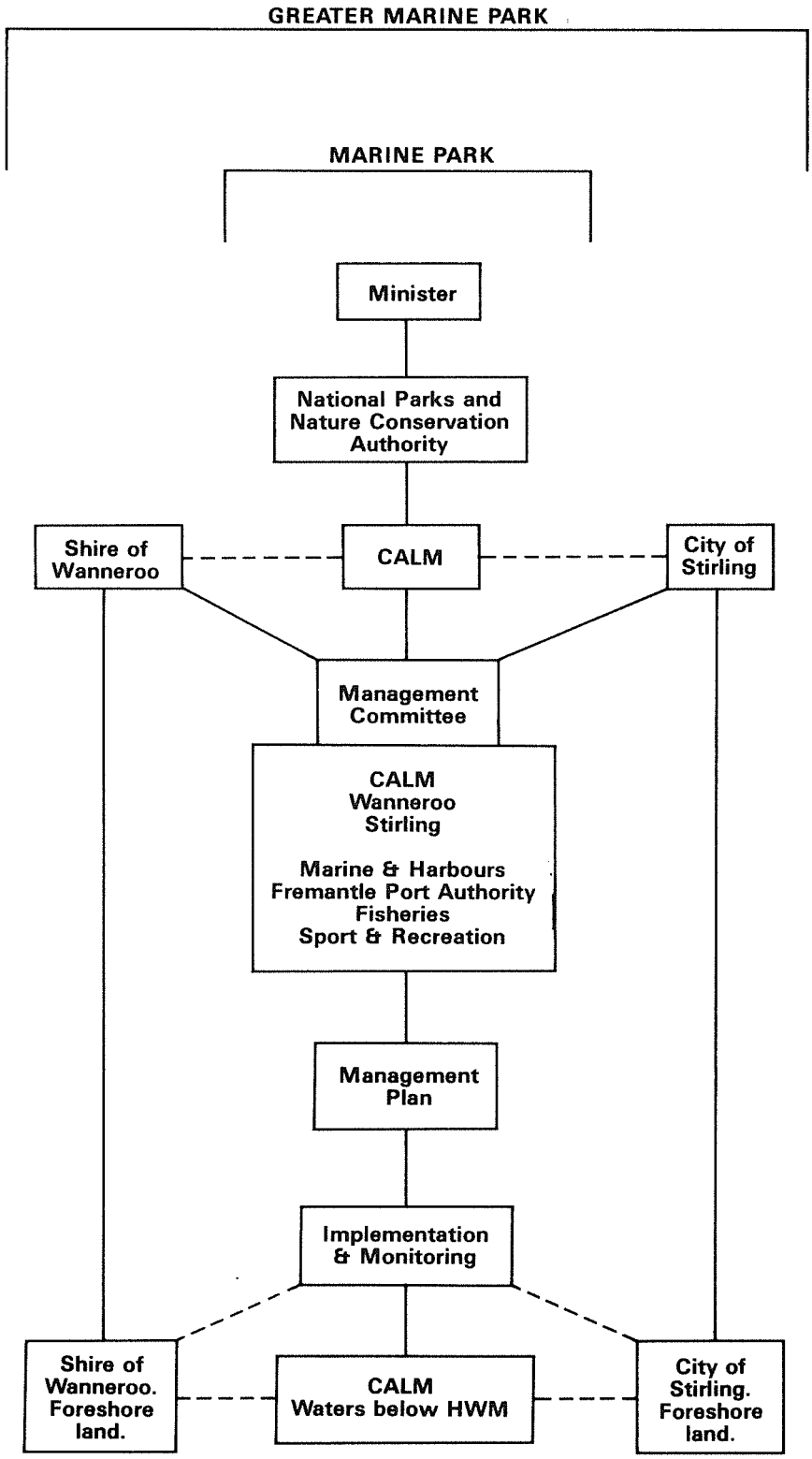


Figure 8 **Management structure suggested for the proposed marine park and greater marine park.**

5.4 Tenure

Currently, land in the greater marine park is owned by, or vested in various bodies which, in practice, will make preparation and implementation of an overall management plan complex. At present, most of the land in the greater marine park area is in the Shire of Wanneroo, and most is either owned or being purchased by State agencies (Figure 5). In order to simplify management responsibility, there appear to be two options in respect of foreshore land tenure in the greater marine park area; namely that all State lands be vested in :

(i) the Department of Conservation and Land Management, or

(ii) the local government authorities (Shire of Wanneroo and City of Stirling).

Under the first option, there would be mixed ownership of land, and management responsibility would be divided between CALM and the two local authorities. Under the second option the land component would be vested in or leased to the two authorities and therefore management responsibility would be more clearly defined, with CALM responsible for the water component (marine park), and the local government authorities responsible for the foreshore lands. The second option is considered the better arrangement.

Recommendation (5): all land owned by the State Government (or acquired by the State) in the greater marine park be vested in, or leased to, the appropriate local government authority, for co-operative management by agreement with the Executive Director of CALM as part of the greater marine park.

5.5 Purpose

Following receipt of submissions from a wide range of user groups, a workshop was held on 12 June, 1985, to assess attitudes to Recommendation M10 of the System 6 Report, to the proposed marine park, and to give user-group organisations the opportunity to contribute to this draft management plan. A major issue that arose during the workshop was the question of primary purpose of the area. The majority opinion was that recreation and conservation should have the highest priorities followed by education and scientific research which are also of high priority.

5.5.1 Recreation and Conservation

The greater marine park as recommended in this management plan includes both marine waters and coastal foreshore land, and, therefore, recreation and conservation aspects of both components (marine and terrestrial) should be considered. In view of the proximity to Perth and the evidence that the study area has been considerably altered by human activities over the past 50 years, preservation of the area, in the sense of preserving a pristine wilderness, would be difficult to justify, especially considering the popularity of the study area for recreation. Certain features, however, are worthy of preservation for conservation, education and scientific research purposes, and for aesthetic reasons.

