SOUNDING OUT

A WAY FORWARD

A journey towards facilitating Multiple-use of Cockburn Sound and Owen Anchorage

Stage One
Parts I, II and III

Background paper for the Cockburn Sound Management Council
Prepared in consultation with the Multiple-use Support Team
2009

COCKBURN SOUND MANAGEMENT COUNCIL

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Background Paper for the Cockburn Sound Management Council

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The authors wish to emphasise that the information provided is a humble attempt to capture some of the extensive and fascinating history as well as catalogue the wide range of multiple uses of this remarkable marine embayment. It is hoped this document will be used to help guide the CSMC and the wider community into ensuring that sustainable long-term future uses and management of Cockburn Sound are such that it remains a healthy, fun, productive and valuable Perth metropolitan waterway and environment for all.

Contents

Part II.
A review of written, spatial, verbal and photographic information for Cockburn Sound and Owen Anchorage (1900–2008)

Part III.
Examples of Multiple-use Marine Planning Approaches around Australia, in New Zealand and China
A Suggested Formula for Cockburn Sound Management Council Facilitated Multiple-use Planning Gaps in Knowledge and Information and Identified Research Needs

Appendices

Figures

Tables:

1. Setting the Scene – Cockburn Sound and Owen Anchorage and the Cockburn Sound Management Council

Cockburn Sound is located some 20 kilometres south of the Perth-Fremantle area. Owen Anchorage lies to the north of Cockburn Sound between Parmelia Bank and Success Bank. Parmelia Bank 'separates' Cockburn Sound and Owen Anchorage.

The shoreline of Cockburn Sound includes beaches such as Woodman Point, Challenger Beach, Kwinana Beach, Rockingham Beach and Palm Beach. Owen Anchorage beaches include Woodman Point and Coogee Beach. The seaward boundaries of Cockburn Sound and Owen Anchorage are defined by the Garden Island Ridge which has Garden Island, Carnac Island and Stragglers Rocks as emergent features.

Their accessibility in all weather, their unique natural assets and proximity to transport routes, industry and port infrastructure have resulted in Cockburn Sound and Owen Anchorage becoming two of the busiest and most popular marine water bodies in Western Australia. Development and use of the shores and waters have been ongoing since colonial settlement in 1829 and have resulted in substantial economic benefits to all Western Australians. However, these benefits have increasingly put pressure on social and environmental values which need careful management, especially as all types of use are expected to intensify.

In the late 1960s to early 1970s most of the seagrass meadows in Cockburn Sound were severely degraded as a result of nutrient enrichment of the waters of the Sound. Sediments, water and biota were also contaminated with toxicants and pathogens. These impacts were attributed to waste discharge to these waters from the mid-1950s (Department of Environmental Protection 1996). Since the 1970s the Western Australian State Government, in partnership with industry, local government and the community, has worked to improve the environmental values of Cockburn Sound. Through this effort the water and sediment quality within the Sound has improved substantially. However, issues still remain in regard to tributyltin (TBT) contaminated sediment and biota at Careening Bay and Jervois Bay Northern Harbour, and nutrient enrichment and pathogen transport via groundwater flow from the catchment. Seagrass, while never expected to return to pre-1970 levels, has had a slight increase in area, with shoot density at monitoring sites comparable to healthy seagrass located in Warnbro Sound.

The partnerships formed over a number of years and strong community support and concern for the state of the marine environment, resulted in the formation of the Cockburn Sound Management Council (the Council) in 2000 for the purpose of maintaining the value of Cockburn Sound and Owen Anchorage as a premier multiple-use marine area.

The Council is a collective group of twenty-two representatives from a variety of organisations and interest groups in metropolitan Perth, Western Australia, with an interest in Cockburn Sound and Owen Anchorage (see Appendix 1 for Representation List). The Council is appointed by the Western Australian Minister for the Environment under section 25 of the Environmental Protection Act 1986 and acts as an advisory body (see Appendix 2 for CSMC Terms of Reference).

The Council is serviced by officers of the State Department of Environment and Conservation and has an office adjacent to Cockburn Sound in the seaside city of Rockingham. Originally the Council's area of responsibility included only Cockburn Sound, but in 2006 the government extended the boundary to include Owen Anchorage due to community concern that this area may be adversely affected by development and use over time (Figure 1).

In 2005 the Council endorsed its first Environmental Management Plan (EMP) (Cockburn Sound Management Council 2005), having worked with an interim plan (CSMC 2002) for three years while awaiting the completion of the State Environmental (Cockburn Sound) Policy 2005 (SEP) (Environmental Protection Authority 2005).

The SEP is a guiding policy for development proponents, the Environmental Protection Authority (EPA) and the Government of Western Australia, to assist with decision-making processes; it also governs ongoing monitoring of environmental values relating to seagrass health and extent, and sediment and water quality in Cockburn Sound. The EMP provides guidance to the Council for its activities. Section 1 outlines the Council's involvement in the implementation of the SEP (see Appendix 3 for information about SEP, EMP and Council publications).

An important part of the Council's responsibility is to provide advice and comments to proponents of development proposals. Often a referral to the Council is made through Ministerial Conditions or EPA imposed environmental conditions. At other times proponents approach the Council directly to seek advice prior to advancing their proposals. In most cases the advice provided by Council relates directly to the requirements and intent of the SEP, with additional comment offered on the basis of the Council's EMP. The Council is able to influence positive outcomes because of the 'power' behind the SEP and the collective Council endorsement of the EMP from a wide variety of stakeholder perspectives (see Appendix 3 for examples of Council advice and comment offered).

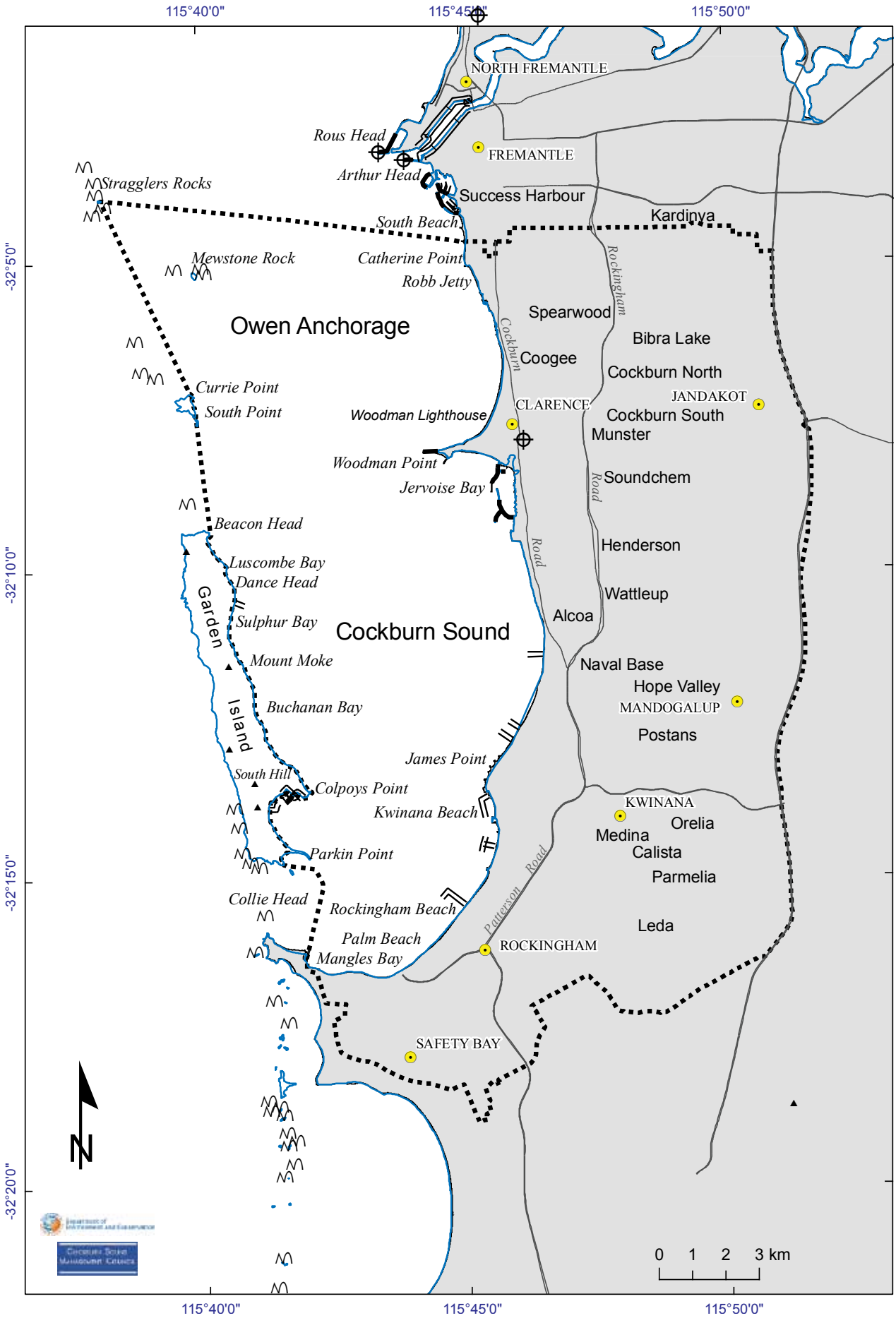


Figure 1: Cockburn Sound Management Council boundary

2. Cockburn Sound Management Council Objective for the Multiple-use Framework

To facilitate an integrated approach to the use and development of Cockburn Sound and Owen Anchorage in keeping with the State Environment (Cockburn Sound) Policy 2005 and Environmental Management Plans for Cockburn Sound[1] and Owen Anchorage[2] and their catchments.

Section 2 of the EMP directs the Council to pursue the overarching objective: 'To recognise and facilitate multiple-use management of Cockburn Sound and its foreshore'. Approaches towards achieving this objective have been discussed by the Council at intervals for the past three years, and in April 2007 the Council endorsed the first stage of a three stage process (Figure 2). With a multiple-use framework in place the Council can work towards more effectively providing advice to government and proponents, and offering an informative range of documents and data to assist the community to form a better understanding of the range of uses and resources of Cockburn Sound and Owen Anchorage.

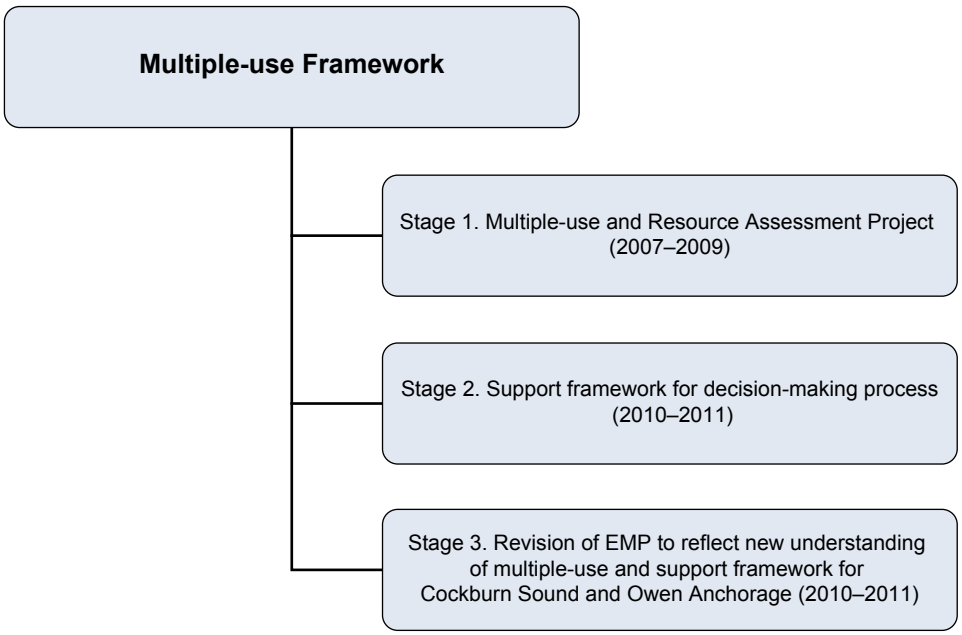


Figure 2: Cockburn Sound Management Council approach to the facilitation of a Multiple-use Framework for Cockburn Sound and Owen Anchorage

Stage 1: Multiple-use and Resource Assessment Project

This stage has involved the collation of spatial, written, verbal and photographic information. The information presents a picture of Cockburn Sound and Owen Anchorage now, in relation to past events. 'Sounding Out' is the outcome of the Multiple-use and Resource Assessment Project and finalises Stage 1.

Stage 2: Support Framework for Decision-making Processes

This stage involves the Council establishing key principles and re-affirming a vision to support decision-making processes for planning and management in Cockburn Sound and Owen Anchorage. It will also include consideration of computer based decision support tools.

Stage 3: Environmental Management Plan

This stage involves the preparation of a revised EMP for Cockburn Sound and Owen Anchorage which reflects the support framework for decision-making processes, and the understanding that the Multiple-use and Resource Assessment Project ('Sounding Out') provides.

1 Completed in 2005
2 Expected to be completed by the end of 2010

3. ‘Sounding Out’ – Part I, II and III Outline

Part I of this paper is presented in two sections:

1. A historical overview of multiple-use in Cockburn Sound and Owen Anchorage;
2. A description of current administrative/ management boundaries in Cockburn Sound and Owen Anchorage.

Information presented will focus mainly on the marine environment and foreshores of Cockburn Sound and Owen Anchorage as these are the primary areas of the Council’s focus and it is in these areas that the greatest pressures and conflicts of use are expected.

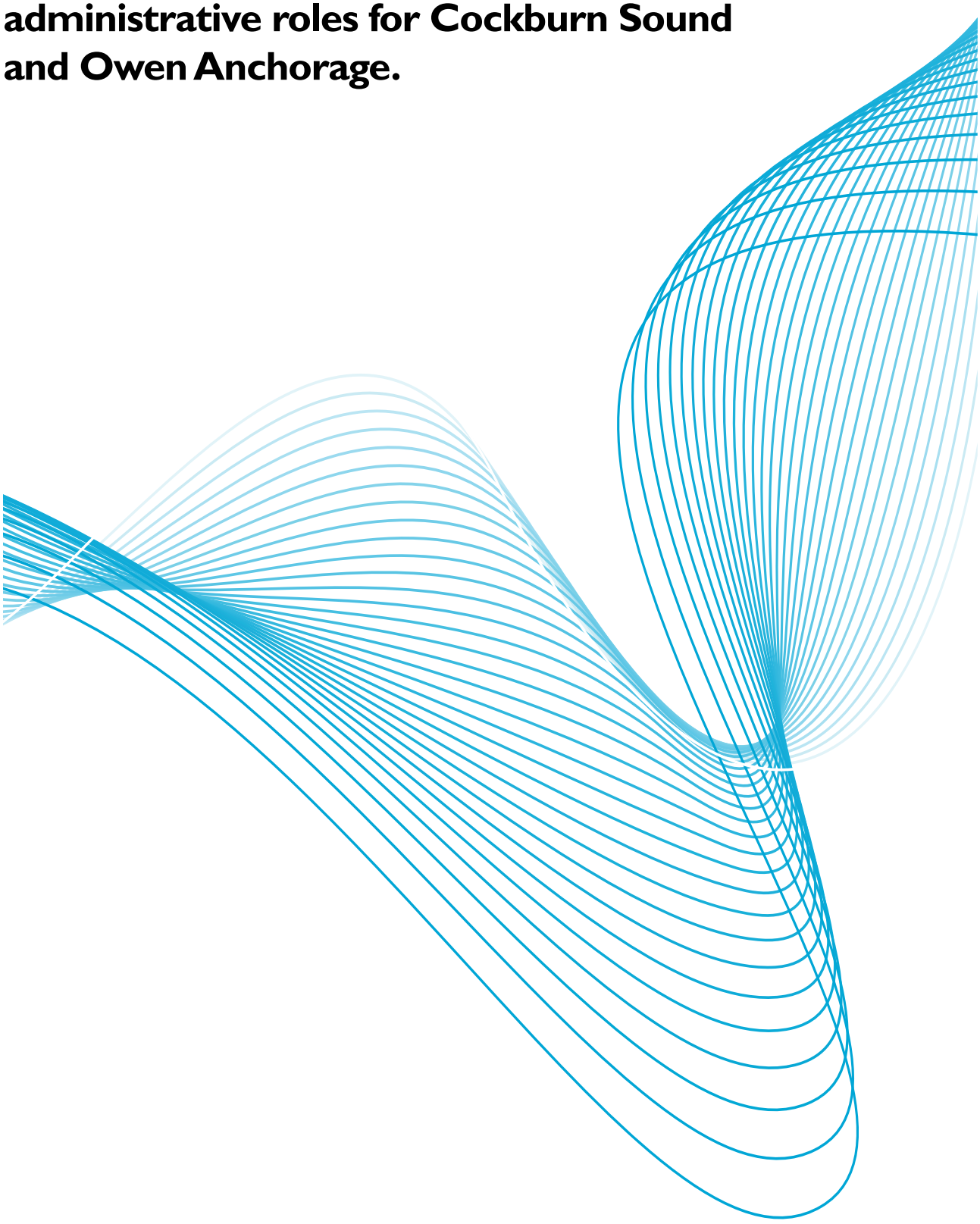
Part II of this paper outlines the methodology behind the information collection and presents all information collected during the time allocated for Stage 1 of the Multiple-use Framework. This includes:

1. Spatial Information
2. Written Information
3. Oral Information – in summary
4. Photographic Collection

Part III of this paper provides a suggested formula for Cockburn Sound Management Council involvement in a facilitated approach to Multiple-use Planning and Management; a description of multiple-use planning approaches in use in Australia and overseas; and a review of information gaps and research needs.

Part I.

A review of historical and current use, and administrative roles for Cockburn Sound and Owen Anchorage.






1. Cockburn Sound and Owen Anchorage – A History of Multiple-use

1.0 Indigenous History

Evidence of Indigenous occupation can be found around many coastlines in the south west of the state, although density of population and sites are influenced by resources and the availability of water. Favourite residential areas were the alluvial flats where rivers and creeks entered the sea or where there were freshwater lakes behind the dunes ('Sea countries of the south: Indigenous interests and connections within the South-west Marine Region of Australia, Australian Institute of Aboriginal and Torres Strait Islander Studies, June 2006').

Archaeological evidence is usually restricted to those items of material culture that can survive several hundred years of exposure and weather. Therefore, although stone tools of many kinds are evident, wooden spears and handles to which they were hafted are seldom found. However, museum collections hold many examples of the wide range of wooden, shell, string and woven items of daily life that give insights into how Indigenous people lived. A number of people also continue to practise skills such as making baskets, string bags and mats and are keeping this knowledge alive to pass on to the next generation.

Archaeological research over the past thirty years has provided crucial evidence of Indigenous occupation of the south-western coastline, including Cockburn Sound and Owen Anchorage, and this has supported Indigenous understandings and oral accounts of past times. Following the end of the last Ice Age – approximately 13,000 years ago – sea levels rose roughly 120 metres in the next few thousand years. Previously occupied coastal lands were drowned by this inundation and coastal populations would have moved inland with the encroaching shoreline (Australian Institute of Aboriginal and Torres Strait Islander Studies 2006).

Prior to white settlement, local Indigenous coastal lands were managed by an annual seasonal cycle that supported sustainable land and sea economies. It is believed some local coastal Indigenous communities utilised both inland and coastal resources in accordance with natural cycles.

Key practices and strategies in the pre-colonial management of sea country included:

the conduct of ceremonies with the purpose of nurturing the wellbeing of particular places, species and habitats; control of entry to marine clan estates by outsiders and restricting resources use to clan members and others by agreement; seasonal exploitation of particular marine resources; restrictions on the harvesting of particular species based on age, gender, reproductive conditions, health, fat content; restrictions on resource use and distribution by clan members and others based on age, gender, initiation status, marital status and other factors; restrictions on the use of particular animals and plants of totemic significance to individual clans; and prohibition of entry to certain areas of land and sea, often associated with storms or other sources of danger (Smyth & Bahrdt 2001).

Knowledge of resource availability, including fresh water and game, fertile river valleys and resource-rich coastal inlets, determined the first areas to be colonised and farmed by European settlers to supply growing markets. Indigenous resources in the form of forests, fisheries, and coastal lands were fenced off and exploited for the production of Western agricultural products.

Early relations with Indigenous people in the colony were usually harmonious. A range of documentary sources demonstrate that historical relations on the Swan coastal plain were complex and not consistently adversarial (Reece 1987). As Green observed 'contrary to popular belief the Aborigines did not regard the settlers as a common enemy, and many settlers and Aborigines established close friendships' (Green 1984). By 1831 that harmony was drawing to a close with the introduction of three major sources of conflict: competition for resources; the need for Aboriginal labour; and the fencing off of land and denial of Aboriginal access.

Since colonisation, Western development and government policies that restricted Indigenous access to and use of lands and waters have marginalised Indigenous interests and the ability to care for country (Australian Institute of Aboriginal and Torres Strait Islander Studies 2006).

Recent government programs have aimed at engaging Indigenous knowledge in the management of national parks and conservation zones and in an effort to reverse the degradation of Australia's natural and cultural resources. These have been eagerly taken up by Indigenous groups who are actively participating in programs aimed at reinvigorating Indigenous knowledge as a means of countering environmental problems. Recent shifts to include Indigenous communities and individuals in this process are welcome and necessary. These efforts require clear communication and negotiation (Baker, Davies & Young 2001).

The integrated planning approach has the potential for negotiated regional planning processes that take into account specific and individual Indigenous community realities. These include capacity and access to country, as well as the potential for new partnership agreements with government and industry groups that go beyond the current programme-based approach (Australian Institute of Aboriginal and Torres Strait Islander Studies 2006).

Specific information on Indigenous heritage in Cockburn Sound can be sourced in the desk top study prepared for the Cockburn Sound Management Council undertaken by Rory O'Connor in 2001 <http://portal.environment.wa.gov.au/pls/portal/url/ITEM/EB9F96161CCC619DE03010AC6E052188>.

1.1 Colonial Settlement

Cockburn Sound was named in 1827 by Captain James Stirling, probably after Admiral Sir George Cockburn. Cockburn was born in London in 1772 and was a renowned British naval officer. It was he who took Napoleon to exile on the island of Saint Helena after the Battle of Waterloo in 1815 (Berson 1978). Captain Stirling later became the first Governor of Western Australia, leading the development of Fremantle and Perth with the assistance of the first settlers who landed on the shores of Cockburn Sound in 1829.

The settlement of Western Australia was very much reliant on the geographic proximity of Cockburn Sound to the Swan River. History may have transpired very differently for Australia if Cockburn Sound had been found to be inadequate for safe anchoring, ship repair and small boat travel to the shore (interpreted from James 1979).

1.2 Whaling and Sealing

In 1837 two whaling companies were operating: the Fremantle Whaling Company, out of Bathers Beach below the Round House gaol in Fremantle; and the Northern (or Perth) Fishery which was based on Carnac Island. The first whale was caught by the combined efforts of the two companies on 10 June 1837, the timing indicating that the whale was probably a Southern Right. In its first year of operation whaling generated 100 tonnes of oil and 5 tonnes of whalebone. There was intense conflict and competition with American and French whaling vessels which also operated in Cockburn Sound. By 1840, increased competition, a decline in international whale oil and bone prices and increased costs led to the closure of the two Western Australian companies. The industry resumed in 1844 with works being initiated in many other areas around the State. From limited information it appears that whales with calves were prevalent in Fremantle waters, both Southern Right whales and Humpback whales. In 1848 the Fremantle whale fishery casked 34 'tuns' of whale oil. The industry went into decline in the 1860s (Heppingstone 1966, 1969, 1973).

'Seals' were common around Garden Island, Carnac Island and Mangles Bay when Captain Fremantle arrived in 1829. His diary records the number of seal (presumed to be sea lions) killed and that *'they have been so attacked* [by his crew] *that they have deserted it* [Carnac Island]*'* (from James 1979).

Whales are now very rarely seen in Cockburn Sound or Owen Anchorage due to the dramatic decline in numbers caused by whaling. Although Southern Right whales have been fully protected since 1935 and Humpback whales since the late 1960s, population increases have been slow. Given the bathymetry of the Sound and Anchorage it is less likely that Humpbacks would be regular visitors as they tend to avoid shallow bars. However, the bathymetry could be attractive to calving Southern Rights as they prefer to bring calves into shallow water for at least 6–8 weeks after birth (Personal Observation). Male sea lions still haul out

at Carnac Island, with an occasional sighting on the north end of Garden Island.

1.3 Jetty Structures

The suitability of Cockburn Sound and Owen Anchorage for safe shipping activity resulted in the construction of a number of jetties, many of which are still part of the culture and identity of the shoreline today. Most of these jetties were built prior to the permanent opening of the bar at the mouth of the Swan River at Fremantle in 1897, after which time the inner Fremantle Port was established and expanded to cater for increasing maritime activity. Jetties still remain along the coast at Coogee Beach, Woodman Point Regional Park, Woodman Point Boat Ramp, Alcoa, Naval Base, James Point, Kwinana Bulk Terminal, Wells Park, CBH, Rockingham Beach, Val Street Rockingham, Palm Beach and at the Mangles Bay Fishing Club. The City of Rockingham has plans to upgrade its jetty structures, and the Coogee jetty was replaced completely by the City of Cockburn in the mid 1990s.

1.4 Ship Building and Repair

Ship repair has been carried out in Cockburn Sound since 1829 when Captain Fremantle provided support for the repair of a ship that ran aground while entering Cockburn Sound near Carnac Island.

In the 1980s Jervoise Bay became the focus for a large-scale shipbuilding industry with the construction of the Rankin A drilling platform at Woodman Point. The ship repair and ship building industry is now well established on the shores of Cockburn Sound within the constructed Northern and Southern Harbours.

The larger shipbuilding area is now referred to as the Australian Marine Complex(AMC). The AMC has been developed to facilitate and enhance the opportunities created by the clustering of industries servicing the marine, defence, mining and petroleum industries. The complex has become Australia's leading integrated marine industry estate with a deepwater port, world-class multi-user load out and fabrication facilities, and high-wide load road access.

Home to the largest marine industry in Australia, the AMC has established international credentials for the repair, maintenance and construction of naval and commercial vessels, as well as infrastructure for the fabrication and assembly of offshore oil and gas modules <www.landcorp.com.au/pls/portal/url/page/jbay1/overview>.

1.5 Light Industry – Owen Anchorage

To the south of Fremantle, the development of the Owen Anchorage coast was centralised around meatworks and lime kilns from the early 1900s, with meatworks becoming prevalent from the 1940s (Department of Conservation and Environment 1979, <www.heritage.wa.gov.au>. The largest of the meatworks was the Robb's Jetty Abattoir located just south of South Beach, Fremantle. The only remaining link to this industry is Watsonia Foods located in Spearwood which is still operating today. Prior to the mid- 1980s the meatwork industries disposed of their untreated waste directly into the sea (Department of Conservation and Environment 1983) and were eventually forced to close down when improved environmental legislation was introduced to control pollution, and because of public health concerns. In 1971 it was found that 'none of the present salmonella examined from effluents were of the typhoid inducing strains' (Environmental Resources of Australia 1971). Thankfully, health standards have improved since this time.

Lime kilns were a common industry in the Cockburn area with remains still in evidence as heritage sites <www.heritage.wa.gov.au>. Cockburn Cement Limited began in 1953, and is a modern version of the early lime kilns which provided quicklime (burnt lime) for the construction of buildings and infrastructure throughout Western Australia. Cockburn Cement Limited is now the largest lime producer in Western Australia <www.cockburncement.com.au>. Calcareous shell material for lime production has been dredged from the seafloor of Owen Anchorage by Cockburn Cement since 1971 under a State Agreement Act. Over time dredging has contributed to the loss of approximately 90 hectares of seagrass in the Owen Anchorage area (Department of Environmental Protection 1996).

1.6 Heavy Industry – Cockburn Sound

The first large industrial complex, the BP Refinery, was opened on the eastern shore of Cockburn Sound in 1955 to much fanfare and excitement. In 1961, an inter-departmental committee, known as the Cockburn Sound and Kwinana Development Committee, was formed to examine the Cockburn Sound area and to make recommendations as to zoning for use. The object of planning at that time was to utilise the area for industrial growth (Department of Conservation and Environment 1979). During the period 1955–1965 other industries developed in the Kwinana area including Western Mining, Alcoa, Australian Iron and Steel and CSBP. Most of these industries were supported by the government of the day through State Agreement Acts (T. Grigson Pers. Comm).

PLATE 1

This Plate shows a 'slug' dose of effluent being released from the AIS outfall (arrowed 1). The red-black colour of the effluent is due to large amounts of particulate iron. James Point, denuded of seagrass, is seen in the foreground (arrowed 2).

The Kwinana Industrial Area now hosts many industries and is the State's largest industrial centre, providing a major source of revenue for the State and Australian economies with direct sales in 2007 of $8.51 billion per annum. At present the industrial area provides direct employment for over 4800 people and a further 26,000 indirect jobs. $2,560 million is expected to be invested in capital expenditure in the area over the next ten years (Sinclair Knight Mertz 2007). Currently many companies in the industrial area have in place or are working towards preparing Environmental Management Systems and accreditation to ISO 14001 environmental standards. Some companies are also voluntarily preparing Environmental Improvement Plans with assistance from the Department of Environment and Conservation. There is no doubt that the environmental performance of local industries has improved over time.

While industry has provided significant economic and social opportunity for Western Australia it has had a significant environmental impact in the past. There is direct evidence that in the early days of industrial development extensive seagrass loss occurred on the eastern shelf of Cockburn Sound because of the discharge of untreated contaminants and nitrogen which increased shading of seagrass, and nutrient availability to epiphytes, benthophytes and planktonic algae (Cambridge 1975; Cambridge et al 1986, Department of Consevation and Environment 1979, 1983, 1985, Environmental Resources of Australia 1971, 1972, 1973, 1974, Meagher and Le Provost 1975).

1.7 Wastewater Treatment, Re-use and Sewage Discharge

The first wastewater treatment plant, south of Perth, was built in South Fremantle in 1910. It served the immediate Fremantle area with three large septic tanks that discharged wastewater into the waters of Owen Anchorage from Robbs Jetty. In 1966 a new plant was established at Woodman Point and primary treated effluent was discharged directly to Cockburn Sound for nearly twenty years. Due to concerns about nutrient related water quality issues during the late 1970s the Cape Peron pipeline was built and treated wastewater was then discharged 4 km out to sea off Cape Peron from 1984. The Woodman Point plant was upgraded to a secondary treatment plant in 2002. An emergency outfall pipe still remains in Cockburn Sound but discharge has only occurred once in the last eight years when the pipe required testing for maintenance purposes (M. Nener Pers. Comm.).

The Woodman Point Wastewater Treatment Plant now treats wastewater for a population of more than half a million people living south of the Swan River in the Perth metropolitan area. The wastewater is predominantly from household kitchens, bathrooms, toilets and laundries. Treated wastewater travels 23 kilometres by underground pipeline to Cape Peron, then 4.3 kilometres along a pipeline to be discharged to the Sepia Depression, a 20 metre deep depression behind the Garden Island Ridge System. This pipeline is referred to as the SDOOL (Sepia Depression Ocean Outfall Line) <www.watercorporation.com.au/_files/publicationsregister/20/WoodmanPoint_Wastewater_Treatement_Plant.pdf>.

The State Government has recognised the value of using recycled water and has taken a lead role in exploring opportunities to increase water recycling within the framework of a State Water Strategy for Western Australia (Government of Western Australia 2003). The Kwinana Water Reclamation Plant has been a major initiative and is capable of processing 6 gigalitres of wastewater a year. The reclamation plant accesses secondary treated effluent from the SDOOL, processes it further and provides high quality industrial grade water to industry in place of scheme water. A second initiative is the receival of industrial wastewater to the SDOOL to be discharged to Sepia Depression. This initiative means that industrial discharge to Cockburn Sound has been reduced and has the capacity to reduce further in the future.

1.8 Port Operations

In 1891, WA's first Premier, Sir John Forrest, appointed Irish-born engineer Charles Yelverton O'Connor as Engineer-in-Chief. Work on developing a safe harbour at Fremantle began the following year. The project involved blasting away the rocky bar blocking the Swan River estuary, dredging to deepen the river basin, construction of the North and South Moles to protect the entrance to the harbour, and reclaiming land for wharves and warehouses. Fremantle's Inner Harbour was opened in 1897 and while it has been deepened, extended and modernised over the years, its design remains essentially unchanged.

In 1897, out of the 474 ships that visited the port, 127 were sailing ships with the remainder classed as steam and sail. The gross tonnage of the ships was 550,000 tonnes. In 2005–06, there were 1687 ship visits to the Inner and Outer Harbours and the gross tonnage was 45,938,000 tonnes. In 2005–06, the total value of trade going through the Port of Fremantle was almost $20 billion <www.fremantleports.com.au/mediapublications/4072.asp>.

Development of Cockburn Sound as the outer harbour for the Perth-Fremantle area really began in earnest in the 1950s and gained momentum for the next 25 years (Department of Conservation and Environment 1979) with the introduction of maritime structures, dredged shipping channels and navigation markers. Planning for the development of Outer Fremantle Harbour infrastructure has been underway intermittently since the mid 1950s (Fremantle Port Authority 1966). Currently, Fremantle Ports is investigating two options for constructing significant outer harbour infrastructure in Cockburn Sound (Figures 3a and 3b) <www.fremantleports.com.au/mediapublications/4191/asp>. The options have been approved by Cabinet in 2007 with permission to apply for planning and environmental approval.

Figure 3: Fremantle Port proposals for Outer Harbour Infrastructure
(Sourced <www.fremantleports.com.au/mediapublications/4191.asp>)

1.9 Defence of Australia

Cockburn Sound has long been, and continues to be, considered a strategic component of the defence of Australia and has hosted naval infrastructure at Careening Bay, Garden Island, since the early 1940s. Other naval facilities were located at Palm Beach Jetty, Woodman Point and 'Naval Base', now a locality of the Town of Kwinana, in early years.

A causeway extending from Cape Peron to Garden Island was completed in 1973 to enable easy access to HMAS Stirling from the mainland, resulting in the extensive development of Careening Bay to host the Department of Defence's Fleet Base West. During World War II, a submarine fence extended from Woodman Point to Garden Island along Parmelia Bank. This fence was dismantled in about the 1960s (J. Smedley Pers. Comm.) A second fence, known locally as the 'Boom', was located across Southern Flats and became a popular snorkelling and fishing area during the 1950s (R. Sergeant Pers. Comm.).

In establishing HMAS Stirling, Controlled Naval Waters were declared along the eastern coastline of Garden Island to provide naval jurisdiction over approaches to the Defence installations. In 1992, Controlled Naval Waters were extended around the entire Island (Department of Defence 2005).

HMAS Stirling now provides strategic defence support for protection of Australian interests in the Indian Ocean and the west coast of Australia.

1.10 Power Supply

A power station, the building still standing today, albeit an empty shell, was constructed in 1949 at Owen Anchorage to service the metropolitan area. Seawater was used for cooling during the power production process and then discharged to the sea. This power station was shut down in the 1980s.

Kwinana Power Station, on the shores of Cockburn Sound, is unique in WA in that it can burn three fuels – coal, gas and oil. The station has a total generating capacity of 900 MW or enough energy to light nine million 100 watt globes. It is connected by 66,000 volt, 132,000 volt and 330,000 volt transmission lines to the South West Interconnected System (SWIS), an area which stretches north to Kalbarri, south to Albany and east to Kalgoorlie.

It was officially opened on 20 November 1970 and was designed and constructed as an oil-fired power station. Due to increases in the world price of oil it was converted to coal, and gas firing was later introduced and oil firing reintroduced in 2005.

Cockburn Power Station, built in 2003, uses combined-cycle technology which features capturing exhaust heat from a gas turbine and using the heat to drive a steam turbine. Combined-cycle gas turbine technology is used widely and

reliably in other parts of the world, but Cockburn Power Station is the first such project in Western Australia. The new plant, with its sophisticated electronic systems, is highly automated and needs a very small team to look after it.

Both Kwinana and Cockburn Power Stations supply power to the State's south-west and the metropolitan area. The location of Kwinana and Cockburn Power Stations is of strategic importance to Verve Energy due to access to established transmission infrastructure and proximity to cooling water from the ocean and natural gas fuel supply pipelines <www.verveenergy.com.au/maincontent/powerstations>.

1.11 Commercial and Recreational Fishing

Fish catch was plentiful during the early days of settlement. Captain Fremantle, who formally claimed Western Australia for Britain in 1829, recorded in his diary on 28 April '*The ships company caught an immense number of fish called Snappers, capital large fellows weighing ten and twelve pounds. Caught a shark, very broad but not more than 8 feet long, the Sound abounds with them and some are very large ones. Plenty of fish and we continue to catch as many as will supply the Ships company'* (from James 1979). It could be said that the abundance of fish in Cockburn Sound and Owen Anchorage contributed greatly to the survival and success of the first settlement due to limited resources from farming produce and external supply. It's also interesting to note that Captain Fremantle made this entry in his diary in April. Recent (1994–1999) catch figures for pink snapper indicate that very few snapper are caught at this time of the year within Cockburn Sound (Department of Fisheries 2004). Little information exists on the commercial and recreational catch over time; however, it is known that crabs, squid, snapper, herring, whiting, baitfish, and mullet have been the mainstay catches of Cockburn Sound for some time (Department of Fisheries, 2006).

The first commercial trawling operations in Cockburn Sound were undertaken in the early part of the 1900s when horses were used to tow small nets on the shallow banks. Later from 1955 to 1962 mechanical trawling was practised over the weed beds in the shallower areas of the Sound. Political pressure and reduction in catches caused some areas to be closed. In 1970, as a conservation measure and because of increased usage of the major part of the deep Sound by ocean going ships, the entire area, including Owen Anchorage, was finally closed to trawling (Penn 1977).

Although it is evident that early industrial practices resulted in the loss of seagrass in Cockburn Sound, scallop dredging in the 1960s and early 1970s also significantly contributed to the loss of large areas of seagrass in both Cockburn Sound and Owen Anchorage.

Scallops and King Prawns were the main catch during this time with the fishery being fully exploited prior to closure. Dredge trawling is no longer allowed in Western Australian waters because of its damaging effect on the benthos (T. Capulletti Pers. Comm.) although otter trawling does occur for prawns and scallops outside Cockburn Sound within the Western Australian Trawl Managed Fishery (Department of Fisheries 2006). Although scallops and prawns were once plentiful in Cockburn Sound they now exist in small numbers that are not often targeted by commercial or recreational fishers (based on interviews with fishers for the Multiple-use and Resource Assessment Project).

An aerial view taken one mile west of Garden Island and looking south. The plate shows "cloudy" water moving out of the southern entrance to Cockburn Sound and southward along the coast (Note that it skirts the outside of Warnboro Sound and Penguin Island). The water is moving into a strong south-westerly breeze (15 knots).

Aerial view westward across Southern Flats and Careening Bay, Garden Island. This plate shows intruding wedges of "marine water" (Clear) and the "Sound water" (Cloudy). The cloudiness of the water was due to scallop dredqing in the Sound, July–November, 1970.

There are currently five managed fisheries in Cockburn Sound and Owen Anchorage:

- **West Coast Beach Bait Managed Fishery**

  Beach access restrictions limit bait fishing from the shore.

- **West Coast Purse Seine Managed Fishery**

  This fishery is based primarily on the capture of pilchards and sardines, but may also include herring, scad, anchovy and maray.

- **Cockburn Sound (Fish Net) Managed Fishery**

  Fish are taken by gillnet and haul net, with the main targeted species being southern sea garfish and Australian herring. Shark, whiting and mullet are taken opportunistically.

- **Cockburn Sound (Line and Pot) Managed Fishery**

  The fishing methods employed include handline, longline and squid jigging; the pots used are unbaited octopus pots.

- **Cockburn Sound (Crab) Managed Fishery**

  Blue Swimmer crabs comprise the bulk of the State's commercial inshore crab catches, with more than three-quarters of the annual catch coming from Shark Bay and Cockburn Sound. Fishers now use specialised crab pots.

Cockburn Sound is a dynamic environment for commercial fisheries and as such requires constant monitoring and evaluation (T. Capulletti Pers. Comm.).

Mussels have become naturally abundant in the Sound, with recreational fishers having memories of mussel mounds being prolific along the shores of Careening Bay (J. Smedley Pers. Comm, Personal Observation).Mussel mounds were also abundant in the seagrass at Woodman Point during the years that nutrient rich sewage was discharged directly to the Sound (J. Brewer Pers. Comm.). Jetty pylons and navigation markers remain today as a grow-out substrate for the abundant mussel spat that occurs in Cockburn Sound waters. A commercial fishery for the collection of wild mussels in Cockburn Sound has existed since the 1970s but most licence holders are now operating mussel farms.

In the main, recreational fishers are targeting squid, crabs, King George whiting, sand whiting, tailor, herring, skipjack and snapper. It is clearly evident that areas of seagrass are the most popular destinations for fishing. Southern Flats is regularly fished by people leaving from the Rockingham area, while Owen Anchorage is regularly fished by people leaving from the Woodman Point area (from interviews with recreational fishers for the Multiple-use and Resource Assessment Project).

Most regular fishers have noticed changes in catch over time, with King George whiting now being more prevalent than at any time in the last fifty years – particularly on Southern Flats (R. Sergeant Pers. Comm.). Fishers have noticed that snapper and crab numbers in particular have declined with few now targeting snapper within the Sound. Fishing closures associated with the snapper and crab recreational fishery have been generally welcomed by recreational fishers because of their concern over the decline in numbers (from interviews for the Multiple-use and Resource Assessment Project).

1.12 Aquaculture

Mussel aquaculture started in Cockburn Sound in the late 1980s and has had a chequered history of development and tenure. Early farming proponents found it difficult to establish the industry due to poor coordination between government agencies and restrictions on the use of particular areas of the Sound. The first mussel farms allowed in the Sound were positioned at the north end of Garden Island, outside naval waters, away from shipping areas and, unfortunately, in an area exposed to wind and swell and with a low nutrient load (D. Bliss Pers. Comm.). With the discovery of high phytoplankton levels and significant mussel spat availability in the water around the disused BHP jetty and Cooperative Bulk Handling jetty, the industry began to develop and now has a foothold in competitive markets (G Dibbin Pers. Comm.).

Mussel farming now occurs at the northern edge of Southern Flats, in addition to the waters around the CBH jetty, with a lease area still remaining at the northern end of Garden Island. There are currently seven lessees and the Fremantle Port Authority has delegated lease management to the Department of Fisheries to faciliatate coordination of industry development and administration, Leases, generally for five years, do not provide lessees with secure tenure beyond that period.

1.13 Tourism

From the early 1900s through to the 1960s ferries carried day trippers and holiday makers to Garden Island on a regular basis. For some time Garden Island had a registered post

Rockingham Jetty and Val Ray Café, 1930s

office and general store and provided basic accommodation. Holiday homes were built on the southern end of the island around Careening Bay and at one point land was released for sale (W. Durant Pers. Comm.).

In the 1980s a ferry service travelled from Fremantle to Garden Island, stopping for passenger pick up at the Palm Beach jetty. Over time access to Garden Island was restricted due to the development of HMAS Stirling (W. Durant Pers. Comm.).

At present, the public can land their boats on Garden Island for day trips at designated picnicking locations at the north end of the island. No overnight stays are allowed on the island itself but mooring areas have become established to allow people to stay overnight on boats. Pig Trough Bay, Luscombe Bay and Buchanan Bay are popular pleasure boat destinations from Woodman Point and Point Peron boat ramps (from interviews for the Multiple-use and Resource Assessment Project).

At present there is one marine-tourism operator in Cockburn Sound who facilitates dolphin watching and in-water dolphin interactions. This business employs 35 people for nine months of the year and works from two vessels which depart from the Val Street jetty. Swimming with dolphins in Cockburn Sound has proved to be a reliable tourism product for nearly 20 years and is dependent on the health and wellbeing of a population of dolphins that rarely leave the Sound. This business is also collecting important information about dolphin behaviour and makes observations of other fauna of interest, such as Little Penguins.

1.14 Recreational Boating and Mooring

Up until about the 1960s most recreational boats were made of wood and were of relatively heavy construction. This meant that they had to be moored or beached at locations around Cockburn Sound and Owen Anchorage and their numbers were relatively few. Now, because most recreational boats are transported by trailer, boat ramps have become an important recreational boating requirement. Trailered boats are launched into Cockburn Sound at Woodman Point, Challenger Beach (beach launching), Kwinana Wreck, Palm Beach and Cape Peron. A recent study by the Department for Planning and Infrastructure has predicted that the number of recreational boats will increase by 77% between 2006 and 2025 and that additional infrastructure is required to cater for this increasing demand (Department for Planning and Infrastructure 2007).

It appears that most boats leaving the Woodman Point area are travelling to Owen Anchorage, northern Garden Island, Carnac Island, Mewstone and Stragglers Rocks, while all other ramps are facilitating access to the southern portion of Cockburn Sound and south-eastern shores of Garden Island (from interviews with recreational fishers and boaters for the

Multiple-use and Resource Assessment Project, including members of the Cockburn Power Boat Association).

A recreational use study undertaken in 1978 (Fielman & Associates 1978) indicated that most people who owned boats and launched them in the Owen Anchorage/Cockburn Sound area used them primarily for fishing and secondly for pleasure boating. A copy cat study in 1994 (Dielesen 1994) indicated that people were using their boats primarily for pleasure boating, with few people indicating they were fishing. This showed a shift in purpose over a period of just less than 20 years.

A large area of Cockburn Sound was gazetted a Mooring Control Area in late 2007. This will allow the Department for Planning and Infrastructure to manage mooring introductions to the Sound, and establish regulations that restrict the type of mooring used and where those moorings can be placed. It is not yet known how many moorings there were prior to the control area being established. Most appear to be used on an occasional basis and are considered as fair weather moorings only.

The Department of Defence has prepared a mooring policy for Herring Bay and Pig Trough Bay at the northern end of Garden Island and liaises with users on the care and maintenance of those moorings (Department of Defence 2005).

Two small yacht clubs have been established on the shores of Cockburn Sound and Owen Anchorage: the Cruising Yacht Club in Rockingham, and the Jervoise Bay Sailing Club at Woodman Point. In addition to these two clubs the Royal Freshwater Bay Yacht Club, the South Perth Yacht Club and the Fremantle Sailing Club are occasional users of these waters (K. van Kruyssen Pers. Comm; A. Stachewicz Pers. Comm.).

Cockburn Sound and Owen Anchorage are regularly used over the spring, summer and autumn period for pleasure sailing and competition. Sail training and small vessel handling training occur on a regular basis between the Val Street Jetty and Town Jetty in Rockingham.

The Cockburn Power Boat Association was established in 1961 and now has 1200 members and an extensive waiting list for membership. It is a unique club in the metropolitan area of Perth and caters for member interests in pleasure boating, fishing, diving and socialising. The club has its own boat ramp and jetty facilities.

The Mangles Bay Fishing Club was established approximately 40 years ago and has a current membership of 500 and an extensive waiting list. The club facilitates and supports access for fishers to Cockburn Sound and has its own boat ramp and jetty facilities.

1.15 Shore-Initiated and Shore-based Recreation

The shores of Cockburn Sound and Owen Anchorage have always been a major recreational resource. Currently shore-initiated and shore-based activities include pleasure boating, sailing regattas, sail training, diving, snorkelling, swimming, kite and windsurfing, walking, nature appreciation, sunbathing and shore and snorkel fishing.

The development of the Kwinana Industrial Area and the Australian Marine Complex has resulted in a large proportion of the Cockburn Sound foreshore becoming unavailable for recreational use. This has made the remaining foreshore areas significantly important to the Cockburn, Kwinana and Rockingham communities and has placed them under increasing impact and management pressure. Woodman Point Regional Park and Rockingham Beach are attractive to visitors from the wider Perth area as they are well resourced family picnic areas, particularly during the summer months. Coogee Beach, Woodman Point Regional Park (John Graham Reserve), Woodman Point Beach, Kwinana Beach (Wells Park), Rockingham Beach, Palm Beach and Mangles Bay beach have long been considered high use recreation areas (Fielman & Associates 1978; Dielesen 1994).

1.16 Natural History Research and Pollution Management

The 1960s saw a dramatic increase in formal natural history research in Cockburn Sound. Research work included studies of: hydrology and groundwater (Passmore 1967 & 1970); sediment (Ives 1961; Davies 1963; Nunn 1966), flora and fauna (Marsh & Hodgkin 1962; Phillips, Burbridge, Chong & Graham 1963; Wilson 1964; Meagher 1966; Jones, Jones Meagher & Nunn 1966; Wilson & Hodgkin 1967; Meagher 1970); and sea temperature (Hodgkin & Phillips 1969).

