Perth's Coastal Waters

Environmental Values and Objectives

the position of the EPA - a working document

Environmental Protection Authority

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Summary

The Environmental Protection Authority (EPA) has developed an environmental management framework aimed at protecting the coastal waters of Western Australia from the effects of pollution. This framework is being applied to Perth's coastal waters in consultation with the community and stakeholders. A three month public involvement and consultation program has been undertaken to help the EPA identify the Environmental Values of these waters, develop a set of Environmental Quality Objectives (ie. management goals) to protect the Environmental Values, and provide an indication of where the objectives should apply within Perth's coastal waters.

Four Environmental Values were identified as relevant to Perth's coastal waters. Six Environmental Quality Objectives (EQOs) or management goals were developed to protect those Environmental Values. The Environmental Values and their associated EQOs are:

- **Ecosystem Health:**
  EQO 1 Maintenance of ecosystem integrity (naturally diverse and healthy ecosystems)
- **Fishing and Aquaculture:**
  EQO 2 Maintenance of aquatic life for human consumption (seafood safe to eat)
- **Recreation and Aesthetics:**
  EQO 3 Maintenance of primary contact recreation values (waters safe for swimming)
  EQO 4 Maintenance of secondary contact recreation values (waters safe for boating)
  EQO 5 Maintenance of aesthetic values (pleasant, attractive environment)
- **Industrial Water Supply:**
  EQO 6 Maintenance of industrial water supply values (water suitable for industry use)

Maps are presented in the body of this report to provide a general indication of the relative size and locations of the areas where the EQOs will apply, or not apply, in Perth's coastal waters.

The first EQO (EQO 1: Maintenance of ecosystem integrity), will apply throughout Perth's coastal waters. In order to meet this objective and maintain a healthy and diverse ecosystem overall, the vast majority of Perth's coastal waters (over 99%) will have a high level of protection, with less than 1% designated a medium or low level of protection. The areas with reduced protection are largely confined to harbours and marinas, and adjacent to some industrial and domestic wastewater outfalls.

The EQOs 2, 3 and 4, which support social uses such as fishing, swimming and boating, will be designated for the vast majority of Perth's coastal waters. However, some of these EQOs will not apply in small areas near domestic treated-wastewater discharge points.

EQOs 5 and 6, which relate to maintaining the attractiveness of the environment and industrial water supply, will apply throughout Perth's coastal waters.

Maps are presented in the appendices of this report to provide a better indication of where the EQOs apply, and do not apply, in Perth's coastal waters.

The next phase of the management and consultative process for Perth's coastal waters will address the more technical issues of developing Environmental Quality Criteria and defining the precise boundaries of the areas where the different EQOs apply.

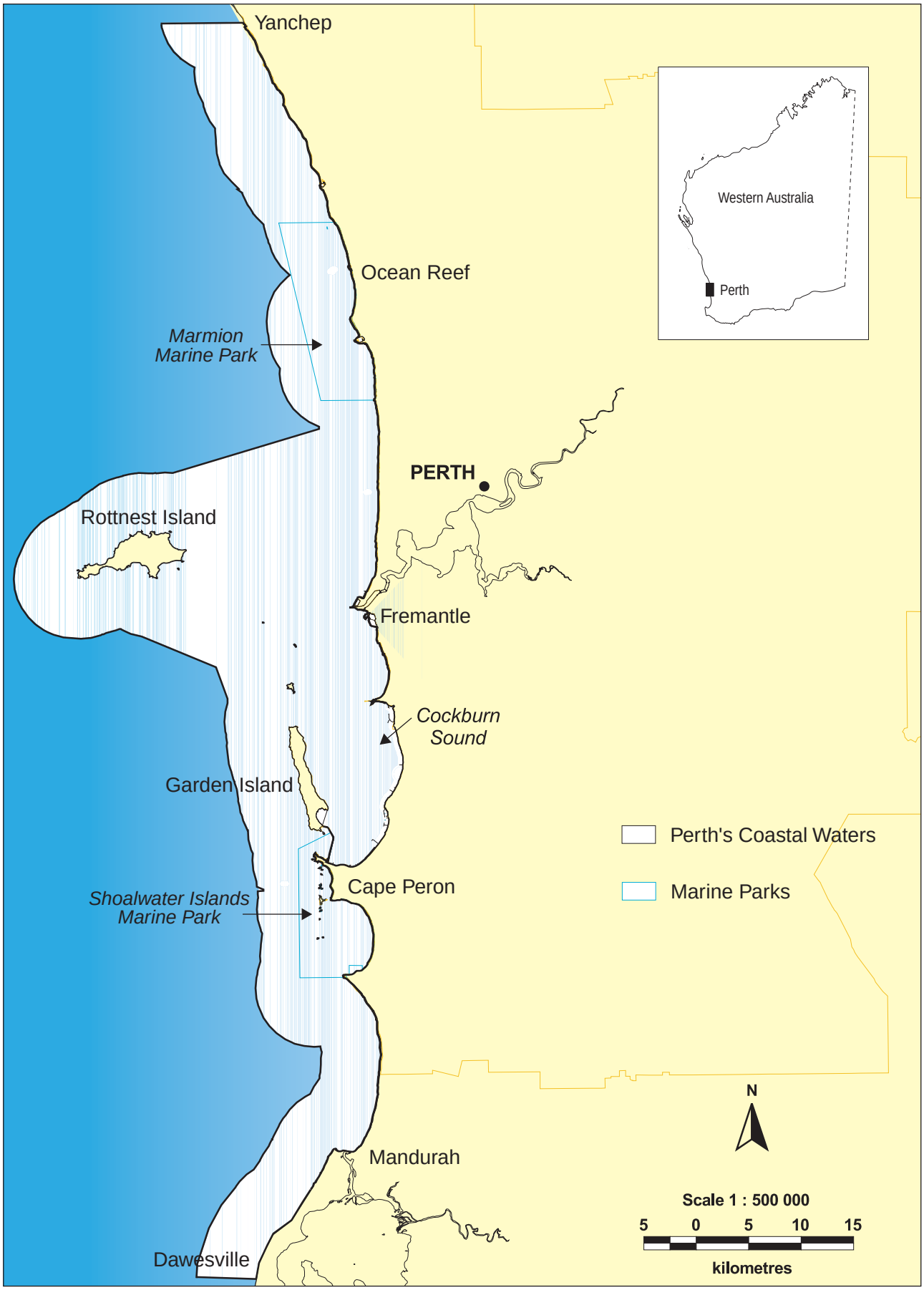


Figure 1. *Perth's coastal waters.*

1.0 Introduction

Perth is a coastal city and its population is expected to increase by more than 50 per cent over the next 30 years. With the increasing number of people, it is inevitable that the pressures on our coastal waters will also increase.

The Environmental Protection Authority (EPA) recognises that the environmental quality of our coastal waters in the future, and the opportunities these waters could provide for future generations, will be strongly influenced by the decisions and actions we take now. In response, the EPA, through a process of consultation with stakeholders and the community, is implementing a management framework for Perth's coastal waters (Figure 1) that will establish an agreed set of environmental quality objectives and guide decision-making so that these objectives are maintained or achieved in the long term. It is intended that the objectives reflect the values held by the community for our coastal waters, and are expressed in terms of what people presently believe the quality of our coastal waters should be, both now and in the future.

The EPA's objective is to maintain the ecosystem integrity and biodiversity of the marine ecosystems of Western Australia, whilst recognising the current and projected future uses.

The management framework being implemented in Perth's coastal waters is consistent with the National Water Quality Management Strategy (ANZECC and ARMCANZ, 1994) and is supported by two key scientific studies on Perth's coastal waters conducted by the Department of Environmental Protection (DEP, 1996) and the Water Authority of Western Australia (Lord and Hillman, 1995). The framework will be finally implemented through the statutory process of an Environmental Protection Policy (EPP). To be effective the EPP must be derived in consultation with all sections of the community, and should ultimately provide clear, definitive guidance to all. Therefore, the EPA wants to give particular attention to the views of the community before arriving at such an EPP for submission to Government.

The key elements that need to be considered during the consultative process are the environmental values and quality objectives to be adopted, the areas to which the objectives should apply, and the criteria by which environmental quality will be judged.

The first phase of the consultative process commenced in October 1998 with the release of a discussion paper entitled *The Future of Perth's Coastal Waters: Have Your Say.* The discussion paper addressed environmental values, environmental quality objectives and provided a starting point to consider where those objectives might apply. The CSIRO was contracted to undertake the community consultation and involvement program and has now provided its report to the EPA (Jacoby *et al.*, 1999), as well as making it available to the public.

The views expressed through the community consultation program were carefully considered by the EPA during the preparation of this document which establishes the environmental values and quality objectives to be used in the next phase. Following release of this document, work will commence on the development of environmental quality criteria in consultation with stakeholders and the public generally.

The EPA wants to ensure that when the protection program for Perth coastal waters is presented to Government for consideration as an Environmental Protection Policy, the key issues will have already been fully debated through a public consultation process.

2.0 Outcomes of the Public Involvement and Consultation Program - the CSIRO report

The CSIRO was commissioned by the EPA to consult with stakeholders and the broader community to find out what they thought the environmental quality of Perth's coastal waters should be like now and in the future. A public discussion paper entitled *The Future of Perth's Coastal Waters: Have Your Say* was made available to assist public understanding of the subject and to focus the discussions. Based on the outcomes of this public involvement and consultation program the CSIRO prepared a report to the EPA (Jacoby *et al.*, 1999) which outlined the consultation program and identified the key values and uses of our coastal waters that the community wanted to be protected. The report also recommended a broad approach for setting the 'management goals' or 'environmental quality objectives' to support those values and provided a notional indication of the areas where they should apply in Perth's coastal waters. The CSIRO report to the EPA is now a public document.

Overall there was support for having a clearly expressed vision for our coastal waters and for the proposed management framework needed to achieve and maintain it. There were a number of issues raised and a certain level of concern and confusion over the implications of the framework and how it would help to achieve positive environmental outcomes. Appendix A provides further clarification and a general response to the issues identified by the CSIRO team, as outlined in Chapter 3 of the CSIRO report.

2.1 Environmental Values

The way in which we protect and manage our marine environment is based on an underlying set of values. These values will reflect the contemporary views that the community holds on the importance and place of the marine environment within society. The values will change through time and are influenced by a range of concerns including the economic and social well-being of present and future generations.

The consultation program has confirmed that the community of Western Australia places a high value on the marine environment. There is an expectation that people will be able to recreate in marine waters without suffering illness or infection; consume seafood in the knowledge that it is safe to do so; and enjoy the benefits of a healthy, abundant and diverse natural environment. The marine environment is regarded as a "commons" where there is common ownership. Accordingly the community expects that their asset will be protected both now and into the future. At the same time there was general acceptance of the need to accommodate other valid societal uses of the environment such as industrial and domestic treated-wastewater discharge, shipping, mining, harbours and marinas, even though they can lower environmental quality and/or preclude certain social uses in localised areas.

Environmental Value

The term Environmental Value (EV) has been created within the framework of the National Water Quality Management Strategy (NWQMS: ANZECC and ARMCANZ, 1994). EVs have been defined as *"particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits"*.

Four Environmental Values were identified as relevant for Perth's coastal waters:

- **Ecosystem Health** (called Ecosystem Protection in the NWQMS)
- **Fishing and Aquaculture,**
- **Recreation and Aesthetics,**
- **Industrial Water Supply.**

These Values are essentially of two types: *ecological* and *social*. The first of these EVs (ie Ecosystem Health) is an *ecological* value because it relates to the protection of the inherent characteristics of the natural ecosystem. It can also be regarded as a fundamental value because practically all human uses ultimately depend on the condition of the natural system. The other three EVs are regarded as *social* or utilitarian values because they relate to specific human uses of coastal waters. Each EV is briefly discussed below.