Looking at the entire area from a conservation point of view, it is acknowledged that:

- the biota of the area is very diverse, but no species, community assemblages or habitats have been identified or indicated which are unique to the study area; and
- other natural features in the area, such as the inshore reefs, may be regarded as outstanding, but the geomorphological structures and the biological assemblages are similar to those found elsewhere.

Conservation of this particular area, therefore, is important in that the biological resources and natural features must be protected to provide for other purposes on a sustainable basis.

Participants at the M 10 workshop endorsed the principle that conservation of the marine park should be directed at maintaining resources for the other activities. At the same time, it was acknowledged that certain activities may have to be restricted as some areas are more sensitive than others, and these areas could require protection to maintain their value. This principle is therefore consistent with the EPA (1983) recommendations, which acknowledged the importance of the area for conservation, education and recreation, and consistent with the consensus opinion reached at the M 10 workshop, that conservation be directed at maintaining resources of the area for the other purposes, especially for recreation.

It is clear that two types of recreation occur in the study area, namely consumptive recreational activities and non-consumptive activities. In particular, it has been recognised that consumptive recreation will need to be regulated to maintain the consumed resources on a sustainable basis, whereas non-consumptive recreation can be enjoyed and promoted with minimal loss of resources.

As described in the CALM Act 1984, a marine park can be set aside for conservation and recreation. Therefore, declaration of the marine park will ensure its conservation without precluding its use for recreation. Recreation is regarded as the primary user activity in the park, but it must be recognised that conservation of the resources is the ultimate and most important objective of the park management and managers.

5.5.2 Education and Scientific Research

As an important part of their education programmes many schools and tertiary institutions conduct class excursions to the coast in the proposed park. The following resources are studied:

- intertidal, onshore reefs
- coastal dune systems (Whitford Plain)
- geological section at Ocean Reef
- geomorphological features, including the 'pinnacles', caves and solution pipes
- offshore marine communities

Of the resources used for educational purposes in the study area, the onshore intertidal reefs are the most susceptible to degradation through collecting, active interference with biological and physical resources, and trampling damage. The onshore reefs, nearshore reefs and Little Island have enormous potential for the development of marine nature appreciation courses by secondary schools and recreational diver training groups.

Education of both students and the public will be important in managing any marine park, because it will lead to a greater understanding and appreciation of marine life and marine processes. This in turn should introduce, or reinforce, the conservation ethic in users, which should in the long term lead to increased awareness of the importance and value of the area, thereby facilitating comprehensive management.

The study area is well suited to marine research, as it contains diverse marine environments in relatively sheltered waters, though few major scientific research projects are being undertaken there at present. Scientific research is important not only in providing an understanding of the physical and biological processes, but also in providing baseline and monitoring data for management strategies.

Concern: Educational activities and scientific research be regarded as approved, and necessary, purposes of the greater marine park.

5.5.3 Professional Fishing

As indicated in Section 3.3.5, professional fishing in the marine park provides significant economic benefit to the people of Western Australia.

Since the EPA (1983) recommendations were made, there have been representations that professional fishing should be permitted in the marine park, as it is in other Australian marine parks. At the M10 workshop, the general consensus of opinion from participants, representing a wide range of user groups, was that professional fishing in the area should be permitted, providing that the effects of fishing are monitored and assessed. It was also acknowledged, however, that as recreational pressure on the park increases, the effects of recreational fishing pressure will also need to be monitored and assessed, and that the fish resources as a whole should be managed in a rational, scientifically-based manner to accommodate both recreational and professional fishing activities.

Suggestion: Professional fishing be permitted to continue in the marine park.

5.6 Management Strategy

From the foregoing discussion it is clear that the proposed park is important for many reasons, and that an overall management strategy is needed to take advantage of existing opportunities and to avoid ad hoc decision making.

5.6.1 Objectives

In view of the System 6 Report (EPA, 1983) recommendations, their endorsement by State Cabinet, the many preliminary submissions received, and consensus views reached at the M 10 workshop, eight objectives are proposed as a guide for development and management of the greater marine park for sustained multi-purpose use for the benefit of the people of Western Australia.

Objectives

1 to maintain and restore where appropriate, the terrestrial and marine resources

2 to preserve and manage resources of conservation, education, recreation, scientific, aesthetic or historic value

3 to provide appropriate facilities for a wide range of recreational activities, consistent with the capacity of the natural systems to accommodate them

4 to provide public access to the coast in such a manner that minimal environmental damage takes place

5 to ensure that any permitted development along the coast is consistent with management objectives of the greater marine park

6 to develop the educational potential of the marine park in order to increase appreciation, understanding and enjoyment of the natural terrestrial and marine environments

7 to encourage scientific research in order to reach a better understanding of the greater marine park environments and communities, and

8 to encourage research into the impact of permitted uses on resources, environments and communities within the greater marine park.