In 1969, because of concern about the deterioration of the marine environment, and water quality in particular, the Cockburn Sound Conservation Committee was formed including the Fremantle Port Authority, local government and industry representatives (Department of Conservation and Environment, 1979). This committee could be seen as an early version of the Cockburn Sound Management Council. In the early 1970s the Fremantle Port Authority and the Commonwealth Department of Works financed a range of environmental studies (undertaken mainly by

Environmental Resources of Australia 1970–1974) triggered by plans for the building of the Garden Island causeway, and potential infrastructure development for the outer Fremantle harbour (Department of Conservation and Environment 1979).

In 1975 the Environmental Protection Authority reviewed these studies and proposed approaches to solutions and aspects requiring further research. This culminated in the 'Cockburn Sound Environmental Study 1976–1979' (Department of Conservation and Environment 1979) and ultimately the formal acknowledgement by Government of the extent of environmental degradation that had occurred in Cockburn Sound. The next two decades saw only minor improvements in the water quality, sediment quality and seagrass extent in Cockburn Sound, resulting in a comprehensive study being again initiated by Government in 1991 (Department of Environmental Protection 1996). This study found that water quality, as measured by chlorophyll *a* concentrations and light attenuation, of Cockburn Sound was only slightly better than during the late 1970s, when the water quality of the Sound was in its poorest recorded state.

The presence of a high biomass of epiphytes on the leaves of seagrass in south-west Cockburn Sound and the chronic high phytoplankton biomass clearly illustrated the eutrophic condition of the Sound. Groundwater represented 70% of the total external loading of nitrogen to the Sound and about 80% of this load originated from contaminated groundwater under the industrial estate. Seagrass dieback in Cockburn Sound had slowed considerably since the early 1970s although some losses were still occurring, particularly in the southern end of the Sound, and there was no evidence of *Posidonia* seagrass recovery in the Sound (Department of Environmental Protection 1996).

There are now only extremely small remnants of seagrass on the eastern shelf, with little hope of it returning through natural or transplanted means. It is estimated that 80–90% of seagrass in Cockburn Sound has been lost.

Conversely, there had been significant improvement in the nutrient-related water quality of Owen Anchorage since the 1970s (Department of Environmental Protection 1996) in the most part due to the closure of meatworks, and the management of effluent from remaining industry in the area.

Public pressures gave impetus to the formation of the Cockburn Sound Management Council in 2000 and the implementation of a suite of monitoring programs to enable annual reporting of water quality, sediment quality and seagrass health and extent. This led to the development of Environmental Quality Criteria and Objectives for Cockburn Sound, and the development of the *State Environmental (Cockburn Sound) Policy 2005*.

2. Current Administrative Boundaries in Cockburn Sound and Owen Anchorage

Management of the waters of Cockburn Sound and Owen Anchorage are currently facilitated by several government agencies with responsibilities relating to maritime activity. Management of the foreshore reserves is spread between local government, the Conservation Commission of Western Australia through the Department of Environment and Conservation, the Department for Planning and Infrastructure and industry or developers that have tenure to the high, medium or low water mark.

2.1 Cockburn Sound Management Council

CSMC Boundary

The Cockburn Sound Management Council, being an umbrella organisation for all stakeholders with an interest in Cockburn Sound, undertakes a coordination role within a boundary that encompasses Cockburn Sound and Owen Anchorage and the catchment for these water bodies. While the Council is not a statutory body, it is required to coordinate the implementation and reporting of monitoring in accordance with the *State Environmental (Cockburn Sound) Policy 2005* and to provide advice and carry out research for the benefit of the Sound in accordance with its Environmental Management Plan for the area.

2.2 Environmental Protection Authority and Department of Environment and Conservation

SEP Policy Area and Ecological Protection Areas

The *State Environmental (Cockburn Sound) Policy 2005* policy area extends across the water area of Cockburn Sound to the eastern limit of the Cockburn Sound Management Council boundary. It includes a protected area which encompasses the waters of Cockburn Sound only. The policy establishes the basis on which Cockburn Sound and the environment of adjacent land is to be protected. The policy establishes high, moderate and low ecological protection areas within Cockburn Sound. The High Ecological Protection Area allows for small changes in the quality of water, sediments and biota; the Moderate Ecological Protection Area allows for moderate changes in the quality of water, sediments and biota; and the Low Ecological Protection Areas allow for a reduced level of environmental quality.

The boundary of the policy area will be extended in the near future to reflect government commitment to the maintenance of environmental values for Owen Anchorage.

2.3 Fremantle Ports

Port Limits

The Fremantle Ports is the vesting body for the seabed and some shoreline extending from Inner Fremantle Harbour to Mangles Bay in Rockingham. The port area and operations of the Port are governed by the *Port Authority Act 1999* with vesting being administered through the *Land Administration Act 1997*. The *Land Administration Act* allows the Port to lease areas of port waters should it be necessary, as in the case of aquaculture leases. Property vested in a port authority for the purposes of this Act includes: all Crown land in the port, including the seabed and shores; all navigational aids; all fixtures on land in the port that belong to the State; and any improvements effected on vested land leased to another person that have been acquired on the termination of the lease concerned (extracted from the *Port Authority Act 1999*).

A restricted zone can be applied, under the orders and notice of the Harbour Master through Port Authority Regulations, around the Kwinana Industrial Area if required for Port purposes.

2.4 Department of Defence

Naval Waters

The Department of Defence has specific, limited powers to control certain activities in naval waters that are under the Commonwealth *Control of Naval Waters Act 1918*. This Act can apply to waters that are wholly within a distance of 5 nautical miles from a defence installation. At present naval waters within Cockburn Sound extend to varying distances around the whole of Garden Island with public access excluded completely at Careening Bay and the ammunitions loading wharf. Fremantle Port limits are contiguous with controlled naval waters.

2.5 Department of Fisheries

Aquaculture Leases

The Department of Fisheries, in liaison with the Fremantle Ports and Department of Defence, is responsible for the issuing and management of aquaculture licences and leases within Cockburn Sound. The development and licensing of aquaculture is managed under the *Fish Resources Management Act 1994* but leases within Cockburn Sound are provided for under the *Port Authority Act 1999*. Lessees are provided with a minimum 5 year lease but are not given certainty of continued tenure. The public is not excluded from these areas but they may be difficult to navigate and therefore are rarely accessed.

2.6 Department for Planning and Infrastructure

Navigable Waters[1]

Under Part VI of the *Western Australian Marine Act 1982* the Department for Planning and Infrastructure may regulate the use of pleasure vessels in State waters through Navigable Waters Regulations 1958. In Owen Anchorage and Cockburn Sound these regulations impose speed restrictions and determine prohibited swimming areas, water ski areas and special use areas for personal water craft and parasailing.

Mooring Control Area

The Department for Planning and Infrastructure recently (August 2007) announced a moratorium on unauthorised moorings in Mangles Bay as the first step in developing a marine safety management plan for the area. As part of the moratorium a mooring control area has been declared. Once implemented fully the Mangles Bay Mooring Control Area will allow for improved coordination of moorings within Mangles Bay and will ensure moorings do not compromise other aquatic uses of the area. In a mooring control area boat owners are required to apply for a mooring licence and pay a fee to secure tenure over an exclusive piece of water. The Department of Defence has permitted and manages approximately 30 private, recreational boat moorings within Naval Waters in Pig Trough Bay on the north-east coast of Garden Island (as well as a further approximately 90 moorings in Herring Bay on the north-west coast). The moorings in Pig Trough Bay include a number installed by the region's boating clubs. The Department of Environment and Conservation, which manages public access to Garden Island under an MOU with Defence, maintains picnic areas with toilet and BBQ facilities on Pig Trough Bay and Herring Bay. The mooring arrangements with Defence are coordinated by the 'Garden Island Fishing and Aquatic Association, Inc (GIFAA).

2.7 Cockburn Cement Limited

Dredging Areas

Cockburn Cement Limited operates under the *Cement Works (Cockburn Cement Limited) Agreement Act 1971*. This Act ratifies an agreement made between the State, the Minister for Works, Fremantle Ports and Cockburn Cement Limited and relates to cement and clinker manufacturing operations and any other operation approved by the State from time to time. Currently, under the Act the allocation of rights to dredge within the Agreement Act area, subject to the provisions of the *Environmental Protection Act 1986*,

applies for a forty year period expiring in 2011, and this can be extended at the company's request for a further period of ten years.

In late 2000, Cockburn Cement undertook a review of its operations and, following environmental assessment, approval was granted in 2002 for long-term shellsand dredging in Owen Anchorage, to be undertaken in two stages to approximately 2030. The Act is currently under review to reflect the new environmental and operating conditions placed on the company by Government.

2.8 Department of Environment and Conservation

Regional Parks

The Cockburn Sound and Owen Anchorage foreshore area consists of a system of Regional Parks including the Rockingham Lakes Regional Park (Point Peron/Mangles Bay area inclusive of Lake Richmond), Woodman Point Regional Park, Beeliar Regional Park (extending from Melville to Kwinana and including the Henderson Cliffs and a chain of wetlands). These reserves have a variety of vestings[2] but all are managed by the Department of Environment and Conservation in collaboration with the vesting body. Generally, these reserves are used for recreation, tourism and the protection of wildlife and vegetation.

2.9 City of Cockburn, Town of Kwinana and City of Rockingham

Foreshore Reserves

The three local governments in the Cockburn Sound and Owen Anchorage area have responsibility for the management of foreshores reserves vested[2] in them.

The City of Rockingham has the largest area of responsibility in regard to foreshore management, almost extending the length of Cockburn Sound.

1 "navigable waters" means rivers, lakes, inlets and other inland waters on which any vessel or any type of marine craft can be navigated and also means the territorial sea adjacent to the State and the sea on the landward side of the territorial sea adjacent to the State that is not within the limits of the State

2 Vesting – when a parcel of Crown land is placed in the care, control and management of an incorporated body through the *Land Administration Act 1997*

The Town of Kwinana manages Challenger Beach, Wells Park and the 'Kwinana Wreck' area for recreation purposes. Other foreshores reserves include the beaches of the Kwinana Industrial Area.

The City of Cockburn has responsibility for areas intermittently extending from Coogee Beach to the periphery of the Woodman Point Regional Park. Generally, these reserves are managed for recreation purposes or leased for commercial enterprise.

2.10 Industry

Industry Tenure of Foreshore and Beaches

Heavy industry located along the Cockburn Sound coast excludes public access in some areas due to tenure extending to the high water mark and median water mark. Safety issues and risk management related to operations of wharves and other industrial infrastructure can also preclude public access.

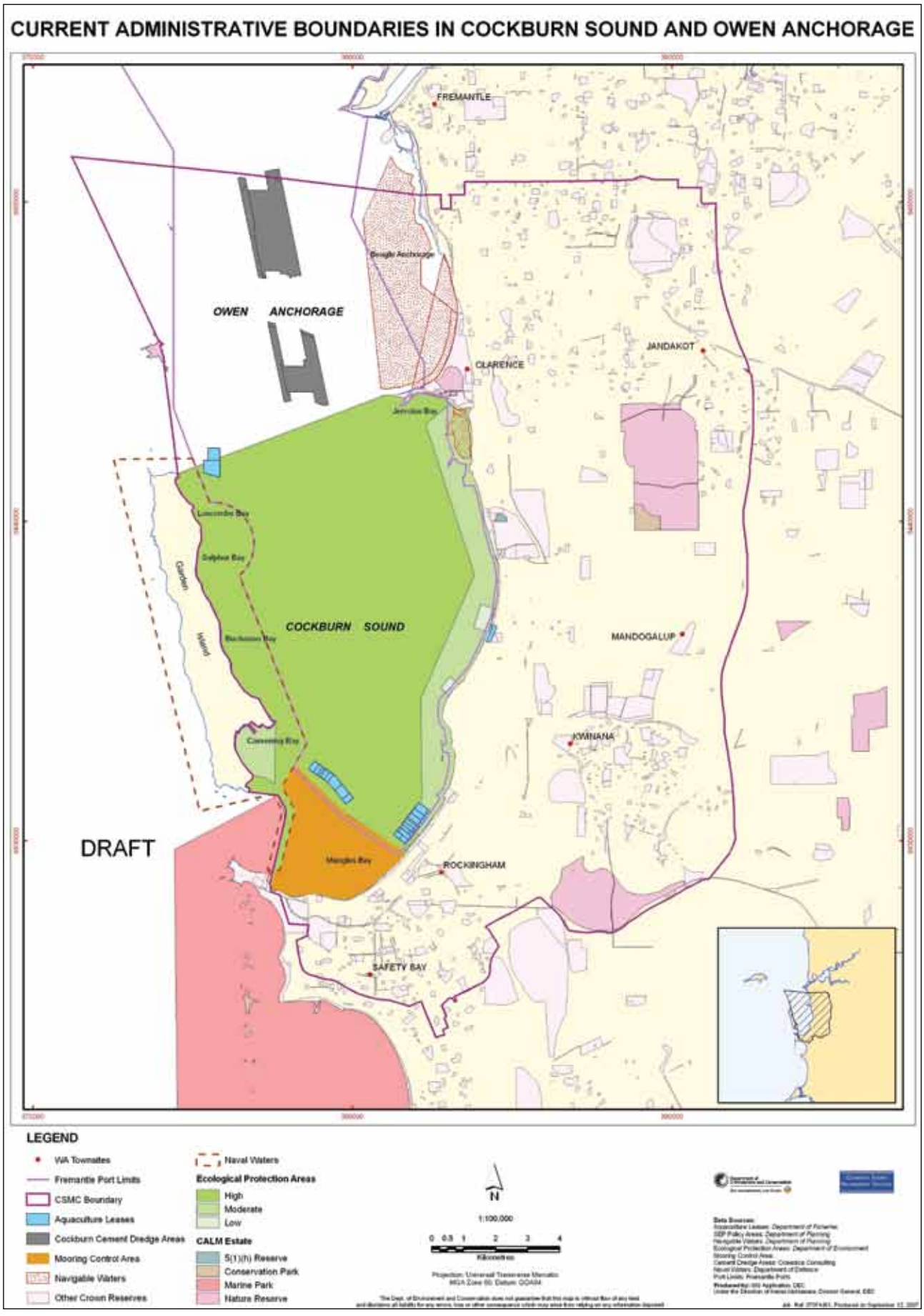
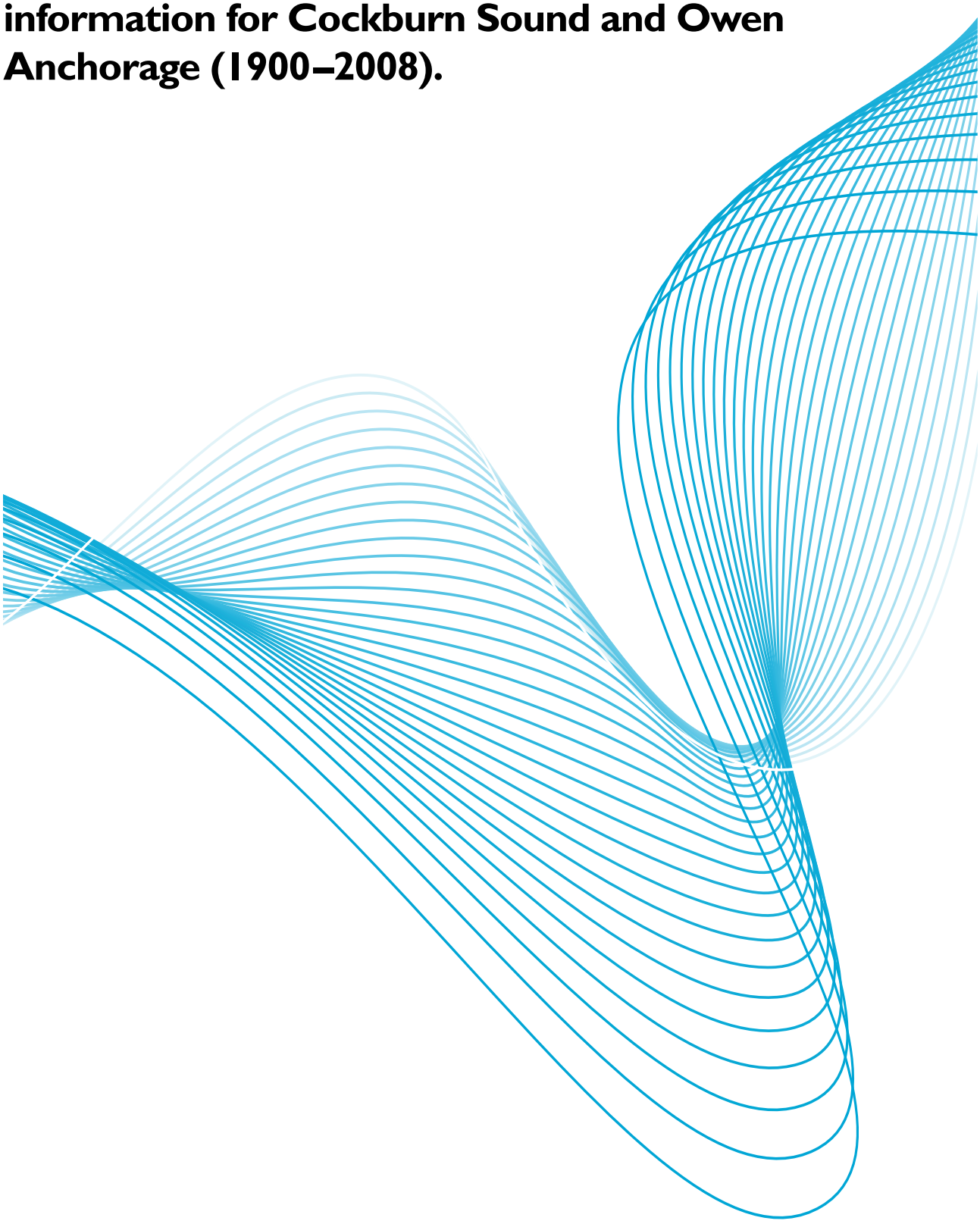


Figure 4: Administrative Boundaries for Cockburn Sound and Owen Anchorage and their foreshores

Part II.

A review of written, spatial, oral and photographic information for Cockburn Sound and Owen Anchorage (1900–2008).






1. Link to Environmental Management Plan Objective and Recommendation

The Environmental Management Plan for Cockburn Sound and its Catchments (EMP) (Cockburn Sound Management Council 2005) and *State Environmental (Cockburn Sound) Policy 2005* (Environmental Protection Authority 2005) are the guiding documents for the Council's effort to protect the environmental values of Cockburn Sound. As the Council has matured and completed many of the recommendations within the EMP it has become evident that it is now in a position to undertake a major requirement of the plan – to recognise and facilitate multiple-use management of Cockburn Sound and its foreshore.

Section 2 of the EMP recommends that CSMC 'coordinate a comprehensive study to establish future types, areas and intensities of use as the basis for the long-term multiple-use management (sustainable use framework) of Cockburn Sound and its foreshore'. The EMP makes eighty-two further recommendations in section 2 that attempt to identify information gaps and ensure consideration is given to known uses of the Sound.

Table 1: Overall Objective and Guiding Recommendation from the Environmental Management Plan for Cockburn Sound and its Catchment.

Section 2 Overall Objective:
To recognise and facilitate multiple-use management of Cockburn Sound and its foreshore.
Section 2 Guiding Recommendation:
'Coordinate a comprehensive study to establish future types, areas and intensities of use as the basis for the long-term multiple-use management (sustainable use framework) of Cockburn Sound and its foreshore'.

2. Method for Information Collection

This report provides the outcomes of a comprehensive study of Council's extended boundary area – Owen Anchorage. The information is presented in four parts:

- ★ Spatial Information
- ★ Oral Interview Information
- ★ Written Information
- ★ Photographic information

The information collected presents the most up-to-date assessment of use and resources in Cockburn Sound and Owen Anchorage available at this time and 'tells a story' about these water bodies that may not have been previously known to all. The report is a public document and therefore provides all interest groups and stakeholders with the same level of knowledge, understanding and background material available to the Council. There has been a serious attempt to ensure information presented is objective and accurate. *It must be made clear that information contained in this document does not necessarily reflect the views of the Council, or individual members.*

2.1 Resourcing

The Council works within resources provided to it by State Government on an annual basis and must be take this into account when determining long-term projects. A strategic review was discussed by the Executive of the Council (April 2007) to determine how multiple-use and resource information would be used and how it would benefit the planning and management of Cockburn Sound and Owen Anchorage. In considering this the Executive of the Council accepted the following strategic framework. The framework suggests a staged approach which, with appropriate resources given to each stage, would lead to a strong outcome – namely a revised Environmental Management Plan for Cockburn Sound and Owen Anchorage.

2.2 Multiple-use Support Team (MuST)

A first step in undertaking this project was the formation of the Multiple-use Support Team (MuST) (see inside cover for membership) led by the Chair of the Council. MuST members provided advice to a project officer of the Department of Environment and Conservation dedicated to completing this report on Council's behalf. The MuST met a number of times during the development of the project and reviewed the progress of the project and reporting.

2.3 Information Collection Strategy

A strategy was prepared outlining a predetermined approach to information collection. The strategy was endorsed by the MuST prior to implementation. (see Appendix 5 for Information Collection Strategy).

2.4 Limitations

The following pages present the first attempt at a comprehensive collation and presentation of information for Cockburn Sound and Owen Anchorage. The amount of written information relating to these water bodies and their shores far exceeded expectation. Over 1000 documents have been written, mostly since the 1950s, and collectively provide insight to the 'story' of Cockburn Sound and Owen Anchorage through time. This 'story' is of course ongoing, but a strong understanding of past events and efforts may allow future planners and managers to better protect the environmental values of these two important water bodies.

It is expected that there is more information available than could be found within the time frame of this project. This is a limitation of the project; however it is not expected to affect it substantially given the breadth of information presented. Of significance was the paucity of spatial data. The Council, through the officers who service it, have prepared a number of new maps showing information collected from the written material, oral interviews and through their own understanding of the area. All spatial data is supported by metadata which describes its extent and limitations in regard to accuracy and sourcing. Information gaps and research needs identified during the preparation of this work are discussed in Part III.

3. Spatial Information

The spatial information provided in this report has been sourced from a range of providers. The Council is indebted to all agencies, businesses and individuals who helped in the collection and creation of this information. All spatial data should be viewed in combination with metadata provided.

NOTE: MAPS WILL NOT BE PRODUCED FOR THIS SECTION UNTIL THE END OF THE PROJECT. THE TABLE PROVIDED PRESENTS DATA AVAILABLE FOR DISPLAY.

Table 2: Spatial Information Record (see below)

Shapefile Name	Description	Source	Acquired Y/N
TERRESTRIAL VEGETATION			
Swan Coastal Floristic Survey – CALM 98	Survey points recorded by Gibson *et al.* which characterise vegetation communities across the Swan Coastal Plain	DEC	yes
Remnant Vegetation, Metropolitan Area – DA 12/00	Polygons identifying the measurable area of remnant vegetation as at 2000	DEC	yes
Pre-European Vegetation – DA 01/01	Broad-scale descriptions and extent of remnant vegetation prior to colonisation	DEC	yes
Heddle Vegetation Complexes – DEP 21/6/95	Comprehensive mapping of vegetation complexes and vegetation structure. Referred to often by botanists	DEC	yes
Vegetation Trends 88-04 LM 25M – DLI 04	No information attached to theme	DEC	yes
Vegetation History 88-04 LM 25M – DLI 04	No information attached to theme	DEC	yes
Vegetation Decline 2006 – DEC	Requires metadata to interpret	Dept. of Water	
Clearing Regulations – Environmentally Sensitive Areas – DoE 30/5/05	Section 51 EP Act	DEC	yes
Clearing Regulations – Schedule 1 Areas – DoE 10/3/05	Unknown	DEC	yes
Declared Rare and Priority Flora List – CALM 1/7/05	Approximate locations of threatened flora, their name and priority listing	DEC	yes
Bush Forever, Nominated Areas – DPI 07/02	Areas nominated as Bush Forever Sites. Provides limited supporting data	DEC	yes
	Vegetation extent and condition of foreshore to 100 m	GAP	
	Rehabilitation areas	GAP	
GROUNDWATER			
Perth Basin Hydrogeology, Warnbro Group – DoW	Contours and elevation of groundwater hydrogeology	DEC	yes
	Groundwater flow directions	DEC (DoE)	
Groundwater Contours, Minimum – DoW	Contours and elevations of groundwater	DEC	yes
TERRESTRIAL FAUNA			
Threatened Fauna – CALM 30/9/05	Approximate location of threatened fauna. Does not name species.	DEC	yes

Shapefile Name	Description	Source	Acquired Y/N
Threatened Ecological Communities – CALM 12/4/05	Approximate location of TEC. No description provided, only reference.	DEC	yes
MARINE FAUNA, FLORA AND ALGAE			
	Dolphin preferred feeding, breeding, calving sites		yes
	Seabird preferred feeding, breeding, nesting sites	DEC	yes
	Snapper aggregation and spawning areas	DoF- Brad Smith	
	Blue Swimmer Crab Distribution	DoF- Brad Smith	
	Marine nursery areas	GAP Glen Hyndes/ Fiona Valesini	
	Benthic habitat mapping	Cockburn Cement/ Oceanica	yes
	Coral locations	U/WATER EXP. CLUB	yes
	Introduced pest risk areas		yes
HYDRODYNAMICS			
	Water circulation in Cockburn Sound and Owen Anchorage	GAP	
	Bathymetry	DEC	yes
	Prevailing wind directions		
WETLANDS			
Ramsar Wetlands – CALM 14/2/03	The area and name of each Ramsar Wetland.	DEC	yes
EPP, Wetlands 2004 (Draft) – DoE 21/7/04	Wetlands covered in draft Environmental Protection Policy	DEC	yes
LANDFORMS			
Topographic Contours, Metropolitan Area – DLI	Land contours and elevations	DEC	yes
	Coastal landforms (beaches, cliffs, artificial)	GAP	
BOUNDARIES			
Cockburn Sound Management Council	Cockburn Sound boundary to include Owen Anchorage and office locations	DEC	yes
	CS Low, Medium and High Ecological Zones – SEP	DEC	yes
	SE Policy Area	DEC	yes
Fremantle Port Authority	Port Waters	DPI	yes
NHT – NRM Regions Boundaries – DEH	Regional NRM Boundaries across Western Australia	DEC	yes
Interim Biogeographic Regionalisation of Australia – EA18/10/00	Aka IBRA. **The Interim Biogeographic Regionalisation for Australia** (IBRA) divides the Australian continent into 85 bioregions. 404 sub-regions have now also been defined Australia-wide based on major geomorphic features in each bioregion. The bioregions and sub-regions are the reporting unit for assessing the status of native ecosystems and their protection in the national reserve system and for use in the monitoring and evaluation framework in the Australian Government's current Natural Resource Management initiatives.	DEC	yes
Interim Biogeographic Regionalisation of Australia (subregions) – EA	As above	DEC	yes
Local Government Authorities – DLI	Boundaries of LGAs (labelled)	DEC	yes
Interim Marine and Coastal Regionalisation for Australia – DEH 7/3/9	IMCRA regions around Australia. Names of regions not given.	DEC	yes

Shapefile Name	Description	Source	Acquired Y/N
INDUSTRY USE			
	Land-use FRIARS	DPI	yes
	Industry information – table in preparation	GAP	
RECLAMATION/SHORELINE MOVEMENT			
	Measurable extent of reclamation and development on shores and water of CS, OA and Garden Island – dredged, spoils, jetty, wharves, groynes, revetment	GAP	
	Recommended set-back	TO BE CREATED BASED ON MP ROGERS REPORT	
	Shoreline movement since 1942 (presented in 10 year gaps)	DPI	yes – not GIS
RECREATION USE			
	Boat ramps	DPI	yes
	Jetties	DPI	yes
	Beach launching, sailing clubs, power boat clubs, naval training	TO BE CREATED	
	Beach access points, car parks, picnic areas, playgrounds, SLSC, swimming lessons	TO BE CREATED	
	Kitesurfing, windsurfing, PWC, sailing areas	TO BE CREATED	
	Beach use popularity – dependent on amount of use (swimming, walking, picnicking, fishing)	TO BE CREATED	
	Walk trails, multiple-use paths	DEC/ LGAs	
	Preferred recreational boating areas and destinations		yes
	Popular recreational fishing areas		yes
DEFENCE AREAS			
	Naval waters		yes
EDUCATION			
	Interpretive signs – non-commercial educational activities	CREATE	
VANTAGE POINTS			
	Undeveloped scenic vantage points and lookouts	GAP	
COMMERCIAL USE			
	Commercial fishing zones and types	DoF	yes
	Dolphin Swim and Observation preferred areas of contact		yes
	Mussel aquaculture sites	DPI/DoF	yes
DRAINAGE			
Drains,Metropolitan Area – WC 1/5/02	Drain lines as mapped by Water Corporation 2002	Dept. of Water	
	Stormwater outlets on coast and drainage network	LGAs/ DoH	
TRANSPORT			
	Mooring areas/zones Anchorages – separate commercial and recreational	DPI	yes
	Navigation aids	DPI	yes

Shapefile Name	Description	Source	Acquired Y/N
	Navigable waters	DPI	yes
	Shipping channels, routes and shipping manoeuvre requirements at jetties	FPA	
Road Centrelines – DLI 1/5/04 (DoE)	Road network – freeways, highways, local and main roads and tracks	DEC	yes
Railways DLI 14/2/05 (TypeCode)	Railway network	DEC	yes
CULTURE/HERITAGE			
Register of Heritage Places – DPI	Places listed as places of heritage value. Requires cross-reference with State Register of Heritage Places <www.register.heritage.wa.gov.au>		
	Maritime heritage sites – wrecks, relics, previous jetty locations, historical anchorages and landings	Coordinates available	
Aboriginal Sites of Significance – DIA	Places listed as having Aboriginal significance. Requires cross-reference with DIA web search <www.dia.wa.gov.au/heritage>	DEC	yes
Register of National Estate – EA 28/01/03	The Register of the National Estate is Australia's national inventory of natural and cultural heritage places which are worth keeping for the future. It is compiled by the Australian Heritage Commission, the Commonwealth Government's adviser on the National Estate. There are now more than 12 000 natural, historic and Indigenous places in the Register. They occur in all parts of Australia and are owned variously by Commonwealth, State and local governments, by businesses, voluntary and other organisations and by private individuals. All places entered in the Register are strictly assessed against publicly available criteria outlining national estate values	DEC	yes
Native Title Claims – DLI 7/11/05	Shows the extent of Native Title claim and states claimant bodies/individuals. Requires cross-reference with listing on <www.nnht.gov.au>.	DEC	yes
DIA Estate – DIA 14/2/02	Estate held by the Department of Indigenous Affairs.	DEC	yes
LAND TENURE			
CALM Managed Lands and Water – CALM 1/7/05	Estate managed by the Department of Conservation and Environment (formally CALM). Does not include Regional Parks.	DEC	yes
CALM Regional Parks – CALM 12/4/02	Extent and location of Regional Parks	DEC	yes
	TPS Cockburn	DPI	yes
	TPS Kwinana	DPI	yes
	TPS Rockingham	DPI	yes
	MRS	DPI	yes
Cadastre for Labelling – DLI	Broad land tenure categories and area	DEC	yes
	Tenure of coastal foreshore	DEC	yes
WATER SUPPLY			
Public Drinking Water Source Areas	Areas zoned as Public Drinking Water Resource Areas	DEC	yes
CONTAMINATED SITES			
	CSMC marine contaminated sites – e.g. Northern and southern harbour (based on monitoring outcomes)	TO BE CREATED	
Contaminated – Reported Sites	Known and suspected contaminated sites. Should be cross-referenced with contaminated sites register <www.environment.wa.gov.au>	DEC	
RESOURCE EXTRACTION			
	Cockburn Cement Dredge Areas	Cockburn Cement/ Oceanica	yes

Shapefile Name	Description	Source	Acquired Y/N
Mines and Mineral Deposits – DMPR 11/6/02	Location of and commodity mineral type	DIR	
Mining Tenements – DOIR	Location, extent and holder of tenement	DEC	yes
RESEARCH/MONITORING			
	CSMC monitoring sites – SEP		yes
	Fisheries Research sites	DoF	
PROPOSED DEVELOPMENT			
	Outer Harbour Proposal	FPA	
	Point Peron Tourist Precinct	RKDO	
	James Point Private Port	James Point P/L	
	Port Rockingham Marina	Rosewood Grove P/L as a trustee for Rockingham Beach Unit Trust Paul Ogilvey (Developer) Wayne Sankey WS Architects Patrick Hollingworth BBG Consultants	
AERIAL PHOTOGRAPHY			
Cockburn 1.2 m Orthomosaic – DoLA 99	Aerial photography showing full extent of CSMC area.	DEC	yes
Swan Coastal Plain North 20 cm Orthomosaic – DLI06	Aerial photography showing full extent of CSMC area.	DEC	yes
Swan Coastal Plain North 1 m Orthomosaic – DLI 01/04	Aerial photography showing full extent of CSMC area.	DEC	yes
Swan Coastal Plain Central 20 cm Orthomosaic – DLI06	Aerial photography showing full extent of CSMC area.	DEC	yes

4. Written Information

The reference bibliography provided here contains all sourced documents relevant to Cockburn Sound Management Council's interest in Cockburn Sound and Owen Anchorage. An electronic copy of the reference bibliography is maintained by CSMC which holds additional entries that have yet to be sourced and is also updated as new documents are identified or located. Each document in this printed version of the reference bibliography is summarised by purpose and major outcomes. The references are listed by decade of publication, then year of publication and then by author, in alphabetical order.

Table 3: Reference Bibliography for Cockburn Sound and Owen Anchorage (see below)

WRITTEN INFORMATION COLLECTION

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Pre 1900			
Fraser C (1827) *Exploration Diaries: Vol. 1 PR5441 pp 56–57 Remarks on the botany, geology and general character of the banks of the Swan River, Geographe Bay and Cape Naturaliste, Garden Island, Carnac Island and the entry to Cockburn Sound*	An account of the first expedition to ascertain the suitability of establishing the Swan River Colony by Captain James Stirling	Early in 1827, Fraser was appointed to accompany Captain (later Admiral Sir) James Stirling on the Swan River expedition of 1827, an expedition to explore the Swan River on the west coast of Australia, and assess its suitability as a site for a new British settlement. The expedition arrived in the area on board the HMS *Success* on 4 March. After surveying the coastal waters off the Swan, Stirling and Fraser briefly reconnoitred the lower reaches of the river on the 7th.	<www.en.wikipedia.org/wiki/> Charles_Fraser_(botanist)
Dr Alexander Collie (1829) *Exploration Diaries: Vol. 1 PR5441 Observations on the coast from Cockburn Sound to Geographe Bay between 17 and 30 November 1829*	An account of Dr Collie and his initial botanical explorations of Garden Island and its surrounds in 1829	Dr Alexander Collie (2 June 1793–8 November 1835) was born in Aberdeenshire, Scotland, and was a surgeon on board the HMS *Blossom* from 1825 to 1828. He took part as a naturalist in the voyage of Lieutenant Preston in 1829 to Western Australia, was Government Resident at King George Sound in 1831 and explored around Albany. Collie is credited as the man who named the Kalgan River. He became the Colonial Surgeon at Swan River Colony from 1833 to 1835. He died at King George Sound. The *Sulphur* arrived at Rottnest Island on 3 June 1829. Collie spent the early weeks on Garden Island where the first hospital tent was erected. His spare time was occupied in botanical studies. He was allotted 1500 acres (607 ha) on the Swan River and in 1831 received another 500 acres (202 ha) at Albany. With Lieutenant Preston on 17 November 1829 he set out to explore the south-west. They discovered two rivers, named by Stirling the Collie and the Preston. In 1830 the Governor appointed him to investigate conditions on the unfortunate Peel estate	<http://www.adb.online.anu.edu.au/biogs/A010225b.htm>
Moore G (1884) *Diary of Ten Years Eventful Life as an Early Settler in Western Australia,* London, Walbrook	10 year diary of George Fletcher Moore in Western Australia between 1830–1840	Detailed account of life in the Swan River Colony.	Murdoch University SWL1 994.102 MOO

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
De Heers JE (1899) *The part borne by the Dutch in the discovery of Australia 1606–1765,* London	The documents, here either republished or printed for the first time, are all of them preserved in the State Archives at the Hague, unless otherwise indicated. They have been arranged under the heads of the consecutive expeditions, which in their turn figure in chronological order. This seemed to me the best way to enable readers to obtain a clear view of the results of the exploratory voyages made along the coasts of Australia by the Netherlanders of the seventeenth and eighteenth centuries.	In writing my biography of Tasman, forming part of Messrs Frederik Muller and Co.'s edition of the Journal of Tasman's celebrated voyage of discovery of 1642–1643, I was time and again struck by the fact that the part borne by the Netherlanders in the discovery of the continent of Australia is very insufficiently known to the Dutch themselves, and altogether misunderstood or even ignored abroad. Not only those who with hypercritical eyes scrutinise, and with more or less scepticism as to its value, analyse whatever evidence on this point is submitted to them, but also those others who feel a profound and sympathetic interest in the historical study of the remarkable voyages which the Netherlanders undertook to the South-land, are almost invariably quite insufficiently informed concerning them. This fact is constantly brought home to the student who consults the more recent works published on the subject, and who fondly hopes to get light from such authors as Calvert, Collingridge, Nordenskiold, Rainaud and others. Such at least has time after time been my own case. Is it wonderful, therefore, that, while I was engaged in writing Tasman's life, the idea occurred to me of republishing the documents relating to this subject, preserved in the State Archives at the Hague – the repository of the archives of the famous General Dutch Chartered East-India Company extending over two centuries (1602–1800) – and in various other places? I was naturally led to lay before Messrs Frederik Muller and Co. the question whether they would eventually undertake such a publication, and I need hardly add that these gentlemen, to whom the historical study of Dutch discovery has repeatedly been so largely indebted, evinced great interest in the plan I submitted to them.	Electronic copy only due to large size @ <http://gutenberg.net.au/ebooks05/0501231h.html>
1900–1909			
1910–1919			
Australian Government (1919) *Historical Records of Australia Series 1. Vol. 12,* Library Committee of the Commonwealth of Australia, Canberra	To record the Governor's dispatches to and from England	An account of the Governor's dispatches to and from England, June 1825–1826. Captain Stirling to Governor Darling: dispatch about settlement proposed at Swan River. He believed that this area around the Swan River would be the best location for settlement as the climate was mild, it was in a good position relative to Europe, Cape of Good Hope, Isles of France, India and Malay islands. He goes on to say that this location would have great economic advantages. He states 'His Excellency is aware that the Coast between Cape Lewin and Shark's Bay has never been explored by any British Officer; its soil and productions are as yet unknown; but as it is situated in the same parallel as NSW in the same climate as on the same Island, it is fair to assume that it is in other respects similar to this Country; if this assumption is correct it will admit of labour by Europeans and produce commodities well suited to the wants of neighbouring Countries.' 'As a Naval and Military station upon a great scale the neighbourhood of Swan River would be of the highest importance.' He went on to say that ' at a time when we have one French Vessel of War in these seas with objects not clearly understood and when we hear of an American Vessel being also in this area, seeking a place for settlement, it becomes important to prevent them from occupying a position of such Value.'	Murdoch University SWL4- GJ 994. H673 3 V12
1920–1929			
Alexander WB (1921) 'Excursion to Garden Island', *J. Proc. R. Soc. West. Aust.* 6:54–57	An account of a trip to Garden Island in December 1919	The party noted Crested Terns resting on limestone rocks and Brown-winged Terns (*Onychoprion anaethetus*) were also seen. Three tern eggs were found under the protection of overhanging ledges of rock without any attempt at nest making. A young Silver Gull was also found in a nest among the bushes on the top of one of the rock stacks. The party noted that the whole exterior of the north end of the island was covered in a thick covering of cypress pines (Callitris), interlaced with various creepers forming a dense matted jungle. Nearer the coast on the slopes of the hills, thickets of wattle (*Acacia cyclopis*) with the occasional tea-trees (*Melaleuca*) occurred and in places there were open tracts covered mainly with grasses. *Athrixia australis* and *Trachymene coerulea* were found among the grasses. On the limestone headlands running out to the sea, various shrubby plants such as *Boronia alata* and *Westringia rigida* occurred. 30 different plants	Murdoch University SWLR 887

Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		representing 20 orders were found on the island including *Scaevola crassifolia*, *Rhagodia billardieri, Eremophilia brownie, Phyllacanthus calycinus, Leptomeria preissiana, Isopogon* sp., *Senecio* sp., etc. The north-western shores of the island are fringed with reefs, which were not exposed during the visit. The reef was covered with thick growths of seagrasses (Fluviales), the two common species being *Cymodocea antarctica* and *Posidonia australia*. On the bases of the leaves numerous chitons of the genus *Stenochiton* were found. Two possible species *S. juilides* and *S. posidonialis*. In some rock pools a great number of a Springtail, of the family Poduridae were also found. The party encountered a dolphin on the return trip to Fremantle.	
Alexander WB (1921) 'The birds of the Swan River District', *Emu* 20:149–168	A list of the birds of the Swan River District is provided, which included species identified in and around Cockburn Sound and the surrounding islands.	This document provides a comprehensive list, gathered over a five plus year period, both from the observation of the author and knowledge gained from the Western Australian Museum of all of the observed bird species of the Swan River District, including the outer lying islands surrounding and including Cockburn Sound and Fremantle.	CSMC & @ <http://www.publish.csiro.au/?act=view_file&file_id=MU920149.pdf>
Colebatch HC (1929) *Story of a Hundred Years: Western Australia 1829–1929,* Government Printer, Perth	To present an outline of the progress of Western Australia in the first hundred years of its existence so that people should be afforded a convenient means of acquiring reliable information as to its present position and prospects.	A broadscale description of the settlement of Western Australia and its subsequent development over one hundred years. Includes descriptions of flora, fauna, marine life, Aboriginal interaction, town development and economics of the time.	Murdoch University SW L2 994.1 STO 1929
1930–1939			
Serventy DL (1938) 'Birds of the islands off Fremantle, Western Australia', *Emu*: 37:265–268	A study and summary of bird life identified on Carnac and Garden Islands	This study outlines the result of research into the bird life identified on Carnac and Garden Islands as well as bird life identified on Rottnest Island. It discusses island location and size, and is general in nature; it states that the status of inhabitants is somewhat uncertain due to the short period of study.	CSMC & @ <http://www.publish.csiro.au/?act=view_file&file_id=MU937265.pdf>
1940–1949			
Blauert L (1943) 'The ocean birds of Perth beaches', *J. Roy. Soc. W.A* 27:219–228	A record of ocean birds found between the beach between 1915 and 1940 from Safety Bay to North Beach	Ocean birds found include: Little Penguin – found to breed on Penguin Island and adjacent inlets but also feed far out to sea. There was some concern about the penguin's safety and it was stated that 'Unless the protection under law is made more effective it is only a question of time before the bird is driven away from these local breeding grounds'; *Diomedea exulans* (Wandering Albatross), *Diomedea chrysotoma* (Black-browed Mollymawk), *Macronectes giganteus* (Giant Petrel), *Daption capensis* (Cape Petrel), *Halobaena caerulea* (Blue Petrel), *Pachyptila* sp. (Prions), *Puffinus carneipes* (Flesh-footed Petrel), *Puffinus pacificus chlororhynchus* (Wedge-tailed Petrel), *Puffinus assimilis glauerti* (Little Shearwater), *Pterodroma lessonii lessonii* (White-headed Petrel), *Pterodroma macroptera albani* (Grey-faced Petrel), *Pterodroma mollis mollie* (Soft-plumaged Petrel), *Pterodroma lugens* (Kerguelen Petrel), *Oceanites oceanicus parvus* (Wilson Storm Petrel), *Pelagodroma marina dulcia* (White-faced Storm Petrel), *Phaethon rubricauda westralis* (Red-tailed Tropic Bird), *Morus serrator serrator* (Australian Gannet) found in Cockburn Sound, *Fregata minor minor* (Greater Frigate Bird), *Catharacta skua lonnbergi* (Broen Skua), *Stercorarius parasiticus* (Arctic Skua), *Stercorarius pomarinus* (Pomarine Skua), *Sterna dougallii gracilis* (Roseate Tern), *Sterna fuscata glauerti* (Sooty Tern) and *Anous tenuirostris melanops* (Lesser Noddy). The majority of the bird specimens were found near Cottesloe, Fremantle or Rottnest Island.	Murdoch University NW L2 J500 R887 2

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Tydeman F (1948) *Report on the Port of Fremantle*	A report on the development of the port of Fremantle	In 1948, F. W. E. Tydeman, a consulting engineer, prepared a report on the development of the Fremantle port. This report was only partly implemented because of ensuing arguments as to the best approach to upgrade the Inner Harbour. Tydeman himself was appointed General Manager of the Fremantle Harbour Trust, a position he held until 1963, and it was under his administration that the modernisation of the Inner Harbour was undertaken. Mechanisation and containerisation were the primary programs introduced under Tydeman. Under the auspices of these programs, modern equipment was purchased, mechanical workshops built, methods of bulkhandling improved, berths modified and seven quay cranes were installed. The majority of these new works were concentrated at North Quay.	
1950–1959			
Fairbridge RW (1950) 'The geology and geomorphology of Point Peron, Western Australia', *J. Roy. Soc. WA* 34:35–72	To broadly document the geology and geomorphology of Point Peron	In 1946 a survey was carried out by UWA. A detailed map was established through ground traverses with the assistance of air photographs. It was found that Point Peron, as well as the limestone hills on which Rockingham and Safety Bay occur, are made up of Pleistocene and recent sediments. The oldest rock is the coastal limestone; overlain with beach sand, beach ridge and dune deposits. The present limestone shore is bevelled by broad marine platforms forming a low water level and the shores are terraced by relics of earlier recent sea level forming platforms. Two parallel systems of dune rock formations, 5 miles apart, run in a north-south direction. These dune systems were drowned as the sea level rose by 10 feet above its present level 4000 years ago (world-wide occurrence). The sea remained at this level for 100s of years; during this time the range of limestone hills, Point Peron being one of them, and east Rockingham, became silted up with deposits of sand. During this long period, row after row of long beach ridges grew up in front of the eastern row of hills. The sea level dropped sharply in two steps, first to 5 feet and then to 2 feet, during which time the limestone shores of Point Peron and islands became further benched by the marine terrace seen today. About 2000 years ago the sea level stablised to what it is today. Since then, extensive benching of the limestone shores has taken place and produced wide reef flats and erosion of the soft beach country. As a result of this history, Mangles Bay and Warnbro Sound must be regarded as compound.	Murdoch University NW L2 J500 R887 2
Serventy DL (1951) 'Interspecific competition on small islands', *W. Aust. Nat*. 3:59–60		The author notes that native fauna species of a closely related group may be found on one island and another species on another. This can be seen in marsupials and reptile species such as the Quokka on Rottnest and the Tamar on Garden Island; the Carpet Snake on Garden Island, the Dugite on Rottnest Island and the Tiger Snake on Carnac and Garden Islands. All of these islands were formerly joined to the mainland. The article explains possible reasons why they do not exist on the same island.	Murdoch University SWL2 500. W527.1
Carrigy MA & Fairbridge RW (1953) 'Recent sedimentation, physiography and structure of the continental shelves of WA', *J. Roy. Soc of WA* 38: 65–95	To establish origins of the morphology of the shelves of the Western Australian coast and to detail the relationship between mainland tectonics and ocean floor morphology.	The shelf that Cockburn Sound occurs on is the Rottnest Shelf. Shelf sediments are mainly clastic, calcareous and organogenic, being derived from fragments of molluscs, corals, algae, bryozoa with small amounts of residual sands. The shelves are remnants of an arid, ancient landmass of low relief. The paper goes on to detail the relationship between mainland tectonics with shelf and adjacent ocean floor morphology such as deep sea basins, sedimentary basins, broad concave sectors and deep sea ridges. It also details the possible origins of the shelves that occur along the Western Australian coast.	Murdoch University NW L2 J500 R887 2
Stephenson G & Hepburn JA (1955) *Plan for the Metropolitan Region, Perth and Fremantle, Western Australia,* Government Printing Offices, Perth Western Australia	Plan developed for land requirements for Perth and Fremantle	The first major investigation of future land requirements in metropolitan Perth was *Plan for the Metropolitan Region: Perth and Fremantle, Western Australia*, (Stephenson and Hepburn, 1955). This plan recommended the creation of a regional statutory planning authority to prepare a regional statutory plan. The result was the *Metropolitan Region Town Planning Scheme Act 1959*, which directed the preparation of the Metropolitan Region Scheme (Metropolitan Regional Planning Authority, 1963) approved by State Parliament in 1963 and based largely on the 1955 Stephenson-Hepburn Plan.	Murdoch University SWL4 711.40994111 STE 1955