2.1.1 Ecosystem Health (an ecological value)

Until recently water quality management was primarily focused on protecting human health by maintaining water quality so it is safe to swim, or to farm or collect seafood for human consumption. However, the intent of this EV is to explicitly recognise that we value our natural ecosystems for their own sake; that is, the community places value on a healthy marine ecosystem. This signals a desire to maintain, or where necessary restore, the essentially natural structure and function of any ecosystem found in Perth's coastal waters.

2.1.2 Fishing and Aquaculture (a social value)

This EV relates to ensuring environmental quality is suitable for the gathering and farming of seafood for human consumption. The intent is to ensure seafood collected or grown in waters where this EV is protected would not have levels of contaminants in the flesh that would exceed the Australian Food Standards. Fishing and aquaculture are treated here as a separate EV in anticipation that the next version of the Australian Water Quality Guidelines for Fresh and Marine Waters (in preparation) will adopt this approach. The current version of these Guidelines (ANZECC, 1992) incorporates fishing and aquaculture within the EV of Ecosystem Health.

2.1.3 Recreation and aesthetics (a social value)

This EV relates to human uses of the environment and includes sporting and leisure activities with frequent direct body contact with the water (eg. swimming), or less-frequent body contact with the water (eg. boating) and passive recreation which does not involve contact with the water (pleasant places to be near or look at).

2.1.4 Industrial Water Supply (a social value)

The intent of this EV is to ensure that marine water quality is suitable for use in industrial processes (eg. for cooling purposes). However, unlike industrial water supply, other societal uses of the marine environment that generate wealth, or are otherwise in the public interest (eg. industrial and domestic wastewater discharge, shipping and mining), do not require protection under this management framework because they do not require any particular level of environmental quality for them to be undertaken safely.

2.2 Environmental Quality Objectives

Environmental Quality Objectives (EQOs) define the management goals for designated areas of the environment. They signal the environmental quality needed to protect the EVs. Whereas the EVs are quite broad and express a human held ethic or desire, the EQOs describe more precisely and in greater detail what is to be protected.

Environmental Quality Objective
An Environmental Quality Objective (EQO) is a specific management goal for a part of the environment. EQOs can be either *ecologically-based* and describe the desired level of health of the ecosystem (eg. in terms of limits of acceptable change from natural conditions), or *socially-based* and describe the specific human uses to be protected (eg. swimming or boating).

Management plans would aim to maintain environmental quality where the objectives are presently met. Where the objectives are not met, management plans would be devised and implemented to achieve the designated EQOs within a specified time frame. The ecological EQOs and the social EQOs are described separately below.

2.2.1 Ecological EQOs

The EQO for the Environmental Value "Ecosystem Health" is aimed at maintaining ecosystem integrity and biodiversity thereby ensuring the continued health and productivity of our coastal waters ecosystems (Table 1).

Table 1. *The Ecological EV and it's corresponding EQO for Perth's coastal waters.*

ECOLOGICAL EV	EQO	DESCRIPTION
Ecosystem Health	**EQO 1**	***Maintenance of ecosystem integrity.*** Ecosystem integrity, considered in terms of structure* and function**, will be maintained throughout Perth's coastal waters. The level of protection^ of ecosystem integrity shall be high (E2) throughout Perth's coastal waters, except in areas designated E3 (moderate protection) and E4 (low protection).

* (eg. the biodiversity, biomass and abundance of biota)
** (eg. food chains and nutrient cycles)
^ see Table 2 and Appendix B for explanation

There are a number of elements that contribute to ecosystem integrity. These need to be considered when developing the criteria by which environmental quality will be judged.

The key elements that need to be considered include:

- ecosystem processes such as growth rates and food chains that link living things and their environment;
- the variety of biodiversity (at the genetic, species and ecosystem levels) at the local and/or regional level;
- the abundance and biomass of marine life; and
- the levels of contaminants in biota, water and sediments.

Four levels of protection have been defined for EQO 1 (Table 2) and these levels are generally described in terms of the limit of acceptable change from natural conditions.

Table 2. *Four levels of protection and their corresponding limits of acceptable change for EQO 1: Maintenance of Ecosystem Integrity. (see Appendix B for more detail)*

EQO 1 Level of protection (code)	Relative protection	Limit of acceptable change
Level 1 (E1)	total protection	no detectable changes from natural variation
Level 2 (E2)	high protection	some small changes from natural variation
Level 3 (E3)	moderate protection	moderate changes from natural variation
Level 4 (E4)	low protection	large changes from natural variation

Appendix B provides more detail to help highlight the differences between the levels of protection in terms of the limits of acceptable change from natural conditions for each of the key elements that contribute to ecosystem integrity, identified above.

2.2.2 Social EQOs

The social EQOs relate to the social EVs (recreation and aesthetics, fishing and aquaculture and industrial water supply) and aim to protect the associated human uses by ensuring that it is safe to swim and eat seafood grown or collected from these waters, the waters are suitable for extraction for industrial purposes (eg cooling water), and that the marine environment in general is aesthetically pleasing.

The social EQOs have been identified and are defined in terms of suitability for sustaining a particular use (Table 3). The EPA considers that as a starting point, all social EVs should be protected in Perth's coastal waters. However, there are some areas where the community is prepared to accept that some social EVs will not be protected. These areas will be designated and carefully monitored and managed to ensure there is no loss of social EVs outside their boundaries. These areas are designated by the letter "S" (to signify it relates to a social value) followed by the number of the EQO that does not apply to that area (eg S2 indicates seafood collected from these waters may be unsafe to eat; S3 indicates water quality may not be suitable for swimming).

Table 3. *The social EVs and their corresponding EQOs for Perth's coastal waters.*

SOCIAL EV	EQO	DESCRIPTION
Fishing and Aquaculture	**EQO 2**	***Maintenance of aquatic life for human consumption.*** Seafood will be safe for human consumption when collected or grown in all of Perth's coastal waters except areas designated S2
Recreation and Aesthetics	**EQO 3**	***Maintenance of primary contact recreation values*** Primary contact recreation (eg. swimming) is safe in all of Perth's coastal waters except areas designated S3
	EQO 4	***Maintenance of secondary contact recreation values*** Secondary contact recreation (eg. boating) is safe in all of Perth's coastal waters except areas designated S4
	EQO 5	***Maintenance of aesthetic values*** The aesthetic values of Perth's coastal waters will be protected except in those areas designated S5
Industrial water supply	**EQO 6**	***Maintenance of industrial water supply values*** Perth's coastal waters will be of suitable quality for industrial water supply purposes except in areas designated S6

The social EQOs can be defined in terms of the quality of the water and quality of the edible plants and animals within it. However, unlike the ecological EQOs, it is difficult to set different levels of protection for social EQOs related to human health because the environmental quality is either such that it is safe to undertake that social activity, or it is not. For instance, the National Health and Medical Research Council (NHMRC) have set a safe limit for swimming of 150 bacteria/100ml of water. If levels of bacteria are

lower than this standard, the water is considered ‘safe’ to swim in. If levels of bacteria exceed this standard, the water is considered ‘unsafe’ to swim in. The same situation applies to aesthetics, although the measures are more subjective.

3.0 The spatial application of Environmental Quality Objectives in Perth’s coastal waters

The management framework being applied to Perth’s coastal waters is fundamentally based on designating EQOs and monitoring and managing to ensure these objectives are achieved and/or maintained in the areas they have been designated. It is important that all stakeholders (managers, regulators and users of our coastal waters) know where the EQOs apply or do not apply. The clearest way of describing where the EQOs apply is in the form of maps.

EQO 1 (maintenance of ecosystem integrity) applies throughout Perth’s coastal waters (see Table 1). The levels of protection for EQO 1 are shown on the maps as underlying base colours. The social objectives (EQOs 2-6; Table 3) apply throughout Perth’s coastal waters except in a few small designated areas near domestic treated-wastewater discharge points. The areas where the social EQOs do not apply are shown as brightly coloured diagonal stripes that overlay the base colours which depict the ecological levels of protection. The colour of the stripe is used to identify which social EQO does not apply. This approach helps to differentiate between the ecological and social objectives, and highlights the areas where there is risk to human health associated with activities such as swimming, or eating seafood collected within the defined area. The way this information is built up and represented as a series of layers on a map is shown on the facing page using the coastal waters off Swanbourne Beach as an example (Figure 2).

Figure 2. *This describes how the Environmental Quality Objectives can be represented as layers of information on a map using a small section of Perth’s coastal waters, including the Swanbourne Treated Wastewater Outlet, as an example.*

a) Perth’s coastal waters showing the location of the area used in this example.

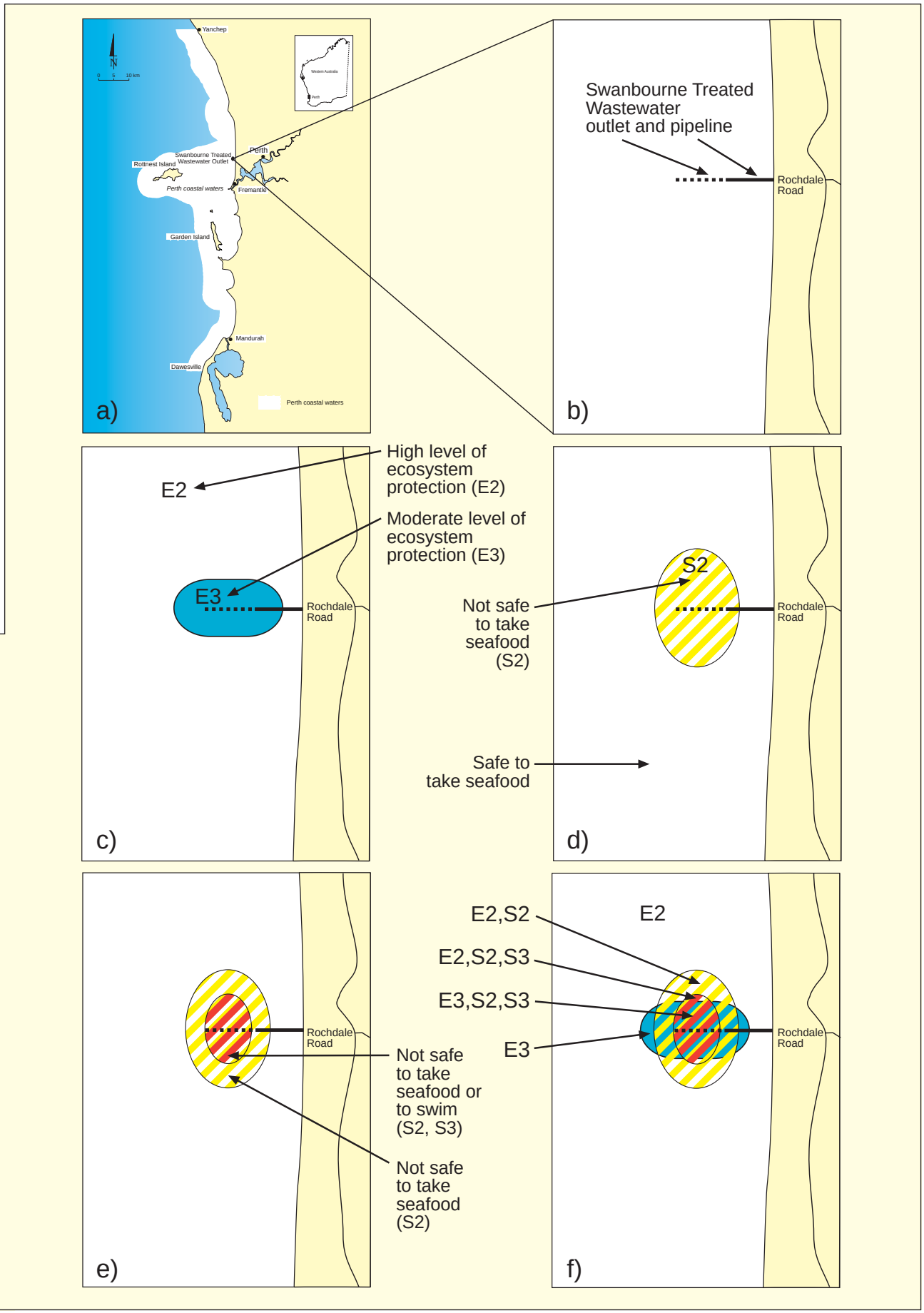
b) Map of the area showing the location of the Swanbourne Treated Wastewater Outlet with no EQOs shown.