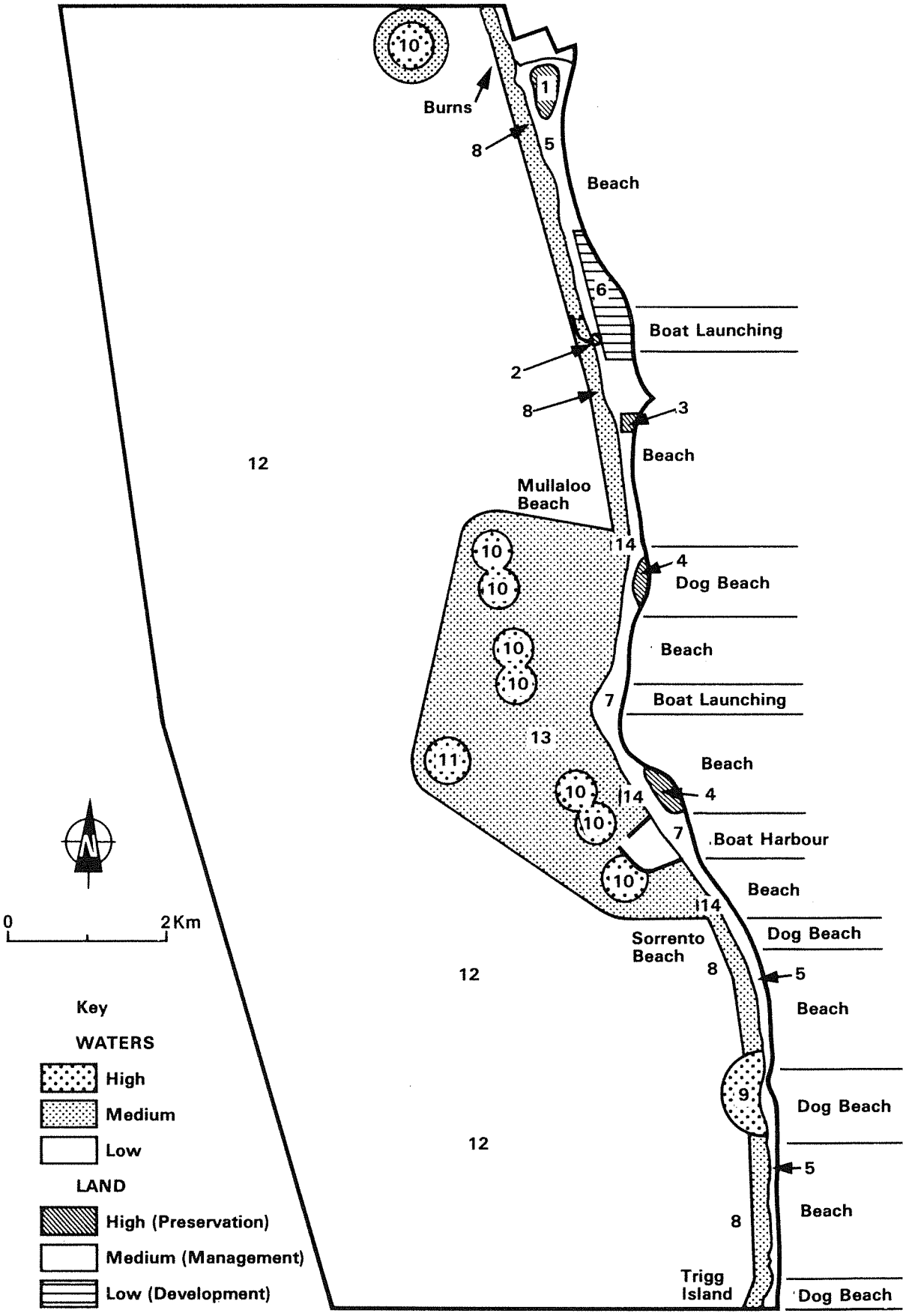


Figure 9 Proposed zoning of land and waters (see Table 3 for key to numbers).

5.7 Resource Allocation

In order to achieve the above objectives, a system of zoning is proposed which takes into account:

- the attractions or resources in the area
- the limitations or constraints imposed by the natural environment
- demand and use pressures
- practical management considerations.

It is proposed that the system of zones be reviewed regularly, perhaps every two or three years and if necessary be modified to take into account new monitoring data and scientific information. Through a flexible system of zoning:

- potentially conflicting user groups can be separated
- the impacts of destructive activities on specific resources can be assessed and controlled
- results of monitoring can be incorporated into the management process, to allow for permanent or temporary closure of areas that are degrading.

5.7.1 Marine Zoning

For the marine component of the park, three major zones are proposed: high, medium, and low protection, in which different activities are permitted according to the main purposes of the zone. A suggested zoning layout is shown in Figure 9 and Table 3, and suggested permitted activities are shown in Table 4. The areas covered by each zone are shown in Figure 10.

TABLE 3: Features, characteristics, management aims and proposed zoning of resources in the greater marine park

	Features	Characteristics	Management aims	Proposed zoning
	LAND			
1	coastal heath at Burns	good representation of closed coastal heath	preserve resource	high
2	geological cross-section	exposed Pleistocene beach section	preserve resource	high
3	Pinnacles at Ocean Reef	unusual limestone formation	preserve resource	high
4	coastal dune system on Whitford Plain	good example of large dune system	preserve resource	high
5	rocky coast: Trigg to Sorrento Ocean Reef to Burns	platforms, caves and solution pipes	maintain resource	medium
6	land behind coast at Ocean Reef	elevated and stable land	maintain options for development	low
7	remainder of coastal land	generally well vegetated, partially developed, and in places potentially unstable	develop recreation facilities while minimising environmental' degradation	medium
	WATERS			
8	onshore reefs	easily accessible intertidal reef platforms supporting marine communities	maintain resource and provide limited consumptive recreation	medium
9	onshore reef (Waterman)	diverse marine life	preserve resource	high
10	nearshore reefs	high habitat and marine life diversity due to the geomorphology	preserve resource	high
11	Little Island	only island - refuge for seabirds and sea lions	preserve resource	high
12	offshore reefs	large areas of low and high reef with a high habitat diversity	main resource as a productive fishing and diving area	low
13	Lal Bank	shallow water over seagrass stabilised sand	maintain resource and provide limited consumptive recreation	medium
14	sandy beaches	naturally mobile land form	accommodate recreation pressures	medium