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Smith GG (1957) 'A guide to sand dune plants of south western Australia', *W. Aust. Nat. 6:1-18*	To establish a description and key of the dune vegetation of the Perth area.	This article describes the dune vegetation of the south-west of Western Australia and covers 20 miles north and south of Perth. A key is also provided. Species include *Spinifex longifolia, Spinifex hirsutus, Ammophila arenaria, Scirpus nodosus* (Knotted Club Rush), *Lepidosperma gladiatum* (Coast Sword Sedge), *Anthericum divaricatum, Atriplex isatidea* (Coast Saltbush), *Salsola kali* (Prickly Saltwort), *Tetragonia zeyheri* (Sea Spinach), *Carpobrotus aequilaterus aequilaterale (*Pig-face), *Cakile maritime* (Sea Rocket), *Acacia cyclopis, Pelargonium drummondii, Oenthera drummondii* (Evening Primrose), *Myoporum insulare, Scaevola crassifolia, Oleria axillaris, Angianthus cunninghamii, Calocephalus brownie, Senecio lutus, Arctotheca nivea* and *Sonchus megalocarpu* (Dune Thistle).	Murdoch University NW L2 J500 R8872
Hodgkin EP & Di Lollo V (1958) 'The tides of south-western Australia', *Journal of the Royal Society of Western Australia* 41: 42-54	To document the main characteristics of tides at the ports of Fremantle, Albany and Bunbury.	This article details tides and sea levels in Fremantle, Albany and Bunbury. It was found that the tides are mainly of daily type and of small range (max 3 ft at Fremantle and 4ft at Albany). Sea level varies both with atmospheric and hydrological conditions. The extreme range of daily sea level was 4 ft at Fremantle—greater than the maximum tidal range. Monthly sea levels are generally 1 ft higher in winter than summer but there is much variation from year to year.	Murdoch University SW L2 J500 R8872
Churchill DM (1959) 'Late Quartenary eustatic changes in the Swan River District', *Journal of the Royal Society of Western Australia* 42:53-55	To document late Quaternary eustatic changes in the Swan River District from pollen analyses of submerged freshwater peat from 68 feet below sea level.	Samples of peat with pollen were taken from the Swan River area during the construction of the Narrows bridge. The species of plant that the pollen was found to come from and the radiocarbon age of the peat (9,850 years before 1958) led to the following findings: rising sea level since 12 000 BC has flooded and drowned an old dune topography situated between Perth and Rottnest; Cockburn Sound was an interdunal lake before rising sea levels flooded it—this was thought to occur between 3000 and 4000 BC; the Swan River crossed the exposed coastal plain in 6000 BC and discharged into a wide bay ENE of Rottnest and Rottnest Island was found to be cut off from the mainland since 5000 BC; Garden Island was cut off at the same time, although numerous islands would have occurred between Cape Peron and the southern end of Garden Island.	Murdoch University SW L2 J500 R8872
1960–1969			
Hodgkin EP (1960) 'Patterns of life on rocky shores',*J. R. Soc. West.Aust.* 43:35-43	To document the patterns of life on rocky shores of Cape Leeuwin and Poste Lafayette in Mauritius and establish the biological relationship for the zonation of life.	This article details the factors that may contribute to zonation of life on rocky shores. These factors include water movement, weather, food availability, competition between organisms. It was established that while weather and shore climate determine the zonation of life on rocky shores, biological factors can affect the patterns of distribution of life. These factors include food and grazing pressures, availability of places to live, hazards of larval settlement and predation.	Murdoch University NW L2 J500 R8872
Gillham ME (1961) 'Alternation of the breeding habitat by seabirds and seals in Western Australia', *Journal of Ecology* 49:289-300	To determine the degeneration and regeneration of plant communities associated with fluctuating populations of sea-birds and seals.	This study looked at the vegetation of 23 islands along 500 miles of coastline from Cape Leeuwin to the coral islands of the Abrolhos. It was found that large numbers of birds nesting in close proximity are themselves largely responsible for the instability of the plant communities in which they live on the islands of WA. The colonial habit of the majority of seabirds leads to heavy guano deposition and trampling and the plant community is radically changed; at the beginning this is a advantage to the birds but in the later phases it is to their detriment. Burrowing birds such as penguins, petrels and shearwaters are less damaging to vegetation and can return to ancestral breeding grounds.	Murdoch University SWL2J 574.5
Marsh LM & Hodgkin EP (1962) 'A survey of the fauna and flora of Rocky shores of Carnac Island', *Western Australia W. Aust. Nat*. 8:62-72	To document the findings of a survey of the fauna and flora of the rocky Shores of Carnac island, WA.	A survey was conducted in March 1951. The south shore is bounded by narrow platforms which extend from a notched cliff. The platforms are exposed to moderate to strong wind action; they are open to the SW but protected from the NW. The commonest animal of the platforms was the mutton fish (*Haliotis roei*). Algae that occurred included *Jania Pterocladia, Ecrocarpus, Laurencia, Hypnea, Dictyolta* and *Cyatophora*. There was a narrow *Jania* zone of coralline algae with its associated fauna of small gastropods. The densest animal populations lay along the outer edge. Two Chiton species were almost confined to this area. *Balanus nigrescens* and *Patellanax laticostata* occur there as well. In the notch above the platform level *Melaraphe unifasciata* and *Tectarius ugosus* occurred; in the region of wave wash was a zone of smal limpets, *Notoacmea onychitis* and *Patellanax peroni.* In the lower part l	Murdoch University NW L2 J500 W5271

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		of the notch there was a band of Chiton and below this, anemone (*Actinia tenebrosa*). The west reef platform extends westwards from a sandy beach at the NE corner of the island. The platform is high and is moderately exposed to wave action. Sand from the beach spreads on to it and modifies the animal distribution. At the shore, a partially exposed rock ramp was populated by patches of mussels, *Hormomya,* and the limpet *Siphonaria baconi*. From the ramp the following associations succeed one another across the platform: A) *Jania* zone with much sand, B) a shallow pool, C) a short turf of coralline algae with *Sargassum, Dictyota, Colpomenia and Hypnea,* D) an outer zone of dense molluscs (*Haliotis roei, Patelloida alticostata, Patellanax laticostata, Onithochiton occidentalis and Clavarizona hirtosa).* The north-west reef platform is about 120 ft wide but has several deep pools and the north-east reef has similar fauna and flora. In conclusion, the fauna and flora of Carnac Island shores are similar to Garden Island and Point Peron in that most of the species have a southern distribution. Tropical species abundant on Rottnest Island are represented by only a few species.	
Western Australian Planning Commission (1963) *Metropolitan Region Scheme,* Perth Western Australia [still in use today with amendments]	To provide statutory guidance to land use planning within the Perth Metropolitan Region.	The Metropolitan Region Scheme (MRS) is a large town planning scheme for land use in the Perth metropolitan area. This area stretches from Singleton in the south to Two Rocks in the north and east to The Lakes. The MRS defines the future use of land, dividing it into broad zones and reservations. It requires local government town planning schemes to provide detailed plans for their part of the region. These schemes must be consistent with the MRS. The MRS uses a set of maps and a scheme text. The scheme text provides planning rules for zones and reservations which are shown on the maps in different colours and patterns. This plan has been in operation since 1963 and provides the legal basis for planning in the Perth Metropolitan Region. To plan for changing needs, the Metropolitan Region Scheme map is amended frequently.	DPI
Committee for the Development of Cockburn Sound (1966) *Proposed Port Development South/ West of Rockingham,* Perth Western Australia	Identification of Mangles Bay as the Outer Harbour expanded port site	After examining various criteria including design, environment, transport and operational needs, the Rockingham–Mangles Bay area (where the Garden Island Causeway was later constructed) was identified as the preferred site to develop an offshore port facility.	Not located, ref found in <http://www.fremantleports.com.au/Planning/Port_Expansion_History_Rev_A_lowres.pdf>
Fremantle Port Authority (1966) *Development of Outer Harbour, Port of Fremantle* Vols. 1 & 2, Fremantle Western Australia	To establish a detailed program for further investigation with the view to preparing an assessment of the port potential of Cockburn Sound and to outline possible port development schemes both for the short and long term.	This report includes information on ocean swells that were seen in Cockburn Sound before the causeway was built. It states that the swell appears to be perpetual, although the Sound is protected from the west by Garden Island. a) It was noted that the swell entering from the north of Garden Island refracts and approaches the shore with the wave crest parallel to it. b) The degree of refraction of the swell entering from the north of Rottnest Island is such that it does not alter the conditions resulting from the swell as described above. c) The swell which enters Cockburn Sound from the south of Garden Island meets Southern Flats, this shoal causes the swell to refract around both the north and south of it and eventually the wave crests again meet the shoreline parallel to it. It was also noted that the Rockingham Foreshore, without protection from the north, would be unsuitable for port purposes. The report states that littoral drift was limited in Cockburn Sound, with some along the Rockingham shore in a northerly direction. The Southern Flats appeared to be stable and a comparison between old and recent charts has shown that it hasn't moved to any extent over a period of 70 years. This report goes on to describe the existing facilities in the outer harbour area (from Rottnest to Mangles Bay) and identifies future requirements. These include the development of facilities for general cargo handling, bulk cargo handling, container handling and for harbour craft. The report goes on to detail a plan for the development of an outer harbour including a causeway to Garden Island. The plan included the	Fremantle Ports Authority Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		mainland coast between north Rockingham and Kwinana, Southern Flats bank and the eastern shore of Garden Island. The coast between Rockingham and Kwinana was recommended for bulk cargo handling facilities. This was because this section of the coast was unsuitable for general or container cargo handling due to swell, there was ample storage area for bulk cargoes and the installations would have minimum interference with the existing recreational areas on the coast. The main port development was proposed to be centred on Southern Flats bank with a causeway to provide access to Garden Island and to protect against swell entering Mangles Bay from the west. It was planned to create a channel under the causeway and to place this sand on the west side of the causeway to establish a wide beach for recreation. The report goes on to state that the provision of the causeway would also open up Garden Island for recreational purposes thus providing recreational facilities far exceeding those which may be affected by the proposed port development. The report also lists further investigations that are required before development begins. A brief history of the uses of Cockburn Sound is provided in the appendix of the report. It states that since 1829 the waters of the Sound were used extensively by whaling vessels and a thriving timber exporting centre grew up at Rockingham at the southern end of the Sound. From 1837 there have been proposals for the development of the Port of Fremantle with some for the development of the outer harbour in Cockburn Sound. 1860–1880 there were 5 ships a week leaving Rockingham jetty, more than the commerce being handled at the mouth of the Swan River. The development of the inner harbour diverted attention from Cockburn Sound where shipping gradually dwindled to the point of insignificance. A few holiday shacks and picnics on the beaches marked the only usage of its waters for almost 50 years. In 1913 work began on a naval base in Rockingham. The whole of Garden Island was resumed by the Commonwealth and a strip of land running along the mainland coast 6 miles long and 1.5 miles wide. During WW1 Success and Parmelia Banks were dredged and in 1942 further dredging occurred for navy purposes. The channels were then extensively used by US submarines entering Careening Cove for refitting trials. From 1953–1955 further deepening of the channels occurred.	
Heppingstone ID (1966) 'Bay whaling Western Australia', *Early Days J. Roy. West. Aust. Hist. Soc.* Vol. 1 (5)	To present information that deals with that period of Western Australian history when the early settlers, struggling to maintain a foothold on the new land, hunted those mammals which frequented the seas round our shores from land-based whaling stations.	Governor Stirling, Governor of the first settlement in 1829, reported in a dispatch on 20th January 1830 'The facilities which are offered for carrying on a whale fishery have not escaped the attention of some of the settlers even this early. I have had applications from several parties but judging the time not arrived I have not hastened by particular encouragement such establishments. It is believed that there is an abundance of fish to make a fishery profitable and the coast is visited between the months of May and November by a multitude of whales; it will be my object to foster these fisheries and boats and small vessels drawing their maintenance from these shores.' In 1837 two whaling companies were formed, one the Fremantle Whaling Company, and the other the Northern (aka the Perth) Fishery which had its station on Carnac Island. The two companies produced oil to the value of about 1,140 pounds and bone worth 360 pounds in the first year. (The value of wool exported in this year was 1,584 pounds). Both companies continued for a couple of years but both worked at a loss and closed by 1839. The Fremantle company reopened in 1844 and continued for several decades.	CSMC
Wilson BR & Hodgkin EP (1967) 'A comparative account of the reproductive cycles of fives species of marine mussels *(Bivalvia: Mytilidae)* in the vicinity of Fremantle',	A comparative account of the reproductive cycles of five species of marine mussels (*Bivalvia mytilidae)* in the vicinity of Fremantle, Western Australia	This article provides descriptions of the reproductive cycles of 5 marine species of mussels. They are *Mytilus edulis planulatus, Xenostrobus pulex, Septifer bilocularis, Brachidontes* Cf. *variablis* and *Amygdalum glaberrimum*. Two of these species have a southern Australian distribution and three are tropical indo-pacific species. The study area was Fremantle where the mollusc fauna is composed of almost equal proportions of southern and northern species. It was found that the reproductive cycles differ significantly with each species exhibiting a characteristic breeding pattern. A distinction is seen between the	Murdoch University SWL2 574.92 A938 1 <http://www.publish.csiro.au/nid/126/paper/MF9670175.htm> CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Australian Journal of Marine and Freshwater Research 18:175–203		season of gametogenic activity and the season of actually spawning. In four of the species the major features of the reproduction cycles correlate with latitudinal distribution. This is evidence supporting the role of temperature as a principal determining factor in the control of the broader aspects of the reproductive cycle. Differences in finer details of the reproductive cycles (e.g. spawning season, and number of spawning peaks) appear to be controlled by unknown factors besides temperature.	
Heppingstone ID (1969) 'American halers in Western Australian waters', *Early Days J. Roy. West. Aust. Hist. Soc*. Vol. 7 (1)	To present information that deals with a period of fifty years from 1820 to 1870, when the United States of America was the leader in the whaling enterprise.	The first American whalers reported to have visited our shores were the *Asia* and *Alliance* which were from Nantucket (US) in 1791 and made landfall at Shark Bay. No less than 260 American whaling ships are recorded as having visited WA shores up to 1890. When bay whaling became established on the coast at Bunbury, Fremantle, Vasse and King George Sound, much resentment was felt at the competition from American whalers and there were many complaints to the Government, who intimated that it would give protection to the local men in the settled bays of the Colony, but had not the resources to do so in the outlying positions of the State. It was reported in the Gazette of February 1841, that there were a great number of whalers on the coast. Ten had put into Gage Roads to obtain supplies from Fremantle.	CSMC
Hodgkin EP & Phillips BF (1969) 'Sea temperatures on the coast of south western Australia *J. Roy. Soc. WA* 52 (2): 59–62	To establish the sea temperature of Cockburn Sound.	Since the establishment of the BP oil refinery at Kwinana the maximum and minimum temperature of surface water has been taken (1960–67). This data has been supplied to the author to conduct this study. It was found that the annual curve of inshore water temperature is similar to air temperature with a peak in January/February and a min in July/August. The highest monthly mean water temperature was 24.7 degrees C and the lowest was 12.8 degrees C. Offshore water temperature showed a marked lag compared with inshore temperatures and the annual range was smaller than that for Cockburn Sound.	Murdoch University NW L2 J500 R8872 JRS WA
Waterman P (1969) *The Equilibrium of the Cockburn Sound Natural Environment,* Post Graduate Research, University of Western Australia (funded by Fremantle Port Authority)	To outline suggested research required for an understanding of the Cockburn Sound environment.	Suggested research includes: the geomorphic structure of the Sound; seasonal and diurnal variation in water movement; patterns of waves and swell; tide patterns; tide-induced oscillations; sediment movement; beach transformation; ecological assessment;photographic recording; temperature and salinity; current patterns; and seagrass distribution.	CSMC
1970–1979			
Australian Conservation Foundation (1970) *Conservation of Cockburn Sound (Western Australia) – A case study* Special Publication No. 5	To review the requirements for conservation of Cockburn Sound and its resources, which the Australian Conservation Foundation regards as of national significance.	The report reviews information about Cockburn Sound for geomorphology, water circulation, marine life, island species, recreation, commercial fishing, teaching and research, industry and the problems and responsibilities relating to those topics. The report makes the following recommendations: 1. Planning for overall development of Cockburn Sound and adjacent coasts and islands be placed in the hands of the Minister for Conservation (about to be appointed by the WA Govt). 2. The Minister for Conservation set up a planning committee representative of all sections of the community concerned in the use of this area to produce a master plan for its multiple use. 3. Ecological surveys of the area be financed by the Minister, the results being passed to the planning committee. Monitoring of the ecology should then be maintained. 4. Adequate water circulation of the Sound must be ensured. 5. A rigid policy to prevent pollution should be enforced. 6. Selected areas of the important seagrass community should be protected. 7. The northern two and a quarter miles of Garden Island, together with coastal waters within 20 chains of this part of the island, be declared a full sanctuary for all fauna and flora, access being granted only for scientific study.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Coffey & Hollingsworth Consulting Engineers (1970) *Geotechnical Investigation – Cockburn Sound Naval Base Western Australia,* Vols 1, 2 & 3, Prepared for the Commonwealth Department of Works, Perth, Job No. 4456B	To present the results of the investigation on the construction of the causeway and causeway bridges to Garden Island for the Cockburn Sound Naval Base.	Discusses the composition of substrate and the logistics involved in driving piles, accessing materials and construction methods.	CSMC
Environmental Resources of Australia Pty Ltd (1970) *Report on the Ecology of Cockburn Sound: Winter 1970* Vols I&II, Report to Fremantle Port Authority Western Australia	To choose indicator plants and organisms which can be measured over many years, to adequately show any change induced, either naturally or by man; To investigate some of the additives now being presented to the environment, for the first time, by industry and to determine how these are accumulated or removed from the area; To suggest how the interaction of these products may affect plant and animal communities now, and in the future.	**Hydrology:** During winter, water outfall from the Swan River area moves through Cockburn Sound. This water has a characteristically different colour to that of the normal onshore seawater at this time. Movement of these patches of water, together with the movement of bottom water agitated by trawling in the Sound, enabled a description of the path taken by water as it moves through Cockburn Sound. Water moves north through Cockburn Sound in autumn and south in winter. There is a bloom of unicellular green algae in the water entering Cockburn Sound from the Swan River area during winter and spring. There is no sediment load in this water. Causeway construction and harbour development is anticipated to have a marked reduction on the throughput of water to Cockburn Sound. Water throughput and contaminant load from industry will need to be carefully balanced to maintain Cockburn Sound as a recreational resource. **Seagrass:** A major feature of the Cockburn Sound area is the extensive seagrass meadows which occur on the shallow sandy margins of the Sound and across the Southern Flat areas bordering both the northern and southern ends of Cockburn Sound. The study shows that with more intensive monitoring, it will be possible to predict a change in environment by the change in length/width of the *Posidonia* in the area; and the health of the grass being affected by either structural alteration or industrial contamination. Decrease [of seagrass] may be due to either chemical poisoning of the plants or suspended material, reducing light available for photosynthesis. These effects may become more severe as the planned development of Cockburn Sound proceeds, e.g. construction of the Causeway, establishment of Outer Harbour facilities and increase in the number of industries requiring discharge facilities into the Sound. **Epiphytic Algae:** An interesting feature of the epiphyte distribution during the winter period when this sampling was done, is the epiphytic algae bloom and diversity all through the area, so that there is a maximum number of species present in the Sound. **Plankton:** The concentration of all animals considered is remarkably higher in Cockburn Sound than in the open sea, i.e. animals occur in 10s and 20s per sample in the open sea, compared with many thousands per sample in Cockburn Sound. Data shows the highest concentrations start at Owen Anchorage. This may be due to some influence of Swan River outflow. **Mussels Chemistry:** High levels of aluminium were found in both the flesh and the shells of animals taken at Alcoa Jetty. This suggests the animal is passing the aluminium through the entire tissue. Both manganese and iron levels were high in mussels at the AIS Jetty. **Thermal Disruption:** It may be concluded that thermal pollution in Cockburn Sound, at the present time (1970), is restricted to local small areas.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Coffey & Hollingsworth Consulting Engineers (1971) *Geotechnical Investigation Cockburn Sound Naval Base Stage 2 Investigation,* Prepared for the Commonwealth Department of Works Perth,Job No. 4456B	To describe investigation work for the foundations for causeway bridges and embankments which has been carried out subsequent to a previous report presented in 1970.	Discusses the outcomes of bore hole drilling for a trestle bridge, a high level bridge and the causeway embankment. Presents specifications for installation of pylons and causeway rock.	CSMC
Coffey and Hollingsworth Consulting Engineers (1971) *Geotechnical Investigation: Cockburn Sound Naval Base – Colpoys Point Docking Facility,* Prepared for the Commonwealth Department of Works, Job No. 4456B/2	To present the results of a foundation investigation for the proposed docking facility at Colpoys Point, Garden Island, Cockburn Sound Naval Base.	Discusses the logistics involved in driving pylons and the settling velocity of dredged materials. Also presents information on the sub-surface composition.	CSMC
Crook KAW (1971) 'Cockburn Sound Naval Facility: A question of environmental management, *Search* Vol. 2 No. 1: 8–17	To assess the proposal for the development of the Garden Island causeway.	The assessment of the proposal used criteria and techniques based on environmental management. The article looks at the engineering feasibility, ecosystem destruction, environmental disturbance, economics, public amenity, multiple utilisation (i.e. compatible with future plans for development of port facilities in the Sound) and time considerations of the causeway. Conclusions: the data on engineering design that the proposal is based on are so incomplete that it should be called a concept instead of a design; costing of the proposal is imprecise; the claim that the structure will not cause environmental modification is not supported by physical data and doesn't stand up to critical analysis; inadequate attention has been paid to the effects that further developments in the Sound interacting with the proposed causeway will have on the environment. If built in its present form the structure may cause significant problems in Cockburn Sound. The report recommends that the proposal should be referred back to the responsible departments for review of both the concept and design; the review should be based on a rigorous interpretation of hard data from site investigations; environmental data should be collected over an adequate length of time to ensure a thorough understanding of the environment; the concept should be modified if necessary in the light of environmental data so as to ensure that no untoward environmental modification of the Sound occurs; the possibility of the rockfill causeway being replaced in the final design by bridged openings should be considered; the review should take in to account the possible ecosystem destruction and future development within the Sound; the final concept should provide adequately for multiple use of the Sound and for public amenity; claims as to the degree of environmental modification should be backed up with hard data; at each stage in the above process the Government should make public data and design proposals and to allow sufficient time for public comment; and the Commonwealth should establish a Cockburn Sound Commission to assume overall responsibility for the Sound and its environs so to ensure that development will not create problems in environmental management.	Murdoch University SWL2 500.A938 1

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Environmental Resources of Australia Pty Ltd (1971) *A Report on the Disposal of Industrial Effluent into Owen Anchorage WA,* Prepared for the West Australian Chamber of Manufacturers and the Department of Industrial Development	To evaluate the assimilative capacity of the Owen Anchorage marine basin to receive waste without impairment to the general ecology of the area; To determine the physico-chemical form in which waste should be discharged, together with the most suitable locations for discharge, so that a viable balance between minimum cost and maximum aesthetic improvement is achieved; To determine the present health hazards from the disposal of animal processing waste to people using the area for recreational purposes and ensuring that future waste disposal will not be injurious.	The report found that: • Waste disposal through a number of outfalls is preferable to a combined outfall system. • Outfalls from those factories located south of the Fremantle Power Station should be extended 800 ft from shore (into a deep basin). • The WA Meat Export Works outfall should be relocated 1200 ft south-west of its present location. • Effluent must be released through multiple ports to obtain maximum dilution and dispersion. • Effluent pipelines need to be trenched through the beachline to the sea (put underground). • There is a need for some effluent to have physical treatment before release, particularly for removal of grease, suspended solids and blood discoloration. • There is no need for waste treatment on account of BOD values in relation to the assimilative capacity of the environment. • High costs for waste purification are not warranted as no biological communities are endangered. • Biological treatment for faecal contamination is not presently warranted unless infective strains of bacteria are introduced from diseased animals. None of the present salmonella examined from effluents were of the typhoid inducing strains.	CSMC
Environmental Resources of Australia Pty Ltd (1971) *The Effect of Industrial Waste Discharge into Cockburn Sound, Western Australia,* Prepared for the Fremantle Port Authority Western Australia	To present evidence obtained during a study of the ecosystem of Cockburn Sound which was made on behalf of the Fremantle Port Authority which recognised the growing need to retain maximum benefit from a multi-purpose use of the Sound for: • Development as a viable port facility; • Increased industrial use of both the foreshore and nearshore; and • Increased recreational use by an expanding general public.	The results of these initial studies indicate that some undesirable effects caused by industry are already in evidence within the Sound and that deterioration has been both recent and rapid. Foreshore instability in both industrial and non-industrial areas appears to be directly related to the destruction or expansion of seagrass meadows in the shallow nearshore areas. The area of seagrass meadows destroyed by industrial wastes has expanded greatly in the past twelve months and is expected to continue. If industrial contamination is allowed to continue at its present level then it is considered that root bases in denuded areas will be killed and seagrass meadow will be permanently destroyed. Analyses of sediments, plant and animal tissues indicate an accumulation of a wide range of heavy metals in the Kwinana area when compared to identical control samples taken at unindustrialised areas through the Sound. Oil spillages do occur in the industrial area of Kwinana with a frequency of one per month. The causeway construction may enhance the pollutant effect of industrial effluent because of reduced nett exchange of waste with the sea. Large fish kills have been observed in relation to high density releases of industrial wastes. These occur with a frequency of one every five weeks. Thermal pollution does not present an environmental problem in Cockburn Sound. Primary treated sewage is discharged into the northern end of Cockburn Sound. Surface water bacterial counts at this outfall are very high. The report makes strong recommendations regarding the control and management of industrial waste and identifies further studies that are required.	CSMC
Environmental Resources of Australia Pty Ltd (1971) *The Ecology of Cockburn Sound Autumn 1971,* Prepared for Fremantle Port Authority Western Australia	To present information on the third in a series of investigations made over a one-year period to establish a baseline for monitoring the ecology of Cockburn Sound.	**Seagrass recruitment and regrowth:** Studies show that successive denudation due to industrial contamination mimics complete harvesting. Not only are existing fronds removed, but the recruitment of new fronds is substantially reduced. **Seagrass productivity:** An increase in production of new leaves at the expense of the older leaves occurs between December and April. The residual clumps of living seagrass at AIS Kwinana disappeared between February and April. **Epiphytic algae:** Approximately seventy species of epiphytic algae belonging to five major phyla have been recorded on *Posidonia australis*	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		fronds collected in Cockburn Sound during sampling over nearly nine months. Sampling indicates that rapid successional changes occur in the whole epiphyte flora in Cockburn Sound. **Zooplankton:** Plankton distribution in relation to hydrological characteristics is a useful indicator of the history of a water body and is effective in tracking water movement through Cockburn Sound. There is diurnal movement of plankton in Cockburn Sound. **Ascidians:** Results show that there are four major groupings of ascidian species in Cockburn Sound. Stomach contents of ascidians from different locations around Cockburn Sound provide for an ideal and sensitive assessment of the content of trace elements in the water mass. Bacterial levels in water are presented, and show most beaches around Cockburn Sound being affected by *E. coli.* An account of seagrass transplanting in Florida is given as an example which may need to be considered.	
Environmental Resources of Australia Pty Ltd (1971) *Report on the Ecology of Cockburn Sound: Summer 1970–71,* Report to the Fremantle Port Authority Western Australia	To report the findings of the second phase of the ecological studies of Cockburn Sound inclusive of: • Conducting detailed investigations as to the suitability of indicator plants and animals to monitor aspects of the marine environment of Cockburn Sound; • To document natural seasonal changes in plant and animal community structure; • To identify any seasonal changes in the effect of industrial waste discharged into the area; • To refine research techniques to produce a simplified program to monitor environmental changes.	**Hydrology:** There was a general replacement of water in Cockburn Sound. Water temperatures were 2–3 degrees Celsius higher the than adjacent sea. The main body of water in the Sound is naturally less transparent than the adjacent sea. The shallow margins have a marked diurnal oxygen flux due to photosynthesis and respiration by plants. **Seagrass:** Seagrass meadows are vital components in the stability of the nearshore environment in Cockburn Sound. Optimal and sub-optimal seagrass habitats have been defined by measurement of leaf dimensions and density. *Posidonia australis* was sampled for blade length and width at James Point and north of the AIS jetty. Aerial reconnaissance of the Sound foreshores has shown the deterioration of seagrass meadows in the Kwinana industrial area. **Algal Epiphytes:** Epiphytic algae are sensitive and predictive indicators of differences in water quality. There is a wide range (67 varieties) of epiphytic algae on seagrass leaves. There was a highly significant difference between samples taken from industrialised and non-industrialised areas. **Plankton:** The copepod fauna of Cockburn Sound has a greater density to that of the adjacent sea in the summer. **Mussels:** Mussels have been found to be unsuitable as indicator organisms in Cockburn Sound because of problems with population succession and because they do not readily accumulate contaminants. **Ascidians:** Ascidians have been found to be suitable indicator organisms to detect the presence of chemical contaminants in the water of Cockburn Sound. **Chemical Analysis:** Most of the organisms analysed showed a proportionate increase in trace element concentrations near the industrially developed area of Kwinana.	CSMC
Pearman GI (1971) 'An exploratory investigation on the growth rings of *Callitris preissii* trees from Garden Island and Naval Base', *West. Aust. Naturalist* 12: 12–17	To establish the age structure of two stands of *Callitris preissii* at Garden Island and on the mainland at Naval Base; To determine whether cyclic patterns of wood growth are present which might act as indicators of past climate conditions in the area.	It was found that the Garden Island trees could not be more than 50 years old at the time of the study, with some younger stands of an age that suggests that they may have developed after the fire that burnt most of the island in 1955. The Naval Base trees were found to be 100 years old and another group 45 years old. Results suggest that there was a period of rapid growth during the 1920s when Perth experienced a higher annual rainfall.	Murdoch University NW L2 J500 W527 1

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Environmental Resources of Australia Pty Ltd (1972) *Beach Morphology Cockburn Sound: Autumn 1971,* Prepared for Commonwealth Department of Works	To develop an understanding of beach morphology and dynamics in Cockburn Sound.	Cockburn Sound beaches have a maximum volume in late summer due to deposition by predominantly low-steepness waves. Presents beach profiles for beaches along mainland Cockburn Sound.	CSMC
Environmental Resources of Australia Pty Ltd (1972) *Beach Morphology of Cockburn Sound July 1971–June 1972,* Report to the Commonwealth Department of Works, Canberra ACT [Volume 1 Text, Vol. 1, Vol. 2, Vol. 2 Figures]	To present and review beach profiling and dynamics at eleven mainland and seven Garden Island beaches in Cockburn Sound.	Of the beaches examined on the mainland, those situated at the southern end of Cockburn Sound showed the smallest fluctuations in beach volume. On Garden Island the most stable beaches examined were Buchanan Bay, Careening Bay, Naval Barracks, Colpoys Point North and Perkins Point North. The beaches which displayed large fluctuations in beach volume on Garden Island were Sulphur Bay and Colpoys Point South showing a significant nett loss of material. Study results indicated that the sediment eroded from Colpoys Point South did not accumulate off the southern edge of the submarine bank at Colpoys Point. Generally, all beaches reached maximum volumes during late winter/early spring, and had minimum volumes in autumn. Sediment tracking during winter of 1971 showed that the dominant direction of sediment movement within the Sound was northerly.	CSMC
Environmental Resources of Australia (1972) *Cockburn Sound Ecosystem, Autumn 1972,* Prepared for Commonwealth Department of Works and Fremantle Port Authority	To document the condition of the ecosystem of Cockburn Sound in the autumn of 1972.	There is a distinct difference in the health of seagrass meadows according to location, ranging from complete denudation in the Kwinana Industrial areas through an area of transitional effect to unaffected areas. The denudation is related to industrial modification of the content of cooling water which is reintroduced to the Sound at the Kwinana foreshores. There has been no effective recolonisation of areas documented as denuded in previous reports. In areas of consistent denudation there is a continuing fretting and removal of old seagrass root material which is presently binding the submarine sand areas. There is active removal of sand adjacent to these denuded beds. When residual root material is removed, erosion will increase markedly. A transition occurs in the composition of epiphyte species between polluted locations and unpolluted areas. There is a low frequency of fruiting species at polluted areas. Results show that zooplankton are directly related to water quality, and that zooplankton distribution is markedly different to the adjacent sea and that these changes are due to modification in habitat, i.e. water quality.	CSMC
Environmental Resources of Australia (1972) *Cockburn Sound Ecosystem, Spring 1972,* Prepared for Commonwealth Department of Works and Fremantle Port Authority	To document the condition of the ecosystem of Cockburn Sound in the spring of 1972.	The results of investigations documented in this report show that there has been a general deterioration in the condition of the biotic community of the nearshore area of Cockburn Sound since the previous study. The area now affected is from Woodman Point to Palm Beach jetty. The investigations indicate that the deterioration along the eastern foreshore is due to the cumulative effect of industrial effluent discharge from the Kwinana Industrial Area. The survey of the epiphyte distribution shows that the 'transitional area' between those seagrass meadows affected by proximity to industry and those unaffected has extended and now encompasses the area between Woodman Point and Palm Beach. Significant defoliation of seagrass meadows occurs throughout the area between the transitional zones as indicated by epiphyte modification. In many of the defoliated areas the residual mat of seagrass fibre is exposed and standing proud of the surrounding sand flat. This indicates instability of the near-shore sediment budget. Where there previously was an equilibrium situation some foreshore readjustment may now occur. The Rockingham foreshore is now affected in this manner. The concentration of trace elements introduced in the Sound has increased in the area adjacent to industry which was previously sampled. The area affected has also expanded. This result is shown in sediments and animals. The analysis of trace elements has been used as an indicator of the area affected by waste. Certain trace elements that are being	Murdoch University SWL4 G 574.52636 E61 6

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		introduced into the Sound are of public health concern. They include cadmium and mercury. Analyses of the edible animals in the Sound show that these two elements are not passing through the food chain. It is considered that future investigations should be orientated towards the assignment of responsibility to individual industries causing an adverse affect upon the environment.	
Environmental Resources of Australia (1972) *An Integration of Hydrological Investigations, Cockburn Sound, July-August 1972,* Prepared for the Commonwealth Department of Works, Perth Western Australia	To document the rate and direction of water exchange between Cockburn Sound and the adjacent marine areas during the winter period, July to August 1972.	Although the offshore oceanic drift appears predominantly southward in winter, frequent short-term changes in direction may occur. The direction of flow of water under the Trestle Bridge was predominantly westward, but showed numerous short-term changes in direction. Various independent lines of evidence show that on some occasions during the period of the investigation, water did not flow southward through the Sound but southward down the eastern coast of the Sound and northward up the western coast. The exchange rates based upon separate estimations varied between 2–9 days. This rate took into account exchange through both the southern opening and the Garden-Carnac Island gap.	CSMC
Smith GG (1972) 'A red tide of Trichodesmium in coastal waters of Western Australia', *Western Australian Naturalist* 12 (4): 81–83	Discusses the occurrence of a red tide of the planktonic alga within Cockburn Sound, including Careening Bay.	During Easter of 1972 several people reported the occurrence of a red tide of the planktonic alga *Trichodesmium erthraeum* in the ocean on the south-west coast of WA. This occurred in Cockburn Sound as samples were taken near Careening Bay. Samples were also taken 6 miles north of Rottnest Island and from Geographe Bay, 148 miles south of Fremantle. Another sighting of this bloom was recorded 15 miles out to sea from Lancelin, 84 miles north of Fremantle. Several dead fish were seen floating in the bloom. Another fisherman reported the bloom from 25 miles west of Fremantle, describing it as 'in vast swathes, looking like gravel roads in the sea'. At Careening Bay the bloom was extensive, dense and in some areas a pale green while in others a red-brown. The prevailing winds at Careening Bay blew the bloom ashore where it dried as a rusty film on the beach. It gave off an offensive odour under the high temperatures that occurred.	Murdoch University NW L2 J500 W527 1
Environmental Resources of Australia (1973) *Hydrological Investigations Cockburn Sound December 1973* Vol. 1, Prepared for Australian Department of Works	To document the results of hydrological investigations conducted in Cockburn Sound and adjacent waters from 1–15 December 1973.	The hydrological program is the first summer monitoring of the water movement since the Garden Island Causeway construction was completed in May 1973. The hydrodynamic measurements during December 1973 showed that a parcel of water would be steadily driven northwards through Cockburn Sound, by the action of the Indian Ocean seasonal longshore drift, at a rate of 2–3 km/day. An internal circulation pattern was described from the results of current metering and float tracking. Atmospheric depressions suppressed the flow through the southern openings and the main body of Cockburn Sound. Once these depressions passed to the east, the northerly drift would again take over.	CSMC
Environmental Resources of Australia (1973) *An Integration of Hydrological Investigations, Cockburn Sound December 1972,* Prepared for Commonwealth Department of Works	To outline the results obtained from an investigation of the hydrological characteristics of Cockburn Sound during the period from 6–15 Dec. 1972 and to determine the characteristics of the hydrological regime of Cockburn Sound at a similar period of the year to earlier hydrological studies conducted before and during the construction of the Garden Island Causeway.	The period of water replacement is of the same order of time, for equivalent energy conditions, as before causeway construction. Evidence indicated that there is some internal circulation of water. Water velocity prior to the construction of the Trestle Bridge was 15–30 cm/sec. Velocities after construction were 30–60 cm/sec.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Environmental Resources of Australia (1973) *Cockburn Sound Ecosystem, Spring 1972,* Prepared for Fremantle Port Authority, Fremantle Western Australia	To document the ecology of Cockburn Sound during the spring and summer of 1972.	Results show that there has been a general deterioration in the condition of the biotic community of the nearshore area of Cockburn Sound. The area now affected is from Woodman Point to Palm Beach Jetty. The deterioration along the eastern foreshore of Cockburn Sound is due to the cumulative effect of industrial effluent discharge from the Kwinana Industrial Area. Significant defoliation of seagrass meadows occurs throughout the area between Woodman Point and Palm Beach jetty. In many of the defoliated areas the residual mat of seagrass fibre is exposed and standing proud of the surrounding sand flat. This indicates instability of the nearshore sediment budget. It is considered that future investigations should be oriented toward the assignment of responsibility to individual industries causing an adverse effect upon the environment.	CSMC
Environmental Resources of Australia (1973) *Beach Morphology-Cockburn Sound,* Prepared for Australian Department of Housing and Construction	To present the results of monitoring beach profiles around Cockburn Sound during the six-month period from Dec. 1972 to June 1973.	Conclusions as to whether a particular beach within Cockburn Sound is eroding or building up on the basis of this study can not be made. It has been identified that the main parameters affecting beach shape are: • Length of wind fetch to the beach • Duration and intensity of wind in a given direction • The direction and intensity of wind/wave induced nearshore currents • The angle of attack of (a) wind waves and (b) swell after entering the Sound through each of its openings • The variation in water level around the Sound due to wind set • The final height and period for waves approaching the beach • The depth of water in the immediate nearshore areas • The width of beach and obstructions to lateral sand movements (groynes, seagrass meadows, Kwinana Wreck).	CSMC
Environmental Resources Australia (1973) *An Investigation of the Effect of Waste Discharge from Australian Iron and Steel into Cockburn Sound, Kwinana,* Prepared for the Fremantle Port Authority Western Australia	To detail the results of an investigation of the effects of the Australian Iron and Steel Proprietary Limited plant operations on the nearshore area of Cockburn Sound; To establish what accumulation had taken place in the nearshore sediment, together with the characteristic composition of the cooling water effluent of the AIS plant and the aesthetic impact.	This study affirms that contaminants in solution and suspension originating from the AIS works at Kwinana have contributed to the degradation of the nearshore seagrass plant and animal community. The effect of the effluent on the environment occurs in three ways: (1) The particulate material falls out of suspension and forms a mantle of foreign material over the plants and animals, thus smothering them; (2) The increased turbidity after outfall or due to resuspension during intensive wave action prevents light transmission sufficient to support the photosynthesis of plants; (3) Some elements contained in the material in solution most likely enter the metabolism of plants and animals and act as a cumulative poison. The seagrasses have been killed and no longer grow in the area influenced by the AIS outfall. It is anticipated that continuing long-term degradation of the binding root material will lead to increasing sediment instability in this area. The chemical analyses show that there has been a marked elevation in the concentration of metal ions in the sediment as a direct result of AIS production; some of these values are significantly high, e.g. iron, zinc, manganese and chromium. At the time of the study AIS was exempt from the requirements of the *Environmental Protection Act 1971.*	CSMC
Heppingstone ID (1973) 'Whaling in Cockburn Sound and thereabouts', *Early Days: Journal of the Royal Western Australian Historical Society* Vol. 7, Part 5	To present historical information about whaling in Cockburn Sound and waters nearby.	The establishment of the Fremantle Whaling Company and the Northern or Perth Fishery in 1837 caused a scarcity of farm labour in the colony. 'The guns of Fremantle have been firing for two or three hours this morning proclaiming the memorable event of the first whale caught near Cockburn Sound. An intimation to the Fremantle Company by Mr T. Peel who was yesterday proceeding to Perth from the Murray by way of Fremantle, that he had seen two whales in Cockburn Sound was the	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		occasion of the boats being immediately manned, and it would appear the Carnac party had previously observed the whales at a distance and were in chase. Both parties assisted with its capture. The first fatalities from the occupation of whaling occurred July of the first year. Six young men (all about 21 years of age) were drowned when their boat, belonging to the Carnac Company, was upset in heavy sea. The rough conditions caught them unawares shortly after they left Carnac Island and when they were still some distance from The Stragglers. The hunting of Humpbacks in Cockburn Sound led in 1858 to a famous lawsuit between Joshua Harwood and Captain Cumiskey of the whaler *Lapwing.* The former was accused of interfering with the catch of a whale when the two boats were in close proximity. Whales caught in the Fremantle area appear to have been cows with calves.	
Smith GG (1973) *A Guide to the Coastal Flora of South-western Australia,* Western Australian Naturalists' Club Handbook No. 10, Perth Western Australia [and 2nd edition 1985]	To provide background information on the flora of the coast of south-western Australian and highlight its value.	Background information is given regarding coastal flora in relation to geology of the coast. Provides a description of how to undertake a field study and a comprehensive list and description of coastal plants. Provides a basic field key for identification.	Murdoch University SW L2 581.75 10994
Environmental Resources of Australia (1974) *Cockburn Sound Ecosystem, Autumn 1973,* Prepared for Fremantle Port Authority, Fremantle Western Australia	To present the results of a continuing research program which monitors the persistence of the Cockburn Sound ecosystem in relation to constructional and industrial modifications and to establishing a cause for the deterioration of the main stabilising agent of the foreshore community—the seagrass meadow.	The results of this investigation indicate that there has been a continuing deterioration of the marine ecosystem of Cockburn Sound. Preliminary studies conducted in this investigation suggest that the introduction of nutrient wastes such as phosphate, nitrate and organics may be the major factor having direct influence on primary productivity. The enrichment may be altering the water quality beyond the level to which the seagrass meadows are adapted. Effluent tracking studies suggest that effluents disperse along the inshore area of the Sound thus directly influencing the eastern seagrass meadows rather than the Sound in general. The area markedly affected is between Woodman Point and Palm Beach. In the James Point area, remnant clumps of seagrass leaves have become increasingly scarce. Investigations involving the shell *Pinna* are being hampered by the gradual disappearance of animals from the contaminated areas. Their distribution is no longer sufficiently widespread throughout the Sound to enable them to be a useful indicator organism. There is virtually no phytoplankton in water entering the Sound. There is a marked increase in phytoplankton abundance on the eastern side of Cockburn Sound but no corresponding increase along the western side of Cockburn Sound.	CSMC
Environmental Resources of Australia (1974) *Cockburn Sound Ecosystem Spring 1973,* Prepared for Fremantle Port Authority Western Australia	To document the findings of ecological investigations conducted during the spring-summer period of 1973–4.	A series of photographs taken in summer 1974 (contained in report) portrays the eutrophication of Cockburn Sound along its eastern and southern margins and the typical water quality throughout the 1973–4 summer. A review of aerial photography 1942–1957 shows that the distribution and extent of seagrass within the Sound remained substantially the same. From 1957 to 1968 there was a gradual decline in the vigour of certain of the seagrass meadows along the eastern foreshores and a gradual retreat of the seagrass meadows from the deeper margin of the sand banks fringing the shores of the Sound along its eastern side. From 1968 to the present time, there has been a major denudation of seagrass meadows along the Cockburn Sound eastern shore. The vigour and productivity of seagrass at present is documented and shows that there has been a consistent decline along the eastern and southern margins of the Sound since monitoring began in 1970. The zone substantially influenced by pollution presently extends from Woodman Point in the north to the Palm Beach jetty in Mangles Bay.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Lenanton RCJ (1974) 'The abundance and size composition of trawled juvenile snapper *Chrysophrys unicolour* (Quoy and Gaimard) from Cockburn Sound, Western Australia', *Aust. J. Mar. Freshwat. Res* 25: 281-5	To establish the growth rate, relative abundance and size composition of pink snapper over a 20-month period.	This article documents the first description of growth of juvenile snapper in WA. Snapper were observed to be in spawning condition in November 1974. In October of the same year snapper in the same area were observed to have ovaries in a developed condition. The study then assumed that snapper whose young first appeared in the trawls in Cockburn Sound in April with a mean size of 8–9 cm were spawned at a time after the preceding October. By January (14 months later) they had grown a further 6 cm at an age of 1+ years. The larger 1+ year old snapper were absent from trawl catches from Feb/March onwards suggesting that they moved off ground. A peak in juvenile snapper catches occurred during April/May.	UWA Biology Library Level 2. Journals. 574.9205 P1
Cambridge ML (1975) 'Seagrasses of south-western Australia with special reference to the ecology of *Posidonia australis* Hook.f in a polluted environment', *Aquatic Botany* 1:149-161	To provide new ecological data for the nine species of seagrasses of south-western Australia, with special reference to *Posidonia australis* in Cockburn Sound, a polluted marine embayment.	1952 aerial photography indicated that the seagrass meadows once formed an almost continuous cover around the perimeter of the Sound between 1–6 m on the sublittoral platform and that they have become fragmented or have died along much of the extent of the eastern shorelines since the establishment of the industrial complex. Underwater inspection of the meadows in different parts of the Sound confirmed the unhealthy condition of the meadows, particularly near the outfalls of effluent. In areas close to effluent outfalls where seagrass meadows have severely declined or disappeared since the first industrial facilities began discharging into the Sound, the once continuous meadows have been replaced by small residual patches of *Posidonia* often less than half a metre wide.	CSMC
Meagher & LeProvost (1975) *Eutrophication in Cockburn Sound,* Prepared for Commonwealth Department of Housing and Construction	To quantify and describe the occurrence of algal blooms on a monthly sampling basis during the period Nov. 1974 to April 1975; To relate, if possible, the observed characteristics of eutrophication to the pattern of water circulation in the Sound; To evaluate and roughly quantify the amount of nutrient input to the Sound; To determine deterioration in seagrass meadows condition along the industrialised foreshores; To determine if previously healthy seagrass is showing signs of deterioration; To determine if mercury and cadmium were accumulating in the flesh of fish residing in the Sound.	The results show that excessive production of both phytoplankton and phytobenthos does occur in Cockburn Sound. The affected area extends from Woodman Point to Rockingham. The western foreshores of the Sound remain unchanged [healthy] and areas outside the Sound are not affected. The affected areas are consistently influenced by eutrophication during the summer period and show a deterioration in the condition of the original seagrass meadow habitat. The seagrass meadow has been completely removed over much of the affected area and is in very poor condition throughout the remainder. The levels of eutrophication recorded in terms of chlorophyll a content approximate the highest levels for coastal embayments in Australia and are similar to North America in locations renowned for their eutrophication characteristics. Results show there is substantial addition of nutrient to the Sound. In general terms this equates to 1600 large bags of granulated garden fertiliser (80 kg) per day. The major nutrient contributions were from CSBP and Woodman Point Sewage outfalls. Fish were collected within the Sound and analysed for heavy metal content in the flesh. Concentrations were found to be below accepted levels, with particular reference to mercury and cadmium. In Cockburn Sound the role of primary production was dominated by seagrass which formed meadows in shallow areas of the Sound. In recent years small algae suspended in the water mass and filamentous algae loosely attached to sand in inshore areas have observably increased in abundance. In those areas where these algae have proliferated there has been a commensurate diminution in the occurrence of the original seagrass meadow.	Murdoch University SW L2 628.1680994 M482
Penn JW (1975) 'Tagging experiments with the western king prawn, *Penaeus latisulcatus* Kishinouye *I*: Survival, growth and reproduction of tagged prawns', *Aust. J. Mar. Freshwat. Res*. 26:197-211	To test two tag methods for adult western king prawns in the field using an unexploited population in Cockburn Sound	Two tags for adult western king prawns, *Penaeus latisulcatus,* have been field tested in an unexploited king prawn population in Cockburn Sound, Western Australia. Both toggle and Atkin tags have been found to cause little physical damage to the prawns apart from limited scarring at the points of entry and through the musculature adjacent to the tag. Long-term survival of both toggle- and Atkin-tagged prawns did not differ significantly from that of the untagged population, but a variable amount of initial tagging mortality occurred during the first 72 hr after release due to both handling and tagging. Mortality related to size or sex was not evident for the toggle tags, but for Atkin tags there was a tendency towards smaller prawns having a better survival rate. Growth of all	UWA Biology Library Level 2 Journals. 574.9205 P1, CSMC & @ <http://www.publish.csiro.au/?act=view_file&file_id=MF9750197.pdf>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	.	tagged prawns was found to be retarded during the first month from release, but in subsequent months appeared to be faster than the average control animals. Although the growth of tagged prawns recaptured during the spawning season was retarded, normal ovary development occurred and some females spawned while tagged. Some of the problems in the use of tag recapture data from penaeid prawn stocks have been discussed.	
Penn JW (1976) 'Tagging experiments with the western king prawn *Penaeus latisulcatus* Kishinouye *II:* Estimation of population parameters', *Aust. J. Mar. Freshwat. Res*. 27:239-50	To examine the suitability of a number of methods for estimating population parameters of penaeid populations.	12 000 prawns were tagged during the study in Cockburn Sound. The study focuses on establishing the best method of estimating population size and catchability. It does not go into detail of the population parameters of the western king prawn population in Cockburn Sound.	UWA Biology Library, Level 2 Journal. 574.9205 P1
Penn JW (1977) *Trawl Caught Fish and Crustacean from Cockburn Sound,* Report No. 20 Department of Fisheries and Wildlife Western Australia	To review the importance of Cockburn Sound in regard to trawl caught fish and crustacea.	The first commercial trawling operations in Cockburn Sound were undertaken in the early part of this century when horses were used to tow small nets on the shallow banks. Later from 1955 to 1962 mechanical trawling was practised over the weed beds in the shallower areas of the Sound. Political pressure and a drop in catches caused some areas to be closed. In 1970, as a conservation measure and because of increased usage of the major part of the deep Sound by ocean-going ships, the entire area including Owen Anchorage was finally closed to trawling. Research into the trawling catch was undertaken by Department of Fisheries and Wildlife from 1971. Whiting was one of the most abundant fish captured. The catches of mature and juvenile snapper in Cockburn Sound indicate that the area is probably one of the more important snapper spawning/nursery areas on the south-west coast of WA. The presence of juvenile Samson Fish would suggest that Cockburn Sound is probably a significant nursery area for this species. Data indicates that large adult Mulloway ranging in size from 90–138 cm utilise the deep basin of the Sound. Observations suggest that Mulloway may migrate to the river, possibly to spawn during the summer after overwintering in the Sound. Blue Manna crabs were the dominant species in the trawl catch especially from autumn to spring. The deep basin is essentially an adult habitat for the King Prawn. Peak recruitment occurs when juveniles arrive from the Swan River estuary and the shallow sand bank nursery areas around the Sound. There appear to be two major reasons why Cockburn Sound provides an ideal and essential environment for many species of marine life. Firstly, the Sound is the only significantly protected embayment between Cape Naturaliste and Shark Bay, a distance of ~1000 km. Secondly, the area with its associated shallow banks has many of the advantages of the productive coastal estuaries, without being subject to the radical salinity and temperature fluctuations which occur in estuaries during each year.	CSMC
Feilman & Associates (1978) *Cockburn Sound Recreation Survey,* Report to the Cockburn Sound Study, Perth Western Australia	To provide sufficient data on the recreational use of Cockburn Sound both present and future to help make assessments on the relative value of the multiple uses of the Sound and its foreshore.	**Major Findings:** 41% of the mainland shore is available for recreation (will increase to 48.6% when Woodman Point becomes available). Cockburn Sound is 3.5 times the area of the Swan Estuary between Fremantle Traffic Bridge and Heirisson Island. Beaches tend to be narrow < 20 m. Fishing for crabs and fish occupies two-thirds and more of the boat users of the Sound. The Mangles Bay shoreline from the Causeway to Kwinana Beach is unique on the metropolitan coast in that its features make it the largest section of shoreline suited to intensive, family beach recreation activity in the region.	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		Additional boat launching facilities will be needed in the near future. Bell Park will require improved facilities in the near future. Parking at Rockingham Beach is inadequate. There are 170 small boats and yachts on swing moorings (40 in Jervoise Bay and 130 in Mangles Bay). An estimated number of 7030 people are on the beaches on a typical hot summer weekend day. An estimated number of 620 boats carrying 2160 people use the waters of Cockburn Sound, Owen Anchorage and Garden Island on a typical hot summer weekend day. Most beach users are found at four nodes: Coogee Beach, Kwinana Beach, Rockingham Beach and Palm Beach. Churchill and Bell Park (Rockingham Beach) accommodate over half these users. Boat users mainly go fishing (66%) with 21% going pleasure boating. Popular boating destinations were Southern Flats, Garden Island west, Jervoise Bay and Mangles Bay. Few boats launched in Cockburn Sound travelled north of Woodman Point. Very few boats launched in Fremantle travelled to Owen Anchorage or Cockburn Sound. 44% of boat users surveyed visited the Sound weekly. Most beach users are family groups from Cockburn, Rockingham, Kwinana and Fremantle. Rockingham Beach could be considered a regional node given its popularity to people living outside the above areas. Most boat users are from Rockingham, Kwinana, Cockburn, Melville and Gosnells. Dislike of pollution and industry around the Sound was a major attitude. Community groups felt that industry needed to be controlled by location off the foreshores, control or prevention of industrial effluent or by growth restrictions. Most groups wanted more recreation area or the maintenance of the current level. Most felt that industry is tolerated on economic grounds but the recreational potential of the Sound has been disregarded. It is felt that the approach roads through an industrialised landscape and regular reports of pollution affecting beaches have placed a stigma on Owen Anchorage and Cockburn Sound which deters use. It is estimated 8300 people use the beaches of Owen Anchorage and Cockburn Sound daily. This is expected to rise to 15–500 by 1990. There are 3 public boat launching ramps in Cockburn Sound with a total of 8 lanes. It is expected that an additional 4–8 lanes will be required by 1990. It is expected that greater use of Shoalwater Bay and Warnbro Sound beaches will occur as families look for alternative beaches. These areas are dedicated to recreation but are not as well protected as Cockburn Sound beaches. **Coogee Beach** – Family beach; mostly car transport; mostly Australian and British users; 0–49 age group most common; most swim, sunbathe or picnic; weekly use; users mainly from Cockburn; visit because it's safe for children and a good swimming beach. **Kwinana Beach** – Family beach; mostly car transport; mostly Australian and British users; all age groups common; most swim, sunbathe or picnic; high use at all times; users mainly from Kwinana, Kelmscott and Cockburn; visit because it's close to home and nice and quiet.	Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		**Rockingham Beach** – Family beach; mostly car transport; mostly Australian, British and Italian users; all age groups common; most swim, sunbathe and picnic; high proportion of infrequent visitors; users mostly from suburbs north of Rockingham; visit because it's a good swimming beach safe for children and has shade. **Palm Beach** – Family beach; mostly car transport but 21% walked; mostly Australian and British users; 0–49 age group most common; most swim or sunbathe; high use at all times; users mostly from suburbs north of Perth with highest numbers from Rockingham and Stirling; visit because it's safe for children and close to home.	
Department of Conservation and Environment (1978) *Cockburn Sound Environmental Study Progress Report,* Prepared by RG Chittleborough, Bulletin No. 40	To provide a progress report on 18 months work towards the Cockburn Sound Environmental Study.	No outcomes within this report.	CSMC
France RE (1978) *The Sedimentology of Barrier and Fringing Banks in Cockburn Sound and the Effects of Industrial Development on Sedimentation,* A report to the Cockburn Sound Study, Department of Conservation and Environment by Sedimentology and Marine Geology Group, Department of Geology, University of Western Australia	To determine historical trends in the evolving sedimentary history of Cockburn Sound, starting with the Holocene marine inundation 7000 to 8000 years BP and extending to the contemporary environmental system.	During the Holocene rise in sea level two major types of sediment have built up in Cockburn Sound. The fringing and barrier banks draw their sediment supply from the seagrass community, from material eroded from the Garden Island and Spearwood Ridges, and from material moved north along the coast from south of Cockburn Sound. These banks show a change from seagrass-related sediments to sandflat-related sediment, which is thought to be caused by a combination of bank-shoaling and sea level fall. In general these Holocene bank sediments are predominantly carbonate sands. The basin sediments consist mainly of clay-sized carbonates reworked from the Cockburn and Owen Anchorage basins. Bank build-up and substrate stabilisation is primarily controlled by the seagrass community, the wave pattern predominant within the Sound, and the amount of sediment available to the meadows. Seagrass is the main biologic factor in the build-up and maintenance of the banks due to significant amounts of skeletal carbonate debris contributed by dying flora and fauna associated with seagrass. The seagrass meadow acts as a wave-energy baffle while its roots bind and stabilise the substrate. Cockburn Sound was probably geomorphically evolving to a new equilibrium involving limited supplies of sediment and a sparse seagrass community. The sudden widespread seagrass death has been superimposed on this system. The effect may be the speeding up of the Sound's evolution to a point when there is no seagrass development at all. This will mean the de-topping of the unprotected barrier banks, increase in wave energy within the Sound and large-scale beach and sublittoral erosion around the Sound's shores.	CSMC
Grasby JC (1978) *Coastal Dunes Report for Cockburn Sound Study,* Prepared by Soil Conservation Service, Department of Agriculture, Western Australia	To present a subjective assessment of existing and potential erosion of the coastal sand dunes around Cockburn Sound, together with suggestions about some management aspects of specific sites.	The coast is described in three main sectors: • Fremantle to Woodman Point • Woodman Point to Point Peron • Garden Island Describes the morphology of the beach and stability issues affecting those beaches.	CSMC
Marsh LM & Devaney DM (1978) *The Benthic Fauna of Cockburn Sound, Western Australia* *Part II: Coelenterata* *Part III: Echinodermata: Ophiuroidea*	To present the results of fauna surveys undertaken 1956–1960 in Cockburn Sound.	Coelenterates are represented in Cockburn Sound by hydroids, several species of jellyfish, several species of soft corals and sea pens, anemones and stony corals. This report considers stony corals, sea pens and anemones because of their importance in the benthic fauna of Cockburn Sound. At the time of the WA Naturalists' Club survey (1956–1960) there was a fairly rich coral fauna in Cockburn Sound despite a more severe temperature regime than on the open coast, with seasonal extremes of 14–26 degrees Celcius.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page *Part IV: Echinodermata, Crinoidea, Asteroidea, Echinoidea and Holothuroidea,* Western Australian Museum, Perth Western Australia [also see Wilson et al 1978]		12 species in nine genera of hermatypic (reef building corals with zooanthellae) and 4 species in three genera of ahermatypic (do not have zooanthellae and are not limited by light) corals are recorded for the Sound. Many of the corals were found on a substrate of dead coral of unknown age which formed extensive patches on the north-eastern shelf, and on the western shelf (see figures within document). Of interest among the anemones are *Bundactis maculosa* of which the type locality is Mangles Bay and *Dofleina armata*, a large tropical species only known on this coast from Cockburn Sound and notable for its severe stinging properties. Sea pens formed a major part of the fauna of the central basin and were particularly abundant in the soft mud of the southern central basin.	
Wells FE (1978) *A Quantitative Examination of the Benthic Molluscs of Cockburn Sound, Western Australia,* Western Australian Museum, Perth Western Australia	To report on the status of molluscs in Cockburn Sound and to allow comparisons to be made with fauna surveys undertaken by the WA Naturalists' Club 1956–1960.	Molluscs dominated sampling, comprising 72.19% of all individuals collected and 89.56% of the biomass. Among the molluscs the four most common species *Musculista glaberrima, Dosinia incisa, Anomia* cf. *trigonopsis* and *Circe sulcata* constituted 95.8% of the molluscan biomass. The dominance of a few species in an ecosystem is a common feature and is not limited to Cockburn Sound. The preponderance of a few species in the density and biomass data was not unexpected, but the relatively few mollusc species was. Only 34 species were collected. Wilson, Kendrick and Brearley (1978) listed 295 species from the area (surveyed 1956–1960). Two explanations can be offered to reconcile the difference in numbers. The molluscan fauna of the Sound could have become impoverished in the last 20 years as a result of pollution levels. Alternatively the differing number of species recorded can be attributed to the different methods used in the two studies. There is no evidence of substantial changes in the molluscan fauna of the central basin in the last 20 years. With the disappearance of the seagrass meadows on the eastern shelf, the characteristic molluscs have also disappeared.	CSMC
Wilson BR, Kendrick GW & Brearley A (1978) *The Benthic Fauna of Cockburn Sound, Western Australia Part I: Prosobranch Gastropod and Bivalve Molluscs,* Unpublished Report to the Department of Conservation and Environment by WA Museum, Perth Western Australia [also see Marsh & Devaney 1978]	To present the results of fauna surveys undertaken 1956–1960 in Cockburn Sound.	From 1956 to 1960 the Marine Group of the Western Australian Naturalists' Club conducted a survey of the marine invertebrate benthos of Cockburn Sound, the outer harbour of the Port of Fremantle, Western Australia. The survey was undertaken initially because it had been noted that this faunistically rich area seemed to support a surprisingly high proportion of 'tropical' northern Australian species, particularly among the molluscs and corals. When the original sampling was done the only major industrial establishment on the shores of Cockburn Sound was the then new British Petroleum Refinery. Information on the variety, abundance and distribution of species in the Sound before industrialisation began is necessary. Although they were not collected quantitatively or with sufficient rigour for a truly scientific assessment, the Naturalists' Club survey data are now seen to be of great value in this context. A total of 119 prosobranch gastropod species and 157 bivalve species have been recorded so far from Cockburn Sound. The list is still not complete. Many species of 'micro-molluscs' (i.e. less than 2 mm) are known to live in Cockburn Sound but the collecting techniques used so far have not sampled them and few of them are included in the fauna list.	CSMC
Cambridge ML (1979) *Cockburn Sound Study Technical Report on Seagrasses,* Department of Conservation and Environment, Western Australia Report No. 7	To measure the present distribution of seagrasses in the Sound in order to compare with that prior to industrial development; To determine whether the seagrasses continue to recede; To identify the causes of seagrass decline;	The report states that in the last 20 years seagrasses in Cockburn Sound have receded rapidly. It first became evident in 1961. Before 1954, seagrass meadows occupied 4000 ha of the sandbanks rimming Cockburn Sound, extending down the slopes to a depth of 10–12 metres. At the time of the study (1979) only 900 ha remain, mostly along the shores of Garden Island and along Parmelia Bank but no longer at a depth greater than 5–6 m. Only 22% of the meadows survived. The original area of seagrass in 1954 is thought to have produced 23 000 tonnes of leaf material each year. The average rate of production in 1979 is thought to be 4000 tonnes per year. Initial loss of seagrass occurred between 1961–63 at James Point. Major loss occurred in this area between 1967–69. Dieback on the eastern shelf occurred between 1960–1976. These dates are	UWA Biology Library Level 1, 584.74, 1079 - 1