c) Shows the levels of protection for EQO 1: Maintenance of Ecosystem Integrity. The pale blue area (E2) signifies Level 2 (high) protection; the darker blue (E3) area surrounding the outlet signifies that this area will receive level 3 (moderate) protection in recognition that the organic particles in the wastewater may deposit in this area and cause some changes to the biota (an increase in filter-feeding animals) above natural levels. This zonation scheme signals to managers that the organic loading from the outfall should be managed to ensure changes in biota are restricted to the area designated E3; changes are not permitted in the E2 area (see Appendix B for more detail on the limits of acceptable change for each level of protection).

d) Shows a yellow-striped area (S2) where EQO 2 (Maintenance of Aquatic Life for Human Consumption) does not apply (ie. it may not be safe to eat seafood caught here) because bacterial levels may exceed the safe limit of 14/100 ml of water within this area. There are no coloured stripes outside of the area designated S2, signifying to managers that bacterial levels should be maintained below 14/100 ml of water. The absence of coloured stripes (ie. a clear overlay) indicates that all social EQOs (EQOs 2-6) apply.

e) Shows the S2 area and a red-striped area (S3) where EQO 3 (Maintenance of Primary Contact Recreation Values) does not apply (ie. it may not be safe to swim) because bacterial levels may exceed the safe swimming level of 150/100 ml of water. Areas where there are both yellow and red stripes indicates where it may not be safe to both take seafood from, and to swim.

f) Shows the final composite (c and e combined) map of EQOs for this portion of Perth’s coastal waters. The ecological levels of protection are represented by the base or underlying colours. The areas where the social EQOs do not apply are highlighted as an overlay of coloured stripes.


Yanchep
Swanbourne Treated Wastewater Outlet
Rottnest Island
Perth
Fremantle
Perth coastal waters
Garden Island
Mandurah
Dawesville
Perth coastal waters
a)
Swanbourne Treated Wastewater outlet and pipeline
Rochdale Road
b)
E2
High level of ecosystem protection (E2)
Moderate level of ecosystem protection (E3)
E3
Rochdale Road
c)
S2
Not safe to take seafood (S2)
Safe to take seafood
Rochdale Road
d)
Rochdale Road
Not safe to take seafood or to swim (S2, S3)
Not safe to take seafood (S2)
e)
E2,S2
E2,S2,S3
E3,S2,S3
E3
E2
Rochdale Road
f)

The next two sections of this report provide more detail and maps of where the EQOs apply and do not apply at the regional scale (Perth's coastal waters). Finer scale maps, focussing on areas where there are lower levels of protection under EQO 1, or where some social EQOs may not apply, are provided in Appendix C. Although the maps in Appendix C show more detail, it should be remembered that they are only indicative of the size and location of the various areas where EQOs apply or do not apply. The dimensions of these areas will be determined more precisely during the next, more technical, phase of the Perth Coastal Waters Management and Consultative Process.

3.1 Ecological EQOs for Perth's coastal waters

The outcomes of the consultation program clearly indicated that Western Australians expect a naturally diverse and healthy marine environment. The health of the environment overall is the cumulative result of the level of protection that we assign to areas within it. Figure 3 shows the levels of protection in the Perth coastal waters region for EQO 1. The levels have been set to maintain a healthy and diverse ecosystem overall. The vast majority of Perth's coastal waters (99.2%) will have a high level of protection (Level 2), with only 0.7% designated a medium level of protection (Level 3) and 0.1% designated a low level of protection (Level 4). The lower levels of protection are restricted to the vicinity of the treated domestic wastewater outlets at Ocean Reef, Swanbourne and Cape Peron, the Fremantle inner-port areas, boat harbours and marinas, the HMAS Stirling naval base and adjacent to the Kwinana Industrial strip. Level 1 protection (total protection) is unlikely to be set in Perth's coastal waters. It would be unrealistic to expect this level of protection given the diversity and extent of uses supported by these waters and their adjacent river and groundwater catchments. Level 1 protection offers the highest possible level of protection from the effects of pollution and may be set in other areas of the State, recognised as having a particularly high natural heritage significance and distant from existing population centres and other sources of contaminants (eg. the Hamelin Pool Marine Nature Reserve in Shark Bay).

3.2 Social EQOs for Perth's coastal waters

The outcomes of the consultation program clearly indicated that Western Australians also expect to be able to enjoy the intrinsic social values and uses that a healthy and clean coastal environment has to offer. The social EQOs reflect these views and indicate that all social EQOs will be protected throughout Perth's coastal waters except in a few small areas near some of the treated domestic and industrial wastewater outlets. Figure 4 shows three areas where some social EVs will not be protected. These areas are offshore and surround outfalls discharging treated domestic wastewater containing high levels of bacteria (ie. Ocean Reef, Swanbourne and Cape Peron). Four additional areas, which cannot be depicted at the scale of the map, have also been designated at the discharge points of industrial outlets into Cockburn Sound. This level of detail can be seen on finer scale maps contained in Appendix C. At the regional scale, only about 0.2% of Perth's coastal waters will not be suitable for harvesting of seafood and 0.1% will be unsuitable for swimming under this EQO zoning scheme.

3.3 Consequences of the EQOs designated for Perth's coastal waters

The EQOs presented here are the long-term management goals for the marine environment off Perth. The EQO zoning scheme means that the entire shoreline from Dawesville to Yanchep (including harbours and marinas) should be managed to ensure the water quality is safe for swimming and fishing. Over 99% of our waters need to be managed to ensure there are no detectable effects of pollution on the plants and animals and the ecosystem processes that sustain them. The areas where lower levels of protection have been set would need to be managed to ensure there are no detectable effects outside of their boundaries.

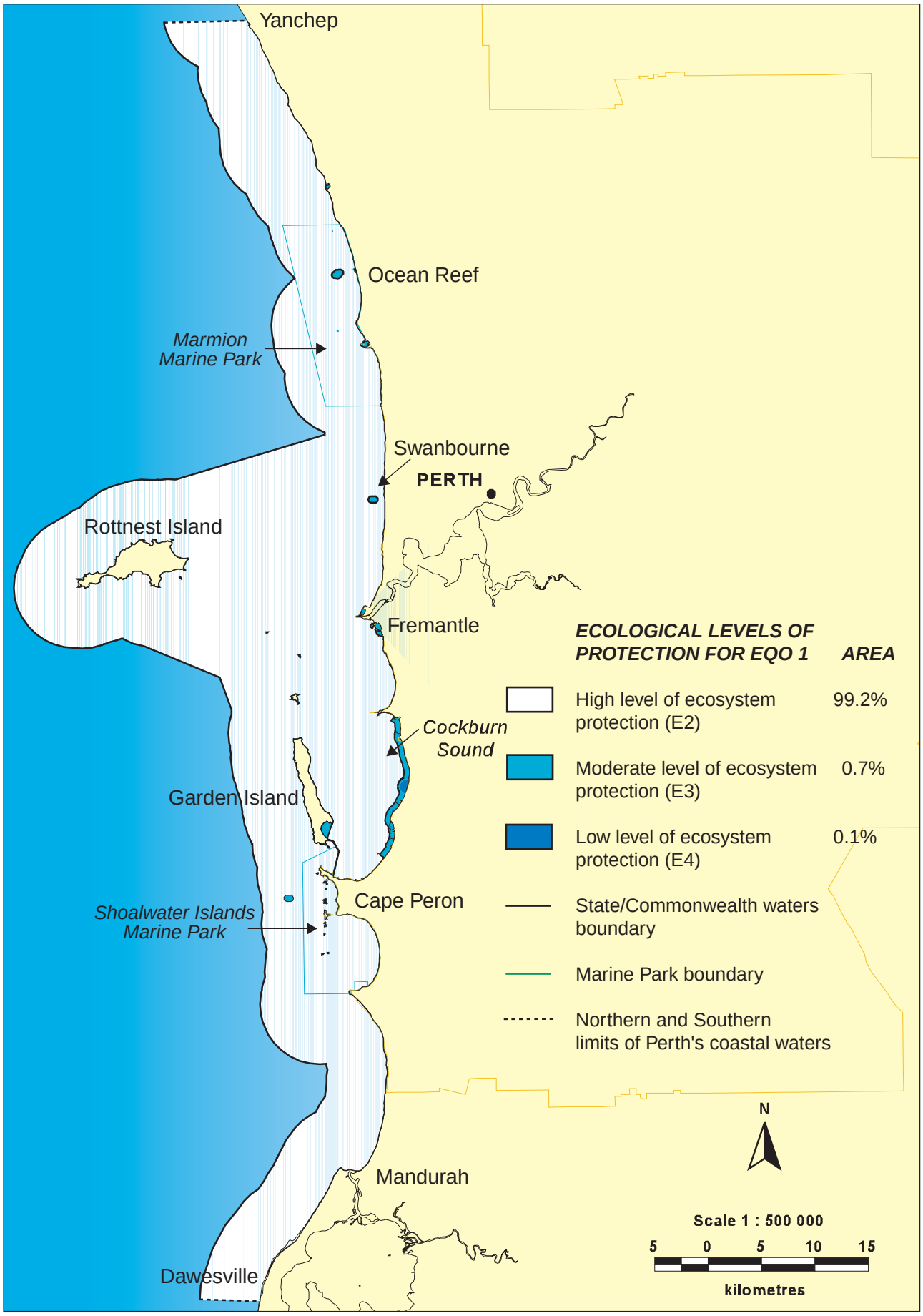


Figure 3. *Map of Perth's coastal waters showing the levels of protection for EQO 1: Maintenance of Ecosystem Integrity. The boundaries to these areas are notional at this stage, and will be finalised during the next phase of the Perth's Coastal Waters Management and Consultative Process.*