i) **High Protection Zone**

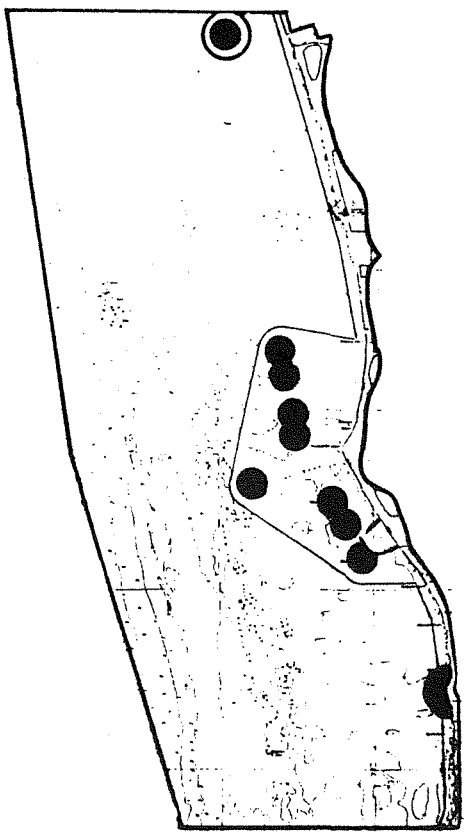
This zone consists of ten discrete areas: part of the onshore reef adjacent to the Waterman Research Laboratory; seven nearshore reefs (Boyinaboat Reef, Cow Rocks, Wanneroo Reef, Wreck Rock, Whitford Rock, the Lumps and North Lump), Little Island and Burns Rocks (south). The management aims in this zone are:

- to preserve the physical and biological character of the area for the purposes of non-consumptive recreational activities, education and approved (non-destructive) scientific research
- to allow recovery of the fish, mollusc and crustacean resources
- to provide control areas against which impacts on other marine parts of the park can be assessed.

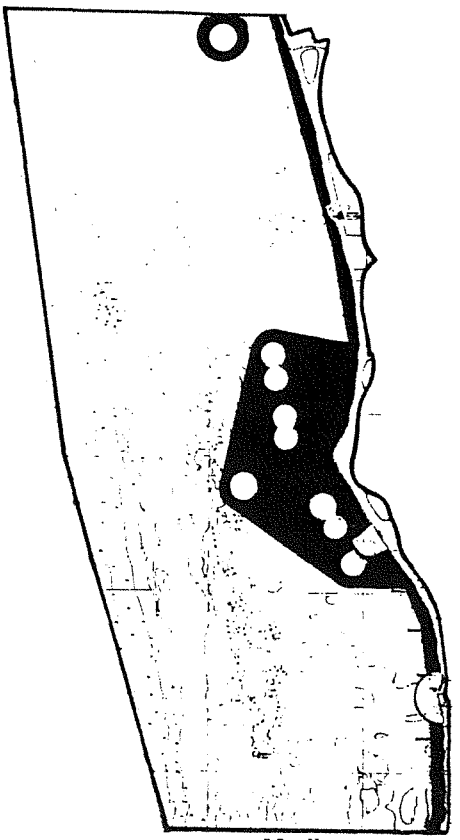
ii) **Medium Protection Zone**

This zone includes the sandy beaches, parts of the onshore reefs, parts of the nearshore reef chain; Lal Bank; part of the offshore reef adjacent to Little Island, and an area surrounding Burns Rocks (south). The management aims in this zone are:

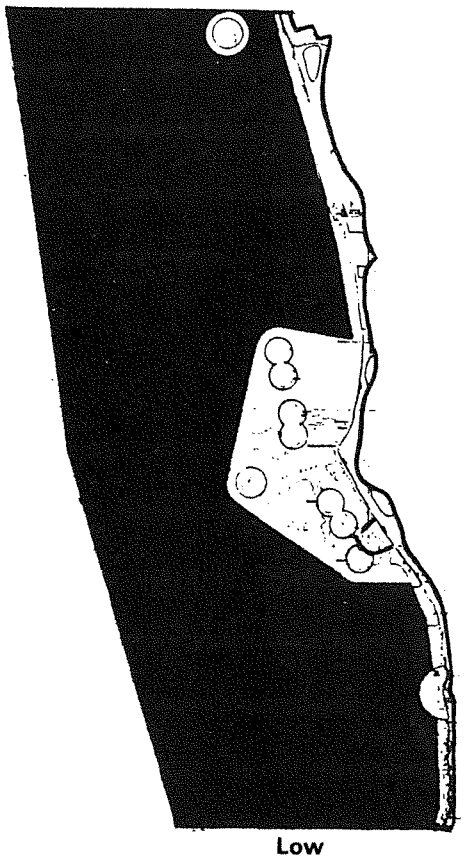
- to provide for limited consumptive recreation in the form of line fishing and abalone collection.
- to provide for education and approved (non-destructive) scientific research
- to provide control areas in which to assess the impact of specific consumptive activities.



High



Medium



Low

Area of High Protection Zone = 2%

Area of Medium Protection Zone = 11%

Area of Low Protection Zone = 87%

Figure 10 Areas covered by the various zones in the marine park.