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	To study the effects of the loss of seagrass both biologically and mechanically; To assess the environmental conditions necessary for seagrasses to re-establish in the cleared areas.	established from incomplete photographic records. In 1973 the causeway in Cockburn Sound was completed. By 1976 of the 550 ha of seagrass on Southern Flats in 1970 , about half was dead or deteriorating. Most of the remaining seagrass in this area was patchy, invaded by mussels or carrying heavy epiphytic algae growth. This widespread deterioration could not be attributed to scouring action. The pattern of deterioration of seagrass was first localised around the BP refinery outfall near James Point and was due to the initial release of effluent rich in nutrients from Kwinana Nitrogen Company. This resulted in excessive growth of epiphytic algae which led to deterioration of Posidonia. The effluent added large qualities of nutrients into the nearshore zone, an area of restricted circulation over shallow banks. Dieback of seagrass then extended north from the CSBP outfall, then south from this point with major deterioration along the Rockingham foreshore. Seagrass death occurred in Southern Flats and Careening Bay following the construction of the Causeway due to a reduction of water exchange. On Parmelia Bank dieback on a similar scale is apparent in the zone of influence of the sewage outfall discharged by the Woodman Point Treatment Plant since 1966. Biological effects of seagrass meadow in Cockburn Sound include the loss of the detritus producing system which has altered the animal associations dependent on the seagrass habitat in Cockburn Sound. Mechanical effects of the loss of seagrass meadows include localised effects on shoreline and bathymetric stability on the eastern shores of Cockburn Sound. The effects of severe storms could be expected to be more marked with the removal of the influence of the seagrass canopy in reducing wave energy and trapping sediments. The study concludes that while disturbances such as dredging, scouring, release of heated or toxic effluents may have resulted in localised loss of seagrass, the release of nutrient rich effluents which promote algal growth was the primary cause of seagrass death. It is thought that nitrogen is the effluent component that causes seagrass decline. If nitrogen builds up then dieback is expected to occur.	
Department of Conservation and Environment (1979) *Cockburn Sound Study, Technical Report on Nutrient Enrichment and Phytoplankton,* Prepared by Chiffings AW, Report No. 3 Western Australia	To describe phytoplankton communities of Cockburn Sound, to quantify seasonal changes in diversity and abundance, and to assess the factors limiting phytoplankton production; To quantify the main sources of nutrients in the Sound, to develop an understanding of the effects of the Sound's hydrological behaviour on the accumulation and dispersal of nutrients, and of the effects of biological processes in the cycling of nutrients; To derive an understanding of the relationship between nutrient cycling in the Sound and changes in phytoplankton abundance, then consider the effects of any reduction in nutrient levels as a result of the control of point sources; To consider the impact of blooms upon the ecosystem and also upon recreation and industry.	• Phytoplankton flora of Cockburn Sound and Owen Anchorage has species diversities and patterns of species succession comparable with those of nearshore coastal waters. • It is concluded that changes in phytoplankton biomass are, to some degree, the result of successional changes and these changes are associated with changes in nutrients. • It has been estimated that industrial effluents, air emissions and groundwater now contribute 30 times more nitrogen and 25 times more phosphorous than would have normally entered the Sound through exchange with the open ocean prior to the industrial development of the area. • Industrial effluents account for 79% of the total nitrogen load to the Sound and 96% of the total phosphorous load. • It is thought that the most important source of nutrients to Owen Anchorage is the nutrient rich waters of the Sound. • Cockburn Sound has persistently high levels of phosphorous whereas Owen Anchorage shows a drop in phosphorous over the winter period. This is taken as evidence of the comparatively poor flushing of Cockburn Sound compared to Owen Anchorage. • Phytoplankton uptake of nitrogen is considered high. • Nutrient distribution within the Sound is dominated by the internal circulation pattern. The residence period of nutrients is a product of the hydrology and this in turn may be a major factor in the net increases in phytoplankton biomass over the summer. • A comparison of Cockburn Sound with other coastal areas and estuaries clearly demonstrates that the Sound is definitely eutrophic and has very high levels of phytoplankton under bloom conditions. • If no changes are made to present nitrogen loads, or if they are increased, the conditions in the Sound can be expected to deteriorate.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Department of Conservation and Environment (1979) *Cockburn Sound Environmental Study 1976–1979,* Report No. 2 Western Australia	To present information on the: Monitoring of industrial discharges; Assessment of the causes of death of seagrass; Assessment of the causes and possible cures for the algal blooms which can and do degrade the Rockingham swimming domains; Analysis of the social and recreational uses of the Sound and its tourist and recreational value; Assessment of the fisheries production and potential for professional and amateur fishermen; Appraisal of water movements to reassess flushing of effluents and to provide alternative options to treatment on land by discharge of effluents into well-flushed areas; Beach movement studies to assess the role of seagrass naturally or the need for artificial devices to control beach erosion.	Beach use is expected to increase due to: • Increased leisure time; • Improvement in water quality with resulting changes in attitude; and • Provision of additional facilities. The five most important species for commercial fishers were scaly mackerel, mussels, pilchards, Perth herring and blue manna crabs. The main species of scale fish taken by amateur fishers were the Australian herring, whiting, skipjack, garfish and yellowtail scad. A comparison of species found in seagrass and sandy substrate habitats showed that the species which prefer the seagrass habitat are of limited direct benefit to commercial and recreational fishing interests. The report presents figures on levels of discharge from each industry. Studies into the causes of the general disappearance of seagrass point to the effects of heavy growths of thick mats of filamentous epiphytes growing on the seagrass itself. The Sound behaves as a tidal 'lake' for much of the time and thus effluents do not move out of the Sound readily. Some of the plants, animals, sediments and inshore waters are contaminated by heavy metals or bacteria. Nutrients, heavy metals and bacteria originate from industrial or sewage effluents. The report outlines solutions to the major environmental problems.	CSMC
Department of Conservation and Environment (1979) *A Study for the Sound Management: A summary of the findings of the Cockburn Sound Environmental Study,* Bulletin No. 73, Perth Western Australia	To summarise the work of the Cockburn Sound Study and its conclusions.	See above.	CSMC
Department of Conservation and Environment (1979) *Cockburn Sound Study Technical Report on Industrial Effluents,* Prepared by PJ Murphy, Department of Conservation and Environment, Western Australia, Report No. 6	To identify sources of man-made input to the Sound by direct discharge, spillage, groundwater contamination or atmospheric fallout; To plot the various effluent streams and locate all discharge points in and around the Sound; To record quantities, physical characteristics and chemical composition of inputs; To recommend means of reducing or eliminating discharges.	The report describes the processes involved in wastewater production and discharge for industries within Cockburn Sound and Owen Anchorage. The sources within an industry are generally identified and suggestions made on the means by which discharge could be reduced or eliminated. Industries discussed include: Australian Iron and Steel, BP Refinery, CSBP and Farmers, Kwinana Nitrogen Company, Woodman Point Treatment Plant, State Energy Commission Kwinana Power Station, Western Australian Meat Export Commission Robbs Jetty Division, Anchorage Butchers, Watson Foods, N.Shilkin & Son, Eagle West, Eagle Wools, Coogee Fellmongers, McGilvrays Tanner and Crayboats Cooperative.	CSMC

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Department of Conservation and Environment (1979) *Cockburn Sound Study Technical Report on Distribution of Contaminants,* Prepared by Chegwidden A, Cockburn Sound Study Group, Western Australia, Report No. 5	To present the findings of an investigation in the levels of heavy metals, hydrocarbons, enteric bacteria and other contaminating agents in water, sediments and biota from the Cockburn Sound area.	The study of levels of heavy metals, hydrocarbons, enteric bacteria and other contaminating agents in the water, sediments and biota from Cockburn Sound has shown significant contamination. The main problem area is the eastern side of Cockburn Sound adjacent to the Kwinana and Owen Anchorage industrial areas. Assumptions that the Sound's waters are regularly flushed so as to achieve good effluent dispersion have been proved to be incorrect. Direct effect of stress on the ecosystem is manifested by the decline of the seagrass meadows. Fish and crabs show levels of contamination above health levels, particularly for lead. The sediments of Cockburn Sound have been contaminated with cadmium, copper, zinc, lead, chromium, nickel, mercury and arsenic. The sediments of Owen Anchorage have been contaminated with copper, lead and chromium. The main source of heavy metal contamination of Cockburn Sound is the gypsum waste discharge from CSBP outfall. The BP Refinery at James Point has the only significant continuous input of hydrocarbons to Cockburn Sound. It has been confirmed that contaminants originating from effluents to Cockburn Sound and Owen Anchorage that enter the waters of the area have infiltrated the marine food web and from there have the potential to enter the human diet.	CSMC
Department of Conservation and Environment (1979) *Cockburn Sound Study: Technical Report on Fish Productivity,* Prepared by Dybdahl RE, Report No. 4, Perth Western Australia	To present production in terms of catches taken by both commercial fishermen and those fishing for recreation; to assess potential production, including resources not yet utilised; to investigate Cockburn Sound's role as a breeding and nursery area for species fished either in Cockburn Sound or adjacent waters; and to advise on the effects of changing habitats in the Sound.	Cockburn Sound supports a substantial commercial fishery. Total professional production for the 1977–78 fiscal year was 760,910 kg. The total estimated value of this catch was $486,287. The five most important species taken by professional fishers were scaly mackerel, mussel, pilchard, Perth herring, and blue manna crab. The number of fish caught in Cockburn Sound by amateur boat fishers during the year 1978 is estimated to be greater than 2.5 million fish. Ranked by numbers of individuals caught, the four most important species are blue manna crab, Australian herring, whiting species and skipjack. The number of blue manna crabs taken by amateurs from Cockburn Sound is estimated to be about one and a half times the total commercial catch of this species for all Western Australia during the 1977–78 fiscal year. One of the resources considered most promising, the edible mussel, is threatened by bacteriological and heavy metal contamination. During the fauna survey, 73 fish species and 8 invertebrate species of commercial and recreational fishing interest were identified out of a total of 144 species collected. As both juvenile and breeding adult sized individuals were collected, Cockburn Sound is evidently a nursery and spawning area for a large number of species. The degradation or loss of the seagrass habitat is likely to affect species of commercial or recreational interest indirectly through reduced input of seagrass detritus to the nutrient cycle.	CSMC
Green N (1979) *Nyungar – The People: Aboriginal customs in the southwest of Australian* Creative Research Publishers in association with Mount Lawley College, Perth Western Australia	Reprints vocabularies from Nind (1831), Moore (1884), Lyon (1833), as well as other ethnographic information. A foreword by Ken Colbung	Reprints vocabularies from Nind (1831), Moore (1884), Lyon (1833), as well as other ethnographic information. A foreword by Ken Colbung.	

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Iveson JB (1979) *Salmonella and* E. coli *in the Owen Anchorage Cockburn Sound Environment: A report on Public Health Department and Cockburn Sound Study Team Investigations in coastal waters, effluent and fauna in the Owen Anchorage Cockburn Sound area including Carnac Island,* Prepared for Department of Health and Medical Services Western Australia	To present the results of water quality testing from 313 samples taken from 31 sites between South Beach and Jervoise Bay.	A total of 85 samples had *E. coli* counts above 55 per 100 ml and 54 samples contained salmonella in one litre of water. The vast majority of contaminated samples were taken at waste discharge points and at sites in close proximity to the shoreline and offshore outfalls. No significant *E. coli* or Salmonella contamination was detected at recreational beaches between South Beach and Coogee and at inshore sites at Woodman Point and Jervoise Bay. High levels of contamination were detected at outfall sites of abattoirs and associated trades. High levels of Salmonella were detected at a small number of sites between Coogee Beach and South Beach. Salmonella was detected in 74 of 200 mussel samples examined from 18 sites.	CSMC
James RM (1979) *Diary and Letters of Admiral Sir CH Fremantle GCB Relating to the Founding of the Colony of Western Australia 1829,* (ed) Lord Cottesloe, Fremantle Arts Centre Press, Fremantle Western Australia	To present a selection from the diary and letters of Admiral Sir Charles Howe Fremantle GCB relating to the foundation of the colony of Western Australia.	On 2 May 1829 Captain Fremantle took formal possession of the whole of the Western Coast of New Holland in the name of King George IV, and the Union Jack was hoisted. On 6 May 6 a party of twenty-five from HMS *Challenger* which he commanded, landed at the bay just south of Arthur's Head and lived there until relieved in the middle of June after the arrival of the merchant ship *Parmelia*, which brought Captain Stirling (the Lieutenant-Governor of the new Colony) and a number of settlers. She arrived on 1 June and was followed by HMS *Sulphur* on 8 June. On 12 August the Town of Perth was formally inaugurated. When Captain Fremantle sailed to India on 28 August, three additional ships had arrived with settlers, cattle and stores. Captain Fremantle's diary for 1832 throws much light on the general condition of the Colony three years after its foundation. Such records well illustrate the dangers and difficulties encountered by those who founded our Colonies, and show the character of the pioneers of Australian settlement. Extracts: '*After dinner went on shore (Garden Island) and tried to walk over the island, but from the thickness of the trees and underwood it was impossible to move. Found nothing on the island but seals. Many started from the woods near the beach on our firing. The ships company caught an immense number of fish called Snappers, capital large fellows weighing ten and twelve pounds, I daresay 200 on board. Landed in Mangles Bay, the same kind of woody country and very thick, killed some birds, shags and curlew, also a seal. Caught a shark, very broad but not more than 8 feet long, the Sound abounds with them and some are very large ones. Plenty of fish and we continue to catch as many as will supply the Ships company.* *Went on shore to catch seal and haul the seine; caught two young seals, and killed 7 shags, one gannet and some gulls. In the seine we got about four buckets of fish generally small, some mullet, whiting and various kinds.* *Went…to the party on shore at the mouth of the river. The party had plenty of fish which they caught from the rocks, and the sharks actually came on the beach within the length of a boat hook 7 & 8 feet long, they are most numerous and voracious, which renders it very disagreeable, as to bathe even from the beach is hazardous.* *Went to the little island [Carnac] which forms the north side of the passage [to Cockburn Sound] and saw quantities of seal, chiefly young ones. We got some young penguin and I shot a bird like a partridge; killed 7 gannet, a fine large bird very handsome but not good to eat. Went on to the little island [Carnac] to get seal, but they have been so attacked that they have deserted it. Went to the colony with four days provisions. Got amongst a quantity of the large snapper fish in going, but they were so large that they broke all the hooks.* *The Purser...had succeeded in killing 14 seal [from the south of Garden Island].'*	

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Layton Groundwater Consultants (1979) *Cockburn Sound Groundwater Survey for Cockburn Sound Study Group,* Department of Conservation and Environment Western Australia	To define the groundwater system into which the effluents, process liquors and/or chemicals migrate from industries in Cockburn Sound; To describe the nature of groundwater recharge, discharge, occurrence and movement within this groundwater flow system; To evaluate the chemical quality of the groundwater	It was concluded that groundwater occurs at relatively shallow depths adjacent to Cockburn Sound (CS). Effluent or chemicals can readily migrate down into the groundwater system. The groundwater is contained in sand or limestone, highly permeable. In Owen Anchorage and Jervois Bay area the aquifer material is cavernous calcareous sandstone and limestone. The base of the shallow groundwater system is marked by impermeable siltstone at a depth of 25–30 metres below sea level. The natural direction of the flow is towards Cockburn Sound. Bacteria, organic nitrogen, chloride and some metals are the most common containments found in the aquifer. They are thought to originate from soakwells and pits, septic tanks and inadvertent seepage from unsealed effluent storage lagoons. Many of the industries have crude wastewater and effluent treatment facilities and outfalls through which effluents are piped directly into Cockburn Sound. The industries include the WA Meat Commission, Drum Services, South Fremantle Power Station, McGilvarys Tannery, Coogee Chemicals and Eagle Wools.They all operate small unsealed effluent disposal and storage lagoons. It is not known if these lagoons leak. The industries that directly pump wastewater into the aquifer include Eagle West Pty Ltd and N.B Love Starches. The groundwater in the aquifer below Alcoa, BP, Chemical Industries, Commonwealth Gases and CSBP plant sites is contaminated with process liquors, chemicals and effluent. The aquifer below the Western Mining Corporation nickel refinery is contaminated with process liquors. In the Owen Anchorage area the rate of groundwater movement into the Sound is 3500 kL/day/km of foreshore, for Kwinana/Rockingham area it is 2280 kL/day. The study recommends that monitoring of groundwater quality and water table levels continue in order that seasonal variations may be identified. It is also recommended that industries be educated about the basic concepts of groundwater occurrence, movement and management in the shallow unconfined aquifer. Also to increase the quality and decrease the quantity of the sources of contamination by conducting detailed investigations into the effluents discharged into Cockburn Sound aquifers so that disposal technologies can be upgraded.	Murdoch University SW L2 551.4909941 L429 C2
Plaskett D & Potter IC (1979) *Heavy Metal Concentrations in the Muscle Tissue of Twelve Species of Teleost from Cockburn Sound, Western Australia,* School of Environmental and Life Sciences, Murdoch University Western Australia	The study was initiated to ascertain whether teleosts, and particularly those of commercial importance, accumulated large amounts of nine separate heavy metals that were known to be discharged in appreciable amounts into the Sound. No attempt was made to measure mercury concentrations since this element was discharged into the Sound in only very small amounts. Values are given as both wet and dry weight concentrations to facilitate comparisons with heavy metal levels found in mussels in the Sound.	Cockburn Sound (32° 8' S., 115° 45' E. to 32° 16' S., 115° 41' E.) is located just south of the point where the Swan River discharges into the Indian Ocean. It extends on the landward side from Woodman Point through James Point southwards to Cape Peron, from which a causeway containing two small entrances passes northwards to join Garden Island. In this study, the northern and outer limit of the Sound is considered to be Beacon Head at the tip of Garden Island. The relatively protected aspect of Cockburn Sound, and its docking facilities and proximity to the two major cities (Perth and Fremantle) of Western Australia, made this region an apparently ideal location for the development of industrial complexes. During recent years, however, concern has grown over the possible harmful effects of the discharge of a variety of heavy metals into this environment. Such dangers are probably increased by the small size of the Sound, which is only 15 km long by 8 km wide. Moreover, although the volume of water flowing into the Sound through the north and south entrances has always been relatively low, it has been further reduced by the construction of the causeway (R. K. Steedman and Associates, personal communication). Initial work carried out on the Sound has shown that the amount of heavy metals in the sediments and water, and in selected invertebrates such as mussels (*Mytilus edulis*), merits concern over the present condition of this marine embayment-like area (A. Chegwidden, personal communication). In addition to its extensive use as a source from which mussels, crabs and scallops are collected for human consumption, the Sound provides a nursery ground for several teleost fishes, and is widely used by both amateur and professional fishermen.	CSMC & <www.publish.csiro.au/?act=view_file&file_id=MF9790607.pdf>

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Steedman RK & Associates (1979) *Numerical Model Study of Circulation and other Oceanographic Aspects of Cockburn Sound,* Prepared for Cockburn Sound Study Group, Department of Conservation and Environment	To examine the use of wind-driven numerical models in determining the nature of the circulation patterns within Cockburn Sound and from this information determine the dispersion of effluent released into the eastern margin of Cockburn Sound so its travel path can be understood.	Nett exchange between the nearshore (including Cockburn Sound) and the mid-continental shelf region is very low. Theoretical analysis shows the wind to be the most important force driving the circulation within Cockburn Sound. Current speeds vary widely depending on water depth and range from 0–30 cm/second within the Sound. Moderate to strong winds (> 5 m/second) develop distinct circulation characteristics, where three major stationary gyres are formed. The largest forms east of the central basin (James Point to Woodman Point) and flows anti-clockwise. To the north-west of the basin a clockwise gyre is formed. These two circulation features often link with the sea. In Mangles Bay a clockwise gyre is formed. Generally, flow through either the northern or the southern opening is so low that the Sound tends to act largely as a self-contained circulation system. Mangles Bay tends to maintain a closed, isolated circulation.	CSMC
1980–1989			
Hammond J (1980) *Winjan's People: the story of the South-west Australian Aborigines,* Imperial Printing Company Ltd, Perth Western Australia	Written from the author's experience of the natives of the south-west.	Dating from the early 'sixties of the last century'. A list of about 90 words of the Nyungar people from the Murray River area, compared with Moore's (1842) vocabulary. A transcription of a corroboree dance song and 14 fish and animal names.	
Penn JW (1980) 'Spawning and fecundity of the Western King Prawn, *Panaeus latisulcatus*, Kishinouye in Western Australian waters', *Aust. J. Mar. Fresh. Res* 31: 21-35	Spawning and fecundity of the western king prawn, *Penaeus latisulcatus* Kishinouye, in Western Australian waters.	The microscopic and macroscopic changes which occur during ovary development to spawning have been investigated for *P. larisulcatus*. The latter stages (3 and 4) of development and the act of spawning have been found to be confined to single intermoult periods, with spawning being possible during each of a series of consecutive intermoult periods. Fecundity was found to vary significantly with the size of the individual, with the number of eggs ranging from approximately 105 000 (123 mm total length female) to 6500 00 (217 mm total length female) at each spawning. The use of an index of population fecundity in combination with estimates of spawning frequency to document spawning seasons is discussed. Using the population fecundity method the two northern populations have been shown to have a year round spawning season, with maximum spawning occurring from autumn to spring while the southern population was shown to have shorter seasons over summer. A relationship between ovary development and temperatures in excess of 17°C is suggested as the probable cause of the differences in duration of spawning seasons along the Western Australian coastline	
Tuck EO, Allison H, Field SR, & Smith JW (1980) 'Effect of a submerged reef chain on periods of sea level oscillations in Western Australia', *Aust. J. Mar. Fresh. Research* 31:719-727	Sporadic sea-level oscillations in Western Australia, with periods in the range 20–40 min, were attributed by Allison and Grassia (1979) to the presence of a submerged reef chain parallel to the shore. This reef chain extends a considerable distance along-shore (Fig. I), forming an elongated basin partly open to deeper water.	A seiching type of sea-level oscillation recorded in Western Australia by Allison and Grassia (1979) is influenced by a submerged reef chain parallel to the shore. Being submerged, the reef chain forms an obstruction, causing the water between it and the shore to be partly open to the ocean. The effect of such a partial obstruction is studied in this paper, both theoretically and experimentally. Results indicate that even a comparatively small gap above the reef chain gives rise to periods of oscillations close to that of a fully open basin. On the other hand, presence of a comparatively small reef gives rise to seiching with oscillation periods near that of the fully open basin, even in the case of the absence of a significant step to deep water in the bottom topography beyond the reef chain.	CSMC & <www.publish.csiro.au/?paper=MF9800719>
Buchwald VT & Miles JW (1981) 'On sreonance of an offshore channel bounded by a reef', *Aust. J. Mar. Fresh. Research* 32:833-841	The period and amplification factor for the dominant mode in a channel formed by the shore and a submerged parallel reef (which separates the channel from deeper water) are calculated from the two-dimensional long-wave	Channels or basins formed by the shore and a submerged, parallel reef occur on both the western and eastern coasts of Australia. On the west coast, Allison and Grassia (1979) have attributed observed sea-level oscillations of about 30 min to resonance in the channel. On the east coast, the Barrier Reef forms a channel about 120 km wide, bounded by a reef 1000 km long. While observations of the Barrier Reef channel over a range of periods are not available, tidal records indicate that there is a resonance of the semidiurnal tides in the Mackay area, with amplitudes about five times as large as on the remainder of the east coast. Moreover, the diurnal tides over the whole of the reef are	

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	equations with linear friction. Results are obtained for both narrow and wide reefs and are compared with observed oscillations on the Western Australian coast and on the Barrier Reef. Although the calculated periods might explain the anomalous tides in the Barrier Reef lagoon, it seems that there is sufficient frictional damping to prevent the required amplification.	significantly larger than would be expected from the equilibrium tide. In this paper we investigate these phenomena, using methods introduced by Buchwald (1980) and Tuck (1980), to consider the response of a channel, bounded by a narrow or a wide reef, to waves normally incident from the deep region outside the reef.	CSMC & <www.publish.csiro.au/?act=view_file&file_id=MF9810833.pdf>
Department of Conservation and Environment (1981) *Water Quality Criteria for Marine and Estuarine Waters of Western Australia,* Bulletin 103, Perth Western Australia	To establish, for given beneficial uses, criteria which may be used to derive water quality objectives.	During its investigation the Working Group found in many cases either a paucity of quantitative data or indeed a lack of consistency in data from different sources. Further, data from sources outside Western Australia are usually based on investigations under local conditions and may not be entirely relevant to Western Australia context. The working group recommended that: this report be submitted to public review; State and Federal authorities be advised on the need for toxicological studies, including radioactive substances, on Australian marine and estuarine species; further concerted research aimed at quantifying nutrient criteria, especially in those areas where anthropogenic nutrient contributions are the greatest; the Environmental Protection Authority establish a standing committee on Water Quality Criteria to review and update the State water quality criteria for marine and estuarine waters and to recommend research and investigation priorities in marine and estuarine water quality.	CSMC
Department of Conservation and Environment (1981) *Assessment of the Decline of Seagrass on the Northern Side of Woodman Point,* Prepared by Silberstein K, Bulletin 135 Appendix 1, Perth Western Australia	To determine the current status of the seagrass meadows and whether or not their conservation can be justified; to provide useful baseline data for future monitoring; and to investigate the extent of the decline of the seagrass surrounding the sand washing jetty and identify possible causes.	The seagrass meadows of the study area are showing signs of decay—the leaf canopy appears to be diminishing and in some areas the shoot density is declining. Since the sand washing plant started operating in 1972, approximately 19 ha of the original seagrass meadows have disappeared. Approximately 60% of this 19 ha was caused by the dredging and stripping of seagrass associated with the approach channels to the sand washing plant. Of the remaining 40%, about 2 ha are in the vicinity of the jetty as are the sections of the meadows which are showing signs of deterioration. The most likely cause for the seagrass decline is the reduction in light reaching the seagrass beds, owing to high turbidity of the water. The seagrass meadows are not beyond saving and if the turbidity of the water in this area was reduced then it is likely that the seagrass meadows will re-establish themselves in the non-dredge areas. If the seagrass meadows are allowed to deteriorate further, not only will the area be less useful or desirable for recreational purposes, but the instability of the sediment may contribute to erosion problems resulting in changes to the present beachline.	CSMC, City of Rockingham
Hillman MO (1981) *Groundwater as a Source of Nutrients to the Coastal Lagoon System, Perth, Western Australia,* Master of Engineering Science, University of Western Australia	To determine the role played by groundwater in the nutrient balance of the inshore marine ecosystem and also to determine the significance of groundwater as a source of nutrients contributing to the in-shore coastal lagoon ecosystem. To understand the process by which the nutrients enter the groundwater and are transported	The marine biomass within a coastal lagoon system immediately north of Perth, Western Australia, is shown to require an external source of nutrients to sustain it against nutrient losses to the land, open ocean and the atmosphere. Groundwater entering this system is shown to have a dissolved solids content that includes small quantities of nutrients such as ammonium, nitrate and phosphate ions, which are considered essential for marine life. It was found that groundwater has historically been capable of supplying most of the nitrogen and phosphorus needs of the lagoon system. In addition it was found that the concentrations and the amounts of nitrogen and phosphorus in the groundwater are increasing as a result of land usage changes. The quantities and concentrations of nitrogen and phosphorus in the groundwater discharging to the coastal lagoon were calculated and compared with other potential external sources to the lagoon and it was shown that groundwater may be the largest source. Groundwater	UWA in Scholar centre Thesis1981 HIL

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
...Continued from previous page	into the aquifer and discharged into the ocean.	may be supplying nutrients to the lagoon at a constant rate of about 3% of the net marine productivity of the ecosystem. Also it was found that groundwater discharge rates are not affected greatly by seasonal effects and can be considered constant throughout the year. The effects of human habitation can be identified on the basis of nutrient levels. It was shown that the higher nitrogen concentrations within groundwater underlying the urban areas can be attributed to leachate from septic tanks and garden fertilising.	
Lenanton RCJ (1982) 'Alternative non-estuarine nursery habitats for some commercially and recreationally important fish species of south-western Australia', *Australian Journal of Marine and Freshwater Research* 33:881-900	The distribution and relative abundance of the 0+ year classes of 16 commercially and recreationally important fish species from the inshore marine and estuarine waters of south-western Australia were investigated. The results of this study, together with data obtained from an investigation of the way in which juvenile fish used the Blackwood River estuary (Lenanton 1977), revealed that only three of these species in this region could be exclusively regarded as estuarine-dependent: two of the species entered the estuary for the entire year and the third was a seasonal migrant. The remaining 13 species all made use of at least 30% of the inshore marine environment sampled during the study, which was equivalent to the total area of nursery habitat availablein the Blackwood River estuary. The main conclusion of this study is that for these species, the inshore marine environments of south-western Australia provide otherwise unavailable alternative nursery areas to those traditionally found in estuaries.	Estuaries throughout the world are widely recognised as valuable nursery areas for many commercially and recreationally important species of fish (Gunter 1967; McHugh 1967; Jhingran and Gopalakrishnan 1973; Bayly 1975; de Sylva 1975; Wallace and Van der Elst 1975; Warburton 1979; Pollard 1981). Several recent studies have shown that this generalisation is applicable to temperate Western Australia (Lenanton 1974, 1977, 1978; Chubb *et al.* 1979, 1981). For example, during 1974–1975, a survey of the fish fauna of the Blackwood River estuary showed that 28 of the 56 fish species recorded from this estuarine system were represented by 0+ individuals (Lenanton 1977). All of these species of fish relied principally on a very abundant macrobenthic invertebrate fauna as food (Wallace 1975~). During sampling in the shoreline marine environment between Busselton and the mouth of the Blackwood River estuary early in 1976 (unpublished data), collections were made of 0+ individuals of many commercially and recreationally important species that were previously shown to be abundant as 0+ fish in this estuary (Lenanton 1977). This study was undertaken to determine the nature and extent of the use of these marine nursery habitats by 0+ fish.	CSMC & <www.publish.csiro.au/?act=view_file&file_id=MF9820881.pdf>
Lenanton RCJ, Robertson AI, Hansen JA (1982) 'Nearshore accumulations of detached macrophytes as nursery areas for fish', *Marine Ecology Progress Series* 9:51-57	The feeding ecology and seasonal pattern of occurrence of the O+ year classes of the fish *Aldrichetta forsteri*, *Cnidoglanis macrocephalus*, *Sillago bassensis* , and *Arripis georgianus* were investigated to determine relationships between these economically important species and surf-zone accumulations of detached macrophytes along the coast of Western Australia	The feeding ecology and seasonal pattern of occurrence of the O+ year classes of the fish *Aldrichetta forsteri*, *Cnidoglanis macrocephalus*, *Sillago bassensis* , and *Arripis georgianus* were investigated to determine relationships between these economically important species and surf-zone accumulations of detached macrophytes along the coast of Western Australia. The main prey of *A. forsteri*, *C. macrocephalus* and *A. georgianus* and the second most important prey of *S. bassensis* was the amphipod *Allorchestes compressa* ; the distribution of *A. compressa* was restricted to detached plants in the surf-zone. The arrival in winter of 3 of the fish species on the open coast corresponded with the period of greatest deposition of detached plants in the nearshore zone, and there appeared to be sufficient plant material, and associated amphipods, to support fish during summer. The large patches of vegetation in the surf-zone of sandy beaches support densities of *A. compressa* up to a mean of 110 g super(-1) dry wt vegetation and provide an alternative feeding habitat for these benthic feeders, one of which is restricted to estuaries in other regions of Australia. It is also likely that this vegetation provides shelter from potential predators such as diving birds and larger fish.	Murdoch University NW L2 J 574.5263 M338 1

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Talbot V & Chegwidden A (1982) 'Cadmium and other heavy metal concentrations in Cockburn Sound, Western Australia', *Aust. J. Mar. Fresh. Research* 33:779-788	Concentrations of some heavy metals in *Mytilus edulis*, *Ostrea angas, Portunus pelagicus, Chaetopterus variopedatus*, *Posidonia* spp. and their epiphytes, and *Ulva lactuca* from Cockburn Sound, Western Australia, are reported. The highest concentrations of Cd; Cr and Pb in *M. edulis* and Cd and Zn in *0. angasi* were found in those animals taken from the vicinity of industrial effluent discharge points. Further, elevated concentrations of some metals were noted in the hepatopancreas of *Portunus pelagicus* and in *C. variopedatus* and *U. lactuca.* Significant correlation coefficients for Cd-Cu, Cd-Fe, Cd-Zn, Cu-Fe, Cu-Zn and Fe-Zn in *M. edulis* indicated that elevated heavy metal levels resulted from industrial effluent discharges. Significant correlation coefficients for Cd-Zn and carapace width were found in the female crab *P.pelagicus* only. *C. variopedatus* and *U. lactuca,* unlike *Posidonia* spp. and their epiphytes, showed potential as trace metal indicators.	Little work has been carried out to determine the impact of the discharged heavy metals (Murphy 1979) on the biota of Cockburn Sound. In a recent paper, Plaskett and Potter (1979) examined heavy metal concentrations in the muscle tissue of 12 species of teleost fish from the Sound and concluded that levels in flesh were low, despite the appreciable rate at which metals are known to be discharged into the Sound. This paper reports the levels of Cd, Cr, Cu, Fe, Mn, Pb and Zn in the common mussel *Mytilus edulis,* of Cd, Cr, Cu, Pb and Zn in the mud oyster *Ostrea angasi,* of Cd, Cu, Pb and Zn in the blue manna crab *Portunus pelagicus,* of Cd, Cu and Zn in the polychaete worm *Chaetopterus variopedatus,* of Cd, Cu, Fe and Zn in the seagrasses *Posidonia australis* and *P. sinuosa* and their epiphytes, and of Cd, Cu, Fe, Mn, Pb and Zn in the sea lettuce *Ulva lactuca,* in Cockburn Sound. The biota sampling sites were chosen for the availability of each species and their proximity to known industrial effluent discharge points. Murphy's results (1979) were used to select the metals deemed necessary for analysis.	CSMC & <www.publish.csiro.au/nid/126/display/citation/paper/MF9820779.htm>
Department of Conservation and Environment (1983) *The Effects of Nutrient Load Reduction on Water Quality in Cockburn Sound,* Prepared by Chiffings AW & McComb AJ, An interim report to the Fremantle Port Authority Water Quality Advisory Committee Western Australian, Environmental Note 132	To document any change in phytoplankton levels and light transmission following the reduction of nitrogen loads and to acquire data to be used in understanding the mechanisms which might be involved in producing any observed changes in a nearshore coastal ecosystem following a major perturbation in nutrient load.	It has been shown that the average daily nitrogen load from the KNC/CSBP outfall was very much lower during the 1982–83 summer than during the Cockburn Sound study. At the same time significant reductions in phytoplankton concentrations and light attenuations have been measured. Given that nitrogen was considered to be limiting to the growth of phytoplankton in Cockburn Sound, it seems reasonable to conclude that nitrogen load reduction by KNC is having a direct beneficial effect on the water quality of Cockburn Sound. It was noted during a flight over Cockburn Sound in February 1983 that much of the shallow banks, once heavily vegetated by seagrass, appeared to be covered in green filamentous material. This was probably *Ulva* and *Euchuma* macroalgae.	CSMC