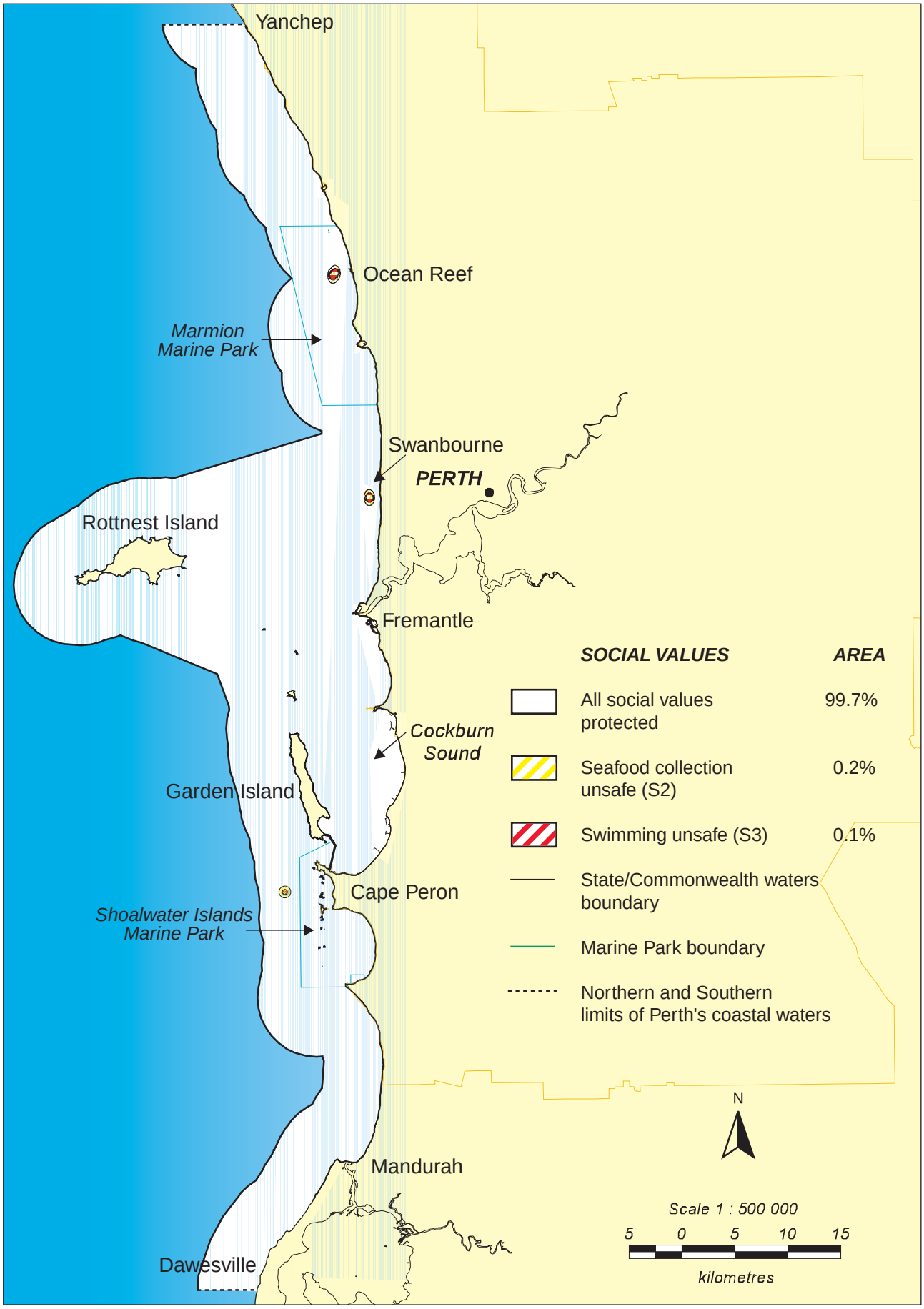


Figure 4. *Map of Perth's coastal waters showing where the social Environmental Quality Objectives (EQO's 2-6) apply, and the areas where they do not apply (S2-6). The boundaries to these areas are notional at this stage, and will be finalised during the next phase of the Perth's Coastal Waters Management and Consultative Process.*

In some cases it is clear that the EQOs are fully or partially met already. In many cases we will not know until we have finalised the criteria and boundaries and compared the results of monitoring programs against these criteria. Where the EQOs are not met it will be necessary to determine why the EQOs are not met and develop management strategies to tackle the cause. In some cases this may be relatively simple and inexpensive, in others it may be more difficult, time-consuming and expensive, or not technically feasible with present technology or scientific understanding. Whatever the case may be, the EQOs provide a common focus for management across government, industry and the community at large.

The EQOs proposed here are not presently met in the vicinity of the Sepia Depression treated wastewater outlet. Through a process of public consultation, the Water Corporation of Western Australia established that the bacterial and nutrient loads from the discharge were reducing environmetal quality over a larger area than the community desired and expected. In response, the Water Corporation initiated a major upgrade of it's treatment plant to reduce the area of influence over time. Figure 5 shows the present area over which the water quality criteria for swimming are not met because of high concentrations of bacteria. It also shows the progressive reduction in the size of the area that is unsafe for swimming as the level of treatment increases from full primary to full secondary by about 2010.

4.0 The process from here

This report signals the end of the first phase of the Perth Coastal Waters Management and Consultative Process (PCWMCP) and presents the position of the EPA with respect to the Environmental Values and Environmental Quality Objectives for Perth's coastal waters and indicates where they should notionally apply. The second phase of the PCWMCP addresses the more technical issues of developing Environmental Quality Criteria (EQC) and defining more precisely the boundaries of the areas where the different Environmental Quality Objectives apply or do not apply. These steps in the process are given in Figure 6.

Defining the EQC (and associated measurement and interpretation protocols) is an important step in the PCWMCP. The EQC are the benchmarks that, in combination with the results of environmental monitoring programs, allow the various stakeholders to assess whether current management strategies are adequate for achieving or maintaining the EQOs. With this information it will be possible to assess the implications of the notional boundaries presented in this report. It is important that all stakeholders are aware of the cost-benefit implications of the proposed zonation scheme, both in terms of their operations and of the environment, before the boundaries are finalised.

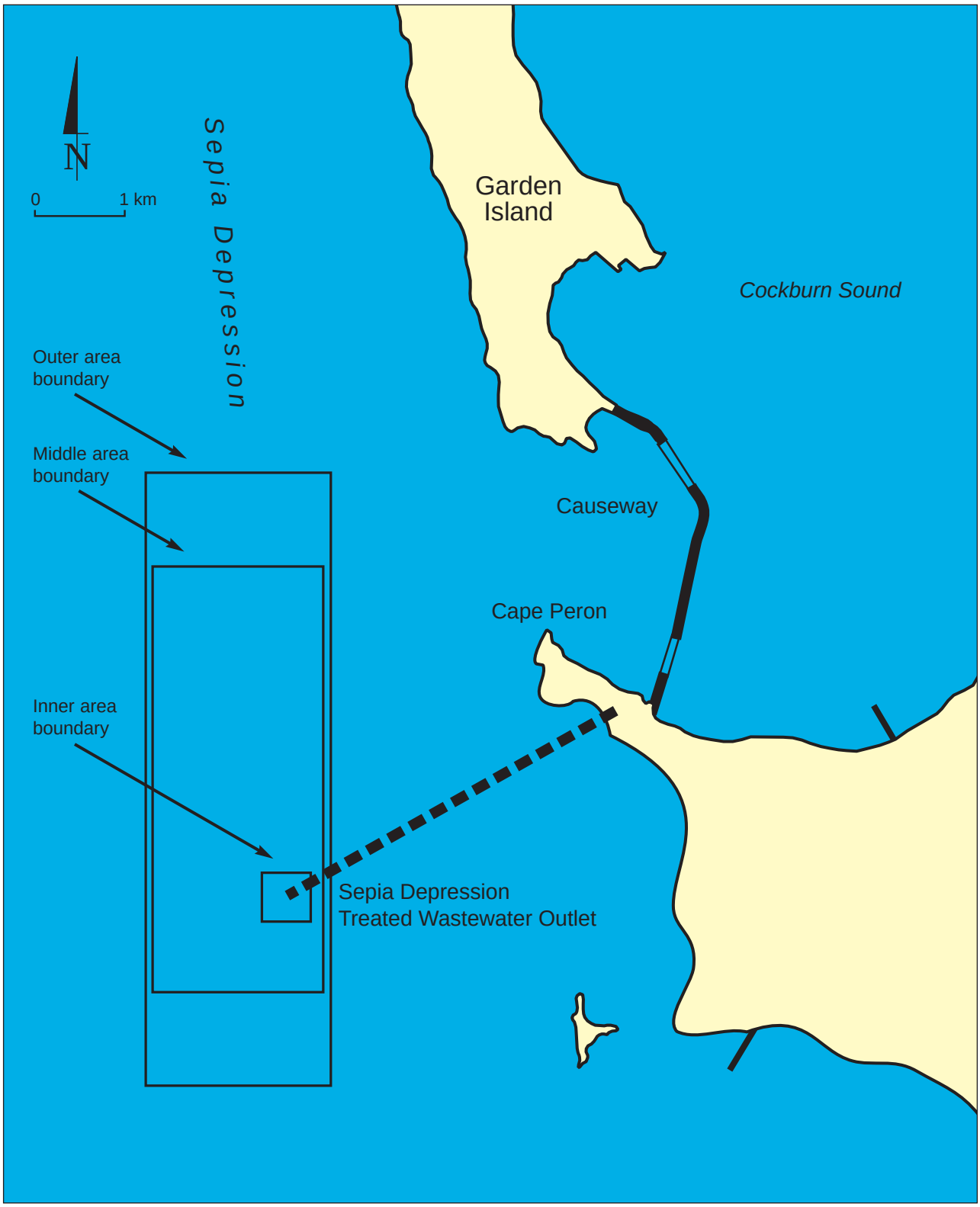


Figure 5. *Areas of influence around the Sepia Depression Treated Wastewater Outlet with changes in level of treatment. Areas of influence indicate a very conservative estimate of where it will not be safe to swim. Outer area=area of influence for existing amount of effluent with primary treatment of wastewater; Middle area=area of influence for more effluent with secondary treatment for seven-eighths of wastewater; Inner area=area of influence for the increased effluent flow with secondary treatment for all wastewater; (Figure from the Water Corporation, DA Lord and Associates and Environmental Drafting Services).*