TABLE 4: Suggested activities for high, medium and low protection zones in the proposed marine park

	High Protection Zone	Medium Protection Zone	Low Protection Zone
RECREATIONAL			
Non-consumptive			
Swimming	Yes	Yes	Yes
Snorkelling (looking, photography)	Yes	Yes	Yes
Compressed, air diving (looking, photography)	Yes	Yes	Yes
Sailing, surfing, Windsurfing, waveskiing	Yes	Yes	Yes
Visiting or landing	Yes	Yes	Yes
Anchoring	No	Yes	Yes
Power boating	No	Yes	Yes
Consumptive			
Beach angling	No	Yes	Yes
Boat angling	No	Yes	Yes
Abalone collecting	No	Yes(S)	Yes(S)
Rock lobster potting	No	No	Yes(S)
Snorkelling (spearfishing, collecting)	No	No	Yes
Compressed air diving (spearfishing, collecting)	No	No	No
Trolling	No	No	Yes
Netting	No	No	No
PROFESSIONAL FISHING			
Anchoring	No	Yes	Yes
Line fishing	No	Yes(P)	Yes(P)
Abalone diving	No	Yes(P)	Yes(P)
Netting	No	Yes(P)*	Yes(P)
Rock lobster potting	No	No	Yes(P)
Compressed air diving	No	No	Yes(P)
Dredging	No	No	No
Trawling	No	No	No
EDUCATION AND SCIENTIFIC RESEARCH			
Destructive	No	Yes(P)	Yes(P)
Non-destructive	Yes(P)	Yes	Yes
OTHER			
Blasting	No	No	No
Dredging	No	No	No

(S) Subject to seasonal restrictions and permit if required
(P) Subject to acquiring a permit

* To be phased out as existing licence holders retire from fishing.

(iii) **Low Protection Zone**

This zone covers the remainder of the park, including the offshore reefs, Marmion lagoon and Whitford lagoon. Management aims for this zone are:

- to provide for appropriate consumptive recreational use (including line fishing, spearfishing, abalone and other mollusc collection), and for professional fishing
- to protect the marine park from specific destructive activities (including blasting, trawling and dredging) which are inconsistent with the stated management objectives for the park.

5.7.2 Land Zoning

For the land component of the park, three zones are proposed: high, medium and low. These correspond to the preservation, management and development units respectively of Woods (1984 a,b). The proposed zoning layout is shown in Figure 9. In order to separate potentially conflicting user-groups, allocation of resources to particular user-groups has been superimposed on the zoning plan. The proposed resource allocation conforms basically with the existing situation in the City of Stirling (City of Stirling, 1984), and the situation already suggested for the Shire of Wanneroo (Scott & Furphy, 1979; Woods, 1984 b).

(i) **High Protection Zone (Preservation Unit)**

This zone includes preservation areas as recommended

in Woods (1984 b); namely, the two dune systems on the Whitford Plain, the area of pinnacles north of Mullaloo, the geological cross-section in the WAWA trench, and the area of heath south of Burns Beach. No preservation areas were recommended in the City of Stirling Coastal Report (City of Stirling 1984).

The management aim for this zone is:

- to preserve the physical and biological resources in their present state for the purposes of non-consumptive recreation, education, approved scientific research, and to maintain the aesthetic quality of the coastal scenery.

(ii) **Medium Protection Zone (Management Unit)**

The zone includes most of the coastal land in the park including the beaches, foredunes, dunes and rocky cliffs. The management aims of this zone are:

- to maintain the integrity of the coastal system, where possible through protecting dunes and their vegetation and allowing natural coastal processes to take place
- to develop appropriate facilities to provide for a wide range of regulated recreational activities in the area
- to provide access to the coast for vehicles, pedestrians and water-based users, as well as along the coast for pedestrians

- to provide for the requirements of recreational users of small boats
- to separate conflicting user-groups

The allocation of the zone to various user groups is shown in Figure 9.

(iii) **Low Protection Zone (Development Unit)**

This zone covers the stable limestone platform adjacent to the Ocean Reef boat launching facility and at Burns. The management aims of this zone are:

- to maintain the integrity of the coastal system (that is, coastal stability) at minimal cost
- to provide access to and along the coast
- to maintain options for development of appropriate high capital cost facilities (for example, hotels, other forms of accommodation, restaurants).

The location of this zone is shown in Figure 9.

Recommendation (6): the concept of zoning, for management of the marine park, and foreshore lands to be included in the greater marine park, be endorsed.

Suggestion: that the arrangement of zones and the activities permitted in each zone (as described in Figure 9 and Table 4) be adopted.

Suggestion: that the declared zones be reviewed at regular intervals of not more than three years, and that the management committee amend the size and location of zones as appropriate within the boundaries of the greater marine park.

6 SPECIFIC MANAGEMENT PROPOSALS

6.1 Access

6.1.1 Onshore

Increasing use of the study area will result in a growing demand for better access to the coast. This demand should be met by an access system that takes into account aesthetic and environmental issues, and which complements existing and proposed facilities.

Suggestion: the recommendations concerning access in the City of Stirling (City of Stirling, 1984) and Shire of Wanneroo (Woods, 1984 a,b; 1985) coastal management plans be endorsed.

Suggestion: vehicle use in the onshore component of the park be controlled by the provisions of the Control of Vehicles (Off-Road Areas) Act 1978.

6.1.2 Offshore

Following construction of the Hillarys Boat Harbour and expansion of the boat launching capacity at Ocean Reef launching facility, much of the current demand for boat access will be met and rationalisation of the existing low-volume ramps at Trigg Island and Mullaloo Point would be appropriate.

Suggestion: recommendations regarding the Trigg boat ramp in the City of Stirling Coastal Report (City of Stirling, 1984) be endorsed (that is, to maintain the facility as a low-volume boat ramp for launching small boats).

Suggestion: in the vicinity of Mullaloo Point, vehicles be permitted access only to the areas immediately adjacent the boat launching ramp, and access of vehicles to the beach be phased out as the ramps in the Hillarys Boat Harbour become operational.

Suggestion: recommendations regarding the Mullaloo Point boat launching area in Woods (1984, b) be endorsed (that is to maintain the area for launching of small boats without the aid of vehicles).

Suggestion: a water ski pick-up and set-down area be designated north of the Mullaloo Point.

6.2 **Conservation of Special Areas**

Certain areas are recognised as being important as representatives of specific habitats and natural features, and activities that may degrade or disrupt use or appreciation of these areas should be restricted.