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Department of Conservation and Environment (1983) *Key Contaminants in Effluents being Discharged into Cockburn Sound and Owen Anchorage,* Prepared by Talbot V, An interim report to the Fremantle Port Authority Water Quality Advisory Committee	To provide the results of water quality survey of effluent from each company discharging to Cockburn Sound and Owen Anchorage.	With the exception of BP, CSBP and WA Meat Exporters, none of the other companies discharging to marine waters replied to requests for information on discharge flow rates. **Cockburn Cement:** This company has no environmental quality control on its discharge system and does not monitor flow rates, and did not supply production figures. **Coogee Fellmongers:** This company shows no interest in the environmental consequences of the disposal of their effluent. The aesthetic quality of their effluent is extremely poor and there is no effort to remove suspended solids. There is no evidence to suggest that the quality of their effluent has improved since the Cockburn Sound Study (1979) and they did not supply production figures or flow rates. **Crayboats Cooperative:** This company has made some effort to improve the quality of discharge; however, use of buckets in a drain to remove large solids is totally inadequate. This company did not supply production figures or flow rates when requested. **Shilkin & Son:** The aesthetic quality of this company's effluent is on par with Coogee Fellmongers. Some screening does occur but appears to be carried out only to facilitate the pumping of the waste to the sea. Sampling results show that with the exception of chromium and suspended solids, the effluent quality has deteriorated since 1978. Concern remains over chromium levels. This company did not supply production figures or flow rates when requested. **Watsonia Foods:** Aesthetically this effluent is completely unacceptable for discharge into a multipurpose area such as Owen Anchorage and the quality of effluent has deteriorated since 1978. There is considerable bacteria load reaching the sea through this company's discharge. This company did not supply production figures or flow rates when requested. **WA Meat Exporters:** No apparent effort has been made by this company to improve its effluent quality since 1978. It does screen its effluent for suspended solids and removes some of the oil and grease, but this is inadequate. There is a high level of bacteria in effluent. This company supplied some information on production figures and flow rates. **BP Refinery:** A considerable improvement in the quality of this company's effluent appears to have taken place since 1978. Total petroleum hydrocarbons, phenols, sulphides, arsenic and copper have fallen by 45.6%, 99%, 98%, 70% and 25% respectively. Contaminated groundwater under the refinery has spread beneath the dunes adjacent to Cockburn Sound and concentrations of phenol are elevated. **CSBP:** All water quality parameters except lead have been reduced since 1978. Cadmium concentrations in mussels have decreased considerably, this coincides with the decrease in gypsum during the same period. Clarification should be sought as to whether this company is still discharging gypsum into the Sound.	CSMC
Steedman RK & Craig PD (1983) 'Wind-driven circulation of Cockburn Sound', *Australian Journal of Marine and Freshwater Research* 34: 187–212	The water quality of Cockburn Sound has attracted much attention in recent years as the demands of heavy industry, fishing and recreational use of these coastal waters have increased (Davidson 1970). This paper examines the use of a wind-driven numerical model to determine the nature of the circulation patterns within Cockburn Sound.	The water circulation within the Cockburn Sound embayment in Western Australia is predominantly wind-driven. Observations by moored current meters showed the mean velocities to be less than 0.05 m s-' within Cockburn Sound and 0.07 m/s-I in the adjacent open coastal waters. Maximum tidal currents were very low, with an amplitude in the order of 0.01 m/s-I. The importance of the wind-forcing was evident in the time-history data collected by the wind and current meters, particularly under storm conditions when winds stronger than 15 m/s-I produce currents, within the Sound, between 0.10 and 0.25 m/s-I. A time-dependent; vertically integrated wind-driven numerical model was used to simulate the various water circulation patterns for each wind category. The circulation Froude number was shown to be of the order of thus allowing a description in terms of the stream function. Correlation between the data collected by the moored current meters and predicted by the model ranged between 0.05 and 0.76. Profiling data showed that under near calm wind conditions (2 m/s-I), local horizontal density	CSMC & <www.publish.csiro.au/?act=view_file&file_id=MF9890113.pdf> Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
...Continued from previous page		gradients, caused by evaporation and heating, produced currents of up to 0.1 m/s-I. The inverse estuary nature of the flow appears to play a significant role in the dynamics at low wind speeds. Under these conditions there was little or no volume exchange with the open sea. By contrast, the wind-driven circulation model showed that under a sea-breeze pattern 1.4 × 107 m^3 was typically exchanged diurnally, and a 2-day winter storm might exchange about 1.1 × lo8 m^3, which is small compared with the volume of the Sound (1.2 × lo9 m^3). The bathymetry is such that the Sound acts mainly as a closed system.	
Talbot V & Chegwidden A (1983) 'Heavy metals in the sediments of Cockburn Sound, Western Australia, and its surrounding areas', *Environmental Pollution* (Series B) Vol. 5 pp,187–205	The extensive industrial development of Western Australia near Cockburn Sound has prompted studies of some physical properties (conductivity and pH), heavy metal levels, and organic and carbonate levels of the calcareous marine sediments of this area.	Regional and local surveys and core and surface sediment samplings showed no evidence of the widespread cadmium (Cd) pollution that is known to exist in the biota due to discharges of Cd-contaminated gypsum. However, lead was concentrated in the carbonate sediments, and chromium (Cr) from tannery wastes was also found. Although the concentrations of metals in sediments correlated significantly with the anthropogenic activities around the Sound, the overall use of marine calcareous sediments as indicators of heavy metal pollution is not recommended when oxidising conditions prevail. (Geiger-FRC)	Not Found
Morphological & Electrophoretic studies of the Palaemonidae (Crustacea) of the Perth Region, WA	Marine populations of *Palaemon serenus* were sampled from Woodman Point and Rockingham main jetty in September 198	A reappraisal of the morphological characteristics currently used to separate the genera *Palaemon, Palaemonetes* and *Macrobrachium* reveals that the present system of classification is inadequate to differentiate the species of these genera occurring in the Swan River estuary, WA. Since separation on morphological grounds proved to be unreliable, an electrophoretic survey of 17 enzymes at 24 loci was carried out. The results suggest that *Palaemonetes australis* may be congeneric with *Macrobrachium intermedium.* The species of *Palaemonetes* from the Swan River estuary are genetically dissimilar to *P. vulgaris* from Nova Scotia, which appears to be phylogenetically closer to *Palaemon afinis.* A discussion of the affinities and likely origins of these species, with emphasis on the anomalous occurrence of *Palaemonetes australis* in south-western Australia, is presented.	CSMC & www.publish.csiro.au/?act=view_file&file_id=ZO9780305.pdf
Department of Conservation and Environment (1985) *The Effects of Epiphytes on Seagrasses in Cockburn Sound,* Bulletin No. 135, Perth Western Australia	To provide more direct information about epiphyte loads and their possible relation to seagrass growth in the Sound.	The continuing degeneration of seagrass meadows in Cockburn Sound was established by mapping the distribution on Parmelia Bank during 1980. Seagrass leaf production at Carnac Island was approximately twice the leaf production at Woodman Point where epiphyte loads were high. Monitoring of environmental parameters indicated that light was the most limiting factor in the Sound; high epiphyte loads were most likely to be the result of increasing nutrient levels in the Sound. It was demonstrated that epiphytes caused a reduction in light levels reaching the seagrass blades, which led to a decrease in seagrass photosynthesis at Woodman Point of up to 80%. It was concluded that the increased epiphyte growth, owing to high nutrient levels, was the probable cause of the diminishing area and density of seagrass meadows in Cockburn Sound.	CSMC, City of Rockingham
Godfrey JS & Ridgeway KR (1985) 'The large-scale environment of the poleward flowing Leeuwin Current, Western Australia: Longshore steric height gradients, wind stresses and geostrophic flow', *Journal of Physical Oceanography* 15:481–495	The results from this study give an improved picture of the broad-scale environment surrounding the Leeuwin Current (a narrow, rapid poleward current along the Western Australian continental shelf edge) and of the wind stresses that may partly or wholly drive the Current.	On annual average, the Leeuwin Current accelerates *into* the wind from 22.5 to 32.5°S; its greatest speeds are at the surface. Below 300 m there is a slow deep equatorward undercurrent with a mass transport comparable in magnitude to the nearsurface polewards flow. These and other results support Thompson's contention that the Leeuwin Current is primarily a convection current, driven by longshore steric height gradients at the continental shelf edge. Sverdrup balance may be violated near the shelf edge. It is suggested that throughflow from the Pacific to the Indian Ocean may create the large steric height gradient along the Western Australian continental shelf, which in turn results in the uniquely large poleward nearsurface flow in the Leeuwin Current. In the depth-integrated longshore momentum equation at the continental shelf edge, the seasonal cycles of the pressure gradient and wind stress terms reinforce one another, resulting in a strong net southward force in May, when the Leeuwin Current is strongest; this behavior is specific to the shelf edge, and does not occur at the coast. This seasonal variation seems to be part of a wavelike pattern; the 'wave' originates north of Australia during the north-west monsoon and progresses rather slowly anticlockwise around Western Australia	Murdoch University NW L2 J551.46 JOU 1 & CSMC &

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Johannes RE & Hearn CJ (1985) 'The effect of submarine groundwater discharge on nutrient regime and salinity regimes in a coastal lagoon off Perth, Western Australia', *Estuarine Coastal and Shelf Science* 21: 789–800	Not known	Submarine groundwater discharge (SGD) into a coastal lagoon off Perth, Western Australia, contains nitrate and silicate in concentrations two orders of magnitude higher than those of the receiving waters. This discharge delivers enough nitrate to replace that dissolved in the lagoon water mass about every eight days and enough silicate to replace the lagoon silicate in about 48 days. The delivery rate of nitrate nitrogen by SGD is equal to about 48% of that required for observed growth rates of lagoon macrophytes. Surface salinity is lower close to the shore as a result of SGD. During calm conditions a salinity front was observed in the lagoon, with a nearshore pool of nutrient-enriched water floating above the more saline ocean water.	
Searle DJ & Semeniuk V (1985) 'The natural sectors of the inner Rottnest Shelf coast adjoining the Swan Coastal Plain', *J. Roy. Soc. of WA* 67 (3/4) 116–136	The results suggest that the sector approach described herein is important to coastal studies of morphology, dynamics, history and function.	The coastal environment of south-western Australia encompassing the inner Rottnest Shelf that adjoins the Swan Coastal Plain, can be compartmentalised into five distinct natural sectors. Each sector has its own ancestral geomorphology, processes of sedimentation-erosion-transport, stratigraphic evolution and modern coastal geomorphology. The results suggest that the sector approach described herein is important to coastal studies of morphology, dynamics, history and function.	Murdoch University NW L2 J500 R8872 JRSWA
Broeze F & Henderson G (1986) *Western Australians and the Sea: Our maritime heritage,* Western Australian Museum, Perth	To provide a brief overview of the maritime elements of Western Australia's history and heritage which formed such an integral part of the development of our society and economy.	Even if most travellers go by airplane, shipping remains crucial, serving a range of modern ports from Esperance to Wyndham. Although commercial whaling has recently ceased the fisheries have gained in international economic trade and public interest. Boat and shipbuilding is going through a phase of expansion and innovation. Yachting has been given a dramatic stimulus by the America's Cup victory, and for the Royal Australian Navy Cockburn Sound has become a major strategic base, reflecting its re-orientation towards Asia and the Indian Ocean. Our State has a vibrant maritime frontier that is not just the result of recent development but also of a long history and tradition.	HMAS Stirlng library 994.1 BRO
Cambridge ML, Chiffings AW, Brittan C, Moore L & McComb AJ (1986) 'The loss of seagrasses in Cockburn Sound, Western Australia II: Possible causes of seagrass decline', *Aquatic Botany* 24:269–285	To examine the possible reasons for the extensive loss of seagrass in Cockburn Sound following industrial development.	Light reduction by enhanced growth of epiphytes and loose-lying blankets of filamentous algae in nutrient enriched waters is suggested as the most likely cause of decline. Heavy epiphyte fouling was consistently observed on seagrasses in deteriorating meadows, as well as on declining, transplanted seedlings, and is known to significantly impair photosynthesis in other systems. Extensive seagrass decline coincided with the discharge of effluents rich in plant nutrients.	CSMC
Department of Conservation and Environment (1986) *The Ecology of* Posidonia *Seagrass Fish Communities in Cockburn Sound, Western Australia,* Technical Series 11, Perth Western Australia	To describe the seagrass fish fauna of Cockburn Sound and document seasonal patterns of fish abundance, changes in fish activity and their use of space within the seagrass beds.	Seagrass beds are a nursery for some species but not exclusively a nursery for others. A community of fish exists in the seagrass, and is not found in the surrounding habitats, including the water column microhabitat above the seagrass. The fish community is spatially and temporally heterogenous which is in fish community organisation. Fish in the Cockburn Sound seagrass community generally feed on crustaceans.	CSMC
Peterson CH & Black R (1986) 'Abundance patterns of infaunal sea-anenomes and their potential benthic prey in and outside seagrass patches on a Western Australian sand shelf', *Bulletin of Marine Science* 38 (3): 498–511	Surface counts and core samples along an intertidal-to-shallow-subtidal depth gradient on a sand shelf bordering the Garden Island shore of Careening Bay, Western Australia, revealed relatively high abundances of the actinarian *Heteractis malu* and three other rarer infaunal sea anemones.	Samples taken in five strata demonstrated that *H. malu* abundance did not vary significantly with presence and absence of seagrass (*Heterozostera tasmanica*) but was lower in shallow sand than in other strata, whereas average individual size (volume) of *H. malu* was smaller in seagrass. Total density and volume of all large (< 3 mm) macrobenthos were greater inside seagrass than in unvegetated sediments. *H. malu* appears to support its high relative abundance with nutrition both from culturing zooxanthellae and from capturing invertebrate prey. A swimming opisthobranch *Akera soluta* and the blue mussel *Mytilus edulis* , often as fragments presumably left by predatory crabs and fishes, dominated coelenteron contents in January 1983 and 1984.	Abstract Only <http://scholar.google.com/scholar?hl=en&cr=countryAU&q=author:%22Peterson%22+intitle:%22Abundance+patterns+of+infaunal+sea+anemones+and+their+...%22+&um=1&ie=UTF-8&oi=scholarr>

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Silberstein K, Chiffings AW & McComb AJ (1986) 'The loss of seagrass in Cockburn Sound, Western Australia III:. The effect of epiphytes on productivity of *Posidonia australis* Hook. F', *Aquatic Botany* 24: 355-371	The hypothesis was examined that increased epiphyte growth was responsible for a reduction in seagrass meadows in Cockburn Sound during the discharge of nutrient rich effluent.	One study site was in a deteriorating meadow near an effluent outfall, the other at similar depth in an unaffected meadow in more oceanic water. Seagrass production at the first was less than that at the second, with 33% lower growth per shoot and 29% less dense meadow. Epiphyte loads (as dry weight or chlorophyll per unit leaf area) were 2–8 times higher at the former site. The observations provide support for the suggestion that seagrass loss in the Sound may be attributed to enhanced epiphyte loads following nutrient enrichment.	Abstract Only <http://md1.csa.com/partners/viewrecord.php?requester=gs&collection=ENV&recid =1360629&q=author%3A%22Silberstein%22+intitle%3A%22The+loss+of+seagrass+in+Cockburn+Sound%2C+Western+...%22+&uid=1173689&setcookie=yes>
Department of Defence (1987) *Fleet Base Relocation Study Report: A report on options for basing the fleet at Jervis Bay, New South Wales and HMAS Stirling, Western Australia,* Facilities and Property Division, Canberra	To discuss options and their implications for establishing a major base for the Fleet's destroyers, afloat support force, submarines, mine countermeasures vessels and patrol boats at Jervis Bay and for increasing the Navy's presence in WA, at HMAS Stirling.	The report concludes that priority should be given to developing HMAS Stirling ahead of Jervis Bay, on strategic, operational and support grounds, and in view of the present lesser Fleet support infrastructure in the west, relative to the east. Options for further development of navy facilities at Jervis Bay should be retained irrespective of whether relocation there proceeds. The additional infrastructure at HMAS Stirling for basing a third or a half of the Fleet there is estimated to cost about $205m or $330m respectively.	CSMC
Department of Defence (1987) *A Review of Information Pertinent to the Further Development of HMAS Stirling: Environmental Working Paper No. 2,* Prepared for the Director General Facilities – Navy by Environmental Management Services, Canberra	To evaluate the range of literature and other information which is available to describe the environments of Cockburn Sound and Garden Island before and after the initial developments of HMAS Stirling were implemented and to identify gaps in information.	The report provides the key findings of studies undertaken in the areas of hydrological and hydrodynamic studies; shoreline stability and coastal processes; marine biology of nearshore and shoreline habitat; recreation; land management and future plans; and socio-economics, and includes a comprehensive reference list of related studies.	CSMC
Environmental Protection Authority (1987) *Effect of Boat Moorings on Seagrass Beds in the Perth Metropolitan Region,* Technical Series No. 21, Prepared by Lukatelich RJ, Bastyan G, Walker DI, McComb AJ, Western Australia	To report on damage to seagrass meadows caused by boat moorings, recovery after disturbance, and more generally other boat impacts on seagrasses in the Rottnest, Warnbro Sound and Cockburn Sound areas.	Holes created in the canopy of seagrasses by mooring interfere with the physical integrity of the meadow, and this influences its biological integrity. Even though only relatively small areas of seagrass are involved in mooring damage the effect is much greater than if the equivalent area was lost from the edge of a meadow. Cyclone moorings are much less damaging to seagrass meadows than 'swing' moorings.	CSMC
Environmental Protection Authority (1987) *Proposed Transport of Sodium Cyanide Solution by Rail: Report and Recommendations of the Environmental Protection Authority,* Bulletin 284, Perth Western Australia	To provide comment and recommendations on the proposal to transport sodium cyanide solution by rail to the Kwinana industrial area.	The Environmental Protection Authority (EPA) reaffirms its conclusion in Bulletin 274 that transportation by road of sodium cyanide in solution is environmentally unacceptable. The EPA concludes that it is environmentally acceptable to construct and operate a sodium cyanide plant in the Kwinana region, and to transport sodium cyanide by rail.	City of Rockingham

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Department of Defence (1988) *The Social and Economic Setting for Further Developments of HMAS Stirling Environmental Working Paper No. 3,* Prepared for the Director General Facilities – Navy by Environmental Management Services, Canberra	To review the social and economic information which provides the setting for the assessment of the future deployment of ships and naval personnel to HMAS Stirling; To present the demographic, social, household and general economic effects of the relocation of additional naval families to the Rockingham-Kwinana subregion; and To present the key areas of social and economic issues affecting naval families living in Rockingham and Kwinana that must be addressed by Government.	The report documents the population growth of the Rockingham and Kwinana areas since the 1960s. The retrospective assessment of the socio-economic effects of the existing naval community shows that although the existing naval community is only a small part of the population of Rockingham and Kwinana it makes an important social and economic contribution. At June 1988, 2580 naval personnel families were located in the Perth metropolitan area. It is estimated that this community is contributing over $20m/annum to the WA economy through wages alone. No unmanageable socio-economic problems are reported for the naval community in regard to housing supply, provision of transport routes, increased traffic congestion. From the assessment it is concluded that there are no adverse socio-economic effects arising from the initial developments of HMAS Stirling. The establishment of a naval community has produced both social and economic benefits for the host communities.	CSMC
Department of Defence (1988) *Management of the Historic Shipwrecks* Day Dawn *and* Dato *at Careening Bay, Garden Island, Western Australia, Environmental Working Paper No. 6,* Prepared for the Director General Facilities – Navy by Environmental Management Services, Canberra	To examine the implications that the historic shipwrecks in Careening Bay, Garden Island may have in the light of the proposed redevelopment of the small boats harbour as part of the further development of HMAS Stirling.	The remains of the *Day Dawn* rests in approximately 3 metres of water, some 20 m north-west of the western jetty in the small boat harbour at HMAS Stirling. The remains are affected by propeller wash from naval tugs and workboats. The remains of the *Dato* lie upside down in 15 metres of water on a seabed of soft calcareous mud. Reconnaissance found that the wreck is about 100 metres long and rises to about one metre off the bottom. The wrecks were inspected and their state reported upon in detail. Four management options are presented.	CSMC
Department of Defence (1988) *RANR Diver Seabed Surveys Cockburn Sound, Western Australia 1986–87, Environmental Working Paper No. 7,* Prepared for the Director General Facilities – Navy by Environmental Management Services, Canberra	To observe the recolonisation of the Minstrel Channel seagrasses and document the stability of the dredge cut; to document the existing conditions in areas which had been affected by development; and to provide a base line for the assessment of environmental impacts.	The survey showed that seagrasses were recolonising the Minstrel Channel, across the Southern Flats. No recolonisation of *Posidonia spp.* has occurred. Little seagrass was found in Careening Bay. The lack of seagrass here contrasts to the extensive meadows along much of the eastern shoreline of Garden Island. Review of aerial photographs shows patchy seagrasses at Careening Bay indicating that the meadows had started to decline before the initial construction commenced for the facilities at HMAS Stirling. The deeper waters of Careening Bay had benthic fauna to the same extent as other silty bottom communities elsewhere in the Sound.	CSMC
Department of Defence (1988) *Overview of Biophysical Environmental Studies, Cockburn Sound Western Australia,* HMAS Stirling Environmental Working Paper No. 4, Prepared for Director	To overview the results of selected biophysical environmental studies of Cockburn Sound; and indicate the scope of research undertaken to document the environmental effects of industrial and port associated developments.	A total of 47 items of literature have been annotated under the headings: meteorology, hydrology and hydrodynamics; coastal processes and shoreline stability; and marine biology. In summary these reports show: • The hydrology of the Sound was not greatly affected by the construction of the Cape Peron to Garden Island causeway. • Under specific meteorological and hydrodynamic conditions there was some reduction in the rate of exchange between Cockburn Sound and the open sea through the southern opening.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page General Facilities – Navy by Environmental Management Services Pty Ltd, Canberra ACT		• The causeway affected the pattern of circulation for some 1500 m from the structure. • On the basis of integraged hydrological investigations seasonal longshore currents were initially proposed as the major force affecting the exchange of water between Cockburn Sound and the open sea, with the wind being the dominant factor. • Wind is believed to be the most important force controlling exchange and the pattern of internal circulation. • Beaches exhibited varying degrees of seasonal change depending on exposure and whether they were dynamically stable. • The causeway had reduced the amount of energy entering the Sound helping to stabilise the shorelines that were shown to have long term erosional trends. • Deterioration in water quality and seagrass extent, and contamination of sediments and organisms occurred prior to the commencement of HMAS Stirling. • The marine ecosystem has been stabilised due to the reduction in the quantities of nutrients discharged into the Sound. • Marine habitats have been identified and work undertaken to describe the fauna. • There have been no systematic studies to show whether industrial and urban pollution has seriously affected commercial and recreational catches. • It appears the development of HMAS Stirling has not had any detrimental effects on ecological aspects of the Sound.	
Environmental Protection Authority (1988) *The Cockburn Sound Environment: Safeguarding a Community Asset,* Bulletin 364, Perth Western Australia	To provide a summary overview of issues affecting Cockburn Sound and the intention to produce an Environmental Management Strategy for Cockburn Sound and its surrounding waters.	Overview of effort and process.	CSMC
Environmental Protection Authority (1988) *Woodman Point Wastewater Treatment Plant Emergency Outfall to Jervoise Bay: Report and recommendations of the Environmental Protection Authority,* Bulletin 356, Perth Western Australia	To provide advice and comment regarding the proposed emergency outfall of wastewater to Jervoise Bay.	The Water Authority of Western Australia has referred to the Environmental Protection Authority a proposal for an emergency wastewater outlet into Jervoise Bay, on the north-east side of Cockburn Sound. The environmental impacts of the proposal are considered relatively minor in terms of the beneficial uses of the receiving environment and preferable to the alternative of overflow of raw sewage into wetlands. The proponent has made a substantial commitment to reporting and monitoring the use of the proposed emergency outfall. In the event of significant problems developing as a consequence of this outlet, the proponent has agreed to conduct additional studies to determine the appropriate length for an extension of the outlet, and then undertake extension. The EPA concludes that the proposed option of an 80 m pipeline into Jervoise Bay is environmentally acceptable and recommends that it could proceed subject to the commitments to reporting and monitoring given by the Water Authority.	CSMC
Searle DJ, Semeniuk V & Woods PJ (1988) 'Geomorphology, stratigraphy and Holocene history of the Rockingham-Becher Plain, South-Western Australia', *Journal of the Royal Society of Western Australia* 70 (4) 89–109	To demonstrate how the Holocene coastal deposits formed on the Rockingham Beacher Plain; To highlight its value as a natural feature of scientific significance.	This article looks at the sedimentary facies, the stratigraphy, age structure and sea level history of the Rockingham-Becher Plain. It also establishes how the Rockingham-Becher Plain was developed through time.	Murdoch University NW L2 J500 R8872 JRSWA

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Brown G (1989) *Rhetoric to Reality: Cockburn Sound and Australia's two-ocean navy* A background paper from the Legislative Research Service Defence Groups	To outline the development of HMAS Stirling, Garden Island, and to outline the strategic issues relating to defence of the western fleet base.	The move to HMAS Stirling needs to be understood in the broader context of Australian defence policy and the chosen military strategy of layered defence. Stirling is not merely a big naval facility on the west coast, it is an important element in overall Defence Force posture.	HMAS Stirlng library SC 359.709941 RHE Special Collection
Environmental Protection Authority (1989) *Further Naval Facility Development at HMAS Stirling, Garden Island, Western Australia: Department of Defence* Bulletin 399 Perth Western Australia	To provide advice following consideration of the public environmental report and the response to public submissions prepared by the Department of Defence.	The Department of Defence proposes to develop additional naval facilities on Garden Island. The EPA's major concerns arising from the proposal relate to the potential for impacts on the water quality and marine ecosystems of Cockburn Sound. Recommendations by the EPA consider TBT accumulation, monitoring and management; seagrass monitoring, beachline erosion and sediment transport; nutrient monitoring program for sewage effluent and groundwater; impact from explosives and sonar; and integration of emergency responses with Kwinana Integrated Emergency Management Scheme.	City of Rockingham.
McDonald, Hales and Associates (1989) 'An archaeological survey of a proposed marina development at Mangles Bay, Rockingham', In *Mangles Bay Marina: Public Environmental Review*, Report No. DMH P15/92, Appendix 7, Perth Western Australia	To conduct and report on an archaeological investigation of a proposed marina development in Mangles Bay, Rockingham.	Due to the high percentage of coverage in this survey, it is not likely that any archaeological evidence could have been overlooked. Lack of archaeological sites in such an area may be due to the poor preservation of the Quindalup Dunes. However, it is unlikely that this area could have been the focus of substantial prehistoric occupation.	CSMC
McDonald, Hales and Associates (1989) 'Report on an ethnographic survey of the Mangles Bay Marina Development', In *Mangles Bay Marina: Public Environmental Review*, Department of Marine and Harbours, Report No. DMH P15/92, Appendix 8, Perth Western Australia	To conduct and report on a survey of Aboriginal sites at Mangles Bay, Rockingham.	The ethnographic survey uncovered the existence of a hitherto unrecorded mythological site concentrated at Rotary Park, and the car park opposite but involving the Mangles Bay beach from the causeway up to the car park beyond Palm Beach.	CSMC
Walker DI, Lukatelich RJ, Bastyan G & McComb AJ (1989) 'Effect of boat moorings on seagrass beds near Perth, Western Australia', *Aquatic Botany* 36: 69-77	To describe the effects of boat moorings on seagrass at Rottnest Island, Warnbro Sound and Cockburn Sound.	A total of 1291 moorings were found in the study. All were situated in dense monospecific seagrass meadows of *Posidonia* or *Amphibolis* spp. Most moorings in Cockburn Sound are situated in Mangles Bay. Of 253 boat moorings in this area, 102 are located outside the seagrass meadow and cause no damage to seagrass. The remaining moorings (151) have resulted in the loss of 1.8 ha of seagrass, which represents ~1.9% of meadow in this area. It seems unlikely that areas scoured of seagrass by moorings will be recolonised by meadow-forming species in the short term.	CSMC
Wells FE & Keesing JK (1989) Reproduction and Feeding in the Abalone *Haliotis roei* Gray	Three platforms in the Perth metropolitan area were selected for examination primarily because they differed in terms of abalone fishing pressures prior to the imposition of the collecting bans.	In the late 1960s, a commercial fishery for the abalone *Haliotis roei* Gray was begun along the central west coast of Western Australia between Cape Leeuwin and Kalbarri. The animals live along the seaward margins of intertidal coastal platforms, with a substantial portion of the catch coming from the Perth metropolitan area. Initially, the Perth fishery was divided into two discrete segments. Professional fishermen were allowed to fish only on the subtidal cliffs at the seaward edge of the platforms. Although amateurs were legally permitted to fish in this area, the great majority collected abalone intertidally on the	CSMC & <www.publish.csiro.au/?act=view_file&file_id=MF9890187.pdf>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	Waterman (31°51' S, 115°45' E) is a fishery reserve established in 1969 and has been subjected to a minimum of fishing pressure. Garden Island (32°14' S, 115˚10' E) supports a professional fishery and is fished only to a minor extent by amateurs.	platform surface. In the early 1980s, increased fishing pressure on the top of the platforms encouraged amateurs to enter the professional fishing areas (J. Penn, personal communication). There were several press and television reports of decreased abalone stocks on the platforms, and at least one clash between a professional fisherman and amateurs resulted in court action. As a result of public pressure, a series of bans on collecting abalone and other platform molluscs in the Perth metropolitan area was introduced in March 1982. To provide information on which to base long-term management programs, a 3-year examination of the fishery biology of *H. roei* was started in November 1982	
1990–1999			
CSIRO (1990) 'Predictions of the hydrodynamic effects of a proposed marina near Rockingham, Cockburn Sound', Report OMR-161 /3, In *Mangles Bay Marina: Public Environmental Review,* Report No. DMH P15/92, Appendix 9, Perth Western Australia	To describe the results of a modelling study into the hydrodynamic effects of a proposed marina, sited at the southern end of Cockburn Sound, WA.	The model was run for a period for 56 hours after which time a steady state was deemed to have been reached. It is evident that the wind-induced currents are rather insignificant compared with those associated with the tidal flow under the Trestle Bridge.	CSMC
Environmental Protection Authority (1990) *The Environmental Impact of Organotin Ant-fouling Paints in Western Australia,* EPA Bulletin No. 447, Perth Western Australia	This report includes information on the impact of organotin on the environment, specifically on marine areas within Western Australia and close to Perth.	Marine fouling is the growth of marine plants and animals that occurs on the hulls of boats. Fouling results in increased drag and therefore increased fuel costs. Anti-fouling paints are applied to the hulls of these vessels to inhibit fouling and function by slowly leaching toxic ingredients into the water that kill marine growth attached to the vessel. However, the leaching of some types of anti-fouling paints can cause elevated concentrations of toxic substances in marine waters resulting in harmful effects to a wide range of marine life. These effects range from physical deformities to interference with reproductive processes and have in the past caused large commercial losses to the aquaculture industry. Since the mid 1960s the most effective and commonly used anti-fouling paint has contained organotin compounds and in particular, tributyltin (TBT).	CSMC & <www.epa.wa.gov.au/template.asp?p=17&area=EIA&Cat=EPA+Bulletins&ID=16&Archives>
Kirkman H & Kuo J (1990) 'Patterns and processes in southern Western Australian seagrasses', *Aquatic Botany* 37:367-382	For 17 and 12 years, respectively, the density and diversity of seagrass cover were described along two transects, 375 and 280 m long, in winter and summer in a temperate Western Australian seagrass meadow. The results indicated that, of the nine species in five genera present, two genera were dominant—*Posidonia* (four species) and *Amphibolis* (two species). Two minor species, *Heterozostera tasmanica* and *Halophila ovalis*, generally increased in cover in summer and were sometimes washed out by winter storms. *Posidonia* meadows changed little in cover	Posidonia and other seagrass genera cover vast areas along the coast of temperate Western Australia, where it seems that disturbance and recolonisation are the dynamic forces which govern the pattern of seagrass beds. Some species of Posidonia may take 60–100 years to cover cleared substratum while species of other genera may come and go within a year. Three case studies of spatially widely separated seagrass beds are given. They illustrate that depth, weather and location make great differences to the extent and diversity of seagrasses. Comments on reproductive ability and observations on seedling growth and vegetative propagation are given with emphasis on the *Posidonia ostenfeldii* complex.	

Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	over the 17 years and in this time the position of the *P. sinuosa* meadow at the lee edges of blowouts did not move. Species tended to grow in monospecific stands but occasional associations between species did occur. Transects through seagrass meadows can be powerful monitoring tools if the limitations to this method are realised and they are used to answer well-defined questions.		
Monk R & Murray F (1990) *Heavy Metal Contamination in the Marine Sediments of the Cockburn Sound Region,* Prepared by School of Biological and Environmental Sciences, Murdoch University, Perth Western Australia	To measure concentrations in the surficial sediment of the range of heavy metals that are known to have entered the area as municipal and industrial wastes during the last thirty years; to compare the above concentrations with the historical values published for Cockburn Sound and Owen Anchorage; and to measure heavy metal concentrations of the sediments in the vicinity of the sewage outfall in Sepia Depression and assess heavy metal enrichment of the sediments by this source.	In general the concentrations of arsenic, cadmium, cobalt, tin and vanadium in the sediments of Cockburn Sound were not significantly higher than those in Warnbro Sound. The low concentration of cadmium in Cockburn Sound sediment indicates that the large quantities of this metal that have entered Cockburn Sound as part of the gypsum waste have not accumulated in the sediment but have dissolved in the water column and been dispersed. The sediment in some areas of Cockburn Sound and Owen Anchorage contains elevated concentrations of chromium, copper, iron, lead, mercury, nickel and zinc as a result of the use of the area as a disposal site for wastes from the Kwinana and Coogee industrial areas and the Woodman Point sewage treatment plant. There has been an eightfold enrichment of mercury and a tenfold enrichment of zinc. This enrichment is not confined to the immediate vicinity of the effluent outfalls. High concentrations of zinc, mercury and nickel were found in the south of Cockburn Sound near Mangles Bay. It is thought that the internal water currents of the Sound have transported particle-bound heavy metals from the outfall sites and subsequently deposited them in areas where the currents are weak. On the basis of a comparison with sediment with heavy metal concentrations in Warnbro Sound basin, Cockburn Sound basin sediments are moderately polluted with lead, mercury and zinc. Heavy metals are not biodegradable. A reduction in the surficial sediment concentration of heavy metals can only be achieved by dilution or dispersal. Due to the protected nature of Cockburn Sound dilution and dispersal of heavy metals are likely to occur very slowly.	CSMC
Pearce RJ (1990) 'Management of Perth's coastal waters and beaches: an ecosystem approach', *Marine Pollution Bulletin* 23: 567–572	In Cockburn Sound (WA), there has been increasing urban and industrial development of the adjacent coast from 1954, and increased inputs of industrial discharges and sewage during the 1960s led to a 97% loss (3300 hectares) of seagrass beds by 1978 (Figure 8). The loss has been attributed to overgrowth by epiphytic algae leading to substantial reductions in ambient light reaching leaf surfaces. The decline in the seagrass coverage was closely correlated with increasing N loadings to the Sound	Seagrasses and marine macroalgae have different C:N:P ratios and changes in the supply of N or P may change conditions to favour the growth of one plant at the expense of others. Because of differences in the supply of a limiting nutrient, increased loading of that nutrient may produce very different responses in different ecosystems. In the case of Port Phillip Bay in Victoria it has been shown that the seagrass, *Herterozostera tasmanica,* has responded positively to N inputs because its growth was limited by N concentrations in the sediment porewater. In contrast, in Westernport Bay, where sediment porewater N concentrations are much higher, the seagrass showed little response to N enrichment.	<http://www.environment.gov.au/coasts/publications/somer/annex2/brodie.html>

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Water Authority of Western Australia (1990) 'Mangles Bay marina: Lake Richmond discharge and water quality data', In *Mangles Bay Marina: Public Environmental Review*, Department of Marine and Harbours, Report No. DMH P15/92, Appendix 5, Perth Western Australia	To prepare discharge estimates for Lake Richmond at Rockingham for the Department of Marine and Harbours.	Lake Richmond is located in Rockingham and is part of the Cooloongup wetland suites on the Quindalup Dunes. It is a permanent freshwater lake. The lake is unspoilt, although it is surrounded by urbanised areas. It forms part of an urban drainage compensating scheme, accepting stormwater runoff from the Rockingham and Safety Bay areas. Lake Richmond discharges to the ocean at Mangles Bay via an outlet drain located at the north-west side of the lake. Outcomes of the study are provided as raw data and are open to interpretation.	CSMC
Dames & Moore (1991) *East Rockingham Industrial Park – Strategic Development Plan,* Prepared for Kwinana Industries Coordinating Committee, Kwinana Western Australia	To formulate a strategic development plan for the IP14 area which would optimise the use of available land by heavy, light and general industry, within the constraints defined by a range of environmental factors, community and public safety concerns, infrastructure requirements and social impact management.	The strategy reviews issues related to: air pollution; light spill; noise; public safety; existing and proposed infrastructure; energy; water supply; sewerage; waste disposal; social impacts; industrial precincts; service corridors; public utilities; road network; passenger railway alignment; buffer zones; foreshore recreation; existing planning controls; proposed planning controls; zoning proposals; landscaping; and administration. Management recommendations are made for all issues.	CITY OF ROCKINGHAM
Environmental Protection Authority and Water Authority of Western Australia (1991) *Protecting Perth's Coastal Waters and Beaches – a plan for doing it better,* Bulletin 511, Perth Western Australia	To present the background, objectives and rationale for the northern and southern metropolitan waters studies.	Provides a brief overview of issues affecting the marine environment of the Perth metropolitan area and introduces the projects underway to investigate the health of these waters.	CSMC
Environmental Protection Authority (1991) *Water Quality in Cockburn Sound – Results of the 1989/90 summer monitoring programme,* Technical Series 47, Perth Western Australia	To present the results of the summer monitoring programme for water quality in Cockburn Sound.	11 sites were monitored between Dec. 1989 and March 1990. The water quality of Cockburn Sound (expressed as mean phytoplankton concentration and mean light attenuation coefficient) has declined significantly since the 1986–87 survey. In 1989–90 phytoplankton levels increased by approximately 59% and light penetration decreased by approximately 10%. The mean nitrogen loading entering Cockburn Sound from the KNC/CSBP outfall during the 1989–90 study increased to 1883 kg/day, a 67% increase from 1986–87. Data suggests that if this trend continues, the water quality of Cockburn Sound will soon return to the poor condition of these waters of the 1970s.	CSMC
Glyde RK (1991) *The Coast Defences of Western Australia 1826–1963* (document deposited with Battye Library by author Q358.16 GLY)	Printed in 1991, this book provides a worthy account of the various coastal defences used in Western Australia from 1826–1963.		
Halpern Glick and Maunsell (1991) 'The implications of contaminant loading and flushing for the proposed Mangles Bay Marina', In *Mangles Bay Marina: Public Environmental Review*, Department of Marine and Harbours, Report No. DMH P15/92, Appendix 4, Perth Western Australia	To provide discussion relating to the expected nutrient budget for the marina and resultant environmental implications.	Cockburn Sound is widely recognised as a eutrophic environment which as suffered from excessive contaminant loading for several decades. The proposed marina will receive extremely high nitrogen loading relative to the wider Cockburn Sound area and tentative permissible levels, due largely to loading from the Lake Richmond Drain. Diversion of this discharge would minimise the likelihood of damage to adjoining seagrass meadows from phytoplankton growth within the marina basin.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Hirschberg KJ (1991) *Inventory of Known and Inferred Point Sources of Groundwater Contamination in the Perth Basin WA: Geological Survey of Western Australia,* Department of Mines, Western Australia	To determine the location and importance of point sources of contamination which may affect groundwater resources in the Perth Basin, and to compile the resultant data in one readily accessible file with a uniform classification system.	This study is an extension of an inventory for Perth metropolitan region, given by Hirschberg (1988).The Perth Basin extends south from near Northampton to Augusta, and from the coast to the Darling Scarp in the east. Within the basin are large resources of fresh groundwater, often at shallow depth. Human activities of a wide variety, e.g. industrial developments, agriculture and domestic waste disposal, result in groundwater contamination which could eventually render at least part of the groundwater resource unusable for human consumption and pose a threat to a healthy environment.	CSMC
Smith RL, Huyer A, Godfrey JS & Church JA (1991) 'The Leeuwin Current off Western Australia', *Journal of Physical Oceanography* 21:813-827	A study of the Leeuwin Current off the WA coast conducted in 1987	The south-east Indian ocean off WA is geographically the analogue of the eastern boundary current regions in the Atlantic and Pacific Oceans. As in these regions, the winds off WA are predominantly equatorward and one might expect to find broad equatorward flow and up welling along the coast.	CSMC & <http://ams.allenpress.com/perlserv/?request=get-abstract&doi=10.1175%2F1520-0485(1991)021%3C0323:TLCOWA%3E2.0.CO%3B2>
Department of Environmental Protection (1992) *Environmental Protection (Swan Coastal Plain Lakes) Policy,* Perth Western Australia	The purpose of this policy is to protect the environmental values of lakes on the Swan Coastal Plain.	The purpose of this policy is to protect the environmental values of lakes on the Swan Coastal Plain. The EPP was gazetted in 1992, together with Miscellaneous Plan No. 1815 which depicted lakes protected under the policy. The EPP made the filling, draining, excavating, polluting and clearing of these lakes an offence unless authorised by the EPA. The policy was subject to a statutory review in 1999. On 23 August 2006 the Minister for the Environment announced to Parliament that he will not approve the revised draft *Environmental Protection (Swan Coastal Plain Wetlands) Policy 2004*. The 1992 Lakes EPP remains in force.	<http://www.epa.wa.gov.au/article.asp?ID=1090&area=Policies&CID=20&Category=Environmental+Protection+Policies+(EPP)>
Department of Marine and Harbours (1992) *Mangles Bay Marina: Public Environmental Review,* Report No. DMH P15/92, Perth Western Australia	To review the environmental impacts and development rationale for a marina in Mangles Bay.	The marina site in Mangles Bay is on the northern side of Rockingham Bank at the southern end of Cockburn Sound. The site is particularly well sheltered and is only exposed to winds and waves of any significance from the north and north-east. The inshore seabed down to a depth of about 5 m is occupied by dense seagrass meadows, predominantly *Posidonia.* The meadow has sustained some damage from swing moorings at the marina site. The major impact will be the loss of about 18.4 hectares of healthy seagrass meadow and 13.7 hectares of patchy meadow which has been damaged by swing moorings. The Steering Committee believes that the advantages to the community of a marina at this site are significant and outweigh the disadvantages of the loss of a small amount of the remaining seagrass in Cockburn Sound.	CSMC
Department of Marine and Harbours (1992) 'Mangles Bay Marina mooring demand analysis', In *Mangles Bay Marina: Public Environmental Review*, Report No. DMH P15/92, Appendix 3, Perth Western Australia	To estimate the demand for moorings in the new marina, including the expected boat size distribution and rate of growth of demand.	The present latent demand is estimated at 226 boats. This will rise to 275 by 1995, when the first pens have been occupied and the latent demand is expected to have been absorbed. The expected increase in pen occupancy is 4% per year. At this rate, the western set of pens will be full to capacity by 2003, and the marina will be fully occupied by permanent pen holders by 2012.	CSMC
Department of Marine and Harbours (1992) 'Selection of the breakwater design wave for Mangles Bay Marina', In *Mangles Bay Marina: Public Environmental Review*, Report No. DMH P15/92, Appendix 4, Perth Western Australia	To review the design requirements of the marina using a numerical model to quantify an inshore swell wave climate, and locally generated wind wave conditions.	A design wave was selected with a height of 1.5 metres and a period of 4.0 seconds. This was considered conservative as the joint probability of maximum offshore and local wave occurrence is low. Also, there will be further attenuation, especially of the offshore wave, at the marina site.	CSMC