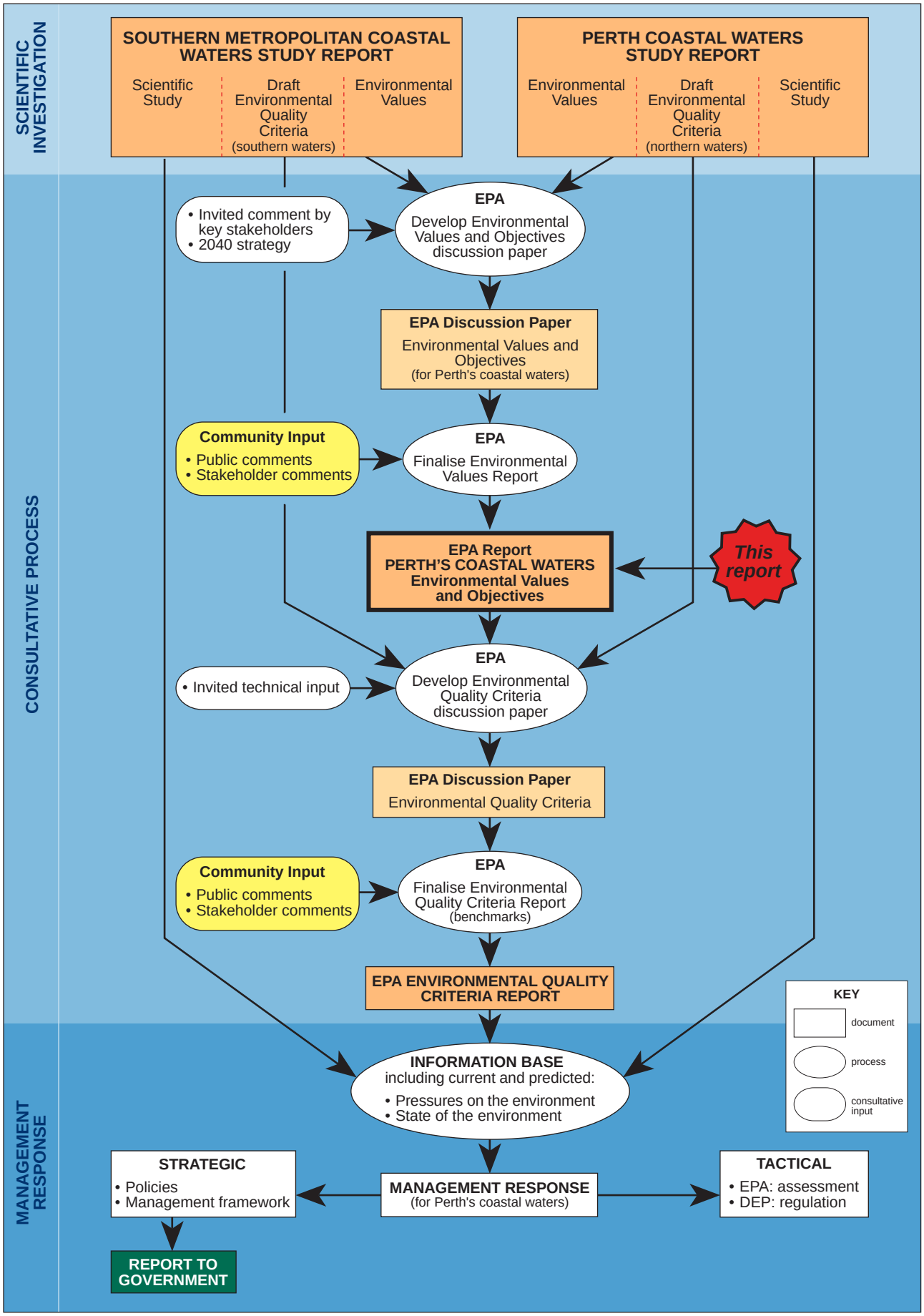


Figure 6. *Perth Coastal Waters Management and Consultative Process.*

5.0 References

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Appendix A

Discussion of Key Issues arising from the Consultation Program

The results of the community involvement and consultation program undertaken by CSIRO is contained in its report to the EPA (Jacoby *et al*., 1999). The report provides general conclusions and recommendations for the EPA to consider during the formulation of its position on Environmental Values and Environmental Quality Objectives for Perth's coastal waters. Overall there was support for the proposed management framework and a clearly expressed vision for our coastal waters. There were a number of issues raised and a certain level of concern and confusion expressed over the implications of the framework and how it would achieve positive environmental outcomes. This section attempts to respond to these issues as outlined in Chapter 3 of the CSIRO report.

How does this process fit into the big picture?

This management framework is aimed at protecting Environmental Values (EVs) from the adverse effects of pollution. These EVs (see Section 2.1) are not all encompassing rather they are restricted to those that depend on a certain level of environmental quality. These EVs used to be called "beneficial uses" or "prescribed uses" but the terminology has changed to "Environmental Values" because natural ecosystems have values that do not relate solely to human uses.

The approach adopted here is not "new" in the sense that it was developed here in Western Australia. The issue is being tackled at the national level through the National Water Quality Management Strategy (NWQMS). This NWQMS is nationally endorsed by councils of all the environment and conservation ministers (ANZECC) and the agriculture and water resources ministers (ARMCANZ) of the Commonwealth and each state and territory of Australia, and New Zealand (ANZECC/ARMCANZ, 1994).

The NWQMS was initiated in 1992 to guide environmental quality management in fresh and marine waters. The Strategy identifies EVs that require protection from pollution; provides guidance on setting objectives for particular parts of the environment; and establishes a comprehensive set of water quality guidelines which represent yardsticks to assess the quality of a given aquatic system for a particular use.

In essence the relevant EVs relate primarily to swimming, fishing and the ecosystem itself. The NWQMS provides guidance on setting management goals (ie. Environmental Quality Objectives; EQOs) to explicitly protect these values. It also recognises that there are other uses of the environment that provide community benefit (ports and marinas, disposal of domestic wastewater) and, that in order to accommodate these uses which can lower environmental quality, parts of the environment may need to be designated where some or all of these values are explicitly not protected (ie. the EQOs do not apply).

The management framework being developed and implemented in Perth's coastal waters is consistent with this nationally endorsed Strategy.

The holistic approach to marine management

The public involvement program highlighted the need for a clear and strongly expressed vision in relation to Environmental Values, presented as part of an holistic approach to coastal waters management.

It must be recognised that the environmental quality management framework being discussed here does not in itself provide for holistic management. It does not address important elements such as Marine Conservation or Fisheries Management. In WA we have sectoral management arrangements with government departments, operating under specific legislation, set up to manage key elements and/or activities. Fisheries WA manage fish stocks and fishing under the Fisheries Act; the Department of Conservation and Land Management manages wildlife under the Wildlife Conservation Act and Marine

Conservation Reserves on behalf of the Marine Parks and Reserves Authority under the Conservation and Land Management Act, and the Health Department manages human health-related issues under the Health Act.

The Environmental Protection Act (1986) establishes the EPA to prevent, control and abate pollution. The EPA also provides advice to the Minister for the Environment on a broad range of matters including the environmental implications of development proposals, land-uses and planning schemes. The EPA can also initiate the development of Environmental Protection Policies (EPPs). A draft Environmental Protection (State Marine Waters) Policy which encapsulates the approach described here was released for public comment in 1998. The EPP provides the vehicle to present the final management scheme (EQOs and the areas to which they apply) and is developed through a consultative process.

The EPP will require Ministerial approval and its publication in the Gazette would give it the force of law as if it was part of the Environmental Protection Act (1986). It will provide a clear set of "Environmental Quality Objectives" that become the common goal to work towards for all who are responsible for managing and regulating the effects of waste discharges and other activities that may pollute the environment.

The EPP will provide guidance to planners and proponents of projects, and to managers and regulators in local government, State Government and industry. It also allows for auditing of environmental quality through the implementation of monitoring programs - we can see if our expectations are being met, identify areas where things are improving, or where they are deteriorating and need attention. To be effective the EPP must be derived through broad consultation and considering all views, but needs to be strong and visionary, and provide clear guidance to all.

The role of this management framework in decision-making

The public involvement program highlighted the need to provide an increased level of understanding of the role of this management framework in the overall decision-making process. This management framework does not change the decision-making process - key decisions will still mostly be made by Government after obtaining expert advice, receiving recommendations and considering the implications from a range of perspectives.

What will change is that the implications of a particular proposal can be both expressed and considered from the perspective of the community's expectations and vision for environmental quality as expressed by the relevant EQOs for that part of the environment.

Development can be designed from scratch with those objectives in mind. Development proposals that are consistent with the objectives will be more likely to be approved. The subjectivity can be taken out of interpreting the results of monitoring programs. There will be a set of Environmental Quality Criteria linked to each EQO to check monitoring results against and determine whether the objectives have been met. Where the EQOs are not met, management responses should be formulated and implemented or increased in effort.

The role of zones and monitoring in the management framework

In practice it will not be possible or practical to protect all values everywhere if we are to accommodate other uses we have for the environment that we gain benefit from (such as marinas, wastewater disposal). Therefore it will be necessary to designate areas where some or all of the "values" (eg. fishing, swimming) will not be protected. These areas can be termed 'zones' for management purposes. The intent will be to focus monitoring on these areas, and areas surrounding them to ensure that impacts are effectively contained within them, that the combined size of these areas is small and, most importantly, that the agreed and designated values and uses of the broader ecosystem are not compromised.

Applying rigid zones in the marine environment may seem inappropriate because of the way that water mixes and moves pollutants around. This is a valid concern, but without guidance on what needs to be protected and where it needs to be protected (or does not need to be protected), it is impossible to develop management strategies and to assess the effectiveness of those strategies through monitoring programs. The technical issues associated with conducting monitoring programs (what, where and how often, you measure), interpreting the results of the monitoring programs (eg. are the criteria exceeded or not), and what types of management responses may need to be triggered, (eg. increased monitoring, criteria refinement, remedial action) will be addressed during the next phase of the process which deals with Environmental Quality Criteria and the finalisation of the boundaries to the environmental quality management "areas" or "zones".

In essence, it is anticipated that occasional minor exceedences of a particular guideline value would not be considered a problem. Upward trends in levels of contamination would receive attention. Occasional large-scale exceedences or very frequent lower level exceedences may be cause for concern and trigger investigations to find the cause, assess the actual implications of the exceedence, and implement remedial management measures if necessary. Extreme exceedences or frequent, large scale exceedences should signal the need for urgent management action.

The purpose of an environmental quality management program should be to ensure that agreed and designated environmental values are protected by achieving the Environmental Quality Objectives. It is intended that this be carried out through a process of 'cooperative best management' involving all stakeholders, and be based on sound environmental arguments. Where the agreed EQOs are not being achieved, management programs, with appropriate performance indicators (eg. interim objectives), should be developed and implemented to ensure the objectives are met within a specified time frame.

Learning and improving as we go

The management framework being implemented here is underpinned by a relatively solid information base developed through the Coastal Waters Studies conducted by the DEP (DEP, 1996) and Water Corporation (Lord and Hillman, 1995) in the early-mid 1990s. It will be supported by guidelines (ie. Environmental Quality Criteria; EQC) related to the key elements of the environment that support the respective EVs, including safe levels of contaminants in waters, in sediments and in the biota (see Appendix B also). The EQC to protect human health are based on a multitude of studies conducted world-wide on a single species (humans). In contrast the guidelines for ecosystem protection are designed to protect the great variety of life forms and species in our oceans. Clearly, we will not have information on safe levels of all contaminants for all our marine species, in fact we have very little data for Australian species let alone for Western Australian species. Most guidelines are based on studies conducted overseas on species not found in our waters. This uncertainty will be incorporated as safety factors when the "safe levels" are determined.

It is intended that the management framework for Perth's coastal waters will encourage the development of integrated and focused monitoring programs, that will allow our collective environmental management performance to be assessed against the common objectives. The approach should lead to a better understanding of the relative susceptibilities of local species to the contaminants of concern, whilst avoiding unnecessary effort and expense. Such a cooperative and integrated approach should be more cost-effective than individual isolated programs and lead to a better level of understanding and assessment of our local ecosystems. It should also make it more straightforward and easier to report on environmental health and easier for the community to interpret the results and assess the implications for themselves.