Recommendation (7): the following areas be recognised as of particular value and significance for the greater marine park:

(a) Little Island

(b) Boyinaboat Reef, Cow Rocks, Wanneroo Reef, Wreck Rock, Whitford Rock, The Lumps, North Lump

(c) Burns Rocks (south)

(d) Waterman Marine Reserve

(e) part of the Whitford Plain dune system

(f) the Pinnacles

(g) geological cross-section at Ocean Reef *

(h) coastal heath (south of Burns).

* Preservation of one of the existing geological cross-section faces, or a new face after further earthworks, is suggested.

Suggestion: high protection zones be declared around Little Island and each of the nearshore reefs listed above, for a radius of 250 m from a defined centre point on each reef.

Suggestion: that consideration be given to establishing fixed mooring sites within the high protection zones, to facilitate the entry of people to the high protection zones for non-destructive activities (such as underwater viewing and underwater photography).

Suggestion: that some of these high protection zones be rotated to a medium protection zone for prescribed periods and purposes as determined by the management committee.

Suggestion: that the Waterman Marine Reserve be increased in size, from the existing 400 m radius to a 500 m radius.

6.3 Recreation

The study area is recognised as having significant recreational value. Declaration of the area as a marine park will lead to further opportunities for controlled development of high recreational potential.

Suggestion: recreational development of the land component, and allocation of beach space to various user groups between Trigg Island and Beach Road, follow proposals in the City of Stirling Coastal Report (City of Stirling,1984)

Suggestion: allocation of beach space to various user groups between Beach Road and Ocean Reef launching facility basically follow proposals in Woods (1984,b and 1985) with allowance made for the Hillarys Boat Harbour (Figure 9).

Suggestion: recreational development of the Whitford Plain area follow the basic proposals by Scott & Furphy (1979) for the Shire of Wanneroo.

Suggestion: new animal exercise (primarily dog) beaches should be declared between the Marmion Angling and Aquatic Club and Clontarf Road, and opposite the dune preservation unit south of Mullaloo Drive.

6.4 Education

The study area is recognised as a valuable educational resource. Declaration of the area as a marine park and management as part of a greater marine park would lead to further expansion of educational use by students and members of the general public. An important consequence of this education process is that interpretation of the natural features and coastal processes should enable people to have a better understanding of coastal environments and increased appreciation of the reasons for conservation.

Recommendation (8): a public education and display area be established in conjunction with a ranger office, in the foreshore component of the greater marine park. An appropriate location for this facility could be in the area proposed for development adjacent to the Hillarys Boat Harbour.

Suggestion: the public education/ranger facility consist of

- a ranger's office and marine park information office
- a public education exhibition and display area, and
- a storage/workshop area for rangers' boats and equipment.

Suggestion: a range of pamphlets and public education materials be prepared that contain information about the greater marine park including:

- aims and philosophy of the greater marine park
- access system and explanatory signs
- zoning and activities permitted in each zone, and
- coastal environments and marine life.

Suggestion: a system of onshore (for walkers) and underwater (for snorkellers and SCUBA-divers) nature trails be established.

6.5 Scientific Research

The area is particularly suitable for marine research. It is clear that there will be a need for research as part of the management process, including gathering of basic data, monitoring of use pressures, and assessment of the effectiveness of management policies.

Suggestion: a review be carried out at the earliest opportunity of research programmes and requirements in the greater marine park.

6.6 Fishing and Collecting

(a) Amateur Fishing

An increasing level of amateur fishing could have major impact on

fish in the marine park; however, recreation is seen as an important purpose of the park, and amateur fishing is one of the most popular recreational activities. To ensure that amateur fishing can be sustained within the park, it must be properly regulated. This will require monitoring and managing amateur fishing jointly with that of professional fishing.

Recommendation (9): that all fish stocks, taken by any means within the marine park, be monitored, and that recreational and professional fishing be allowed and regulated under the Fisheries Act 1905 - 1979 (as amended).

Suggestion: that trawling or dredging within the marine park should not be permitted.

Suggestion: that recreational fishing by netting within the marine park should not be permitted.

Suggestion: that professional fishing by netting within the marine park be phased out as existing licence holders retire from professional netting in the park area.

Suggestion: line fishing by commercial charter operation be a permitted activity in the low and medium protection zones, by permit only.

Suggestion: other forms of fishing (for example, angling and spearfishing) be permitted in the appropriate protection zone as shown in Table 4 (see Recommendation 9).

(b) Collecting

Collecting is carried out by amateurs on impulse or for personal collections, and by professional collectors who take shells, live fish and other marine life for sale or exchange. The uncontrolled taking of fish, shells and other materials is not compatible with the objectives of the park.

Suggestion: collecting of live fish (for aquarium use) or collecting of specimen shells and other marine life be not permitted in the park, other than by permit.

6.7 Monitoring

An essential element of a management programme is monitoring the effectiveness of:

(a) regulations designed to minimise the impact of users on resources;

(b) protecting fragile areas from degradation by human pressures;

(c) providing access to resources and opportunities to users.

Recommendation (10): monitoring programmes be established to maintain constant assessment of resources and human impacts on resources within the greater marine park, to ensure sustained multipurpose use.

6.8 Hillarys Boat Harbour

The proposal to construct a boat harbour north of Sorrento, to provide wet moorings for 1000 deep-keeled craft and four launching ramps for trailer boats, has been supported by the State Government, which approved the construction in June 1985. The EPA assessed the

ERMP for the boat harbour and made a number of recommendations (EPA, 1985) concerning known or potential environmental impacts.

Concern: in addition to commitments made in the ERMP the water quality criteria which should be met within the boat harbour are those in Schedules 1 and 7(c) of the EPA's water quality criteria and which are reproduced in Appendices C and D of the EPA (1985) report. These criteria should be used to assist in setting the objectives of the water quality monitoring and management programme.