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Department of Marine and Harbours (1992) 'Tidal flushing analysis for the proposed Mangles Bay Marina', In *Mangles Bay Marina: Public Environmental Review,* Report No. DMH P15/92, Appendix 11, Perth Western Australia	To estimate the tidal flushing rate for a marina proposal sited in Mangles Bay, Cockburn Sound, using the tidal prism method.	The size of the proposed Mangles Bay Marina is of the same order as Hillarys Boat Harbour, and the potential flushing benefits from secondary forcing parameters are similar. An actual flushing time can therefore be expected to be significantly lower than the predicted flushing time of 7 days. A second marina entrance planned near the causeway will further improve flushing by allowing the existing wind and tidal driven flows under the low level bridge crossing in the causeway to circulate through the marina. It is feasible to assume that the predicted tidal flushing time of 7 days is conservative, and as a result of secondary influences the actual flushing time could be in the order of 1 to 2 days.	CSMC
Environmental Protection Authority (1992) *Development of an Environmental Protection Policy for Air Quality at Kwinana,* Bulletin 644, Perth Western Australia	This policy provides a basis for the establishment of ambient air quality objectives to protect the environment (including human health) in the municipalities of Cockburn, Kwinana and Rockingham.	The Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1992 was approved by the Minister for Environment on 17 July 1992 by order published in the Government Gazette of that date. In brief, this policy provides a basis for the establishment of ambient air quality objectives to protect the environment (including human health) in the municipalities of Cockburn, Kwinana and Rockingham and also provides a mechanism for effective achievement of sulphur dioxide and other objectives within the context of the multi-industry complex at Kwinana	CSMC & <http://www.epa.wa.gov.au/template.asp?p=13&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>
Gales NJ et al (1992) 'Breeding biology and movements of Australian Sealions, *Neophoca cinerea*, off the west coast of Western Australia, *Wildlife Research* 19: 405-416	The Australian sea lion sites located in 1994 were surveyed again in August-September 1995, during a predicted breeding season. In this survey, a total of 284 sea lions was recorded at nine sites in South Australia and one site in Western Australia. This included 90 pups under six months of age, of which 44 were still in lanugo. Overall, we recorded 10 breeding sites and 14 haulout sites.	The Australian sea lion, *Neophoca cinerea,* is the only pinniped species endemic to Australia. Its breeding distribution extends from Houtman Abrolhos (28˚ S, 114˚ E) off the west coast of Western Australia (WA) to The Pages (35˚47' S, 138˚17' E), east of Kangaroo Island in South Australia (SA) (Gales *et al.* 1994). Historically, the range was more extensive and included islands in Bass Strait, those off the north coast of Tasmania and the islands around Albany and Perth in WA (reviewed by Gales *et al.* 1994), and the north and east coasts of Kangaroo Island (Flinders 1814). The Australian sea lion was hunted to extinction in these regions by the early 1800s.	CSMC & <www.publish.csiro.au/?act=view_file&file_id=WR9960741.pdf>
Hillman K & Bastyan G (1992) 'Expected impact of the Mangles Bay Marina on seagrass communities in Cockburn Sound', In *Mangles Bay Marina: Public Environmental Review*, Department of Marine and Harbours Report No. DMH P15/92, Appendix 6, Perth Western Australia	To update and supplement Hillman (1985) on the impact of the proposed Rockingham Marina on seagrass communities in Cockburn Sound. (Unnecessary repetition of the information has therefore been avoided.)	The seagrass mapping exercise carried out during November 1989 for the purposes of this report disclosed that although the main areas of seagrass meadow on Southern Flats and in the waters off the Rockingham shore have remained healthy and unchanged since 1985, there was definite evidence that the eastern fringe of the Southern Flats meadows has been receding. An area classified in 1985 as 'patchy, deteriorating seagrass with mussels and fibre' was almost entirely devoid of seagrass cover in November 1989. It was also found that seagrasses on the eastern and southern fringes of Southern Flats were heavily epiphytised, and those in the main boat mooring area off the Rockingham shore were in poor condition (low percentage cover, and leaves were lying flat and covered with a thick epiphytic scum). The proposed marina site is presently occupied by 20 ha of dense healthy seagrass and 5 ha of patchy, unhealthy seagrass, the main species being *Posidonia sinuosa* and *P. australis.* The proposed development will remove 26 ha of seagrass. The seagrass is unlikely to re-establish within the marina part of the proposed development due to shading by jetties and moored boats and to increased water turbidity associated with boating activity. Adjacent seagrass beds will suffer no long-term deleterious effects, although plant production will decline during site development.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Appleyard SJ (1993) 'Impact of stormwater infiltration basins on groundwater quality, Perth Metropolitan Region, Western Australia', *Environmental Geology* 21(4) 227-236		Twelve bores were sunk adjacent to three stormwater infiltration basins in the Perth metropolitan area to examine the impact of runoff from a light industrial area, a medium-density residential area, and a major arterial road on groundwater quality, and to examine the hydrological response of the aquifer to runoff recharge. Automatic and manual water level monitoring between April and November 1990 indicated that groundwater levels responded within minutes to recharge from the infiltration basins. Peak water levels of up to 2.5 m above rest levels occurred 6–24 hr after the commencement of ponding in the infiltration basins. There was a marked reduction in salinity and increase in dissolved oxygen concentrations in the upper part of the aquifer downgradient of the infiltration basins. Concentrations of toxic metals, nutrients, pesticides, and phenolic compounds in groundwater near the infiltration basins were low and generally well within Australian drinking water guidelines. However, sediment in the base of an infiltration basin draining a major road contained in excess of 3500 ppm of lead. Phthalates, which are US EPA priority pollutants, were detected in all but one bore near the infiltration basins. Their detection may be a sampling artifact, but they may also be derived from the plastic litter that accumulates in the infiltration basins. The concentration of iron in groundwater near the infiltration basins appears to be controlled by dissolved oxygen concentrations, with high iron concentrations occurring where dissolved oxygen concentrations are low. Pumping bores located near infiltration basins may suffer from iron encrustation problems caused by the mixing of shallow, oxygenated groundwater with water containing higher concentrations of iron from deeper in the aquifer.	
Department of Fisheries (1993) *The Impact of Trawling for Saucer Scallops and Western King Prawns on the Benthic Communities in Coastal Waters off South-western Australia,* Fisheries Research Report No. 100, Prepared by Laurenson LJB, Unsworth P, Penn JW & Lenanton RCJ	The impact of trawling for saucer scallops and western king prawns on the benthic communities in coastal waters off south Western Australia.	A 2-year study was undertaken to collect data for the assessment of the impact of the saucer scallop (*Amusium balloti*) and western king prawn (*Penaeus latisulcatus*) fisheries on the benthic communities off south Western Australia. Monitoring of reported commercial landings, on-board sampling of commercial catches, research vessel trawl surveys, experimental and exploratory trawling, and underwater television observations have enabled the development of an extensive database on the fisheries and the benthic community. Concerns about the physical impact of the trawling are apparently unfounded. By-catch effects on the wider community depend very greatly on actual gear used, and vary between zones within the study area. However, there is no evidence that any species of importance to recreational fishing are being overfished.	
Department of Planning and Urban Development (1993) *Metroplan: A Planning Strategy for the Perth Metropolitan Region,* Perth Western Australia		*Metroplan* provides a strategic planning framework for urban growth within the Perth metropolitan region, including b road land use planning guidance for established areas such as Cottesloe. In *Metroplan*, the Cottesloe town centre is designated as a District Centre, consistent with the *Metropolitan Centres Policy*. In subsequent years *Metroplan* has been supplemented by more detailed regional strategies for implementation of this broad direction.	
Environmental Protection Authority (1993) *Baseline Survey of Organic Pollutants in Mussels and Sediments in Perth's Southern Metropolitan Coastal Waters,* Data Report SMCWS ECOL-3, Prepared by Burt JS, Ebell GF & Cunningham DL, Perth Western Australia	To describe the results of a baseline survey conducted in November 1991 to determine the level and distribution of organic contaminants: polychlorinated biphenyls, aliphatic hydrocarbons, polyaromatic hydrocarbons, tributyltin (TBT), organochlorin and organophosphate pesticides.	The concentrations of pesticides and PCBs in the tissue of mussels and in sediment are considerably lower than concentrations in other parts of the world. Pesticides and PCB contaminations are localised to sites in harbours or immediately adjacent to harbours and shipping facilities. The concentration and distribution of hydrocarbons in the tissue of mussels and in sediments are considerably lower than levels detected in the late 1970s and, compared with other parts of the world, are indicative of uncontaminated waters. The distribution of sediment with elevated concentrations of aliphatic hydrocarbons was restricted to harbours and the industrial outfalls on the eastern shelf of Cockburn Sound. The distribution of polyaromatic hydrocarbons in mussels and sediment reflects the direct discharge of hydrocarbons into the Sound from industrial and municipal sources and shipping activity associated with the Kwinana Industrial Area and the Naval facility in Careening Bay.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	To compare these results with past studies to provide an indication of the effectiveness of management measures implemented in response to the recommendations from the Cockburn Sound Environmental Report (1979).	Wide-spread TBT contamination in mussels and sediments was found throughout the study area, with the highest concentrations occurring in boat harbours/marinas or associated with shipping maintenance operations, in Cockburn Sound and Owen Anchorage. The Jervoise Bay Marina exceeds the recommended World Health Organisation health standards for mussel consumption.	
Environmental Protection Authority (1993) *Contaminant Input Inventory of the Southern Metropolitan Coastal Waters of Perth,* Prepared by Martinick & Associates and Mackie Martin & Associates, Perth Western Australia	To estimate the historical contaminant loads, estimate present loads and estimate future contaminant loads to 2021.	A striking feature which emerged from this study is the paucity of information which is available for the preparation of estimates of contaminant loads. The most complete set of available data is that from point source industrial discharges. It is projected that groundwater will constitute the major source of nutrients to Cockburn Sound in future. Annual nitrogen loads to Owen Anchorage are anticipated to decrease from a 1990 value of 137 tonnes to 66 tonnes by 2021. The discharge of heavy metals in treated wastewater to Cockburn Sound was substantially reduced between 1979 and 1990, largely due to improvements in the treatment of industrial wastewater, and to the relocation of the discharge from Woodman Point Wastewater Treatment Plant. Discharges of heavy metals are expected to rise between 199 and 2021, with the bulk of these derived from groundwater. It is estimated that groundwater will contribute 88% of the total annual load of 316 tonnes of nitrogen and more than 90% of heavy metals.	CSMC
Environmental Protection Authority (1993) *A Comparative Survey of Heavy Metals in the Mussel* Mytilus edulis *from Cockburn Sound and Surrounding Waters,* A contribution to the Southern Metropolitan Coastal Waters Study (1991–1994), Technical Series No. 56, Perth Western Australia	To describe the results of a comparative study of the heavy metal concentrations in the tissue of the mussel *Mytilus edulis*, collected from 27 sites in Cockburn Sound and Owen Anchorage (1977 and 1989).	The mean concentrations of Cu, Zn, Cd, Mn, Pb, Cr and Fe in the tissue of *M. edulis* for the entire study area were significantly lower in 1989 compared to 1977. Loadings of Cu and Zn discharged directly into these waters from industries along the shoreline of Owen Anchorage have increased by 10% and 42% respectively since 1977. In 1989 there was no significant difference in mean concentrations of Cu, Zn, Cd, Mn, Cr and Fe between the eastern and western sides of the Sound, reflecting a substantial reduction in loadings of these metals to Cockburn Sound from industrial and municipal point sources along the eastern shoreline. These data support the conclusion that heavy metal contamination of mussels in the marine environment can decrease significantly over relatively short periods if the total loadings of these metals to the system are reduced.	CSMC
Environmental Protection Authority (1993) *Southern Metropolitan Coastal Waters Study – Progress Report,* Technical Series 53, Western Australia	To report on the progress of studies being undertaken for the development of the Southern Metropolitan Coastal Waters Study.	A technical progress report on the studies being undertaken for the development of the Southern Metropolitan Coastal Waters Study being progressed by the Environmental Protection Agency.	
Environmental Protection Authority (1993) *Draft Western Australian Water Quality Guidelines for Fresh and Marine Waters,* Bulletin 711, Perth Western Australia	Draft WA water quality guidelines for marine waters.	Water quality guidelines provide a useful and important tool for environmental management and are essential for managing the effects of toxic materials. But in terms of ecosystem protection, the quality of the water in a waterbody is only an indicator of ecosystem health and should not be considered in isolation of the other components of the ecosystem.	CSMC & <http://www.epa.wa.gov.au/template.asp?p=12&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>
Environmental Protection Authority (1993) *Sustainable Development and the Kwinana Industrial Area: Position paper,* Bulletin 723, Perth Western Australia	The Environmental Protection Authority (EPA) has produced this position paper in order to emphasise its long-term, consistent environmental protection strategy for the Kwinana Industrial Area.	The Environmental Protection Authority (EPA) has produced this position paper in order to emphasise its long-term, consistent environmental protection strategy for the Kwinana Industrial Area, and to reinforce the environmental protection standards that are required of industry. This is timely in view of continuing debate concerning expansion of the industrial capacity and efficiency of the Kwinana Industrial Area. The issues to which these standards related include protection of the Cockburn Sound marine environment, protection of the System 6 areas, air quality, groundwater quality, and environmental risks and hazards.	CSMC & <http://www.epa.wa.gov.au/template.asp?p=12&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>

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Environmental Protection Authority (1993) *Mangles Bay Marina: Report and recommendation of the Environmental Protection Authority,* Proposal submitted by the Department of Marine and Harbours, Bulletin 693, Perth Western Australia	To make recommendations on the proposed development of a marina at Mangles Bay.	The major issue identified by the EPA and raised by the public was the loss of seagrass. It was previously considered that seagrass could be re-established, however current scientific understanding indicates that this optimism may not be justified. Long-term recolonisation with *Posidonia* has not been reported anywhere in the world, and numerous attempts in Cockburn Sound have so far not been very promising. A number of other environmental concerns were also raised, including protection of fish and crab nursery grounds, tidal flushing, nutrient inputs and water quality. These all relate to the issue of seagrass protection, and although many of the issues may be individually manageable, the loss of seagrass is not. The EPA concludes that the proposed marina at Mangles Bay is environmentally unacceptable and should not proceed. In reaching this conclusion, the Authority identified the main environmental factor as the significant impact on the remaining seagrass in the Mangles Bay area and the ecological significance of preserving the small amount of seagrass that remains in Cockburn Sound.	CSMC
Water Authority of Western Australia (1993) *Cockburn Groundwater Area Management Plan,* Report No. WG159, Water Resources Directorate, Groundwater and Environment Branch	To clearly state policies and future plans of the Water Authority of Western Australia for management of the Cockburn Groundwater Area, and to provide information on hydrogeology, land use and monitoring.	The Cockburn Groundwater Area (CGA) was proclaimed in 1988 under the *Rights in Water and Irrigation Act 1914.* The CGA has areas of polluted groundwater which need to be considered in managing groundwater abstraction, but these are principally handled under the pollution control licensing provisions of the *Environmental Protection Act.* Groundwater is used extensively in the CGA which contains the major industrial area of Kwinana, together with major horticultural areas in Lake Coogee and Wattleup, and large areas of urban development. There are also important environmental features which depend on groundwater for sustainability. These are the wetlands, notably the East Beeliar and coastal chains, phreatophytic vegetation and the nearshore coastal strip. No new major allocations will be made in sub-areas which are over-allocated until monitoring has shown that there is no decline of the water table, and there are no adverse water quality trends.	CSMC
Appleyard SJ (1994) *The Discharge of Nitrogen and Phosphorous from Groundwater into Cockburn Sound, Perth Metropolitan Region,* Western Australian Geological Survey Report 1994/39	To interpret and report on the outcomes of groundwater quality sampling programs.	The total mass of nitrogen and phosphorous discharged from groundwater to Cockburn Sound each year is 330$\pm$ 100 and 2 $\pm$ 1 tonnes respectively. Most of the nitrogen is discharged as inorganic species (predominantly ammonia) associated with industrial activity near James Point and industrial activity and a sewage treatment plant near Woodman Point. Phosphorous discharge does not show a clear association with land use. Discharge of nutrients takes place from both the Safety Bay Sand and Tamala Limestone aquifers, with the majority of discharge (~80% of nitrogen) taking place from the Tamala Limestone. It is unlikely that there are large seasonal variations in discharge.	CSMC
Department of Transport (1994) *Cape Peron – Rockingham: Management of siltation at the entrance to the boat ramp basin,* Prepared by the Coastal Investigation and Engineering Services Division, Perth Western Australia	To assess and recommend management measures for the siltation of the Cape Peron boat ramp.	There is a siltation problem at the Cape Peron boat ramps. The beach immediately to the west of the boat ramp basin is accreting, and sand is passing around the groyne on the west side of the entrance and causing siltation problems at the entrance and around the ramps. The construction of the causeway interrupted sand flow from Cape Peron, and sand began to accumulate west of the causeway. Eventually, this beach became saturated and sand started to move into the boat ramp basin. The City of Rockingham added a spur groyne to deflect sand away from the entrance. It is recommended that a single 50 m long groyne at the edge of the seagrass bed approximately 350 m west of the entrance to the boat ramp basin be constructed and the removal of up to 5,000 cubic metres of sand annually be encouraged, by sale to the public or for beach renourishment.	City of Rockingham
Fremantle Ports Authority (1994) Future Port Options Naval Base/Kwinana Future Port Site Study	To identify port, land transport and port related industry land requirements of a future port at Naval Base/ Kwinana.	This study focused on identifying the future development of road and rail infrastructure to provide access to the proposed port, the impact of the proposed port on the road and rail networks, regional planning implications of the port development, land requirements of the port activity related to industrial development, and the impact of port activity on the social and environmental aspects of the adjacent area. It identifies 6 road options for road development from the proposed port to the existing road network.	Fremantle Port Authority

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Dielesen L (1994) *South West Metropolitan Beach Use Survey,* Prepared for South West Groups, Western Australia	To provide a study comparable to one undertaken in 1978. To enhance the Ministry for Planning understanding of the recreational users of the beaches from Leighton to Warnbro.	**Coogee Beach** – Family beach; mostly car transport; mostly Australian/New Zealander; 30–49+ age group most common; most swim; high daily and weekly use; mainly from Cockburn and southern suburbs; visit because close to home; 81% suggested no improvements; 98% did not own a boat. **Woodman Point** – Family beach; mostly car transport; mostly Australian/New Zealander; 30–49 age group most common; most fish; high use all times; mainly from Cockburn and Gosnells; visit because close to home; has good fishing; good facilities or is suitable for families; suggested improvements included more parking, improved maintenance, more shade and rubbish bins; 83% did not own a boat; those that owned a boat went fishing and pleasure boating mostly. **Challenger Beach** – Family beach or visit alone; mostly car transport; mostly Australian/New Zealander; 20–49 age groups most common; most fish, launch a boat or swim; high use all times; mainly from Cockburn; visit because close to home, had become a habit or has good fishing; suggested improvements included improved maintenance, better toilets, more rubbish bins, better traffic control; 77% did not own a boat; those that owned a boat went pleasure boating, water skiing or fishing. **Kwinana Beach** – Family beach; mostly car transport; mostly Australian/New Zealander; 20–49 age group most common; most swim or fish; high use all times; mostly from Kwinana; visit because it's close to home or it's quiet; suggested improvements included more rubbish bins, better toilets and improved maintenance; 85% did not own a boat; those that owned a boat went pleasure boating, fishing or water skiing. **Bell Park** – Meeting place for friends, family beach or visit alone; mostly car transport; mostly Australian/New Zealander; 30–49+ age group most common; most swim or picnic; high use all times; mainly from Rockingham; visit because its close to home, has good facilities, is a good beach or is well sheltered; suggested improvements included better toilets, more picnic facilities, more shade; 98% did not own a boat; those that owned a boat went pleasure boating. **Rockingham** – Family beach, meeting place for friends or visit alone; mostly car transport; mostly Australian/New Zealander; 30–49+ age group most common; most swim; high use at all times but most daily; mainly from Rockingham; visit because it's close to home, has good facilities, is a good beach or is suitable for families; suggested improvements included better toilets, more rubbish bins and better maintenance; 89% did not own a boat; those that owned a boat went pleasure boating. **Palm Beach** – Family beach; mostly car transport; mostly Australian/New Zealander; 20–49+ age groups common; most swim or launch boat; high use all times; mainly from Rockingham; visit because it's close to home, is a personal preference, has good facilities, is a good beach; suggested improvements included better toilets, improved boat ramps, improved maintenance or more shade; 75% did not own a boat; those that owned a boat went pleasure boating, fishing or diving. **Environmental survey:** 60% (2,618) of people believed that environmental problems existed in Cockburn Sound and Warnbro Sound; problems were considered serious but controllable by most; most Rockingham/Kwinana residents felt there should be more recreation use of Cockburn Sound beaches (51%), although 37% considered the balance of recreation and industry good.	CSMC

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Environmental Protection Authority (1994) *Proposed Short-term Continuation of Shellsand Dredging, Success Bank, Owen Anchorage, and Proposed Strategy to Address Long-term Environmental Issues of Shellsand Dredging: Report and recommendations of the Environmental Protection Authority,* Proposal submitted by Cockburn Cement Limited, Bulletin 739, Perth Western Australia	To provide advice and recommendations to the Minister for Environment.	Cockburn Cement proposes to dredge 3.7 million tonnes of shellsand from 67 ha of Success Bank over a two-year period. Of the 67 ha, 17 ha has substantial seagrass coverage. The EPA considers the most important environmental issues to be the potential impacts on seagrass habitat and stability of the submarine banks and shoreline of Owen Anchorage. The EPA has assessed CCL's short-term Consultative Environmental Review and concludes that 50 ha of the 67 ha proposed for dredging of shellsand is environmentally acceptable due to its limited coverage of seagrasses (<25% of seagrass cover). The EPA accepted the 25% cut-off figure as it represents a reasonable compromise between the optimum protection of seagrasses and CCL's Agreement Act with the State.	CSMC
Gales NJ, Shaughnessy PD & Dennis TE (1994) 'Distribution, abundance and breeding cycle of the Australian sea lion *Neophoca cinerea (Mammalia: Pinnipedia), Journal of Zoology* 234 (3): 353–370	Surveys of the Australian sea lion *Neophoca cinerea* were conducted throughout its range in Western and South Australia between December 1987 and February 1992.	Surveys of the Australian sea lion *Neophoca cinerea* were conducted throughout its range in Western and South Australia between December 1987 and February 1992. Almost every island was visited between Houtman Abrolhos and The , many of them more than once. Sea lions breed on at least 50 islands, 27 in Western Australia and 23 in South Australia. Of the 50 breeding sites, 31 have not been reported previously. A further 19 islands may also support breeding colonies. A total of 1,941 pups was counted and pup production was estimated at 2,432. Only five colonies produced more than 100 pups each and they accounted for almost half of the pup production. Most of these colonies are near Kangaroo Island, South Australia. A breeding cycle of 17–18 months has been reported for *N. cinerea* at Kangaroo Island and on the west coast of Western Australia; this was also noted at another 11 islands where repeated visits coincided with breeding. No evidence was found for breeding seasons shorter or longer than 17–18 months. The breeding season was not synchronised between islands, as it is in other pinnipeds. A predictive model is developed to estimate the population size from pup production figures. It indicates that pup numbers should be multiplied by between 3.81 and 4.81 to estimate the total population size just before the pupping season begins. This leads to estimates of 9,300–11,700 for the total population, considerably more than earlier estimates. Causes of the unique reproductive cycle of *N. cinerea* are unknown, but we hypothesise that it results from living in a temperate climate in some of the most biologically depauperate waters of the world. It is also clear that day length and water temperature cannot act as exogenous cues for implantation of the blastocyst; the physiological events of gestation must, rather, be cued endogenously.	No
Walker CJ (1994) 'The effect of size and sediment stabilisation on the survival of seagrass transplants in Owen Anchorage', Honours Thesis, Murdoch University Western Australia	The effect of increasing planting unit size and stabilizing sediment was examined for two seagrass planting methods at Carnac Island, Western Australia, in 1993	The effect of increasing planting unit size and stabilising sediment was examined for two seagrass planting methods at Carnac Island, Western Australia, in 1993. The staple method (sprigs) was used to transplant *Amphibolis griffithii* (J. M. Black) den Hartog and the plug method was used to transplant *A. griffithii* and *Posidonia sinuosa* Cambridge and Kuo. Transplant size was varied by increasing the number of rhizomes incorporated into a staple and increasing the diameter of plugs. Planting units were transplanted into bare sand, back into the original donor seagrass bed, or into a meadow of *Heterozostera tasmanica*, which is an important colonizing species. Sprigs of *A. griffithii* were extracted from a monospecific meadow; tied into bundles of 1, 2, 5, and 10 rhizomes; and planted into unvegetated areas. Half the units were surrounded by plastic mesh and the remainder were unmeshed. All treatments were lost within 99 days after transplanting, and although larger bundles survived better than smaller ones, no significant differences could be attributed to the effects of mesh or sprig size. Plugs of *P. sinuosa* and *A. griffithii* were extracted from monospecific meadows using polyvinyl chloride pipe of three diameters, 5, 10, and	No

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		15 cm, and planted into unvegetated areas nearby. Half the units were surrounded by plastic mesh and the remainder were unmeshed. *Posidonia sinuosa* plugs were also placed within a meadow of *H. tasmanica* (Martens ex Aschers.) den Hartog. Only 60% of *A. griffithii* plug sizes survived 350 days after transplanting back into the donor bed; however, survival of transplants at unvegetated areas varied considerably, and analysis of variance indicated a significant two-way interaction between treatment and plug size. Transplants survived better when meshed (90% survived) and survival improved with increasing plug size. *Posidonia sinuosa* transplants survived poorly (no plugs survived beyond 220 days in bare or meshed treatments) regardless of size. Survival of 10 and 15 cm plugs was markedly better than the 5 cm plugs in vegetated areas, including the *H. tasmanica* meadow. The use of large seagrass plugs may be appropriate for transplantation in high-energy wave environments.	
Waterways Commission (1994) *Harmful Phytoplankton Surveillance in Western Australia,* Report No. 43, Perth Western Australia	To review the presence of harmful phytoplankton in freshwater and marine waters in Western Australia.	Reviews threats to Australia and provides information on work undertaken or underway in broad areas. Cockburn Sound is listed as having at least two *Alexandrium* species. No toxicity has been found in surface mussels from Cockburn Sound but testing has not been comprehensive. The ecotoxicology of *Alexandrium* is poorly understood.	CSMC
Yates A (1994) *Records from the Western Australian State Archives Regarding the Early Nineteenth Century Aboriginal Penal Establishment on Garden Island,* Prepared for Department of Defence, Perth Western Australia	To present historical correspondence regarding the imprisonment of Aboriginals at Garden Island.	Aboriginals were imprisoned on the ship *Champion* in Cockburn Sound at night, and required to work during the day on Garden Island, for a period of approximately one month in 1838. After this time these and other Aboriginal prisoners were detained on Rottnest Island.	HMAS STIRLING
Alan Tingay & Associates (1995) *Rockingham Foreshore Appraisal,* Prepared for City of Rockingham Western Australia	To present an appraisal of the foreshore reserves within the City of Rockingham so that the various foreshore management plans produced to date can be rationalised and outstanding management issues, particularly in the regional context, can be addressed.	The City of Rockingham has 34 km of coastline extending from the Kwinana Industrial Area to Singleton. The Rockingham foreshore has been divided into 11 sectors; three of which abut Cockburn Sound—Industrial Area Sector; Naval Heritage Sector; and City Foreshore Sector. Management issues are identified and discussed, with recommendations and costings for parking, fencing, rehabilitation, access, aesthetic improvements, drainage, landscaping and maintenance. The need for a Rockingham foreshore policy is discussed.	CSMC
Appleyard SJ (1995) 'Investigation of groundwater contamination by fenamiphos and atrazine in a residential area: source and distribution of contamination', *Groundwater Monitoring Review* Fall Edition 110–113	Groundwater in a residential area of Perth, Western Australia, was contaminated with fenamiphos and atrazine, probably as a result of the storage and handling of these chemicals at a residential property	Groundwater in a residential area of Perth, Western Australia, was contaminated with fenamiphos and atrazine, probably as a result of the storage and handling of these chemicals at a residential property. Sampling of existing wells indicated that atrazine and fenamiphos concentrations in groundwater beneath a neighbouring property were 2000 mu g/L and 1000 mu g/L, respectively. Fenamiphos concentrations were sufficiently high to be toxic on prolonged skin contact, and contamination posed a public health threat to nearby residents with private wells. Management of the contamination problem included restricting groundwater use in the area and using a recovery well to pump contaminated groundwater.	No

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Appleyard SJ & Haselgrove KD (1995) *Groundwater Discharge of Nutrients to a Sheltered Marine System: Data Uncertainty and Constraints on Management,* Proceedings of the Australian Systems Conference, Perth Western Australia, Edith Cowan University (ISBN 0-7298-0214-0)	To outline the uncertainties in estimating nutrient fluxes to Cockburn Sound, a sheltered and degraded marine embayment near Perth, Western Australia.	Cockburn Sound has suffered environmental degradation, largely as the result of the input of nutrients from industrial activity near the coast and past sewage disposal. Inputs of nutrients from surface runoff have been mostly eliminated, but persistently high phytoplankton levels indicate that there is probably a continuing input of nutrients from groundwater discharge in excess of the assimilative capacity of the Sound. Analyses of nutrients in groundwater from 39 bores, together with estimates of the rate of groundwater flow from pump tests, suggest that about 330 tonnes of nitrogen and 2 tonnes of phosphorous are discharged each year by groundwater to this water body. This exceeds the estimated assimilative capacity in the Sound of about 300 tonnes per year of nitrogen. Groundwater sampling uncertainties are estimated to cause an error of ± 100 tonnes for nitrogen and ± 1 tonne for phosphorus in the annual groundwater nutrient loads. The monitoring uncertainties cause major difficulties in environmental management of water bodies like Cockburn Sound.	CSMC
Bannister J (1995) *Western Australian Humpback and Right Whales: an increasing success story,* Western Australian Museum, Perth	Humpback and right whales found along the WA coastline	This book tells the story of the two magnificent whales found along the Western Australian coastline—the humpback and the right whale. Both whales were caught close to the coast and were overfished to near extinction.	Book not held ISBN 0 7309 6155 9
Beckwith & Associates Environmental Planning (1995) *Cultural Uses of the Southern Metropolitan Coastal Waters of Perth: a contribution to the southern metropolitan coastal waters study,* Prepared for the Environmental Protection Authority Western Australia	To map existing and future cultural uses of the marine waters from Fremantle to Mandurah including the waters of Cockburn Sound, Owen Anchorage, Shoalwater Bay, Warnbro Sound, Gage Roads and Sepia Depression.	A large number of uses co-exist within Cockburn Sound and Owen Anchorage. It is expected that conflict will increase as population increases. The report presents maps relating to different uses of the water and beaches.	CSMC
Burt JS & Ebell GF (1995) 'Organic pollutants in mussels and sediments of the coastal waters off Perth, Western Australia', *Marine Pollution Bulletin* 30 (11): 723-732	The results of a survey of organic pollutants in the marine sediments and the common mussel, *Mytilus edulis*, from the southern metropolitan coastal waters off Perth are presented.	The results of a survey of organic pollutants in the marine sediments and the common mussel, *Mytilus edulis*, from the southern metropolitan coastal waters off Perth are presented. Organophosphorus and organochlorine pesticides, polychlorinated biphenyls, aliphatic and polycyclic aromatic hydrocarbons and organotin compounds were analysed in surficial (top 20 mm) sediments from 175 sites and in mussel tissue from 35 sites over an area of 500 km^2. Detectable concentrations of pesticides, polychlorinated biphenyls and aliphatic hydrocarbons were recorded at approx. 5% of the sediment sites and 10% of the mussel sites. Contamination was generally confined to areas within or immediately adjacent to shipping facilities and marinas. By contrast, contamination of sediments and mussels with polycyclic aromatic hydrocarbons and organotin compounds, particularly tributyltin, was widespread throughout the study area. Areas of highest contamination occurred in harbours and boat mooring areas and along the eastern side of Cockburn Sound. Comparisons with the results of similar Australian and overseas studies indicate that, in general, sediments and mussels from these waters are not significantly contaminated with pesticides, polychlorinated biphenyls or hydrocarbons. In contrast, elevated concentrations of tributyltin in the sediments and mussels are amongst the highest recorded in Australia and, coupled with the known toxicity of this compound to marine animals, are cause for major concern. The high frequency of imposex in the neogastropod, *Thais orbita*, collected from the study area underlines this concern.	No & link <http://scholar.google.com/scholar?hl=en&cr=countryAU&q=author:%22Burt%22+intitle:%22Organic+pollutants+in+mussels+and+sediments+of+the+...%22+&um=1&ie=UTF-8&oi=scholarr>

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Clapin G & Evans DR (1995) *The Status of the Introduced Marine Fanworm* Sabella spallanzanii *in Western Australia, a preliminary investigation,* Technical Report 2, Prepared by CSIRO, Centre for Research on Introduced Marine Pests, Marmion Western Australia	Large patches of sabellid polychaetes discovered in Cockburn Sound, Western Australia, in 1994 were tentatively identified as *Sabella spallanzanii*.	Large patches of sabellid polychaetes discovered in Cockburn Sound, Western Australia, in 1994 were tentatively identified as *Sabella spallanzanii*, a species reported from Port Phillip Bay, Victoria, where it is spreading rapidly and from Adelaide, South Australia, where it is threatening the local scallop industry. After sampling at 79 sites in WA, *S. spallanzanii* was found in Cockburn Sound and the harbours at Fremantle, Bunbury and Albany. Historical aerial photographs and anecdotal evidence suggest that patches of *S. spallanzanii* had previously been mapped as seagrass beds in the Southern Flats, where worm tubes were found attached to shell fragments, dead seagrass rhizomes, solitary ascidians or anchored into the sediment. In other areas it preferentially attached itself to man-made structures and hull fouling may be an important vector. Destructive control techniques are not useful, as *S. spallanzanii* can regenerate damaged body parts.	<http://scholar.google.com/scholar?q=clapin+g+evans+dr+1995&hl=en&cr=countryAU&um=1&ie=UTF-8&oi=scholart>
Department of Environmental Protection (1995) *Contaminants Inputs Inventory of the Southern Metropolitan Coastal Waters of Perth: An update,* A contribution to the Southern Metropolitan Coastal Waters Study (1991–1994) by Muriale O & Cary JL, Technical Series 72, Perth Western Australia	To revise and update the contaminants inputs inventory of Martinick *et al.* (Environmental Protection Authority 1993) and to determine the nitrogen loads discharged into Cockburn Sound during summer water quality monitoring programs conducted between 1977–78 and 1993–94.	Contaminant inputs into Cockburn Sound from industrial sources have declined significantly since the 1970s whereas contaminant inputs from groundwater have increased and between 1994 and 2021 groundwater will be the major source of nitrogen to Cockburn Sound. The majority of contaminant inputs to Owen Anchorage have declined dramatically since the early 1990s and atmospheric deposition and groundwater will be the major generic sources of contaminants after the late 1990s due to the closure, relocation or connection to sewer of the remaining industries discharging to coastal waters. Ballast water and TBT antifouling paints are the major sources of foreign organisms and contaminants respectively from shipping operations. Contaminant inputs from estuarine discharges have increased significantly since the 1960s and are a major source of nutrients to the southern metropolitan coastal waters of Perth.	CSMC
Environmental Protection Authority (1995) *Shellsand Dredging Project, Owen Anchorage, Proposed Change to Environmental Conditions,* Bulletin 792, Perth Western Australia	In August 1994 the Minister for the Environment approved dredging in the short-term, with further dredging in the medium-term being conditional upon Cockburn developing an acceptable Environmental Management Programme.	Continuation of dredging on Success Bank, Owen Anchorage by Cockburn Cement was assessed by the EPA in May 1994. In August 1994 the Minister for the Environment approved dredging in the short-term, with further dredging in the medium-term being conditional upon Cockburn developing an acceptable Environmental Management Programme.	CSMC & <http://www.epa.wa.gov.au/template.asp?p=10&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>
Environmental Protection Authority (1995) *Advice of Environmental Protection Authority to the Minister for the Environment in Accordance with Ministerial Condition 5-1 for: Short-term continuation of shellsand dredging, Success Bank, Owen Anchorage; and Strategy to address long-term environmental issues of shellsand dredging,* Bulletin 803, Perth Western Australia	The approval addresses access to shellsand in the short-term (approximately 2 years ending in late 1996), medium-term (approximately 5 years ending in late 2001), and long-term.	The Minister for the Environment issued an approval to Cockburn Cement Limited (Cockburn) in August 1994 allowing the continuation of shellsand dredging in Owen Anchorage. The approval addresses access to shellsand in the short-term (approximately 2 years ending in late 1996), medium-term (approximately 5 years ending in late 2001), and long-term.	CSMC & <http://www.epa.wa.gov.au/template.asp?p=10&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Kenderdine S (1995) *Shipwrecks 1656–1942 – A guide to historic wreck sites of Perth,* Department of Maritime Archaeology, Western Australian Maritime Museum, Fremantle Western Australia	To present to the public the wealth of history to be discovered under the sea in the Perth region between Ledge Point and north Mandurah, in the form of historic shipwrecks.	Six historic ship wrecks are located in Cockburn Sound and Owen Anchorage: *James* (1812–1830) – Sunk adjacent to South Fremantle Power Station (32°05.8562'S 115°45.4643'E) *Diana* (1860–1878) – Sunk Owen Anchorage adjacent to South Fremantle Power Station (32°05.9000'S 115°45.4530'E) *Omeo* (1858–1905) – Sunk between Coogee Beach and Catherine Point (32°06.3200'S 115°45.6700'E) *James Matthews* (Unknown–1841) – Sunk near Woodman Point (32°07.9300'S 115°44.6200'E) *Amur* (1862–1887) – Sunk at North Rockingham Beach (32°15.8340'S 115°44.6230'E) *Contest* (1860–1874) – Sunk at Palm Beach, Rockingham (32°16.6000'S 115°43.4900'E)	CSMC
Kirkman H (1995) *Pilot Experiments on Potential Restoration of Seagrass Meadows,* Prepared for Cockburn Cement Ltd, Western Australia	The aim of this study was to investigate characteristics of some south-western Australian seagrasses that might be useful for further investigation with respect to restoration.	The aim of this study was to investigate characteristics of some south-western Australian seagrasses that might be useful for further investigation with respect to restoration. Although seeds and fruits of seagrass species may be useful for producing propagules for planting, their collection is based on knowing when they become available. *Posidonia australis*, *P. angustifolia* and *P. coriacea* flower profusely annually, but *P. sinuosa* does not. Once collected, the fruits dehisce in a few days and are ready for planting. It was found that the best way to plant *Posidonia* seedlings is in clusters in Growool® blocks but the rhizomes do not spread quickly. Single *Posidonia* seedlings, when planted out, were not successful and neither were naturally colonising seedlings of *Posidonia sinuosa* in unexposed unvegetated areas. Successful planting of seedlings and sprigs of *Amphibolis* in matting needs months of calm weather for them to spread out from the matting which must be very securely attached to the substratum. Little success was achieved in growing *Amphibolis*. In a search for *Halophila ovalis* seeds, few were found because of the patchy nature of their fruiting and small size. Germination was slow but 63% germinated within 6 months.	No
Zann LP (1995) *Our Sea, Our Future: Major findings of the State of the Marine Environment Report,* Report for Australian Ocean Rescue 2000 Program	SOMER, the first comprehensive description of Australia's marine environment, human uses and impacts, and management, was produced for the Australian government to provide information for a national marine conservation plan. SOMER was based on 90 commissioned reports by 140 scientists.	SOMER, the first comprehensive description of Australia's marine environment, human uses and impacts, and management, was produced for the Australian government to provide information for a national marine conservation plan. SOMER was based on 90 commissioned reports by 140 scientists. It consists of three Technical Annexes (31 papers); a Technical Summary intended for environmental managers; an overview of the major findings; and an executive summary. SOMER found that Australia's marine environment was of great national and global value. While its condition was rated as 'generally good' (largely because of the large areas of sparsely inhabited coastlines and seas), major problems included declining inshore water quality because of elevated nutrients and sediments; associated declines in estuarine communities and dieback of temperate seagrass, particularly in the south-east and south-west; widespread beach and ocean litter and localised 'hotspots' of heavy metal, hydrocarbon and organochlorine pollution in some metropolitan and industrialised areas; threats to inshore corals; loss of saltmarsh and mangroves on developed coastlines; decline in some fish stocks; effects of trawling on the benthos; introduction of exotic species (particularly toxic dinoflagellates); outbreaks of native species such as crown-of-thorns starfish and *Drupella* snails; and declining marine environments around urban areas. The paper concludes with an evaluation of the achievements and deficiencies of SOMER.	

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
ANZECC (1996) *Best Practice Guidelines for the Provision of Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand,* Australian and New Zealand Environment and Conservation Council	The Guidelines provide information relating to ongoing management, as well as for the planning and establishment of new services and facilities.	The following Guidelines will assist managers of commercial ports, marinas, boat harbours, and administering authorities, to ensure the provision of facilities and services for the reception of wastes from vessels. The Guidelines provide information relating to ongoing management, as well as for the planning and establishment of new services and facilities. The scope of required facilities and services will depend on the types and quantities of wastes carried by visiting vessels and the needs of the operators of those vessels. At large commercial ports, there may be a significant demand for reception facilities that cater for a wide range of shipboard wastes including waste oil and oily mixtures, noxious liquids, sewage and garbage. At small boat harbours, where the normal traffic is limited to recreational and fishing vessels, a solid waste bin and a drum for waste oil may suffice. In all cases, the provision of waste reception facilities should be addressed as part of an overall management plan. Managers of commercial ports may already be familiar with the *Comprehensive Manual on Port Reception Facilities* published by the International Maritime Organization (IMO). These Guidelines are intended to complement and supplement the IMO Manual, by providing 'local' guidance relative to environmental regulatory requirements, standards and practices, and the availability of facilities in Australia and New Zealand. Readers wishing to obtain a more comprehensive coverage of the topic should refer to the IMO Manual and the other reference sources listed in the Guidelines. Preparation of the Guidelines involved extensive consultation with a representative sample of port, marina and boat harbour managers and clients, and other stakeholders. Wherever possible, comments and input from members of these consultative groups was incorporated into the Guidelines	CSMC & <http://www.environment.gov.au/coasts/pollution/dumping/waste-reception/index.html>
Dames & Moore (1996) *Towards Optimising Kwinana – Final Report,* Prepared for Kwinana Industries Coordinating Committee, Kwinana Western Australia	To fully develop the Kwinana Industrial Area's potential as a desirable location for heavy processing industry, with the mission statement 'to build a world class industrial area and a prosperous community… to create space for export industry'.	A structure plan for the Kwinana Industrial Area is presented. Constraints and opportunities were explored to prepare the plan. The study area has been divided into three precincts: Precinct 1: Heavy Industry Policy Areas which are directly adjacent to the coast, west of Rockingham/Patterson Roads. Precinct 2: Support Industry Policy Areas, which are east of Rockingham/Patterson Roads. Precinct 3: Non-industry Policy Areas where industrial development is not supported by the Structure Plan.	CSMC
Department of Commerce and Trade (1996) *Breakwater Extension: Northern Harbour Precinct, Jervoise Bay,* Consultative Environmental Review	This report provides Environmental Protection Authority advice to the Minister for the Environment on the proposal by the Department of Commerce and Trade to extend the existing breakwater in the northern precinct of Jervoise Bay	The Department of Commerce and Trade proposes to extend the existing breakwater in the northern precinct of Jervoise Bay as discussed in the CER document.	CSMC & <http://www.epa.wa.gov.au/template.asp?p=9&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>
Department of Environmental Protection (1996) *The Southern Metropolitan Coastal Waters Study 1991–1994 Final Report,* No. 17, Department of Environmental Protection Perth Western Australia	To develop an understanding of the cumulative impacts and long-term environmental consequences of contaminant inputs to these waters and to facilitate the development of a comprehensive environmental management strategy for the southern metropolitan coastal waters of Perth.	The following major outcomes were achieved: • Quantification of past, current and projected contaminant inputs; • Determination of the current status of the environment; • Establishment of a baseline for the detection of future environmental changes; • A greater understanding of the processes controlling the movement of water-borne contaminants; • A greater understanding of the key ecological processes underlying the relationships between human activities and environmental quality; • Development of draft Environmental Quality Criteria; and • Formulation of actions and recommendations to address existing and potential environmental problems.	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		Total annual nitrogen loading into Perth's wider coastal waters is currently about 6000 tonnes, mostly from ocean disposal of domestic wastewater, from estuarine outflows, and to a lesser extent from groundwater and industrial inputs. The long-term ecological impacts of the project nutrient inputs are unknown and extreme caution should be exercised in considering further proposals involving nutrient discharge to these waters. The current water quality, as measured by chlorophyll a concentrations and light attenuation, of Cockburn Sound is only slightly better than during the late 1970s when the water quality of the Sound was in its poorest recorded state. The presence of a high biomass of epiphytes on the leaves of seagrass in south-west Cockburn Sound, and the chronic high phytoplankton biomass clearly illustrate the eutrophic condition of the Sound. Groundwater now represents 70% of the total external loading of nitrogen to the Sound and about 80% of this load originates from contaminated groundwater under industrial estate. Seagrass dieback in Cockburn Sound has slowed considerably since the early 1970s although some losses are still occurring, particularly in the southern end of the Sound. There is no evidence of *Posidonia* seagrass recovery in the Sound. There has been significant improvement in the nutrient-related water quality of Owen Anchorage since the 1970s when the area was in its poorest recorded state. The water quality declines from about July to September and this appears to be caused mainly by nutrient-enriched outflows from the Swan-Canning Estuary. There have been significant losses of seagrasses on parts of Parmelia and Success Banks since the early 1970s due to shellsand mining operations, smothering by mobile sand sheets and nutrient pollution, particularly on the eastern side of Owen Anchorage. TBT contamination in marine sediments and mussels is widespread with the highest contamination occurring in harbours, marinas and near industrial and naval wharves. Some values are amongst the highest recorded in Australia. The concentrations of most metals have decreased significantly in Cockburn Sound and Owen Anchorage since the late 1970s, mainly as a result of substantial reductions in the discharge of heavy metals from industrial sources. Highest concentrations were found within harbours/ marinas, along the eastern shoreline and the southern half of Cockburn Sound and to a lesser extent along the shoreline of Owen Anchorage. Currently there is no formal integrating management framework for these waters. Instead, environmental management is presently the responsibility of numerous individual agencies operating across four jurisdictions, under provisions ranging from local government by-laws to international treaties. The current situation does not provide the level of integration necessary to ensure the multiple-use of these waters is both socially equitable and ecologically sustainable. Such integration would give due recognition to all the major linkages between land-based activities and coastal water quality and would seek, through agreement between the local, State and Commonwealth governments, to encompass the important natural, spatial and temporal scales of contaminant transport and ecological effect throughout Perth's coastal waters.	
Department of Defence (1996) *Review of the Impact of the Garden Island Causeway on the Cockburn Sound WA Environment,* HMAS Stirling Environmental Working Paper No. 8, Prepared by FL Wilkinson & Associates Western Australia	To re-investigate the possible effects of the Garden Island Causeway WA on the Cockburn Sound physical and biological environment and specifically whether it is a major contributing factor to pollution of Cockburn Sound.	The hydrodynamic conditions that are of concern to the general marine environmental health of the Sound occur during periods of low flow when there may be a concentration of pollutants entering the Sound. All studies show that in these circumstances the current magnitude and directions and the exchange of water between the Indian Ocean and Cockburn Sound is virtually unchanged by the construction of the Causeway, except to the areas within 1500 metres of the Causeway. The environmental management measures implemented by the WA Government have resulted in a large reduction in the nutrient load entering Cockburn Sound resulting in improved quality and clarity of the Sound's waters. These improvements in the water quality have been accompanied by a halt in the dieback of seagrass and some regeneration of seagrass meadows. This is a clear indication it was the industry based nutrients rather than the causeway construction that had the greatest influence on the pollution problem.	CSMC

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Environmental Protection Authority (1996) *Breakwater Extension, Northern HarbourPrecinct, Jervoise Bay,* Bulletin 836, Perth Western Australia	This report provides Environmental Protection Authority advice to the Minister for the Environment on the proposal by the Department of Commerce and Trade to extend the existing breakwater in the northern precinct of Jervoise Bay.	The Department of Commerce and Trade proposes to extend the existing breakwater in the northern precinct of Jervoise Bay as discussed in the CER document.	CSMC & <http://www.epa.wa.gov.au/template.asp?p=9&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>
Environmental Protection Authority (1996) *Short-term Shellsand Dredging, Success Bank, Owen Anchorage,* Bulletin 833, Perth Western Australia	This report is to provide Environmental Protection Authority advice to the Minister for the Environment on the proposal by Cockburn Cement to mine shellsand from Success Bank as set out in CCL's Consultative Environmental Review dated January 1994.	The proposal is to mine 3.7 million tonnes of unconsolidated shellsand from a 67 ha area of Success Bank over the two-year period 1994–96.	CSMC & <http://www.epa.wa.gov.au/template.asp?p=9&area=EIA&Cat=EPA+Bulletins&ID=16&Archives=1>
Fisheries Western Australia (1996) *Aspects of the Biology and Stock Assessment of the Whitebait* Hyperlophus vittatus*, in South western Australia,* Fisheries Report No. 108, Prepared by Gaughan DJ, Fletcher WF, Tregonning RJ & Goh J, Perth Western Australia	The biology, distribution and stock size of whitebait along the lower west coast of Western Australia were studied between 1991 and 1994. Age, growth and reproductive biology of whitebait were investigated using samples collected from the commercial fishery. The distribution of adult whitebait and their main spawning times were determined using data on eggs that were caught in plankton samples. Aspects of the population dynamics of whitebait were investigated by examining the relationships of historical catch data with fishing effort and some environmental parameters.	Whitebait are a small species with most growth occurring in the first year ($K = 1.52$, $T_o = 0.042$ and $L_\infty = 100$). They are also a short-lived species, having a maximum age of three or four year and an estimated natural mortality rate of 1.5. The catch of whitebait from the Swan River estuary, Warnbro Sound and Bunbury predominantly consists of fish less than two years old, while the catch from Mandurah is mainly fish less than one year old. First spawning by whitebait occurs when they are 65–80 mm in length and at an age of about one year. Whitebait are batch spawners, with females producing 750–3500 eggs every three to five days during the peak of the spawning season. Plankton samples indicated that whitebait predominantly spawn from May to August (i.e. winter) with a peak in June and July. The distribution of eggs showed that populations of adults occur along the entire coast between Fremantle and Bunbury and that whitebait do not normally extend very far offshore, with the bulk of eggs occurring within 10 km of the coast. Even within this region, the numbers of eggs found were not usually large and were highly variable, indicative of a small, patchy stock. The plankton data obtained in July 1994 indicated that the spawning biomass was likely to be less than 1000 t. Since populations of whitebait in the study region are not large and are apparently restricted to the nearshore waters, and the bulk of the population consists of only two year classes, they are likely to have little resilience to increases in fishing pressure. Annual catches of whitebait have been strongly influenced by environmental factors. In particular, there was a strong, positive relationship between the annual catch of whitebait and the strength of the Leeuwin Current in the previous year. There was also a relationship between annual catch in some regions and the strength of the Leeuwin Current in the previous two years. Although a direct effect of the Leeuwin Current on whitebait has not been established, the lag period in the relationship suggests that it is likely that this current influences recruitment success. Interannual variations in the strength of the Leeuwin Current may also affect the behaviour of whitebait (e.g. movements within an area) and therefore their catchability. Recommendations for the sustainability of the whitebait resource along the lower west coast of Western Australia are provided.	<http://www.fish.wa.gov.au/docs/frr/frr108/index.php?0401>
Goodale B (1996) *Lake Richmond Conservation Reserve, Karnup Nature Reserve, Baldivis Nature Reserve Draft Management Plan,* Prepared for the City of Rockingham, Western Australia	To formalise the Kwinana/Rockingham/ Mandurah Branch of the WA Naturalists' Club activities in managing flora and fauna reserves on behalf of the community and the City of Rockingham.	(This summary will only refer to Lake Richmond) Lake Richmond is a perennial freshwater lake situated in Rockingham. The water area covers approx. 40 ha and has been measured at 15 m deep in the centre. A marine relic and once part of a southern extension of Cockburn Sound, stromatolitic structures ring the lake. Specific management objectives are presented and protective measures recommended in regard to fencing, pest eradication, weed management, feral animals, fire, rehabilitation and maintenance, public use, upgrading and improvements, monitoring and evaluation and funding.	City of Rockingham