KEY ELEMENTS OF ECOSYSTEM INTEGRITY AND THEIR LIMITS OF ACCEPTABLE CHANGE		LEVEL OF PROTECTION FOR EQO 1: MAINTENANCE OF ECOSYSTEM INTEGRITY			
KEY ELEMENTS	LIMITS OF ACCEPTABLE CHANGE	LEVEL 1 (Total)	LEVEL 2 (High)	LEVEL 3 (Moderate)	LEVEL 4 (Low)
ECOSYSTEM PROCESSES (eg. primary production, nutrient cycles, food chains)	Ecosystem processes are maintained within the limits of natural variation (no detectable change)	✓	✓		
	Small changes in rates, but not types of ecosystem processes			✓	
	Large changes in rates but not types of ecosystem processes				✓
BIODIVERSITY (eg. variety and types of naturally occurring marine life)	Biodiversity as measured on both local and regional scales remains at natural levels (no detectable change)	✓	✓	✓	
	Biodiversity measured on a regional scale remains at natural levels although possible change in variety of biota at a local scale				✓
ABUNDANCES AND BIOMASSES OF MARINE LIFE (eg. number or density of individual animals, the total weight of plants)	Abundances and biomasses of marine life vary within natural limits (no detectable change)	✓	✓		
	Small changes in abundance and/or biomasses of marine life			✓	
	Large changes in abundance and/or biomasses of marine life				✓
THE QUALITY OF WATER BIOTA AND SEDIMENT (eg. types and levels ofcontaminants contaminantssuch as heavy metals, dissolved oxygen content, water clarity)	Levels of contaminants and other measures of quality remain within, limits of natural variation (no detectable changes)	✓			
	Small detectable changes beyond limits of natural variation but no resultant effect on biota		✓		
	Moderate changes beyond limits of natural variation but not to exceed specified criteria			✓	
	Substantial changes beyond limits of natural variation				✓

Appendix B. *Limits of acceptable change in the key elements of ecosystem integrity for the four levels of protection defined for EQO 1: Maintenance of ecosystem integrity. The limit of acceptable change in each element at each level of protection is marked with a tick.*

Appendix C

Notional Boundaries

The following maps focus on the areas within Perth's coastal waters where lower levels of protection for EQO 1 (level 3 and level 4 protection) would apply and where some of the social EQOs (EQO2-6) may not apply. These more detailed maps complement Figures 3 and 4 (pages 11 and 12) which show the entire Perth's coastal waters region. Figure 2 (page 9) provides assistance in interpreting these maps.

Map 1 provides a location key for the other maps.

Maps 2, 3 and 4 are shown at the same scale (1:100,000) for ease of comparison.

Maps 5, 6 and 7 are given at a scale of 1:25,000 in order for the detail to be seen.

It must be remembered that these maps provide only notional boundaries for these areas; the boundaries will be finalised as part of the next phase of the Perth Coastal Waters Management and Consultative Process.

North of Perth, Gage Roads and Owen Anchorage, including Fremantle Harbours (Maps 2 and 3)

The majority of the coastal waters in this area are designated EQO 1, level 2 protection (E2) and EQO2-6 would apply (all social values protected). Small areas surrounding the treated wastewater outlets off Beenyup and Swanbourne would have a moderate level of protection (designated E3) for EQO 1 (maintenance of ecosystem integrity) in recognition of the likely biological response to the particulate organic loading from these outfalls. Similarly, areas around the outlets are designated S2 and S3 indicating that EQOs 2 and 3, which relate to seafood quality and direct contact recreation (swimming), would not be protected in the vicinity of the outlets in acknowledgment of the bacterial loadings associated with the treated wastewater discharged at this location (shown by yellow and red stripes respectively on maps 2 and 3).

In Mindarie Keys Marina, Ocean Reef Boat Harbour and Hillarys Marina some changes in biomass (eg: algae and filter feeders) would be tolerable and EQO1 level 3 protection is designated. EQO2-6 would apply within these areas.

In Gage Roads and Owen Anchorage, and in coastal waters ouside the Fremantle Port Inner Harbour and the adjacent boat harbours, EQO1 level 2 protection should apply. Within the boat harbours and the Fremantle Port Inner Harbour EQO1 level 3 protection and EQO2-6 would apply. There are no areas designated on these maps where EQOs 2-6 would not apply.

Cockburn Sound, Sepia Depression and south to Dawesville (Maps 4 – 7)

Ecological EQOs

The majority of this area is shown as E2 which indicates that a high, level 2 protection is set for EQO 1 (Maintenance of Ecosystem Integrity).

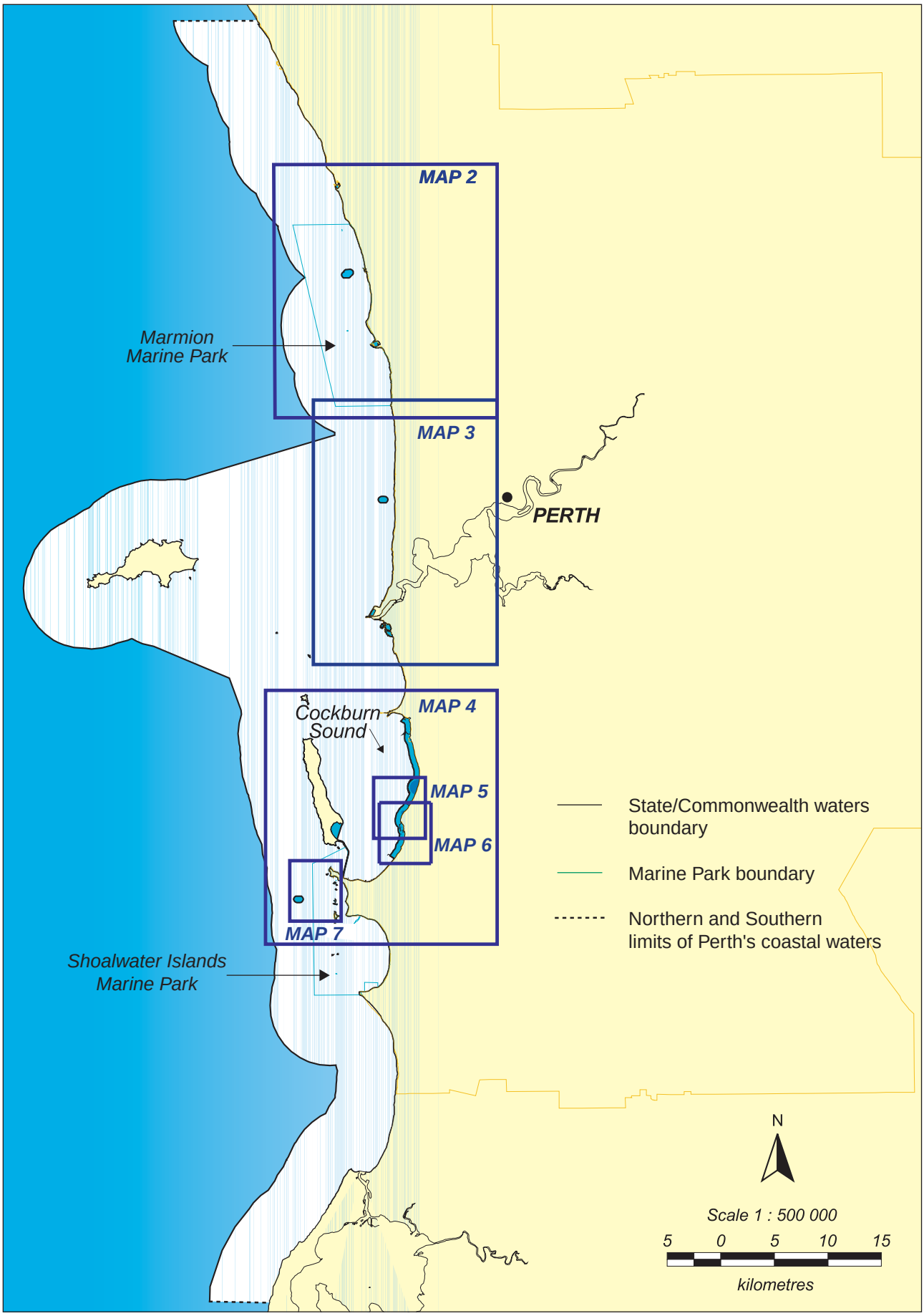
There are three areas shown as E3 where a moderate level 3 protection is designated. These are: a strip along the eastern shoreline of Cockburn Sound adjacent to the Kwinana Industrial Area (KIA), including the existing Jervoise Bay northern harbour, the approved southern harbour and the industrial wastewater outlets; the HMAS Stirling ship maintenance area at the southeastern end of Garden Island; and an area in Sepia depression aligned with the diffuser at the discharge point for the Sepia depression Treated Wastewater Outlet. Some small changes in the biomass or abundance of some organisms would be

acceptable at this level of protection (eg. phytoplankton, benthic infauna) but there should be no effects on ecological processes (see Appendix B for more details).

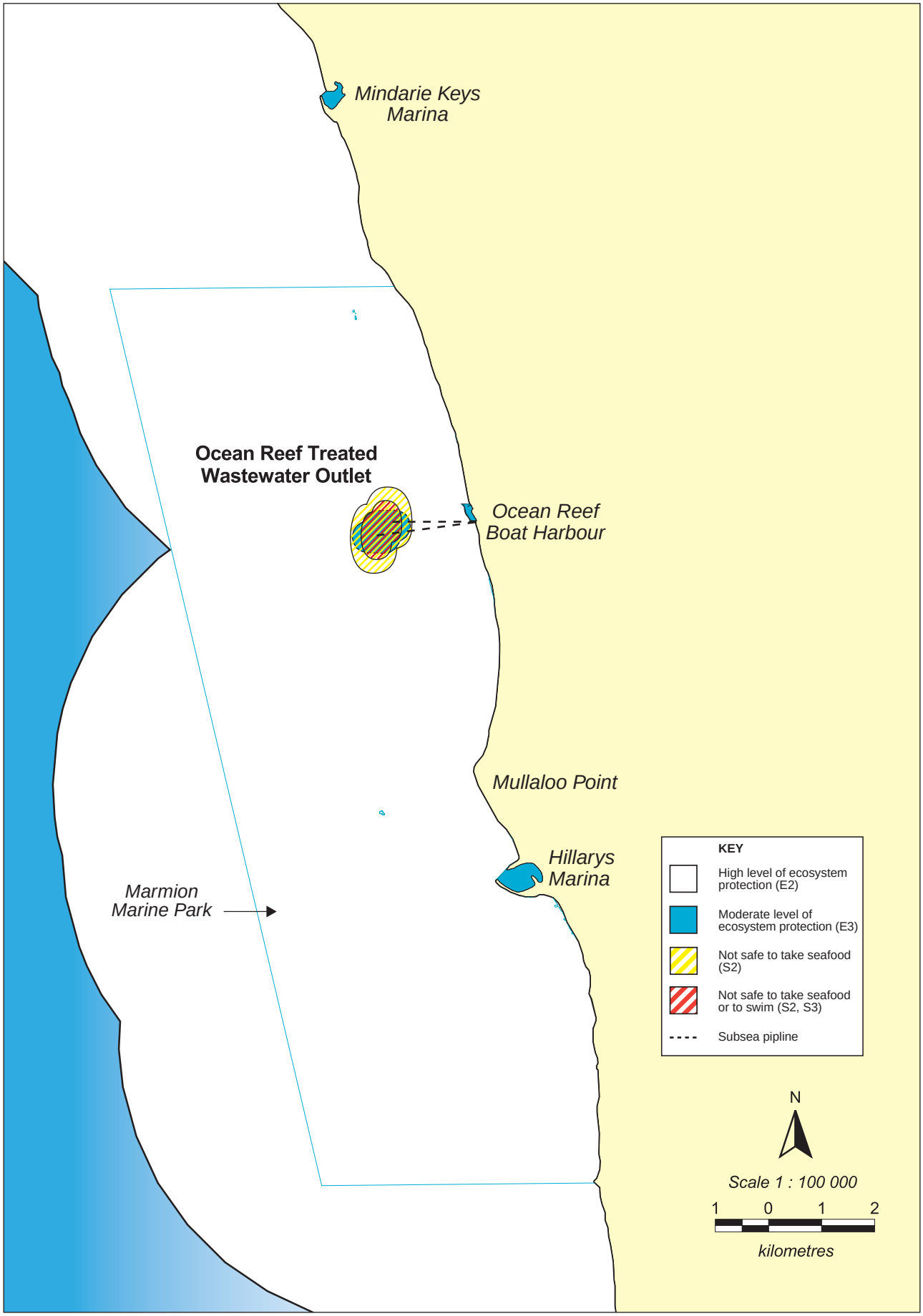
There are four small areas along the coast adjacent to the KIA which are associated with industrial outlets. These areas may be accepted as having a low level of protection as long as Ecosystem Health has a high level of protection in the majority of the waters in Cockburn Sound and there is no loss of ecological integrity of the Sound as a whole.