Concern: a comprehensive monitoring and management programme be developed by the proponent in consultation with the Department of Conservation and Environment to the satisfaction of the EPA, and that appropriate resources be allocated for the proponent to implement it through the body proposed (EPA, 1985).

The programme should aim to achieve the following :

(i) measure physical, biological and chemical parameters appropriate to Recommendation 3 within and outside the harbour;

(ii) develop a predictive model for water circulation and exchange, and test the model with field data;

(iii) include as an objective maintenance of Schedule 7, Class (1) water quality criteria at Boyinaboat Reef;

(iv) include monitoring and management of coastal processes including plans for managing foreshore access and full records of sand movements both natural and management initiated with costs for the latter;

(v) be consistent with approved management principles for the proposed marine reserve;

(vi) ensure that management strategies are developed for implementation in the event of criteria not being met, particularly in the case of accidental spillages;

(vii) ensure that contingency planning in (vi) includes funding and resources;

(viii) report back to the EPA after five years from the conclusion of construction with results of monitoring and recommendations for future requirements, or sooner if any problems arise.

Concern: trucks be required to use designated access roads to the site during construction. The designated access roads should be specified by the Shire of Wanneroo in consultation with the proponent.

Concern: a formal management body for the Hillarys Boat Harbour be established comprising the Department of Marine and Harbours, the Shire of Wanneroo, the vestee of the proposed marine park and representatives of the proposed four commercial lessees of the harbour. The points raised in Section 6.4.2 of the EPA (1985) report should be included in the terms of reference for the management body.

Concern: that, as the Hillarys Boat Harbour is likely to affect longshore sand movements and shoreline position, any cost associated with beach restoration should be borne by the proponents, users and operators of the Hillarys Boat Harbour, through the management body (see immediately above).

This concern reflects the EPA's consideration (EPA, 1985, p. 10) that 'the boat harbour should not be allowed to contribute to erosion of beaches to the north ...'.

Concern: there should be no dredging of Lal Bank.

Concern: during the construction phase of the Hillarys Boat Harbour there should be monitoring of sediment plumes, to determine the area of impact on surrounding marine communities.

Concern: monitoring of the marine communities of Boyinaboat Reef, Cow Rocks, and surrounding areas should be undertaken, to determine the extent and nature of the impact resulting from construction and operation of Hillarys Boat Harbour.

Concern: water quality monitoring, as specified in the ERMP produced by the Public Works Department (1984), and in the EPA report (1985), should be undertaken.

Concern: contingency plans should be drawn up at the earliest possible opportunity, by the Hillarys Boat Harbour management committee, to minimise environmental impacts from any possible spillages of oils, grease, other hydrocarbons, or chemicals, into the waters of the boat harbour.

Concern: the environmental impact of ferry traffic through the marine park should be monitored, and if ferry traffic has a detrimental environmental impact on the marine communities of the park, especially the seagrass

meadows, the ferry service should be modified or discontinued to reduce environmental impact to acceptable levels as determined by the EPA.

Concern: that the management committee should report annually to the EPA, detailing identified impacts of the Hillarys Boat Harbour, results of monitoring, any ameliorative actions taken to reduce environmental impacts, and the outcomes of such actions.

Suggestion: that space be allocated within the Hillarys Boat Harbour precinct for onshore facilities (boat storage areas, clubrooms) for recreational clubs and boating organisations which use the marine park.

Suggestion: angling platforms be built into the outside faces of the breakwaters of Hillarys Boat Harbour: at least four on the southern breakwater and two on the northern breakwater.

Suggestion: a SCUBA diver gearing-up platform be built on the southern breakwater of Hillarys Boat Harbour, immediately opposite Boyinaboat Reef. This platform should have access steps from the breakwater pedestrian walkway to the platform, and from the platform to mean low water level to facilitate entry and exit of SCUBA divers and snorkellers.

Suggestion: no angling be permitted from the southern breakwater of Hillarys Boat Harbour within about 30m of the diver gearing-up platform, to minimise safety hazards to in-water divers.

Suggestion: no anchoring or boat traffic be permitted between Boyinaboat Reef and the southern breakwater of Hillarys Boat Harbour to minimise safety hazards to in-water divers.

Suggestion: consideration be given to providing appropriate wet-mooring sites, loading and off-loading facilities within Hillarys Boat Harbour for commercial fishing vessels, with the intention of eventually restricting the present mooring of commercial fishing vessels near Mullaloo Point.

6.9 **Secondary Treated Effluent and Groundwater Discharge**

To date, discharge of secondary treated effluent at Ocean Reef, and entry of groundwater from beneath urbanised areas is not known to have caused any significant impacts on marine communities in the proposed marine park. Preliminary calculations by DCE suggest that input of wastewater and groundwater may cause significant elevation of nutrient concentrations in Whitford lagoon, and that these concentrations may become biologically significant. Recognising that:

(a) the volume of wastewater discharged from the Beenyup treatment plant will increase by a factor of 3 over the next 15 years (from 35 million to 100 million litres/day);

(b) the nutrient level in groundwater is likely to increase beneath the existing and developing urban areas;

(c) this groundwater moves towards the coast slowly (90 m/y), and

(d) that any problems caused by nutrient enrichment of groundwater will be extremely difficult to rectify;

it is proposed that further studies should be undertaken of nutrient input and pathways in the marine park.

Concern: further detailed monitoring and evaluation of nutrient input and nutrient concentration in waters of the study area should be undertaken to

(i) quantify the ecological effects of the nutrient discharge from the Ocean Reef outfall;

(ii) enable a prediction to be made of the likely levels of nutrients that will discharge at the coast in groundwater; and

(iii) plan necessary or appropriate ameliorative action.