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Hegge B, Eliot I, Hsu J (1996) 'Sheltered sandy beaches of southwestern Australia', *Journal of Coastal Research* 12:748-760	Morphodynamic classifications of sandy beaches have been established for open-ocean, wave-dominated environments. However, many natural sandy beaches exist in embayments, or are landward of protective reefs, where they are sheltered from the full effects of ocean waves.	Morphodynamic classifications of sandy beaches have been established for open-ocean, wave-dominated environments. However, many natural sandy beaches exist in embayments, or are landward of protective reefs, where they are sheltered from the full effects of ocean waves. It is therefore appropriate to question whether such low-energy beaches can be related to conceptual models of beach hierarchies, and to examine whether they have identifiable morphodynamic signatures. Surveys were conducted of the nearshore morphology and dynamics on over fifty beaches on the microtidal coast of south Western Australia, between Cape Arid on the south and Geraldton on the west coast. In most instances, surveys were conducted on beaches that were sheltered by their aspect and/or the presence of offshore reefs. The remaining surveys were conducted on wave-dominated beaches in order to provide a link to the existing morphodynamic models. Descriptions of beach morphology, determined from the surveys, were subjected to a cluster analysis to establish groupings of similar morphologic types. This analysis provided a sixfold classification of beach morphologies and indicated a clear separation between the low- and high-energy beach morphologies on the basis of the overall scale of the nearshore profiles. Four low-energy morphotypes were distinguished. These are essentially planar and characterised by the absence of nearshore bars or other rhythmic features. However, the low-energy morphotypes may be discriminated by variations in beach slope and curvature. Canonical variate analysis was conducted to examine the discrimination of the six morphotypes on the basis of their sedimentary and dynamic characteristics. This analysis indicated consistent sedimentologic differences between the morphotypes, despite moderate overlapping between several of the beach forms. The variation accords with expectations that flatter beaches tend to have finer sediments. Discrimination between the morphotypes on the basis of their dynamic variables was less revealing. This raises questions of misfitting between form and process during the surveys and may indicate the importance of storm events in the formation of these low-energy morphotypes.	No
Lemmens JWTJ, Clapin G, Lavery P & Cary J (1996) 'Filtering capacity of seagrass meadows and other habitats of Cockburn Sound, Western Australia', *Marine Ecology Progress Series* 143: 187-200	Suspension-feeders are a large component of coastal marine ecosystems, both in terms of biomass and numbers. The term 'suspension-feeder' refers to organisms that feed opportunistically on particles suspended in the water; 'filter-feeders' refers to organisms that gather food through filtering of the water column.	Macro-suspension-feeders (predominantly ascidians, sponges, bivalves) and epifaunal suspension-feeders (hydroids, spirorbids, bryozoans, barnacles, amphipods) in Posidonia meadows of Cockburn Sound, Western Australia, demonstrate a clear spatial distribution. Although this may be due to a number of environmental variables, this compares well with spatial patterns in phytoplankton levels, which are relatively high in Cockburn Sound (0.94 to 2.66 g chlorophyll a l-') and are generally highest at the south-eastern boundary. Macro-suspension-feeder biomass was high in Posidonia meadows (28.6 to 41.3 g AFDW m-2 at the south-eastern boundary, 9.6 to 15.4 g AFDW m-' at other sites) and generally lower in bare sediment(0.2t o 9.3 g AFDW m-2), although on bare sediment of the Southern Flats (a site in the south-west) the introduced polychaete *Sabella spallanzanii* reaches considerable biomass (458.9 g AFDW m-'). Heterozostera (1.2 g AFDW m2) and Amphibolis meadows (2.3 g AFDW m-') were found at only 1 site each, but appear to support a low biomass of macro-suspension-feeders. Epifaunal suspension-feeders on Posidonia leaves (hydroids, bryozoans, spirorbids, barnacles, corophiid amphipods) reached a substantial biomass (2.3 × 10b feeding units m-' at the south-eastern site; 0.6 to 0.7 × 106 units at other sites; 'feeding units' refers to individual polyps, zooids, etc.). Amphibolis leaves supported similar numbers of epifaunal suspension-feeders (0.7 × 106 units m-') but Heterozostera supported far lower numbers (80 × 103 units m-'). Initial estimates indicate that the suspension-feeding assemblages associated with Posidonia and Amphibolis meadows in Cockburn Sound are potentially able to filter the overlying water column daily, and may partially control local densities of suspended organic matter.	CSMC & <http://scholar.google.com/scholar?q=clapin+g+1994+spatial+distribution+and+biomass+of+macro+filter+feeders+in+seagrass+communities+of+cockburn+sound&hl=en&cr=countryAU&um=1&ie=UTF-8&oi=scholart>

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Quilty Environmental (1996) *Garden Island Causeway Sand Stabilisation,* Prepared for the Department of Defence, Perth Western Australia	To determine options for remedying the problem of sand drift across the island access road, to identify a preferred option, and to indicate a schedule and cost for implementing preferred option.	The area under investigation extends along the southern edge of the causeway at Garden Island. The area is approximately 800 m long and of varying widths.	HMAS Stirling Environment Office
Cambridge ML & Hocking PJ (1997) 'Annual primary production and nutrient dynamics of the seagrasses *Posidonia sinuosa* and *Posidonia australis* in south-western Australia', *Aquatic Botany* 59:277-295	Above-ground primary production and nutrient fluxes (N and P) were investigated for two species of seagrass, *Posidonia sinuosa* Cambridge et Kuo and *P. australis* Hook. f. from Warnbro and Cockburn Sounds over an annual cycle, at sites ranging in depth from 0.5–10 m where *P. sinuosa* formed either single-species stands or co-occurred with *P. australis*.	Above-ground primary production and nutrient fluxes (N and P) were investigated for two species of seagrass, *Posidonia sinuosa* Cambridge et Kuo and *P. australis* Hook. f. from Warnbro and Cockburn Sounds over an annual cycle, at sites ranging in depth from 0.5–10 m where *P. sinuosa* formed either single-species stands or co-occurred with *P. australis*. Annual leaf primary production ranged from 600 to 900 g m^{-2} yr^{-1} in *P. sinuosa* and 900–1100 g m^{-2} yr^{-1} in *P. australis*, and epiphytes on the leaves produced 130–160 g m^{-2} yr^{-1}. In some patches, flowering shoots and fruits also made a substantial contribution, up to 160 g m^{-2} yr^{-1}. Annual above-ground productivity (dry weight production per unit ground area) of *Posidonia* spp. (600–1300 g m^{-2} yr^{-1}) is similar to that of *Amphibolis antarctica* (Labill.) Sonder et Aschers. ex Aschers. and *A. griffithii* (Black) den Hartog, two species from the other genus of large seagrasses in south-western Australia, but only 30 to 50% of that of the kelp *Ecklonia radiata* (C. Ag.) J. Agardh. (3500 g m^{-2} yr^{-1}). Nitrogen and phosphorus incorporated annually into new leaf tissue ranged from 9–17 g N and 1.1–1.7 g P m^{-2} yr^{-1}, respectively, depending on species and site. Estimates of annual nutrient losses via leaf detritus ranged from 5–9 g N and 0.4–0.7 g P m^{-2} yr^{-1}, compared to maximum losses of 1.2 g N and 0.4 g P m^{-2} yr^{-1} via the fruits at the highest density of flowering shoots (223 m^{-2}). Thus, annual nutrient losses via leaf detritus represent a considerable proportion of the nutrients incorporated annually into new growth, indicating a lower degree of nutrient conservation than might be expected in a low nutrient environment.	
Department of Commerce and Trade (1997) *Industrial Infrastructure and Harbour Development, Jervoise Bay,* Public Environmental Review	To overcome a lack of maritime infrastructure supporting the offshore oil and gas industry in Western Australia, the Department of Commerce and Trade (DCT) has planned the Industrial Infrastructure and Harbour Development at Jervoise Bay Southern Harbour. DCT, in association with LandCorp.	To overcome a lack of maritime infrastructure supporting the offshore oil and gas industry in Western Australia, the Department of Commerce and Trade (DCT) has planned the Industrial Infrastructure and Harbour Development at Jervoise Bay Southern Harbour. DCT, in association with LandCorp.	No
Dunlop JN (1997) 'The foraging range, marine habitat, and diet of bridled terns breeding in Western Australia', *Corella* 21:107–112	The dietary information collected from this and other studies indicate that Bridled Terns forage over rafts of Sargassum and other flotsam particularly in the latter stages of the breeding season. This habit may distinguish the foraging ecology of Bridled Terns from that of other sympatric species. The availability of Sargassum rafts and flotsam in the marine environment may be a key factor influencing the Bridled Terns' breeding and wintering distribution.	Bridled Terns breeding in Western Australia foraged over mid and outer Continental Shelf waters within about 70 km of their colonies. The diet of birds breeding on Penguin Island in south-western Australia consisted of a variety of small marine organisms including fishes, crustacea and cephalopods and also winged terrestrial insects. The most important marine prey were mullid (goatfish) larvae, shoaling clupeids and Columbus Crab megalopae. The dietary information collected from this and other studies indicate that Bridled Terns forage over rafts of Sargassum and other flotsam particularly in the latter stages of the breeding season. This habit may distinguish the foraging ecology of Bridled Terns from that of other sympatric species. The availability of Sargassum rafts and flotsam in the marine environment may be a key factor influencing the Bridled Terns' breeding and wintering distribution.	No

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Government of Western Australia (1997) *Wetlands Conservation Policy for Western Australia,* Perth, Western Australia	To present government policy on the protection of wetlands in Western Australia.	The Government of Western Australia is committed to identifying, maintaining and managing the State's wetland resource, including the full range of wetland values, for the long-term benefit of the people of Western Australia.	CSMC
Halpern Glick & Maunsell (1997) *Industrial Infrastructure and Harbour Development Jervois Bay – Public Environmental Review,* Prepared for the Department of Commerce and Trade in association with LandCorp and Main Roads WA, Perth Western Australia	To describe the proposed development, identify the key environmental and social issues, assess the potential for impacts and detail strategies for the management of such impacts.	Over the past two decades the offshore oil and gas industry in Western Australia has grown into a mature, world class industry. Unfortunately, a lack of supporting maritime infrastructure is a primary reason for much of the associated fabrication, construction and fit-out work being sourced overseas. Recognising this, the Department of Commerce and Trade has planned the Industrial Infrastructure and Harbour Development at Jervoise Bay as the centrepiece of its oil and gas infrastructure program. The layout of the Southern Harbour has been developed on the basis of land use, engineering, environmental and operational constraints. The breakwater layout provides essential wave protection and safe navigability while delivering environmentally acceptable harbour flushing times. The potential impacts of the development have been assessed within their marine and terrestrial aspects. Identified marine related impacts include: habitat, hydrodynamics, water quality, turbidity, coastal stability, contaminant input from vessels and harbour operations. Terrestrial related impacts include: Management of System 6 Areas, landform preservation, fauna, flora, vegetation, wetlands. Heritage, and noise, dust and vibration. Proposed management actions are presented for each impact.	CSMC
Helleren SKR & John J (1997) *Phytoplankton and Zooplankton Dynamics in the Southern Metropolitan Coastal Waters, Perth,* School of Environmental Biology, Curtin University of Technology, Perth Western Australia	To investigate the structure and species composition of phytoplankton and zooplankton communities in relation to physical and chemical parameters in Cockburn Sound and Warnbro Sound by fortnightly sampling August 1992 to August 1994.	Diatoms, dinoflagellates, chrysophyets and cyanobacteria were the dominant groups of phytoplankton. The massive dominance of silicoflagellates during winter and spring is identified as a recent phenomenon not reported in any other temperate coastal waters of Australia. Phytoplankton biomass, measured by cell count and chlorophyll a was two and a half times higher in Cockburn Sound than in Warnbro Sound, and greater than that reported for comparable temperate coastal waters elsewhere in Australia. Copepods were the most abundant and diverse group of zooplankton, the other common groups being gladocerans and protozoans. Zooplankton abundance in Cockburn Sound was more than twice that of Warnbro Sound. Planktonic eggs and larvae showed similar trends. Copepods, cladocerans and radiolarians were identified as the major potential grazers of phytoplankton. There was significant correlation between zooplankton and phytoplankton populations.	CSMC
Kirkman, H. 1997, *Seagrasses of Australia*, Australia: State of the Environment Technical Paper Series (Estuaries and the Sea), Department of the Environment, Canberra.	Development of heavy industries and the discharge of industrial waste into Cockburn Sound commenced in the 1950s. By 1969 there were widespread losses of seagrasses, and by 1978, 97% of the original 34 sq km of seagrass had been lost (Cambridge & McComb 1984). Examination of the many possible causes showed that increased nutrient loading from effluent had given rise to an explosion in epiphytic growth. As a consequence, there was an overall 63% reduction in light reaching seagrasses in declining meadows. Controls on effluent input have helped to arrest the decline but there is little evidence of regrowth.	This paper describes the nature of seagrasses and explains their importance in the marine environment and their relationships with other marine habitats. The body of the paper is split into three parts: the **state** of seagrasses in Australia; the **pressures** that are put on seagrass habitats by people and nature; and the **response** that people can make to preserve and restore seagrass meadows. The extent, diversity and abundance of seagrasses are described for separate regions in Australia. There are about 51 000 sq km of seagrass meadow in Australia. The damage to and loss of seagrass meadows in Australia is recorded, and the way that this decline has occurred is described with examples from various places. People's activities have caused the loss of about 450 sq km and natural events have caused damage to the extent of 1000 sq km in the past ten years. Any recovery from these pressures is described. An issue is made of the poor recovery of many temperate seagrass meadows and some tropical ones. The vulnerability of seagrass meadows is pointed out and the importance of considering their ability to recover after being damaged is emphasised. The ecological values of seagrass meadows should be estimated on a case by case basis as species differ in their abilities to support faunal communities and provide the other values for which they are respected. It is apparent throughout this paper that more research needs to be carried out just to be able to record losses. Mapping, inventories of diversity and abundance and background data on seagrasses need to be collected. Further research on ameliorating damage to seagrass meadows and accelerating the restoration processes needs to be properly funded and carried out. The legislation drawn up to protect seagrass habitats, relevant to each State, is listed. Finally, some recommendations as to further research and ways that seagrass meadows can be preserved are presented.	CSMC & <www.environment.gov.au/soe/1996/publications/technical/pubs/seagrass.pdf>

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DA Lord and Associates (1998) *Historical Review of Water Quality in Cockburn Sound,* Prepared for Kwinana Industries Council, Report No. 97/052/1	To examine historical changes in water quality at each site, and in the overall water quality in Cockburn Sound, particularly changes in spatial patterns of high concentrations of inorganic nutrients and chlorophyll a.	Water quality monitoring has been carried out at irregular intervals from 1982–3 to 1996–7. Some data on chlorophyll a levels and light attenuation from the same sites are available from the late 1970s to 1981. Overall water quality in Cockburn Sound, in terms of dissolved oxygen levels, attenuation coefficients and inorganic nutrient concentrations in the 1996–7 survey was similar to or better than in the mid 1980s. Overall chlorophyll a levels in 1996–7 remained slightly higher than in the mid 1980s. Spatial patterns of areas of poor water quality have changed since the 1970s and 1980s, when the CSBP/KNC outfall was clearly implicated as the major source of nitrogen inputs to the Sound. The most recent data show that the Jervoise Bay area now has the poorest water quality in Cockburn Sound, but it is unclear whether this is largely due to increasing inputs of nitrogen from groundwater; or restricted flushing of the area by oceanic waters. There is a clear need to establish an agreed sampling protocol for future water quality surveys in Cockburn Sound.	CSMC
Environmental Protection Authority (1998) *Results of a Cumulative Impact Study to Provide Strategic Environmental Advice on the Marine Environment of Cockburn Sound,* Bulletin 907, Perth Western Australia	The purpose of this report is to provide the Environmental Protection Authority's strategic environmental assessment and advice to the Minister for the Environment in relation to the cumulative impact of infrastructure proposals on Cockburn Sound.	The Sound receives waste inputs from point and diffuse sources. The development of industry and port facilities on the coastal strip and the intensification of land uses in the surrounding catchments during the past fifty years have generated waste inputs into Cockburn Sound. By the late 1970s these wastes had degraded water quality which in turn had resulted in major habitat loss and contamination of biota, sediments and water in the Sound.	CSMC & <http://www.epa.wa.gov.au/template.asp?area=EIA&ID=16&Cat=EPA+Bulletins&archives=1>
Environmental Protection Authority (1998) *The Marine Environment of Cockburn Sound – Strategic Environmental Advice,* Strategic Environmental Advice to the Minister for the Environment from the Environmental Protection Authority, Bulletin 907, Perth Western Australia	To provide the Environmental Protection Authority's strategic environmental assessment and advice to the Minister for the Environment in relation to the cumulative impact of infrastructure proposals on Cockburn Sound. This advice is provided in accordance with section 16 (e) of the *Environmental Protection Act 1986.*	Recommends to the Minister for the Environment that: • The advice be adopted as a guide for considering cumulative impact issues in the marine environment of Cockburn Sound; • The issues raised in the advice be addressed by proponents during planning and design of their proposals and by government during the decision-making process; • The government commit to an ongoing program of research and investigation in Cockburn Sound to assist in broad decision-making; • The EPA provide a report outlining an ongoing program of management-oriented research and investigation. • The government establish a management structure including representatives of government and community sectors, to coordinate environmental management within Perth's marine coastal waters, including Cockburn Sound, and between these waters and their catchments.	CSMC
Environmental Protection Authority (1998) *Industrial Infrastructure and Harbour Development, Jervoise Bay,* Report and Recommendations of the Environmental Protection Authority, Bulletin 908, Perth Western Australia	To report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented.	Recommends to the Minister for the Environment that: • The report on the relevant environmental factors of marine flora, marine fauna, landform, shoreline, seabed, vegetation communities, terrestrial fauna, wetlands, marine water quality, public health and safety, noise and vibration, dust and particulates, heritage and recreation be considered. • It be noted that chlorophyll a levels are above the nutrient related environmental quality criteria set out in the Southern Metropolitan Coastal Waters Study and the impact of the proposal is likely to lead to a further increase in these levels. • It be noted that the proposal will further reduce seagrass abundance and potential habitat and that the proposal is not able to be managed to meet the EPA's objectives. • A management structure be established, including representatives of government, business and community sectors, to coordinate environmental management within Perth's marine coastal waters, including Cockburn Sound.	CSMC

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Environmental Protection Authority (1998) *Kwinana Ammonia Project, Kwinana Industrial Area: Report and recommendations of the Environmental Protection Authority,* Proposal submitted by Wesfarmers CSBP Limited, Bulletin 882, Perth Western Australia	To report to the Minister for the Environment on the environmental factors relevant to the proposal to construct and operate a 650 tonne per day (tpd) ammonia plant, and on the conditions and procedures to which the proposal should be subject, if implemented.	The EPA has concluded, on the basis of the information available, that the proposal by CSBP to construct and operate the new ammonia plant to replace its existing plant at Kwinana can be managed in an environmentally acceptable manner. The EPA has also concluded that, in comparison with the existing ammonia plant, the proposal represents an overall improvement with respect to public safety and environmental performance.	CSMC
Environmental Protection Authority (1998) *Medium-term Shellsand Dredging, Success Bank, Owen Anchorage,* Report and Recommendations of the Environmental Protection Authority, Bulletin 901, Perth Western Australia	Through this report the EPA provides its advice and recommendations to the Minister for the Environment on the environmental factors relevant to the impact of the Cockburn Cement proposal to dredge shellsand within the medium term area of Success Bank.	Cockburn Cement Limited has proposed to continue shellsand dredging of the medium-term area on Success Bank, Owen Anchorage over the period 1997 to approximately the end of 2002. Shellsand of high quality is used by the company for the manufacture of quicklime and cement products.	CSMC
Environmental Protection Authority (1998) *Draft Environmental Protection (State Marine Waters) Policy,* Environmental Protection Authority, Western Australia	The draft EPP was released for public comment in 1998, and further development is anticipated following the approval of recent amendments to the *Environmental Protection Act 1986.*	The Western Australian coastline is some 12, 500 kilometres long—one of the longest state or provincial coastlines in the world—and embodies a wide range of special environments. These include the bold, red pindan coastlines of the Pilbara; the offshore island retreats of Rottnest, the Abrolhos and the Dampier Archipelago; the coral reefs, rock platforms and broad, white sandy beaches of the metropolitan area; the tropical mangroves, mudflats and wide river estuaries of the Kimberley coast; and the conspicuous limestone and granite cliffs of the south-west. The draft EPP was released for public comment in 1998, and further development is anticipated following the approval of recent amendments to the *Environmental Protection Act 1986*	CSMC
Environmental Protection Authority (1998) *Draft Seagrass Habitat Protection: Guidance for the assessment of environmental factors* No. 22, Perth Western Australia	To maintain the ecological integrity and biodiversity of marine ecosystems of Western Australia.	By world standards, Australia has the most extensive seagrass beds with a high degree of endemism. Approximately 18 species of all known seagrasses are endemic in Australia. The main biological and physical functions of seagrass include: provision of food for diverse marine fauna and fish; provision of habitat and protection for diverse marine fauna and fish; accumulation of calcium carbonate sediment; stabilisation of sediments; and baffling the effects of waves and currents. The EPA places great importance on protecting seagrass habitats and expects that proponents will conduct a thorough appraisal of all options that would avoid affecting these communities before presenting a proposal for evaluation that would involve the direct or indirect loss of these key ecosystem components.	CSMC
Hercock M (1998) *The Relationship between Public Policy and the Environment of Four Western Australian Offshore Islands: a legacy of resource use and perception,* PhD Thesis, University of Western Australia	The apparently unresolvable differences between managing national defence and local conservation, public recreation, and scientific research can be overcome through an advisory committee, with a strong and dedicated entity to drive the processes of governance and change.	The apparently unresolvable differences between managing national defence and local conservation, public recreation, and scientific research can be overcome through an advisory committee, with a strong and dedicated entity to drive the processes of governance and change. The case of the Garden Island Environmental Advisory Committee shows how the organisational and political difficulties of integrating State interests and Commonwealth concerns were met. Garden Island, off the coast of Perth, the capital of the State of Western Australia, is a base for the Royal Australian Navy which is administered by the federal Department of Defence. Examples are given of the committee's approach to integrated environmental management and the implementation of the Navy's environmental policy.	No

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Hine PT (1998) *Contaminant Inputs Inventory of the Southern Metropolitan Coastal Waters of Perth: An update,* Unpublished Report for the Department of Environmental Protection, Perth Western Australia	To present information on sources which are known to have changed since the production of the 1995 contaminants input inventory, with particular emphasis on changes in predicted nutrient loads.	Contaminant inputs to the southern metropolitan coastal waters of Perth are predicated to generally continue to increase over the next 25 years, but not to the same extent as predicated in the 1995 report. Nitrogen loads in particular will decrease significantly in 2002 following upgrading of Woodman Point Wastewater Treatment Plant, and then begin to increase gradually with increasing treatment plant flows. There are no longer any industrial point sources of contaminants to Owen Anchorage. As a consequence, the major contaminant sources for this body of water are the Swan River, atmospheric deposition and groundwater. Contaminant inputs into Cockburn Sound from industrial point sources are continuing to decline and groundwater is increasingly the major source of both nitrogen and phosphorous. Metal and other contaminant inputs to Cockburn Sound are generally predicated to decline or not increase significantly over the next 20–25 years. The major industrial point sources directly discharging to Cockburn Sound are Wesfarmers CSBP, BP Oil and Tiwest Joint Venture. Lesser point sources include ship unloading, Hanwha Advanced Ceramics, Western Power's Kwinana Power Station and Cockburn Cement Limited. Woodman Point Wastewater Treatment Plant has an emergency overflow pipe into Cockburn Sound at Woodman Point and a secondary outlet into Jervoise Bay. The Woodman Point overflow is used on average about once per year for a day or less, usually when repair work is being undertaken on the Cape Peron outfall pipe.	CSMC
Lavery P & Westera M (1998) *A Survey of Selected Seagrass Meadows in the Fremantle-Becher Point Region,* Prepared for Department of Environment by Centre for Ecosystem Management, Edith Cowan University Western Australia	To report the results of a survey of seagrass meadows undertaken for the Department of Environment.	Overall, no site showed evidence of a major shift towards a more stressed state over the time period 1994–98, while four sites (Fish Rock, Stragglers Rocks, Becher Point nearshore and Carnac Island) showed changes in appearance considered indicative of less stress. Mangles Bay remained stressed for the study period.	CSMC
Minister for Environment; Labour Relations (1998) *Industrial Infrastructure and Harbour Development, Jervoise Bay: Ministerial Conditions,* Statement No. 490, Perth Western Australia	To state environmental conditions under which development of Jervoise Bay may be undertaken.	Twelve conditions (32 clauses) were set in regard to this project requiring the proponent to: develop an Environmental Management System; prepare and implement a Seagrass Management Plan; undertake water quality monitoring, inside and outside the harbour; prepare a Dredging Spoil Management Plan; prepare a Public Access Management Plan; prepare a Noise Management Plan; and submit a performance review every three years.	CSMC
NGIS Australia, Department of Botany UWA & DA Lord & Associates (1998) *Changes in Seagrass Cover on Success and Parmelia Banks between 1965–1995,* Report prepared for Cockburn Cement, Western Australia	To assess the areal changes in seagrass coverage in shallow waters (<10 m depth) on Success and Parmelia Banks from 1965–1995 by: • Examining the aerial photography available for the study region and selecting aerial photography	Aerial photography from 1965, 1972, 1982 and 1995 was used to determine the change in seagrass distribution over time. The aerial photographic techniques used in this study only enable seagrass with high leaf densities to be mapped. On Success Bank, seagrass cover has increased from 21% in 1965 to 43% in 1995. On Parmelia Bank seagrass cover has decreased slightly, with 46% coverage in 1965 and 44% coverage in 1995. Groundtruthing indicates that, on both Success and Parmelia Banks, the majority of seagrass growth between 1972 and 1995 has predominantly been in assemblages of *Amphibolis griffithii, Posidonia coriacea* and mixed assemblages of *Amphibolis griffithii* and *Posidonia coriacea.*	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	appropriate for mapping recent seagrass coverage; • Processing the selected photography to enable seagrass mapping; • Identifying, for each of the selected aerial photography sets, on the basis of photo-tonal difference, areas of seagrass, bare sand, and areas that have been dredged on Success and Parmelia Banks; and • Determining the spatial and temporal variability in seagrass cover across Success and Parmelia Banks over the period of seagrass mapping within broad regions on these banks.		
PPK Environment and Infrastructure (1998) *Nitrogen Discharges into Jervoise Bay from Groundwater: Hydrochemical study,* Report to Halpern Glick Maunsell on behalf of the Department of Commerce and Trade, Western Australia	To present the findings of the investigation and assessment of nitrogen discharges undertaken during February and March 1998.	The report reviews previous groundwater investigations for the Cockburn Sound area. Previous information relates primarily to discharges into the existing Northern Harbour section of Jervoise Bay. No bore information is available for nitrogen discharges into the marine waters of the proposed Southern Harbour development. Six new bores were drilled along the 3.5 km coastline of Jervoise Bay approximately 100–400 metres inland from the coast. Samples were collected from the bores and groundwater levels measured. The mass-flux analysis has determined that approximately 5,000 kg of total nitrogen discharges into the Northern Harbour from shallow groundwater. The estimated nitrogen discharging into the sea at the proposed Southern Harbour development is approximately 300 kg/year. The majority of nitrogen discharge from groundwater (90%) occurs at the Woodman Point end of Jervoise Bay within the Northern Harbour.	CSMC
Taylor Burrell Town Planning and Design (1998) *East Rockingham Garden Industrial Precinct – Comprehensive Development Plan & Report,* Prepared for the Kwinana Industries Coordinating Committee, Kwinana Western Australia	To recommend an appropriate Metropolitan Region Scheme and local government authority zoning for the land taking into account risk and hazard modelling and structure planning. To produce a comprehensive development plan and Landscape Master Plan for land contained within the Garden Industrial Precinct. To produce proposed development controls for the subject land taking into account risk and hazard modelling and societal risk issues; To recommend the future uses of Bell, Hymus and Chesterfield Heritage Cottages.	The ERIP IP14 Structure Plan (WAPC 1996) was approved by the Western Australian Planning Commission in 1996. The Structure Plan and Report were based on the Strategic Development Plan prepared by Dames & Moore (1991). The IP14 plan was prepared to facilitate orderly subdivision based on optimal uses identified in the Strategic Development Plan. The IP14 identified land contained within the study area for Garden Industrial, Parkland Buffer, and General Industry Purposes. This report reviews previous studies and identifies existing land uses and land ownership. A physical site description is presented including landform and vegetation. Heritage issues relating to Bell, Hymus and Chesterfield Cottages are discussed and recommendations made for their future. Servicing considerations are discussed including road network, water supply, sewerage, drainage, easements, gas services, power, Telstra and Western Mining Corporation tailings pipeline. The report contains a proposed Statement of Planning Policy for the area and presents figures and information to support recommendations related to future development and landscaping.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	To recommend a procedure for implementation.		
Butler A & Jernakoff P (1999) *Seagrass in Australia – Strategic Review and Development of an R&D Plan,* CSIRO Publishing, Victoria Australia	To provide an Australia wide assessment of: • Gaps in knowledge of seagrass ecosystems • Knowledge of links between seagrass and fisheries • The state of the art in rehabilitation and restoration of damaged seagrass beds; • Monitoring and assessment of seagrass; and • Seagrass and fisheries management. To prepare a research and development plan to guide the Fisheries Research and Development Corporation's (FRDC) future investment in the context of the FRDC's Ecosystem Protection Program.	Research gaps relevant to Cockburn Sound/Owen Anchorage: • The importance, as habitat, of seagrasses in wave-exposed conditions and in deep water is not known. • Understanding of the dispersal and recruitment characteristics of different seagrass species is inadequate. • Comparative studies are needed of the fates and influences of production from the seagrass system—seagrass detritus, plankton, epiphytic flora and fauna, benthic fauna and microphytobenthos.	CSMC
Chiffings AW (1999) 'Cockburn Sound, Western Australia', In *Land-Ocean Interactions in the Coastal Zone: Australasian estuarine systems: carbon, nitrogen and phosphorous fluxes*, pp 68–73, eds SV Smith & CJ Crossland, LOICS International Project Office, Netherlands Institute for Sea Research	To present information on Cockburn Sound relevant to global change.	Summer surveys of nutrient concentrations were undertaken in 1982–3, 1984–5, 1986–7 and then again in 1989–90 through to 1993–94. During the latest intensive study a greatly refined quantitative understanding of the circulation and exchange processes was obtained. There has been considerable change in both sources and total loads of nutrients to the system. The Sound represents an opportunity to look more carefully at the long-term impacts of nutrient loadings on a temperate coastal ecosystem.	CSMC
Environmental Protection Authority (1999) *Fremantle-Rockingham Industrial Area Regional Strategy: A submission by the EPA to the Western Australian Planning Commission,* Prepared under section 16 (j) of the *Environmental Protection Act,* Bulletin 943, Perth Western Australia	To provide advice to the Western Australian Planning Commission on the environmental issues raised by the Fremantle-Rockingham Industrial Area Regional Strategy (FRIARS).	The EPA have provided advice on a complex array of issues related to development options presented in FRIARS. Advice covers issues such as allocation of appropriate buffers; management of air quality, odour and noise; groundwater quality; marine water quality; wetland and vegetation management; and assessment of new developments, industries and transport routes.	CSMC

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Environmental Protection Authority (1999) *Kwinana Export Facility, Kwinana: Report and recommendations of the Environmental Protection Authority,* Proponents are Koolyanobbing Iron Pty Ltd, Fremantle Port Authority & Westrail, Bulletin 953, Perth Western Australia	To provide environmental advice to the Minister for the Environment on the environmental factors relevant to the proposal by the Koolyanobbing Iron Pty Ltd, Fremantle Port Authority and Westrail to build and operate a facility for the export of iron ore at Kwinana.	Koolyanobbing Iron currently exports its iron ore through Esperance; however, it is undertaking an evaluation of alternative export facilities to cater for expansion of mining operations and reduce export costs. It is the EPA's opinion that the following are the environmental factors relevant to the proposal: dust, noise and social surroundings including visual amenity. The EPA notes that the proposal would affect the visual amenity for the users of Kwinana Beach, but would not be significant at Wells Park, Rockingham Beach or areas further away. The EPA has concluded that the proposal can be managed in an environmentally acceptable manner, provided there is satisfactory implementation of the recommended conditions.	CSMC
Environmental Protection Authority (1999) *Seawall Construction, Land Reclamation and Dredging Adjacent to Lots 165 and 167, Including Lots 166 and 168, and Management of Shipbuilding, Repair and Maintenance Activities at Cockburn Sound, Cockburn Road, Henderson,* Bulletin 947, Perth Western Australia	Seawall construction, land reclamation and dredging activities within Cockburn Sound.	<http://www.epa.wa.gov.au/docs/909_B947.pdf>	See Link
Environmental Protection Authority (1999) *Revised Draft Environmental Protection (Swan Coastal Plain Wetlands)Policy 1999: Report to the Minister for the Environment,* Perth Western Australia	To declare and protect the beneficial uses of wetlands on the Swan Coastal Plan.	The policy applies to the area of land known as the Swan Coastal Plain (see policy for map). The policy allows for the designation of categories for wetlands: C – high degree of value for conservation; R – moderate degree of naturalness; M – significant hydrological value and may have been highly modified and exhibit limited ecological or human use value.	CSMC
Fisheries Western Australia (1999) *A 12-month Survey of Coastal Recreational Boat Fishing between Augusta and Kalbarri on the West Coast of WA during 1996–97,* Fisheries Research Report No. 117, Prepared by Sumner NR & Williamson PC	A creel survey of recreational boat-based fishers on the west coast of Western Australia was conducted from September 1996 to August 1997 to provide information required by fisheries managers. The bus route method, where a survey interviewer visits all boat ramps in a district on the one day, was used. The time spent fishing, catch, demographic and attitudinal information was collected from boat crews returning to boat ramps at the completion of a fishing trip.	The Recreational Fishing Program of Fisheries Western Australia has a strategic plan to conduct creel surveys of recreational fishing on a rotating region by region basis. The regions are defined as the West Coast, Gascoyne, Pilbara/Kimberley and South Coast (Figure 1). An integrated approach, where all regions are surveyed on a regular basis (about once every five years), to monitor changes in recreational catch and fishing effort is in place. Information on the marine recreational boat-based catch and fishing effort in the west coast region of Western Australia was required to develop management strategies to ensure the sustainability of fishing activities and conservation of fish stocks and fish habitat. These data will provide fishing quality indicators such as catch rates, length-frequency, and the variety of species caught.	CSMC & <http://www.fish.wa.gov.au/docs/frr/frr117/frr117.pdf>

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Fisheries Western Australia (1999) *Catch, Effort and the Conversion from Gill Nets to Traps in the Peel-Harvey and Cockburn Sound Blue Swimmer Crab* Portunus pelagicus *Fisheries,* Fisheries Research Report No. 113, Prepared by Melville-Smith R, Cliff M & Anderton S	The fieldwork in this study was initiated in March 1994 in Cockburn Sound and in January 1996 in the Peel-Harvey Estuary. It was aimed at establishing gill net to trap conversion ratios that would allow fishers to change from one gear type to the other without a resulting increase in the catching capacity of the gear types.	Blue swimmer crabs occur from Cape Naturaliste in Western Australia around the north of Australia to the south coast of New South Wales and in the warmer waters of the South Australian Gulfs as far as Barker Inlet in Gulf St Vincent (Stephenson and Campbell 1959). In Western Australia, high densities of crabs in the more populated south-west of the State south of Perth (Figure 1) have made them a particularly important recreational fishing species (Dybdahl 1979, Ayvazian *et al*. 1997, Sumner unpub. data), with an estimated 76,000 people participating in the fishery in 1986–87 (Anon. 1989). Commercial fishing targeting blue swimmer crab can be traced back to the late 1950s in the Peel-Harvey Estuary and the mid-1960s in the case of Cockburn Sound (E.H. Barker, Fisheries WA pers. comm.). Traditionally, most of the commercial catch from this fishery has been taken using gill nets with a six inch (152 mm) stretch mesh. Fishers have had licences which entitled them to pull up to 1200 m and 1000 m of crab gill net per day in Cockburn Sound and Peel-Harvey Estuary respectively. Cockburn Sound crab fishers had been required to use gill nets up to 1994, but in that year fishers were given authority to trial traps at a rate of 100 traps for their 1200 m daily gill net allocation. Allowing the fishers to use 100 traps in place of the gill net allocation was believed, based on a net to trap conversion trial conducted in March 1994 and described in this report, to have been an approximate conversion that would allow fishers to catch the same quantity of catch with either fishing method. Since 1994 and the production of this report, there has been no further investigation into net to trap conversion ratios in Cockburn Sound. The 100 traps:1200 m daily net allocation trialed in 1994 was gazetted, unchanged, in March 1995. Success with traps in the Cockburn Sound fishery led to a call by fishers in the Mandurah Professional Fishers Association to trial trap fishing for crabs in the Peel-Harvey Estuary. At the 1995 Annual General Meeting of that association, it was agreed by that body and by the agency, that a number of fishers would assist with an experiment which would provide data on trap and gill net catches and which would enable a conversion for the different gear types to be calculated for the area. The results of this experiment form part of this report.	CSMC & <http://www.fish.wa.gov.au/docs/frr/frr113/frr113.pdf>
Fisheries Western Australia (1999) *A study of Wetline Fishing in Western Australia (1991–1997),* Fisheries Management Report No. 5, Prepared by Crowe F	The objective of this study is to examine the historic and current status and dynamics of wetline fishing, and to compare this with catches from the recreational and charter sectors of the fishery. This will enable the Minister for Fisheries to explore options for management of the wetline fishery and determine an appropriate, cost effective approach that can address resource sustainabilityand allocation. **Fisheries Management Report 5 is contained within Fisheries Research Report 118**	Western Australia's wetline fishery potentially includes every licensed fishing boat in the State and encompasses a number of inter-relationships between various boats and commercial fisheries. This study covers the wetline or open access fishery, which encompasses those activities associated with the unrestricted Western Australian fishing boat licence (FBL). The activities associated with this fishery involve any commercial fishing which is not covered by fisheries legislation. A separate section entitled 'So you want to go wetlining?' is provided at page 101 as an easy reference guide to industry and others interested in wetline fishing. It is recommended that it be read by those who require a more personalised explanation of wetline fishing. When reading the report, also consider that many licensed fishing boats operating in the wetline fishery are also authorised to fish in one or more other fisheries. The reported catch of the wetline fishery (excluding the Pilbara demersal line fishery, which is being placed under management in the near future) during the 1997–98 financial year was 2270 tonnes. It was worth around $11.25 million, which represents about two per cent of the total value of the Western Australian catch or harvest value of $538 million.	Large document not held CSMC, see <http://www.fish.wa.gov.au/docs/frr/frr118/frr118.pdf>

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Fisheries Western Australia (1999) *Management Directions for Western Australia's Estuarine and Marine Embayment Fisheries – a strategic approach to management,* Fisheries Management Paper No. 131	To present a picture of the estuarine and marine embayment fisheries in Western Australia – the nature, dynamics and management issues– as a focus for future discussions and then to pose possible solutions to some of the strategic management problems associated with the fishery today and those looming in the future.	Land adjacent to Cockburn Sound is heavily populated, both by permanent residents and by holiday makers. With this population has come an increasing number of recreational fishers and increasing competition for the finfish resources in the area. The Government has been working with industry over the last 10 years to bring the Cockburn Sound fisheries under management plans and to restructure the commercial fishing effort to reduce resource sharing conflicts. Satisfactory resolution has been achieved, or is near, for all but the wetfish fisheries. As Cockburn Sound is now flanked by residential land and is a popular boating, fishing and tourist destination, commercial fishing in these waters is no longer a priority for the community. The most satisfactory solution in the eyes of the community is the removal of commercial wetfish fishing (excluding baitfish) from Cockburn Sound. Should the Government take this path, it would not be a sudden prohibition, but would be achieved using the legislative and administrative mechanisms available to the Government and to industry, such as the buy-out options and voluntary guidelines processes.	CSMC
Fisheries Western Australia (1999) *State of the Fisheries Report 1998–99,* Perth Western Australia	To provide a Statewide overview of the state of commercial and recreational fisheries for 1998–99.	In relation to Cockburn Sound the following was discussed: • During 1998–99 competition for access to blue swimmer crabs in south-west oceanic waters continued to be a source of contention both between and within the commercial and recreational sectors. • A managed commercial crab fishery, with 16 fishers, operates in Cockburn Sound. This fishery contributed 340 t, nearly half of total State catch. This fishery has fully converted from using demersal tangle nets to using crab pots as the means of capture. • Recreational crab catch is estimated at 18.8 tonnes. • There are six licence holders in the Cockburn Sound Fish Net Managed Fishery. The main species targeted are herring and garfish. There is concern that the increasing commercial catch is having an effect on the recreational sector. • There are 3 mussel licensees. These licences were extended to be inclusive of mussel aquaculture in 1997. • There are currently 34 licensed line and pot fishers in this fishery, although not all licensees exercise their fishing entitlement. • Commercial landings of King George whiting, western sand whiting, squid and octopus from Cockburn Sound have declined in recent years. Possible reasons may include environmental factors, fishing pressure and market driven forces, or a combination of these. The underlying reasons for these declines are yet to be fully investigated. • Cockburn Sound continues to provide one of the most popular sheltered recreational fishing areas in very close proximity to the Perth metropolitan area.	CSMC
Fisheries Western Australia (1999/2000) *Protecting and Sharing WA's Coastal Fish Resources: The path to integrated management,* Perth Western Australia	This paper focuses primarily on future management of the State's coastal fish stocks with a specific emphasis on finfish species, but also has implications for coastal shellfish and crustacean resources.	The need for this review has arisen from increasing concern within the community and Fisheries WA that the directions for fisheries and aquatic resource management need further development, and that a new management framework will be required to meet the challenges of the 21st century. The impact of a growing population, increasing coastal development, and greater demands from a variety of community groups for shares of WA's aquatic and fish resources, as those resources reach the point of maximum sustainable exploitation, are key factors driving the need for a new approach to management. If these challenges are to be met, and WA's fish resources are to remain sustainable, it is imperative that the impact and needs of all resource users are taken into account in the process of fisheries and marine resource management.	CSMC & <http://www.fish.wa.gov.au/docs/mp/mp135/fmp135.pdf>

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Lavery P & Westera M (1999) *A Survey of Selected Seagrass Meadows in the Fremantle-Becher Point Region,* Prepared for the Department of Environment by Centre for Ecosystem Management, Edith Cowan University, Western Australia	To report the results of a survey of seagrass meadows undertaken for the Department of Environment.	Overall, the results indicate that there was no significant change in the status of seagrass meadows at the sites surveyed. At the fifteen sites surveyed for health indicators all except one showed either no change in the variables measured or a change which might be perceived as positive.	CSMC
Mawson PR & Coughran DK (1999) 'Records of sick, injured and dead pinnipeds in Western Australia 1980–1996, *Journal of the Royal Society of Western Australia* 82:121-128	To record the sick, injured and dead pinnipeds in Western Australia from 1980 to 1996.	During the 17 years a total of 244 stranded pinnipeds were recorded the majority of which were *Neophoca cinerea* (Australian sea lion). This is because the area is prime habitat for this species. 28.5% of pinnipeds found dead or moribund on WA beaches were adversely affected by humans in some way. 39% of the pinnipeds that had some interaction with humans died violent deaths; they were either shot, clubbed or speared. And 16% died from collisions with boats. These figures may be underestimates as many carcasses were too decomposed to establish cause of death. The report states that the number of animals that died from collisions with boats can be expected to increase as recreational boating activity increases, especially if these activities occur near haulout sites or breeding islands. There is scope for a public education program to advise boat users about how to interact with pinnipeds. There may also be a need to legislate to restrict the close approach of small boats to haulout areas and breeding colonies.	Murdoch University SWL2 J500 R887
MP Rogers & Assoc. (1999) *Woodman Point West Beach Stage 1 Report,* Report R071 Rev 0, Prepared for Department of Commerce and Trade, Western Australia	To review existing data and technical reports, evaluate the processes which influence the coastal stability and conduct a preliminary evaluation of possible coastal management options for Woodman Point West Beach.	The report reviews meteorological and oceanographic conditions, coastal processes, shoreline movement and sources and sinks of sediment. It then presents five management options and discusses the advantages and disadvantages of each. The following conclusions, in summary, were reached: The Woodman Point West Beach has been highly modified by man since the early 1900s. In the mid 1970s in the order of 200,000 cubic metres of sand was deposited at the eastern end of the Woodman Point West Beach from the oil rig excavation works to the east. The shoreline has accreted around 20–30 metres in response to this input of sand. The recession of the eastern end of the beach is largely due to the shoreline adjusting to the large input of sand from the oil rig excavation works, losses due to rip currents along the Navy groyne, and natural fluctuations of the sandy beach in response to periods of storms and calmer conditions. The northern breakwater of the Jervoise Bay Northern Harbour is not responsible for the erosion to the eastern end of the Woodman Point West Beach over the last 25 or so years. However, it is noted that under some circumstances, waves reflecting off the northern breakwater of the Jervoise Bay Northern Harbour may create localised and increased westwards movement of sand at the eastern end of the beach.	CSMC
MP Rogers & Assoc. (1999) *Woodman Point West Beach Stage 2 Report,* Report R073 Rev 0, Prepared for Department of Commerce and Trade, Western Australia	To undertake a comprehensive evaluation of suitable coastal management options for the protection of the Woodman Point West Beach.	A review and estimation of the cost of each management option is presented. The five management options are: Do nothing; (not discussed) Sand nourishment; Allow recession, reshape and revegetation the dunes; Construct a spur groyne and groyne; and Construct a shore parallel breakwater.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Ove Arup & Partners (1999) *Kwinana Central Core Development Strategy,* Prepared for the Department of Resource Development, Perth Western Australia	To build upon the principles identified in 'Towards Optimising Kwinana' to provide a clear strategy for the development of industrial land in the area; To provide a major contribution to regional planning initiatives; To present a consistent vision for the development of the area, and a clear and logical process for the achievement of that vision.	An extensive review and assessment process was undertaken to determine the development opportunities and constraints in the area. This included investigation of road and rail access, servicing existing land use, and possible industrial uses. Environmental considerations and funding issues were also taken into account. The area under consideration totals close to 350 hectares and comprises some 25 individual allotments ranging in size from 2150 square metres to just over 127 ha. The assessment revealed that the most likely and suitable industries for the central core areas of the Kwinana Industrial Area are industries producing either chemicals or metals/salts.	CSMC
2000–2007			
Dunlop JN (200?) *A Model for Investigating the Bio-accumulation of Metals in the Southern Metropolitan Coastal Waters using Seabird Feathers,* Submitted to the Cockburn Sound Management Council, Western Australia	To detect any residual bio-accumulation of metals that may be occurring in Cockburn Sound food chain, using the relatively unpolluted Warnbro Sound-Sepia Depression system as an indicator of background levels and to attempt to identify the effects of potentially different food chains on metals exposure and trophic levels of bio-accumulation.	No record of the proposal being discussed can be found and as such the study did not proceed.	CSMC
ANZECC/AMRCANZ (2000) *National Water Quality Management Strategy: Paper No. 4 Volume 1, Australian and New Zealand Guidelines for Fresh and Marine Water,* Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand	The Guidelines are intended to provide government, industry, consultants and community groups with a sound set of tools that will enable the assessment and management of ambient water quality in a wide range of water resource types, and according to designated environmental values.	The current Guidelines, including this working volume, arise from a revision of the NWQMS Guidelines published in 1992 (ANZECC 1992). The revision was necessary to: • incorporate current scientific, national and international information in a clear and understandable format; • ensure that the Guidelines complement major policy initiatives and directions undertaken at the State and Federal levels in the areas of ecologically sustainable development and water resource management; • promote a more holistic approach to aquatic ecosystem management; • incorporate more detailed guidance on how to refine national or regional guidelines for site-specific application. Important input to the review process from Australia and New Zealand has included: public submissions on the 1992 Guidelines and on an earlier draft of the revised document; the most recent local and overseas scientific and resource management documents and information; relevant overseas water quality guideline documents and government submissions. In keeping with the underlying philosophy of the 1992 Guidelines, the chapters in this document describe how to apply state-of-the-art practices in water resource management and assessment for the protection of the environmental values.	Link @ <http://www.mincos.gov.au/__data/assets/pdf_file/0017/316124/wqg-ch1.pdf>