Social EQOs

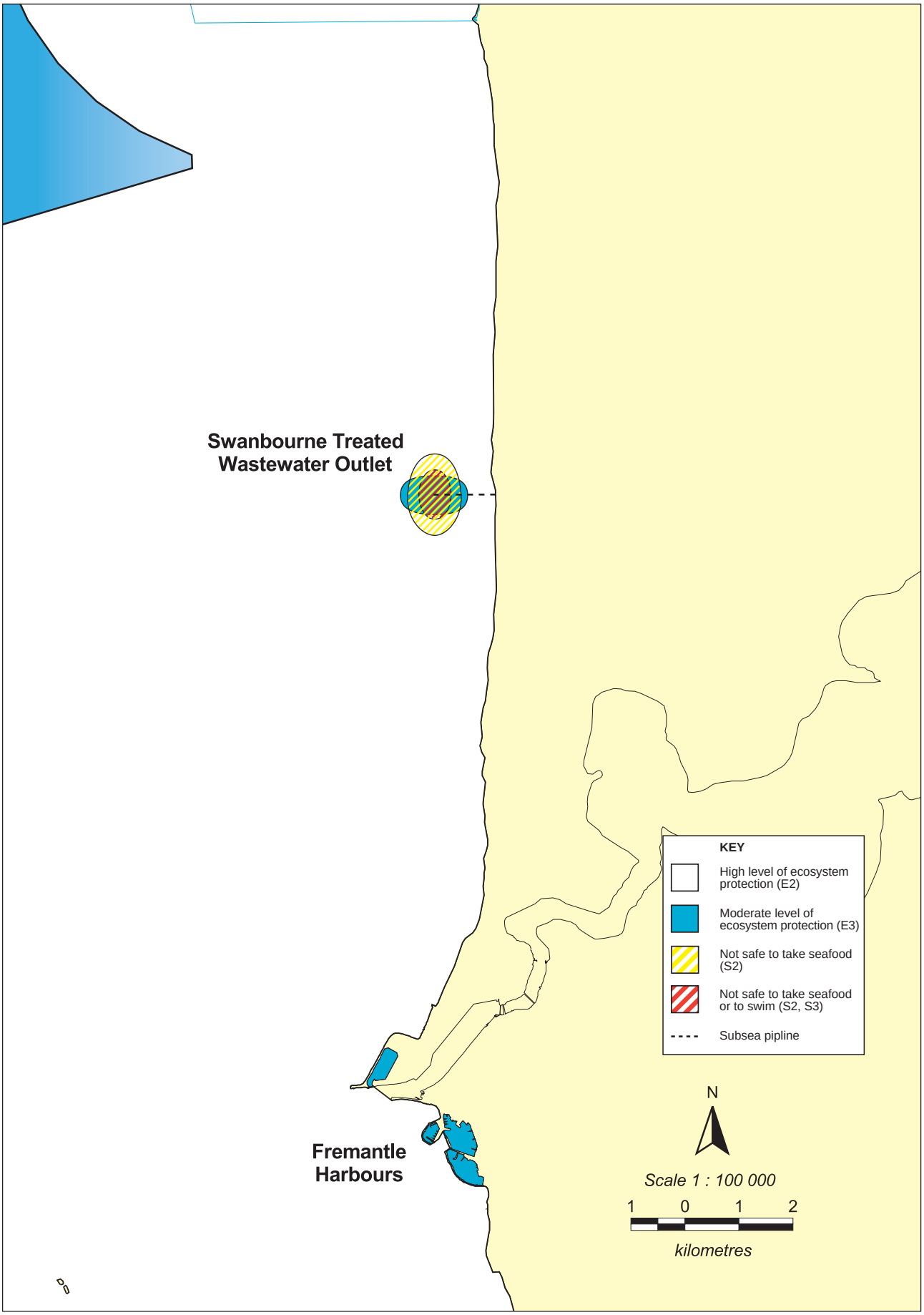
In Cockburn Sound and in the majority of Sepia Depression it is anticipated that all the social values will be protected. However as with the Swanbourne and Beenyup Treated Wastewater Outlets, the effluent discharged from the Sepia Depression Treated Wastewater Outlet contains a significant bacterial load and an area is designated (S2) around the outlet (shown by yellow stripes on Maps 4 and 7) where consumption of seafood collected from this area may be unsafe. Like-wise a smaller area around the outlet is designated S3, identified by red stripes on Maps 4 and 7, where direct contact recreation activities such as swimming may not be safe.



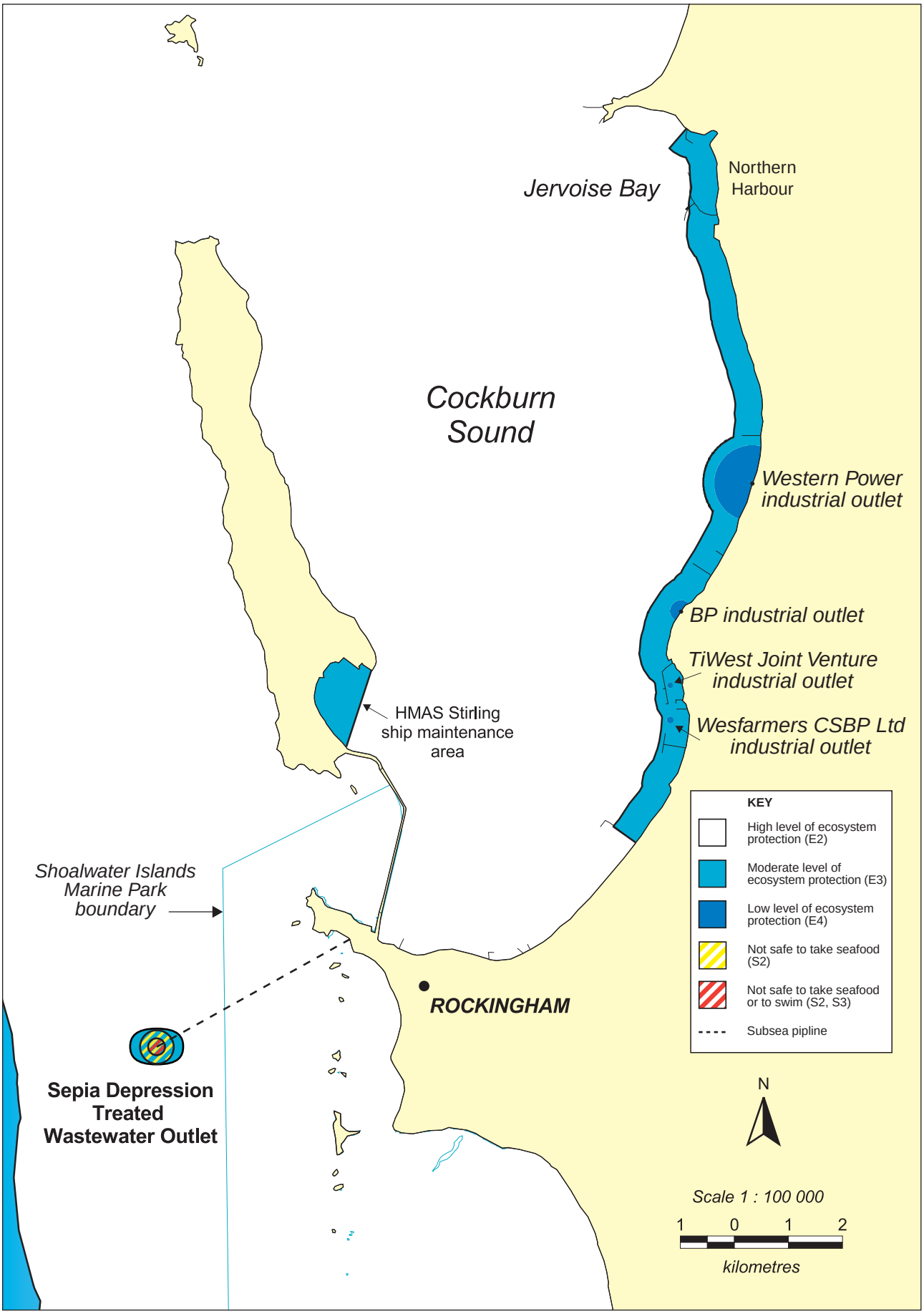
Map 1. Key to maps 2-7 of Perth's Coastal Waters.


Mindarie Keys Marina
Ocean Reef Treated Wastewater Outlet
Ocean Reef Boat Harbour
Mullaloo Point
Hillarys Marina
Marmion Marine Park
KEY
High level of ecosystem protection (E2)
Moderate level of ecosystem protection (E3)
Not safe to take seafood (S2)
Not safe to take seafood or to swim (S2, S3)
Subsea pipline
N
Scale 1 : 100 000
1 0 1 2
kilometres

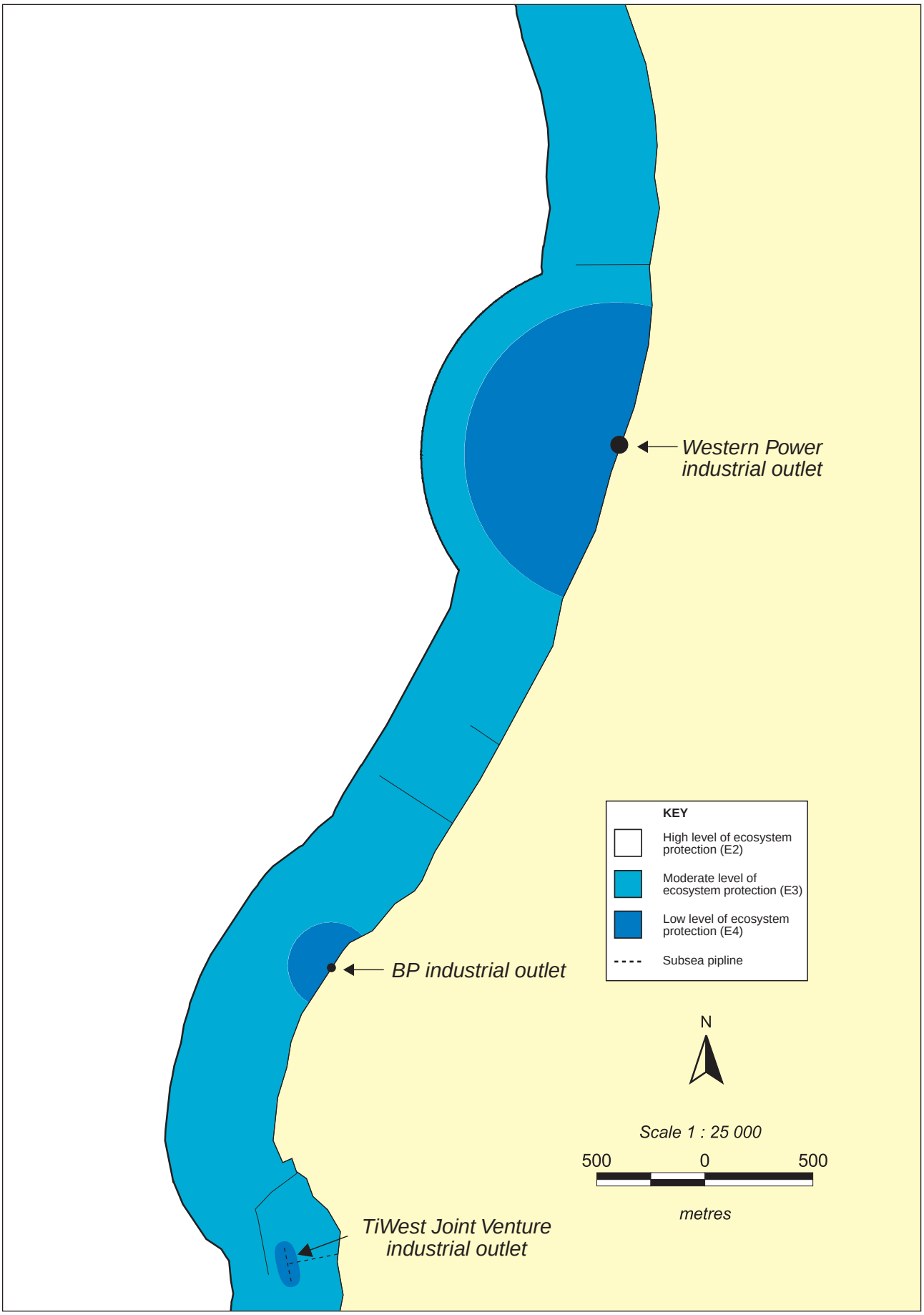
Map 2.