Suggestion: the monitoring and research programmes currently being undertaken in the marine park by State agencies, CSIRO and tertiary institutions, be co-ordinated by CALM.

6.10 **Overseas Telecommunications Commission Cable**

To prevent damage to the OTC cable, the Department of Marine and Harbours (DMH) has given notice to mariners that no anchoring is permitted within 500m of the cable (see Figure 6).

Suggestion: no anchoring be permitted within 500m of the OTC cable path, as notified by the Department of Marine & Harbours, **except** at permanent, marked mooring locations to be determined by the marine park management body in consultation with DMH and OTC.

6.11 **Beach Litter**

Litter is common and obvious at most times on beaches in the proposed marine park. Both recreational users and professional fishermen contribute to the litter problem, which detracts from the quality of the park environment, aesthetically and biologically.

Suggestion: the proper disposal of litter by the public be encouraged through the provision of more collection points, an education programme, and the prohibition of litter disposal in marine park waters.

Suggestion: professional fishermen be encouraged through an education programme to bring all disposable items, including items which biodegrade slowly (plastic materials), ashore for appropriate collection and disposal.

6.12 **Staffing**

In order to manage the park, and implement the management plan, it is important that an adequate number of suitably qualified staff be appointed. Personnel should be capable of undertaking public education programmes, assisting with monitoring and research, communicating effectively with users, and implementing the management programme. The combination of terrestrial and marine management is a new initiative in Western Australia and will require personnel with expertise in both these areas.

Recommendation (11): the Department of Conservation and Land Management present to State Cabinet for approval a detailed budget, specifying additional funding required to enable the appointment of sufficient, full-time, professionally qualified personnel to undertake the ongoing management, monitoring and public education duties required for effective control of the greater marine park, and to establish and operate the public education display area and greater marine park ranger facility.

Recommendation (12): subject to endorsement of Recommendations (1) - (11) (above) and agreement by Government to allocate appropriate funds to the Department of Conservation and Land Management, that

(a) the Department of Conservation and Land Management produce the final management plan for the M 10 marine park,

(b) the Department of Conservation and Land Management proceed with the declaration of the marine park under the CALM Act 1984, and

(c) the Executive Director of CALM enter into agreements with land holders adjacent to the marine park for inclusion of their lands in a non-statutory greater marine park management area.

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APPENDIX 1: **Organisations and individuals who were invited to contribute to this draft management plan**

	M10 submission received	invited to seminar	attended seminar	sent draft management plan	commented on draft management plan	provided specific information
Amateur Fishermen's Interest Group						
B. Mongan, Secretary	x	x	x	x	x	x
Australian Angler's Association						
P. Foster, President				x	x	
Australian Broadcasting Commission						
R. Beilby, Producer (Education Section)				x		x
Australian Democrats						
R. Jeffreys, State Policy Co-ordinator (WA Division)		x		x		
G. Major, delegate (WA Division)		x	x	x		
Australian Fishing Industry Council (WA Branch)						
A. Gibson, Executive Officer (July 1985 - present)					x	
G. Stewart, Executive Officer (1979 - June 1985)	x	x	x	x		
Australian Labour Party						
P. Beggs, MLA (Member for Whitford)		x	x	x		
G. Burkett, MLA (Member for Scarborough)				x		
G. Edwards, MLC (North Metropolitan Province)		x		x		
R.F. Edwards, MHR (Federal Member for Stirling)		x	x	x		
J.P. Watkins, MLA (Member for Joondalup)		x	x	x		

Australian Liberal Party						
J.G. Clarko, M L A (Member for Karrinyup)		x	x	x		
Water Authority of WA						
H. Rule, Senior Engineer				x	x	
West Coast Abalone Divers Association						
F. Jacobi, member		x		x		
J. Cremers, Secretary		x		x		
West Coast Roei Abalone Diver's Association						
D.J. Strickland, member		x	x			
Whitfords Bay Sailing Club						
R. McAtee, Secretary				x		
H. Nankivell, President		x	x	x		
Whitfords Sea Sports Club						
B. Hicks, Secretary	x	x	x	x	x	
G. Smallacombe, Commodore (1984/1985)		x	x	x		
A. Sheehan, Commodore (1985/1986)				x		
Whitfords Volunteer Sea Rescue Group						
G. Hollis, President				x		
L.P. Gutteridge, Commander						x
Women Against Marina Organisation						
B. Richard, member		x	x	x		
Yachting Association of WA						
B.G. Campbell, Oficer	x	x		x		
Individuals						
R. Ballantine, recreational angler						x
P. Barrett-Lennard, recreational diver						x
E.R. Black, commercial abalone diver		x		x		x
W. Boardman, recreational angler						x
R.E. Boffey, recreational angler						x
A. Burns, recreational diver						x
R.V. Campbell, recreational diver						x
D. Clegg, recreational angler						x
D.J. Cosgrove, recreational diver						x

A.L. Dowson, recreational angler				x
K. Eades, commercial diver				x
H. Edwards, recreational diver				x
B. Ellis, recreational angler				x
W. Game, recreational diver				x
M.H. Glazier, recreational diver				x
W. Hamilton, recreational angler				x
L. Harris, professional fisherman				x
J. Harvey, recreational angler				x
A.F. Hogan, recreational angler				x
J.A Hopkins, recreational angler				x
R.B. Humphries, environmental consultant				x
I.M. Jasper, teacher				x
R. Johnson, recreational angler				x
W.T. Lothian, recreational angler			x	x
V.P. Martin, professional fisherman				x
F. Paxman, recreational diver				x
L. Rao, recreational angler				x
P. Robinson, recreational diver				x
W. Sharpe-Smith, amateur diver				x
W. Spencer, commercial abalone diver	x	x		x
R.J.F. Stretton, recreational angler				x

APPENDIX 2: Department of Conservation and Environment

M 10 marine park study team

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