Swanbourne Treated
Wastewater Outlet
Fremantle
Harbours
KEY
High level of ecosystem protection (E2)
Moderate level of ecosystem protection (E3)
Not safe to take seafood (S2)
Not safe to take seafood or to swim (S2, S3)
Subsea pipline
N
Scale 1 : 100 000
1 0 1 2
kilometres

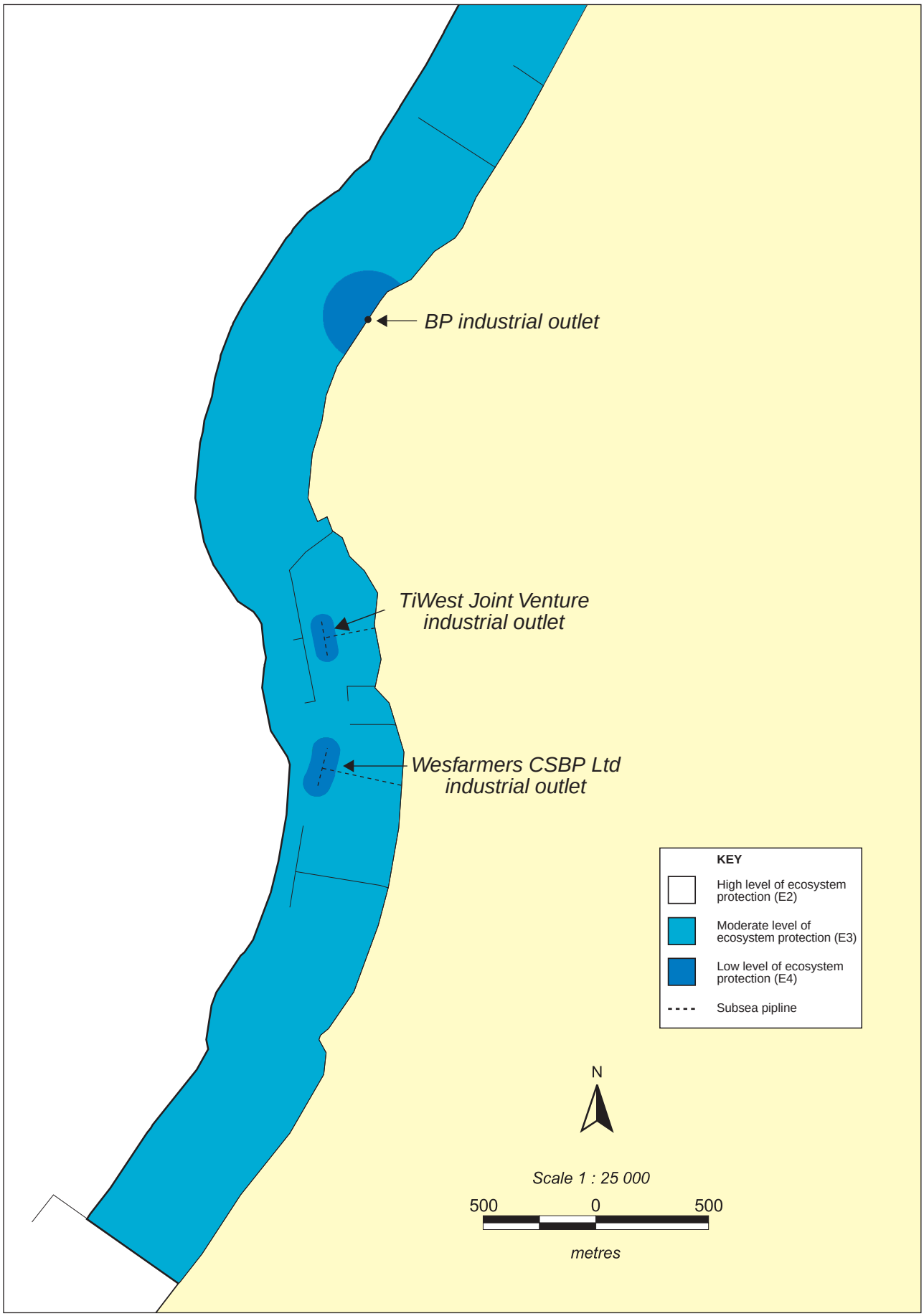
Map 3.


Jervoise Bay
Northern Harbour
Cockburn Sound
Western Power industrial outlet
BP industrial outlet
TiWest Joint Venture industrial outlet
Wesfarmers CSBP Ltd industrial outlet
HMAS Stirling ship maintenance area
Shoalwater Islands Marine Park boundary
ROCKINGHAM
Sepia Depression Treated Wastewater Outlet
KEY
High level of ecosystem protection (E2)
Moderate level of ecosystem protection (E3)
Low level of ecosystem protection (E4)
Not safe to take seafood (S2)
Not safe to take seafood or to swim (S2, S3)
Subsea pipline
N
Scale 1 : 100 000
1 0 1 2
kilometres

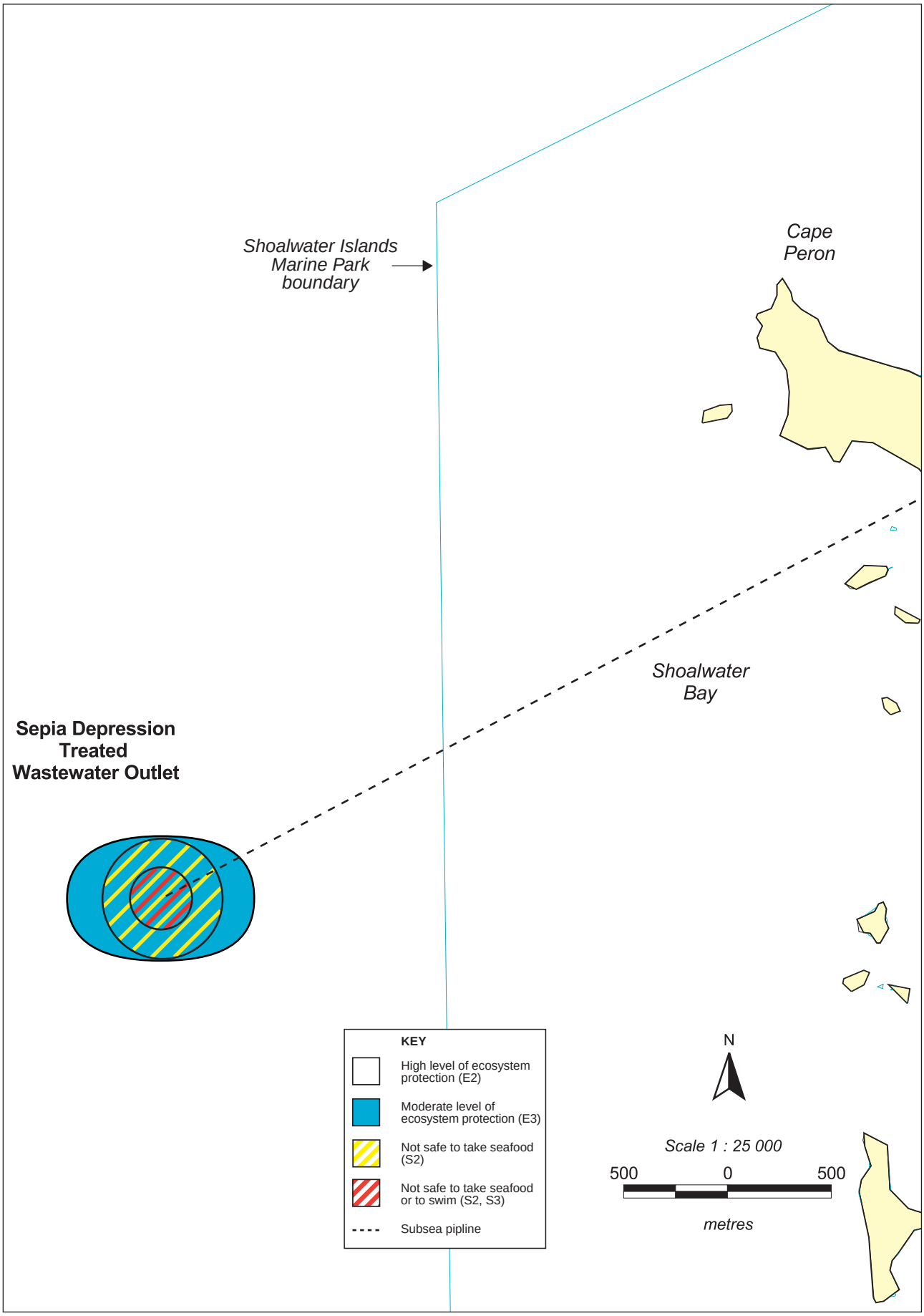
Map 4.


Western Power industrial outlet
BP industrial outlet
TiWest Joint Venture industrial outlet
KEY
High level of ecosystem protection (E2)
Moderate level of ecosystem protection (E3)
Low level of ecosystem protection (E4)
Subsea pipline
N
Scale 1 : 25 000
500
0
500
metres

Map 5.


BP industrial outlet
TiWest Joint Venture industrial outlet
Wesfarmers CSBP Ltd industrial outlet
KEY
High level of ecosystem protection (E2)
Moderate level of ecosystem protection (E3)
Low level of ecosystem protection (E4)
Subsea pipline
N
Scale 1 : 25 000
500
0
500
metres

Map 6.


Shoalwater Islands Marine Park boundary
Cape Peron
Shoalwater Bay
Sepia Depression Treated Wastewater Outlet
KEY
High level of ecosystem protection (E2)
Moderate level of ecosystem protection (E3)
Not safe to take seafood (S2)
Not safe to take seafood or to swim (S2, S3)
Subsea pipline
N
Scale 1 : 25 000
500
0
500
metres

Map 7.