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Barker & Associates Ltd (2000) *Waste to Energy & Water Plant, Lot 15 Mason Road Kwinana, Western Australia. Public Environmental Review,* Prepared for Global Olivine, Western Australia	This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal to build and operate a Waste to Energy and Water Plant at Lot 15 Mason Road, Kwinana. Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.	The EPA has considered the proposal by GOWA to build and operate a Waste to Energy and Water Plant at Lot 15 Mason Road, Kwinana. The EPA notes the potential benefits of the proposal in terms of producing substantial quantities of electricity, potable water and other useful materials from a waste stream that would otherwise be disposed of in a landfill. The EPA further notes that the proposal is one of the technologies that are being considered to help achieve the State Government's goal of 'Towards zero waste by 2020' and that it achieves important reductions in greenhouse gas and reactive organic compound emissions. Air emissions are the main environmental issue associated with waste to energy plants and the EPA recognises that stringent emission limits are required to be met to ensure that air quality is not compromised. The EPA notes the incorporation of 'best practice' air pollution control equipment in the proposal to minimise emissions in accordance with the requirements of the *Environmental Protection Act 1986.* Another more general issue is the uncertainty associated with the introduction of new technology. The EPA wishes to encourage the use of new technology which can achieve better environmental outcomes. Safeguards are needed, however, if the technology does not achieve its design predictions. A number of measures have been incorporated into this assessment to address this issue, such as an independent design audit, staged commissioning with achievement of performance benchmarks before subsequent stages can proceed, specialised training requirements and contingency plans if design predictions are not met.	CSMC & <http://www.google.com.au/search?hl=en&q =barker+%26+associates+ltd+lot+15+mason+road&meta=cr%3DcountryAU>
CSIRO (2000) *Introduced Species Survey Final Report: Fremantle Western Australia,* Unpublished report by Centre for Research on Introduced Marine Pests, Fremantle Western Australia	To determine the extent of introduced marine species in waters of the Fremantle Port (including Cockburn Sound).	Sampling was completed 18 April–14 May 1999. Two Australian Ballast Water Management Advisory Council (ABWMAC) species were recorded from the Port of Fremantle during the survey—*Sabella spallanzanii* (European Fan Worm) and *Musculista senhousia* (Asian Mussel) and one ABWMAC target species *Alexandrium tamarense (*potentially toxic Dinoflagellate[plankton]). Other introduced species collected and identified to this point include the bryozoans, *Bugula neritina, Bugula flabellate, Tricellaria occidentalis, Cryptosula pallasiana* and *Watersipora subtorquat,* the hydroid *Tubularia ralphi* and the ascidians *Ascidiella aspersa* and *Ciona intestinalis,* and the fish *Tridentiger trigonocephalus.* Exotic species in the Port of Fremantle are likely to have been introduced to the Port by one of three mechanisms: • natural range expansion of species introduced to other parts of the south-west coast of the Australian mainland; • directly to the port by shipping using the port, either in ballast water or by hull fouling; • by domestic translocation from fishing and recreation vessels. Given the current level of international ship visits to the Port of Fremantle the risk of new introductions from overseas appears to be greatest at the north and south quay and in Kwinana at the bulk loading berths. The risk of translocation and subsequent establishment of species in ports that trade with Fremantle is deemed to be moderate.	HMAS Stirling Environment Office
Dames & Moore (2000) *Environmental Management Plan for HMAS Stirling and Garden Island: Phase III Environment Strategy and Implementation Plan,* Prepared for Department of Defence, Perth Western Australia	To present the environment strategy and strategic actions for management of the environmental and heritage values of Garden Island.	The Department of Defence has updated and revised its 1993 Environmental Management Plan (EMP) for HMAS Stirling and Garden Island. The EMP covers management of the environment and heritage assets for the whole of Garden Island, including facilities within HMAS Stirling, public access areas and the surrounding sea declared as Controlled Naval Waters. The highest risk issues identified, in order of rank were: development pressure; tributyltin levels in Careening Bay; energy use and efficiency measures; development and implementation of an effective Cultural Heritage Conservation Plan; coordination of environmental management tasks and responsibilities; standard operating procedures to protect the environment; storage, use and disposal of hazardous goods; dependence upon private motor vehicles for transport to and from the island; management of ozone depleting substances; containment of spills and leaks at Otto Fuel and Torpedo Maintenance Facility; spread of weeds and plant diseases; and many more.	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		Overall, HMAS Stirling and Garden Island have benefited from the attention given to environmental management since the time of HMAS Stirling's inception. Nevertheless, many issues identified at the site do not currently meet the requirements for environmental management in relation to Defence policy, sustainability of Defence use, or concurrence with the Defence Organisations 'good neighbour' policy of compliance with State legislation where practicable. Implementation of this EMP will help rectify this problem.	
DA Lord & Associates, Botany Department UWA, Alex Wyllie & Associates, NGIS Australia and Kevron Aerial Surveys (2000) *Seagrass Mapping of Owen Anchorage and Cockburn Sound 1999,* Report to Cockburn Cement Ltd., Department of Environmental Protection, Department of Commerce and Trade, Department of Resources Development, Fremantle Port Authority, James Point Pty Ltd, Kwinana Industries Council, Royal Australian Navy, Water Corporation of Western Australia and Water and Rivers Commission	To present the findings of detailed survey which was undertaken to: • Accurately map seagrass coverage and assemblages of Owen Anchorage and Cockburn Sound for the summer of 1999, using aerial photography and extensive groundtruthing; and • Map the changes in seagrass cover of Cockburn Sound that have occurred since 1967, which is when suitable aerial photography first became available.	**Owen Anchorage:** Owen Anchorage, Success and Parmelia Banks exhibit distinctly different seagrass assemblages. *Amphibolis griffithii, Posidonia coriacea* and the mixed-species assemblage of *Amphibolis griffithii* and *Posidonia coriacea* are the dominant seagrass species on Success Bank. On Parmelia Bank, *Posidonia sinuosa, Posidonia australis* and multi-species meadows are dominant. Along the shallow eastern margin of Owen Anchorage, *Posidonia sinuosa* dominates. It is likely these differences are due to variations in wave energy and sediment transport. The area of seagrass on Success Bank has doubled between 1965 and 1999. The area of seagrass on Parmelia Bank has been reduced by ~51 ha mainly on the east side. **Cockburn Sound:** 1999 mapping of Cockburn Sound shows it dominated by *Posidonia sinuosa* meadows. Historical mapping of seagrasses in Cockburn Sound have shown a large decline in coverage between 1967 and 1999 with loss estimated at ~2269 ha. Seagrasses once formed an almost continuous meadow between 1 m and 6 m depth along the eastern, southern and western flanks of the Sound. By 1972 seagrasses had been lost or fragmented along the eastern and south-eastern shores. These losses are largely due to light reduction to the seagrasses resulting mainly from high epiphyte loads on the leaves due to increased water column nutrient concentrations. The construction of the Garden Island Causeway between 1971 and 1973 reduced the wave energy on Southern Flats and appears to have exacerbated the losses of seagrasses in this area. Since 1981 it appears that the total seagrass area in Cockburn Sound has remained relatively stable. The report presents figures showing changes in seagrass extent over time.	CSMC
DA Lord & Associates (2000) *Long-Term Shellsand Dredging, Owen Anchorage – Environmental Review and Management Programme,* Prepared for Cockburn Cement Ltd for submission to the Environmental Protection Authority, Report No. 96/032/4, Perth Western Australia	To provide a source of information from which interested individuals and groups may gain an understanding of the proposal, the need for the proposal, the environment which it would affect, the impacts that may occur and the measures to be taken by Cockburn Cement to minimise these impacts.	Cockburn Cement is the largest lime producer in Australia, and produces over 90% of the State's lime. Lime is an essential raw material for mineral processing, especially gold and alumina. Calcium carbonate is the sole raw material for lime production and the main raw material used for the production of cement. This material is dredged shellsand from Success and Parmelia Banks in Owen Anchorage. Cockburn Cement currently uses ~ 2 million tonnes of shellsand each year. Cockburn Cement's long-term dredging proposal will be implemented in two stages: • Dredging from a 1.5 km wide seaway to be constructed through Success and Parmelia Banks (estimated to be depleted during the year 2014); • Dredging from an area on West Success Bank. The specific changes associated with the dredging of the long-term resource are: modification to the bathymetry of the Owen Anchorage seabed; and loss of seagrass and bare sand habitat in shallow water on both Success and Parmelia Banks and commensurate gain in deep bare sand habitat. There are considerable social and economic benefits for the State from the continuation of the long-term dredging.	CSMC

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DA Lord & Associates (2000) *Characteristics of Sediment in Perth's Nearshore Coastal Waters,* Prepared for Kwinana Industrial Council, Western Australia, Report No. 99/095/3	To present the results of a survey of sediments using sample collection procedures and contaminant analyses recommended by ANZECC, whilst also attempting to ensure comparability with previous work carried out by the DEP in the Southern Metropolitan Coastal Waters Study (1996). To contribute to the development of EQCs for sediment quality.	Comparison of data obtained in this survey with data obtained at the same sites in 1994 (Burt *et al.* 1994) found that levels of most contaminants have changed little. Two exceptions were large apparent declines in levels of arsenic in Cockburn Sound and TBT in general, but there was sufficient doubt about sampling and analytical variability for these two contaminants to be uncertain whether the 1994 values were as high as reported.	CSMC
Environmental Protection Authority (2000) *Perth's Coastal Waters – Environmental Values and Objectives: the position paper of the EPA, a working document,* Perth Western Australia	To present the Environmental Protection Authority's position on the setting of environmental values for Perth coastal waters after community consultation regarding those values.	Presents the outcomes of public involvement and consultation, environmental values, environmental quality objectives and their spatial application. Results in 99.2% of Perth coastal waters being within a High Level of Ecosystem Protection. Low level area is 0.1%.	CSMC & <http://www.epa.wa.gov.au/docs/1982_PerthsCoastalWaters.pdf>
Environmental Protection Authority (2000) *Managing Perth's Coastal Waters: Towards a Cockburn Sound Environmental Protection Policy – a public explanatory document,* Perth Western Australia	To inform the community about measures being developed to protect the environment of Cockburn Sound, the formation of the Cockburn Sound Management Council and preparation of an Environmental Protection Policy.	Outlines the steps undertaken to pursue the protection of Cockburn Sound through an Environmental Protection Policy (EPP). Discusses the proposed content of the proposed EPP.	CSMC
Fisheries Western Australia (2000) *A Quality Future for Recreational Fishing on the West Coast,* Fisheries Management Paper No. 139, Perth Western Australia	The West Coast Region between Kalbarri and Augusta offers a wide range of recreational fishing opportunities. Sheltered estuary systems, surf beaches and an offshore environment which host both demersal species and gamefish make the region different from any other in WA.	The West Coast Region between Kalbarri and Augusta offers a wide range of recreational fishing opportunities. Sheltered estuary systems, surf beaches and an offshore environment which host both demersal species and gamefish make the region different from any other in WA. The West Coast Region also receives more fishing pressure than any other, with an estimated 380,000 anglers fishing each year. With a growing population and advances in technology, fishing pressure will continue to increase and anglers will become more efficient at targeting fish, particularly offshore demersal species such as dhufish and baldchin groper. Already, the signs of a fishery under pressure are showing. Catch rates of dhufish around inshore reef systems such as the Three-mile are a far cry from the 1950s and 60s when people beachlaunched wooden dinghies to fish the inshore waters for these highly prized fish. Increasing pressure on stocks has led to growing community concerns that the future quality of recreational fishing is under threat. The West Coast Working Group visited regional centres and met directly with recreational fishers to gain a better understanding of community views and issues surrounding the management of recreational fishing. These discussions provided valuable information, particularly on specific regional issues, which assisted in the development of the draft strategy.	CSMC & http://www.fish.wa.gov.au/docs/mp/mp139/index.php?0401
Fisheries Western Australia (2000) *State of the Fisheries Report 1999/2000,* Perth Western Australia	To provide a Statewide overview of the state of commercial and recreational fisheries for 1999–2000.	In relation to Cockburn Sound the following were discussed: • A managed commercial crab fishery with 16 fishers operates in Cockburn Sound. This fishery contributed 238 t, just over one-third of total State catch. This fishery has fully converted from using demersal tangle nets to using crab pots as the means of capture.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		• The Cockburn Sound commercial crab fishery has been reviewed with a 20% reduction in pot numbers occurring. • The commercial catch of garfish and herring has been rising steadily since 1970s. This is a concern for the recreational fishers. • Three licences exist for mussel collection and aquaculture. • There are 31 licensed line and pot fishers, although not all licensees exercise their fishing entitlement. Commercial landings of King George whiting, western sand whiting, squid and octopus have declined in recent years. The underlying reasons for this are yet to be revealed. • The herring catch in Cockburn Sound has declined since 1994 with 22.3 tonnes being caught in 1999–2000. The garfish catch has continued to rise since 1994.	
Gersbach GH (2000) *Upwelling off the Coast of Western Australia,* PhD Thesis, University of Western Australia	Field data were used to demonstrate that upwelling does occur in the presence of the Leeuwin Current. The upwelling was shown to be wind driven and to occur over the inner shelf break between Capes Leeuwin and Naturaliste. The Capes Current was shown to originate from this region between Cape Leeuwin and Cape Naturaliste.	The main coastal upwelling regions of the world are located on the eastern ocean margins. An exception is along the West Australian coastline, where strong upwelling is not observed due to the persistent poleward flow of warm water associated with the Leeuwin Current on the outer continental shelf. Recent observations of cool, equatorward flowing water on the inner continental shelf, coincident with the persistent summer equatorward wind is, however, consistent with wind driven coastal upwelling. The main objectives of this study were to quantify the coastal dynamics off south-west Australia during the summer months. In particular: (a) to determine if upwelling was occurring on the south-west continental shelf of Western Australia, thus providing a source of colder water for the Capes Current; and (b) if upwelling occurs, to identify the major mechanisms by which colder water is upwelled during summer in the presence of the poleward flowing Leeuwin Current. Field data were used to demonstrate that upwelling does occur in the presence of the Leeuwin Current. The upwelling was shown to be wind driven and to occur over the inner shelf break between Capes Leeuwin and Naturaliste. The Capes Current was shown to originate from this region between Cape Leeuwin and Cape Naturaliste.	Abstact onlt @ <http://www.cwr.uwa.edu.au/research/publications.php?rec=1706>
Government of Western Australia (2000) *Bush Forever,* Volumes 1 & 2, Department for Planning and Infrastructure, Perth Western Australia	Regionally significant bushland has been identified on the basis of criteria relating to its conservation value. Important among these criteria is the achievement, where possible, of a comprehensive representation of all the ecological communities originally occurring in the region, principally through protecting a target of at least 10 per cent of each vegetation complex. While Perth is fortunate to have an extensive existing reserve system, it does not provide the required comprehensive representation of all the vegetation complexes and their associated ecological communities originally occurring in the region.	Bush Forever (the plan) has been prepared with the full cooperation and information resources of each of the Ministry for Planning (MfP), Department of Environmental Protection (DEP), the Department of Conservation and Land Management (CALM) and the Water and Rivers Commission (WRC) assisted by their various technical and advisory committees, combining rigorous research and analysis with an implementation framework. Bush Forever identifies 51,200 hectares of regionally significant bushland for protection, covering 26 vegetation complexes.This amounts to about 18% of the original vegetation on the Swan Coastal Plain portion of the Perth Metropolitan Region, and excludes local conservation reserves.	Not held, available @ <http://www.wapc.wa.gov.au/Publications/660.aspx>

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Jacoby C, Griffiths R, Braine S & Jernakoff P (2000) *Monitoring of Seagrass at HMAS Stirling: Environmental Working Paper No. 13,* Prepared for Garden Island Environmental Advisory Committee, Department of Defence, Western Australia	To evaluate seagrass monitoring methods for the marine environment of Cockburn Sound adjacent to Garden Island.	Several monitoring methods were evaluated for use at Garden Island. Overall, this pilot study indicated that multiple observers can conduct reliable and useful monitoring of seagrasses. The Royal Australian Navy should gain useful data from seagrass surveys undertaken by the dive club and Navy clearance divers. In terms of developing a complete monitoring program, it will be important to establish potential management actions to be triggered by the results of monitoring, feedback links that allow the results of monitoring to improve environmental management strategies employed by the RAN, and feedout links to enhance communication with stakeholders.	CSMC
Kangas MI (2000) *Synopsis of the biology and exploitation of the blue swimmer crab,* Portunus pelagicus *Linnaeus, in Western Australia,* Fisheries Research Report No.121	This report summarises the existing studies which have provided information on the biology, population characteristics and exploitation of the blue swimmer crab, *Portunus pelagicus*, in Western Australia.	This synopsis summarises the current biological knowledge of the blue swimmer crab in Australia and overseas, describes the commercial catch trends in WA, and is designed to provide a compilation of information which will be extended by the current research projects being undertaken throughout Australia. These projects include: • genetic (microsatellite) determination of stock structure of the blue swimmer crab in Australia; • the collection of biological data required for management of the blue swimmer crab fishery on the central and lower west coasts of Australia; • estimation of recreational catch of blue swimmer crabs in WA and Moreton Bay, Queensland; • the collection of fisheries data required for management of the blue swimmer crab fishery on the central and lower west coasts of Australia; and • fisheries biology and spatial modelling in South Australia. The synopsis also identifies the geographical, biological and fishery knowledge gaps within Australia to assist in targeting new research initiatives.	CSMC & <www.fish.wa.gov.au/docs/frr/frr121/frr121.pdf>
Kendrick GA, Hegge BJ, Wyllie A, Davidson A & Lord DA (2000) 'Changes in seagrass cover of Success and Parmelia Banks, Western Australia between 1965–1995', *Estuarine, Coastal and Shelf Science* 50:341-353	The results of this analysis indicate that the percentage of seagrass cover on Success Bank has increased from 21% (507 ha) in 1965 to 43% (1036 ha) in 1995, whereas on Parmelia Bank the percentage of seagrass cover has remained relatively constant with 46% cover in 1965 (735 ha) and 44% in 1995 (699 ha). The east, central and western regions of Success Bank have all shown an increase in seagrass cover from 1965 to 1995. On Parmelia Bank the seagrass cover on the western region has increased whereas, the seagrass cover on the eastern region has decreased. On both Success and Parmelia Banks it appears that the majority of seagrass	Changes in seagrass cover on Success and Parmelia Banks, Western Australia, between 1965 and 1995 were mapped from aerial photography using changes in the distribution and size of phototonal categories. Aerial photography from 1965, 1972, 1982 and 1995 was used to determine the temporal and spatial changes in seagrass distribution. Aerial photography was rectified using photogrammetric techniques, and manually interpreted at a scale of 1:10,000 to determine the extent of seagrasses and unvegetated sands. The 1995 data were also groundtruthed to determine the seagrass species assemblages. The mapping of seagrass cover using phototones is only feasible for species of seagrasses with a dense leaf canopy. The species that fit this criteria, and that have high cover on Success and Parmelia Banks, are *Amphibolis antarctica*, *Amphibolis griffithii*, *Posidonia australis*, *Posidonia sinuosa* and *Posidonia coriacea*.	<http://scholar.google.com/scholar?hl=en&cr=countryAU&q=author:%22Kendrick%22+intitle:%22Changes+in+Seagrass+Cover+on+Success+and+Parmelia+Banks,+...%22+&um=1&ie=UTF-8&oi=scholarr>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	growth between 1975 and 1995 has been in assemblages that are predominantly single species or mixed species meadows of *A. griffithii* and *P. coriacea.*		
Max Margetts & Associates (2000) *Rockingham Waterfront Village – Kent Street & Village Green Urban Renewal Study,* Prepared for the City of Rockingham Western Australia	To clarify what could be done to the area to improve its structure and character beyond the limitations of current streetscaping initiatives; to generate solutions which may lead to a greater sense of community occupancy and vitality for the area; to provide a range of options from the utterly pragmatic to the more radical; and to provide a practical implementation platform.	The study has established that the existing configuration of public and private landholdings within the Kent Street and Village Green Precincts at Rockingham Beach needs to be rationalised, upgraded and where necessary redeveloped to meet the contemporary social and economic needs of the local community. A do nothing option is unsustainable. The recommended development plan demonstrates that the historic essence of Rockingham Oval as a venue for community festivals and special events can be retained in a more attractive, urban park configuration around which an array of contemporary land use needs can be provided. As well as a revitalised main street shopping precinct, the plan for urban renewal incorporates a village housing component, opportunities for short stay accommodation and various options for community arts facilities in the midst of a much improved village landscape.	City of Rockingham
Paling EI, van Keulen M, Wheeler K, Walker C (2000) 'Effects of depth on manual transplantation of the seagrass *Amphibolis griffithii* (JM Black) den Hartog on Success Bank, Western Australia', *Pacific Conservation Biology* Vol. 5 314-20	To present findings related to experimental manual transplants of seagrass 'plugs' at varying depths on Success Bank.	Planting unit survival remained higher than 95% for the first few months after planting. Sediment movement over the time of monitoring was highly variable at the sites, the sediment horizon fluctuating from 5–20 cm. It appears that, although transplants were not obviously affected by depth, the dynamic nature of sediments on Success Bank ensures that small units of seagrass cannot be adequately anchored to survive for any extended period and may be unsuitable as a transplant method for this habitat. However, this method may be suitable for regeneration in areas with less energetic wave climates.	CSMC
Rippey E (2000) *Reference Lists for Garden Island and Cockburn Sound: Environmental Working Paper No. 14,* Prepared for Department of Defence, HMAS Stirling, Garden Island, Western Australia	To provide an updated list of references relevant to environmental management of Garden Island.	Listing provided and incorporated into this document.	CSMC
Water and Rivers Commission (2000) *Northern Peel Catchment Study – Hydrogeology and nutrient balance of Spectacles Wetland,* Hydrogeology Report No. HR168, Perth Western Australia	To establish the hydrogeology of the Spectacles; prepare end of summer (lowest) and end of winter (highest) water table maps; determine nutrient concentrations in the groundwater and surface water; identify nutrient sources within the catchment; establish water and nutrient balance for the Spectacles; and assess the nutrient stripping properties of the Spectacles wetland system.	The Spectacles consist of two wetlands known as the 'Large Eye' in the north and the 'Small Eye' in the south. The Peel Main Drain, north of the Peel-Harvey Estuary, flows through the Spectacles from the north before discharging into the estuary. Regionally groundwater flows from east to west through the Spectacles. Generally, water table fluctuation ranges between 0.5 m to the west to about 1 m to the east of the Spectacles. Hydrographs from the last ten years indicate a general recession in the water table. Monitoring data has indicated that no hydraulic connection exists between the Peel Main Drain and the groundwater in the horticulture area at Mandogalup. The Spectacles appears to be a groundwater dominated system. Generally, nutrient concentration in groundwater around the Spectacles is low. The wastewater treatment facility 500 m west of Spectacles is identified as a continuous source of nutrients and pathogenic organisms that will reach the wetland in about 18 months time.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Western Australian Planning Commission (2000) *Western Australia Tomorrow: Population projections for the Statistical Divisions, Planning Regions and Local Government Areas of Western Australia,* Population Report No. 4, Prepared by the Ministry for Planning	Saved to desktop large document		<www.wapc.wa.gov.au/Publications/57.aspx>
Western Australian Planning Commission (2000) *Fremantle-Rockingham Industrial Area Regional Strategy,* Final Report, Perth Western Australia	The FRIARS strategy has been developed over a period of four years and has involved technical investigations and significant input from key stakeholders and the community. A considerable effort has been made to identify the full range of issues and respond to these in a balanced way. Notwithstanding this, implementation of the Strategy will have impacts on the local community.	The Fremantle-Rockingham Industrial Area Regional Strategy (FRIARS) has been prepared by the Western Australian Planning Commission (WAPC) to enable the Government to provide strategic land use planning directions for the Fremantle-Rockingham region for the next 20–25 years. The Strategy is the culmination of an extensive investigation into the issues and redevelopment opportunities for the Fremantle-Rockingham region. It has addressed the key planning issues facing the region including: existing and potential land use conflicts between industrial and other land uses; the protection of the Kwinana Industrial Area (KIA) and preservation of opportunities for heavy industry and port facilities in the region; the future role of the Kwinana Environmental Protection Policy (EPP) buffer as a land use planning and environmental management tool; protection of environmentally significant features in the region, including Cockburn Sound; provision of employment opportunities; identification of land appropriate for general industrial development; and certainty for residents in the region by recommending a clear plan and time frame for redevelopment. The Strategy offers recommendations on land use, infrastructure, social issues and environmental management. These recommendations include the development of approximately 800 hectares of general industrial land over the existing townsite of Wattleup and surrounding rural areas, as well as the extension of heavy industry over the Hope Valley area to create approximately an additional 100 hectares of this land use. The development of these uses is premised on the appropriate management of social and environmental impacts.	<http://www.wapc.wa.gov.au/Publications/85.aspx>
Wood N & Lavery P (2000) 'Monitoring seagrass ecosystem health – the role of perception in defining health and indicators', *Ecosystem Health* 6:134-148	Thirty-four seagrass researchers/managers were asked to identify seagrass sites in Cockburn Sound, Western Australia, which they perceived to be healthy or unhealthy, and indicate the basis for these perceptions.	Thirty-four seagrass researchers/managers were asked to identify seagrass sites in Cockburn Sound, Western Australia, which they perceived to be healthy or unhealthy, and indicate the basis for these perceptions. The average respondent based their perception on three variables, ranging from ecosystem features to plant attributes. Four variables were considered very important in developing perceptions: canopy cover, shoot density, epiphyte biomass, and the proportion of calcareous epiphytes. Three sites perceived to be healthy and three perceived to be unhealthy were then compared to determine if features indicated as important in developing perceptions about health differed between the sites. None of the four variables considered important by respondents differed statistically between 'healthy' and 'unhealthy' sites in winter, but shoot length and above ground biomass were different. In summer, two of the important variables (canopy cover and shoot density) differed, along with shoot height, productivity, and leaf area index. Despite their perceived importance, epiphyte features were not different between perceived healthy and unhealthy sites. The study suggests that shoot density, canopy cover, shoot height, above ground biomass, productivity, and leaf area index of *P. angustifolia* ecosystems differ statistically between sites perceived to be healthy and unhealthy. However, the usefulness of these variables as indicators of seagrass health varies seasonally. Health was clearly a respondent-dependent concept. The basis of perceptions about health among a group of expert scientists did not correspond strongly to measurable differences between sites. The unwarranted importance placed on epiphytes may be due to previous studies that have reinforced their importance. These	<http://www.blackwell-synergy.com/links/doi/10.1046%2Fj.1526-0992.2000.00015.x>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		observations highlight the role of personal perspective and scientific preconditioning in forming concepts of health, and raise the question of the role that 'experts' should be playing in formulating those concepts.	
Wright MD (2000) *The Flushing and Circulation Patterns of Jervoise Bay Northern Harbour,* Department of Environmental Engineering, University of Western Australia	To determine the flushing times and circulation patterns in Jervoise Bay Northern Harbour through modelling.	Field work demonstrated the predominance of wind driven circulation. Currents were observed to flow in the direction of wind stresses. It is expected that exchange will be enhanced by diurnal tides, since flushing times are predicted in the order of days. Flushing times due to tides alone were estimated in the order of 12 to 40 days. This indicates that over long periods, diurnal tidal exchange is likely to be a significant contributor. The incorporation of seasonal groundwater fluxes in modelling greatly reduced flushing times. The fastest flushing time predicted by the wind simulation was 7.2 days in summer. This is attributed to the seabreeze events, where south-westerlies dominate in the afternoon with relatively constant wind speeds of 10 sm^{-1}.	CSMC
Alan Tingay & Associates (2001) *City of Cockburn Greening Plan,* Report No. 99/123, Prepared for the City of Cockburn Western Australia	The development of a Greening Plan for the City of Cockburn provides a strategy for bushland conservation and management, amenity, and a rationalised approach to the greening requirements of parks, major and minor road reserves, non-Council land and private land.	The objective of the City of Cockburn's Greening Plan is to: *develop a long-term strategic plan for the maintenance and enhancement of remnant vegetation within the City of Cockburn, the revegetation of previously cleared areas, road reserves, public land and the enhancement of ecological, landscape and streetscape values and community amenity*. The City of Cockburn has a number of strengths and weaknesses. The strengths include the relatively large amount of bushland and wetlands remaining within the City and the protection of regionally significant bushland within the Beeliar Regional Park. The strengths are tempered by threats to the environment: the amount of bushland proposed for residential development in the future, and the fragmentation of the bushland. As at January 2000, approximately 30% or 4,760 ha of the City of Cockburn is bushland, with over 50% of the bushland in very good condition. This compares favourably with the amount of bushland remaining in more developed areas. The two chains of wetlands that run north-south through the City are included in the Beeliar Regional Park, as well as a number of isolated wetlands in the eastern region of the City. Other bushland and wetland areas are Conservation Reserves under the City of Cockburn's District Zoning Scheme No 2. However, a significant amount of the existing bushland within the City is zoned either Urban or Urban Deferred and is proposed for residential development in the future. The environmental values of the City are shown in Figures 3–6 of the Greening Plan.	CSMC & <http://www.cockburn.wa.gov.au/documents/CouncilServices/Environment/greening.doc>
ATA Environmental (2001) *Notice of Intent for the Construction of Solid Sodium Cyanide Plant Production Facility, Kwinana Version,* Prepared for Australia Gold Reagents Pty Ltd, Perth Western Australia	AGR now proposes to install a downstream processing plant that is capable of producing 25,000 tpa of solid sodium cyanide briquettes from liquid (30% solution) sodium cyanide. There will be no increase in the current production capacity of liquid sodium cyanide. The solid briquettes will be exported overseas, interstate or to remote sites within Western Australia.	AGR now proposes to install a downstream processing plant that is capable of producing 25,000 tpa of solid sodium cyanide briquettes from liquid (30% solution) sodium cyanide. There will be no increase in the current production capacity of liquid sodium cyanide. The solid briquettes will be exported overseas, interstate or to remote sites within Western Australia. The additional plant will be a separate facility that is located close to the existing solution plants (Figures 1 and 2). The solids plant will be designed as a single train, apart from the evaporation section which will consist of two parallel trains. The process flow chart is shown in Figure 3. A continuous feed of sodium cyanide solution from the liquids plant storage tanks will be directed to one of the two batch evaporation units to concentrate the solution to approximately 60%. Following evaporation the concentrated sodium cyanide will be centrifuged to separate the solid crystals, which will then be dried and compressed into briquettes. The briquettes will be packaged in Intermediate Bulk Containers and then placed in either sea containers for export.	No

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Bennet Environmental Consulting Pty Ltd (2001) *Alcoa Kwinana Vegetation Survey,* Prepared for Alcoa World Alumina Australia, Perth Western Australia	To describe and map the vegetation floristic units present; indicate the condition of the vegetation; identify and map any Threatened Ecological Communities; identify and map any Declared Rare or Priority flora; and address regionally significant bushland criteria as in *Bush Forever* (Govt. of WA, 2000).	Alcoa was informed that the proposed development area was nominated as a Bush Forever site in 1999. This site is not listed in *Bush Forever* published by the Government of Western Australia, but was listed after this publication. There are three Bush Forever sites that are relatively close to the Alcoa area: 269, 268 & 267. The Alcoa area was surveyed and found to contain four vegetation communities, four floristic community types and a number of exotic Eucalyptus plantings. Banksia, Tuart, Jarrah Woodland was the dominant community. A total of 155 species, of which 59 were weeds, were recorded during the survey. No rare or priority species were recorded. One floristic community type recorded is regarded as a Threatened Ecological Community under State law. There is no linkage between the vegetation at the Alcoa area with other bushland areas. The Alcoa area is representative of the Karrakatta Complex – Central and South within the Spearwood Dune System where there is less than the 10% conservation target, but it would appear, because of its condition, that it is not worthy of inclusion as a Bush Forever site.	CSMC
Bowman Bishaw and Gorham (2001) *Palm Beach Catchment Strategic Drainage Management Plan,* Prepared for City of Rockingham Western Australia	To identify key stormwater drains and associated surface catchments and characteristics and to develop catchment management measures to minimise the release of pollutants to Cockburn Sound.	Elevated levels of faecal coliforms have periodically been recorded at Palm Beach during monitoring conducted by both the City of Rockingham and the Health Department. Land use in Palm Beach is a mixture of commercial and residential. Stormwater collected from the area is either discharged to Cockburn Sound through one of six drainage outlets along the foreshore, or infiltrates to groundwater via localised collection points. Road sweeping is currently the only pollution control measure implemented by the City of Rockingham. However, due to the limited availability of the sweeper only high trafficked areas are swept regularly. This pollution control method is considered ineffective. A number of recommendations are put forward for implementation by the City of Rockingham, and are equally valid for similar catchments across the City.	City of Rockingham
Bowman Bishaw and Gorham (2001) *Metropolitan Region Scheme Amendment No. 1010/33 (Port Catherine) Environmental Review,* Prepared for the Western Australia Planning Commission	MRS Amendment No. 1010/33 – Port Catherine was initiated by the WAPC in February 1999 and referred to the EPA in accordance with section 33E of the *Metropolitan RegionTown Planning Scheme Act 1959*. After considering the number of significant environmental issues raised by the proposal, including soil contamination, coastal impacts, remnant vegetation and seagrass meadows, the EPA set a level of assessment on the amendment proposal of 'Scheme Assessed – Environmental Review Required' in March 1999.	This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment and Heritage on the proposed Metropolitan Region Scheme (MRS) Amendment 1010/33 – Port Catherine. The Port Catherine MRS Amendment has been initiated by the Western Australian Planning Commission (WAPC) to facilitate the redevelopment of the former South Coogee industrial area into the Port Catherine marina and residential estate. Section 48D of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment and Heritage on the environmental factors relevant to the proposed scheme amendment and on the conditions and procedures to which the proposed scheme amendment should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.	Saved to disk and @ <www.epa.wa.gov.au/docs/1364_B1060.pdf>
City of Rockingham (2001) *Town Planning Scheme No. 2,* City of Rockingham Western Australia	The specific objectives of the Scheme are: to protect and enhance the environmental values and natural resources of the Scheme Area; and to promote ecologically and environmentally sustainable land use and development which minimises resource use and waste.	The general objectives of the Scheme are: (a) to establish the preferred use of land well in advance of development; (b) to optimise the provision of services and facilities for the community; (c) to ensure the coordinated provision of adequate land for development; (d) to conserve and enhance features of cultural, historical, environmental and natural significance; and (e) to reconcile community needs and aspirations with appropriate land use and development	Disk & <http://www.rockingham.wa.gov.au/Planning_and_Developments/town-planning-scheme-2.php>

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Coast*Wise* (2001) *Rockingham Foreshore Strategy,* Prepared for the City of Rockingham Western Australia	To review existing recommendations and prioritise outstanding work; To review existing regional strategies; To review the coastal processes operating with particular reference to erosion and accretion; To identify which foreshore management plans require review; To review the City's coastal policy framework; To identify additional studies to better manage the coast.	Makes a large number of recommendations for management of the coast including: beach nourishment, rehabilitation of coastal dunes, fencing, extension of dual use path, introduction of signage, provision of parking, introduction of toilet blocks, improved disabled access and introduction of public art.	CSMC
Commonwealth of Australia (2001) *Australia State of the Environment Report 2001,* Prepared by Australian State of the Environment Committee, Department of Environment and Heritage, CSIRO Publishing, Canberra Australia	Sound information and understanding of issues are vital to enable Australians not only to feel, but also to be, part of a society capable of managing or ameliorating the changes which affect our distinctive environment. This Report offers Australians an understanding of the Australian environment and highlights how they might relate, individually and collectively, to the major issues affecting their country. Australians should strive to pass on to future generations a healthier environment than they inherited.	The State of the Environment Report in 1996 (SoE 1996) provided the first independent and comprehensive account of the Australian environment and provided an excellent foundation for the ASEC to produce this State of the Environment Report (SoE 2001). SoE (2001) is drawn from seven commissioned theme reports, summarised in the *Thematic findings* The theme reports are: atmosphere, coasts and oceans, land, inland waters, biodiversity, natural and cultural heritage, and human settlements (see http://www.ea.gov.au/soe/). Each theme report used a set of environmental indicators to report their findings. An expert reference group supported each theme author and the reports were peer reviewed. Contributions to SoE (2001) are summarised in *Appendix*. The conceptual structure of the modified 'pressure-state-response' model of the Organization for Economic Cooperation and Development was used in SoE (1996), and also underpins SoE (2001) (see *Appendix 1*). For SoE (2001), more emphasis has been placed on implications of conditions, pressures and responses consistent with the terms of reference. The overall message and key findings of SoE (2001) have been developed by the ASEC following a review of the theme reports and their synopses by ASEC members (see *Thematic findings*). The 2001 Report also contains the views of the ASEC on the context within which Australia's environment is managed and its views on future directions. The principles of ESD are now well recognised in Australian legislation, including the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. Although there is some legislation to protect cultural heritage, traditional Indigenous rules for care of the land and its sacred places and the philosophy enshrined in the Burra Charter of the International Council on Monuments and Sites (ICOMOS) Australia form a good basis for conserving cultural heritage. These principles have broad community and industry support and they form a powerful philosophy for use in both environmental and heritage management. Sound information and understanding of issues are vital to enable Australians not only to feel, but also to be, part of a society capable of managing or ameliorating the changes which affect our distinctive environment. This Report offers Australians an understanding of the Australian environment and highlights how they might relate, individually and collectively, to the major issues affecting their country. Australians should strive to pass on to future generations a healthier environment than they inherited.	Link only @ <http://www.environment.gov.au/soe/2001/publications/report/index.html>

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DA Lord & Associates & PPK Environment and Infrastructure (2001) *The State of Cockburn Sound Pressure-State-Response Report,* Prepared for Cockburn Sound Management Council, Rockingham Western Australia, Report No. 01/187/1	To provide up-to-date information on the environmental state of Cockburn Sound and its catchment.	No further deterioration of the health of surviving seagrass meadows and no significant losses related to water quality have occurred. Overall water quality has improved, apart from in the Jervoise Bay Northern Harbour. Nutrient input has reduced from an estimated 2000 tonnes in 1978 to about 300 tonnes/year in 2000, about 70% of which comes from groundwater. Amounts of metals and oil discharged by industry have continued to decrease substantially due to improved waste treatment practices. TBT contamination is high in the Northern Harbour and at Careening Bay, Garden Island. Two introduced marine pests occur in Cockburn Sound but do not appear to be affecting native species. The main way that land uses affect the environment of Cockburn Sound is by contamination of groundwater. Nutrients are the biggest environmental impact from groundwater flow. A 1999 survey of public boat ramps estimated that 44,270 boats were launched in Cockburn Sound. This is expected to increase by 75% over the next 20 years. Industrial and commercial use of the Sound is estimated to generate over 6 billion dollars per year.	CSMC
DA Lord & Associates (2001) *James Point Port: Stage 1 James Point Cockburn Sound: Public Environmental Review,* Report No. 00/059/6, Prepared for James Point Pty Ltd, Western Australia	To provide sufficient information to the EPA to allow assessment of Stage 1 of the project under the provisions of the Environmental Protection Act and to enable the public to understand the scope of the project and its impacts.	Studies of the capacity of the Fremantle Inner Harbour to service growth in trade have shown there are likely to be constraints on operations through local transport networks and cargo handling capacity. James Point Port: Stage 1 will provide significant benefits to users: it will provide competition in the provision of port facilities with the result being improved responsiveness to customers' needs, efficiency of service delivery and competitiveness in pricing; operations will be best practice; facilities will be tailored to the needs of specific trades and the opportunity to take a coordinated approach to the transport chain will lead to efficiencies beyond the port boundaries; industries requiring port land will have a chearper and potentially more convenient option than is presently available; and the development can attract industries such as livestock export, at a more suitable site than Fremantle Port. Key environmental issues identified as relevant to the project include: loss of coastal dune system and vegetation; impact on coastal processes; impacts on groundwater and surface water quality; impacts on circulation within the port area and Cockburn Sound and associated impacts on water quality; deepening of the seabed within the port and associated impacts on water and sediment quality; increased frequency of ship visits with associated contamination of sediment and waters and increased risk of exotic species introduction; modification of marine benthic habitat associated with dredging and reclamation; increased public risk associated with port operations; increase risk of oil spill and/or pollution events; increased noise and odour associated with some aspects of port operations; loss of recreational amenity; impacts of construction, primarily issues associated with trucking and dredging; and Aboriginal and European heritage.	CSMC
DA Lord & Associates (2001) *James Point Port: Stage 2, James Point Cockburn Sound: Preliminary environmental impact assessment,* Prepared for James Point Pty Ltd, Western Australia	To present the preliminary assessment of the JPPL Stage 2 concept as requested by the EPA and consider the concept in relation to existing and approved developments in the Sound.	In EPA Bulletin 907, the EPA stressed that a better understanding of the marine ecological characteristics and processes in Cockburn Sound was required to enable confident prediction of the ecological response in the Sound to further development pressures. The EPA put forward the view that from a wider perspective, developments along the eastern margin cannot be viewed in isolation from each other; that they will potentially affect water circulation, water quality and ecological function over the broader portion of the Sound. The Stage 1 proposal is currently undergoing public environmental review as part of the WA Environmental Impact Assessment process. The EPA considered it appropriate that JPPL prepare a separate document which incorporated a description of stages of the proposed port development subsequent to Stage 1. Assessment of cumulative impacts in Cockburn Sound is complex as there is a legacy of extensive anthropogenic impacts within the Sound and on the coast associated with past practices; the	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		Sound is not in a pristine state. The key tool for the cumulative impact assessment was the use of a calibrated and validated hydrodynamic modelling was conducted to a very high standard, and the primary improvement which could be made to this part would be the collection of additional calibration data associated with baroclinic flows.	
Department of Conservation and Land Management (2001) *The Jervoise Bay Conservation and Recreation Enhancement Plan,* Perth Western Australia	To execute Commitment 25 of Ministerial Statement No. 1091 in regard to the proposal for the Industrial Infrastructure and Harbour Development, Jervoise Bay, that required the preparation and implementation of a plan to enhance conservation and recreation of Woodman Point Regional Park and Beeliar Regional Park.	Enhancement plans and costing for John Graham Recreation Reserve, Woodman Point Headland, Woodman Point View (Bay Beach Road), Henderson Foreshore, Mt Brown.	CSMC
Department of Conservation and Land Management (2001) *Carnac Island Nature Reserve Draft Management Plan,* Prepared for the Conservation Commission of Western Australia	To provide guidance for the management of the Carnac Island Nature Reserve.	The vision for Carnac Island Nature Reserve is: *In the year 2011, the flora and fauna, habitats and refuge value of the Carnac Island Nature Reserve will be in the same or better condition than in the year 2001 The local community will consider the island an important natural asset.*	CSMC
Conservation Commission of Western Australia, Department of Conservation and Land Management, City of Melville, City of Cockburn, Town of Kwinana (2001) *Beeliar Regional Park: Draft Management Plan 2001–2011,* Department of Conservation and Land Management, Perth Western Australia	To provide broad direction for the planning, management and development of Beeliar Regional Park and encourage the protection of the Park values, anticipating future community requirements and developing strategies aimed at addressing management issues and concerns.	Urban growth in the vicinity of the Beeliar Wetlands has led to concern regarding the potential impact on the wetlands. Beeliar Regional Park is located in the south-west of the Perth metropolitan area. The park extends from Blue Gum Lake (Melville) to the Spectacles (Kwinana). The park comprises 19 lakes and many other associated wetlands in two main chains (western and eastern) located parallel to the coast. The western chain of wetlands consists of a number of depressions behind the coastal dune system. This chain comprises Manning Lake, Market Garden Swamps 1 and 2, Lake Coogee, Brownman Swamps and Lake Mount Brown. The eastern chain of wetlands is more extensive than the western chain and encompasses Blue Gum Lake, Booragoon Lake and Piney Lakes Reserve, North Lake, Bibra Lake, South Lake, Little Rush Lake, Yangebup Lake, Kogoloup Lake, Thomsons Lake, Bangenup Lake and The Spectacles.	CSMC
Environmental Protection Authority (2001) *Explanatory Document on the Draft Environmental Protection Policy and the Draft Environmental Management Plant for Cockburn Sound,* Perth Western Australia	To provide information on management measures being introduced to protect the environmental values of Cockburn Sound.	The objective of the proposed management framework for Cockburn Sound is to maintain a level of water and sediment quality that will preserve the integrity and biodiversity of the marine ecosystem, as well as to manage and provide for the current and projected future social uses that are not in conflict with the preservation of this environmental quality. Towards this end the Environmental Protection Authority and the Cockburn Sound Management Council are developing an Environmental Protection Policy and an Environmental Management Plan, building on previous research including the Cockburn Sound Environmental Study (1976–1979) and the compilation of the most recent work, the State of Cockburn Sound Report (2001).	CSMC

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Environmental Protection Authority (2001) *Long-term Shellsand Dredging, Owen Anchorage-Cockburn Cement Limited: Report and Recommendations of the Environmental Protection Authority,* Bulletin 1033, Western Australia	To provide advice and recommendations to the Minister for Environment and Heritage on the environmental factors relevant to the proposal by Cockburn Cement Limited to dredge a 1.5 km wide seaway through Success Bank and Parmelia Banks in Owen Anchorage and dredge an area of West Success Bank in the Mewstone area.	The EPA details the reasoning behind its consideration of the proposal and makes recommendations to the Minister for Environment and Heritage that may reduce environmental impacts on seagrass.	CSMC
Environmental Risk Solutions Pty Ltd (2001) *Livestock Holding Facility – Public Environmental Review,* Prepared for James Point Livestock Pty Ltd, Doc. No. J9247/PER, Applecross Western Australia	To present information regarding the proposal to construct a livestock holding facility in the Kwinana Industrial Area.	James Point Livestock proposes to construct and operate a livestock holding facility on a site north of the BHP No. 1 Jetty in the Kwinana Industrial Area. If the James Point Port proceeds, the livestock facility will be situated on a reclaimed area behind the berth face, extending east across the adjacent vacant industrial land. Should the James Point Port project not proceed, the livestock facility could alternatively be established solely on the existing vacant industrial land. The buildings will have a physical area equivalent to 250,000 sheep capacity, but due to the rotation of stock through the facility and the cleaning cycles between vacation and restocking a pen, the maximum effective capacity is approximately 160,000 sheep at any time. Livestock holding facilities are 'Prescribed Premises' under schedule 1 of the Environmental Protection Regulations 1987 and require a licence to operate. Environmental impacts identified include dust management, odour management, noise management, waste management, surface and groundwater protection, vehicle movement management, storage of chemicals and protection of visual amenity. The proposal aims for a zero discharge from the livestock holding facility to the environment.	CSMC
Fisheries Western Australia (2001) *State of the Fisheries Report 2000/01,* Perth Western Australia	To provide a Statewide overview of the state of commercial and recreational fisheries for 2000–01.	In relation to Cockburn Sound the following was discussed: • A managed commercial crab fishery, with 11 fishers, operates in Cockburn Sound. This fishery contributed 305 t, nearly half of total state catch. • The commercial pressure on crab stocks, together with increasing demand from the recreational sector, has resulted in a number of management changes. Catch allocation has become a major issue and there is research planned to review arrangements in Cockburn Sound. • The commercial catch of garfish and herring has been rising steadily since 1970s. This is a concern for the recreational fishers. • Two licences exist for mussel collection and aquaculture, although wild capture was very low due to the integration of the fishery with the mussel aquaculture operations. • There are 25 licensed line and pot fishers, although not all licensees exercise their fishing entitlement. Commercial landings of King George whiting, western sand whiting, squid and octopus have declined in recent years. The underlying reasons for this are yet to be revealed. • The herring catch in Cockburn Sound has declined since 1994 with 14.2 tonnes being caught in 2000. The garfish catch has declined since 1999–2000. • Catch and effort data identified the key recreational species in Cockburn Sound as herring, King George whiting, other whiting, skipjack, trevally, tailor and garfish. The estimated catch of these species was 39 tonnes.	CSMC

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Fremantle Ports (2001) *Proposal for the Provision of a Bulk Fertiliser Storage Facility at the Bulk Cargo Jetty, Kwinana,* Fremantle Western Australia	To present information on the proposal to construct a Bulk Storage Facility.	The Fremantle Port is presently considering the expansion of the facilities at the Bulk Cargo Jetty. The expansion will include construction of a bulk fertiliser storage shed holding approximately 60,000 tonnes of product. To allow for the simultaneous storage of a variety of products, the storage shed will have a number of separate compartments. It is envisaged that the products to be stored will include a number of fertilisers such as: calcium ammonium nitrate; sulphate of potash; ammonium sulphate nitrate; muriate of potash; TSP; urea; mono ammonium sulphate; single superphosphate; and di ammonium phosphate.	CSMC
Hale J & Paling EI (2001) *Water Quality of Cockburn Sound and Warnbro Sounds (Dec. 2001 to March 2001): A report to Kwinana Industries Council,* Report No. MAFRA 02/4, Marine and Freshwater Research Laboratory Environmental Science, Murdoch University Western Australia	To compare the water quality indicators measured during summer 2002 with previous years; to determine if there were any regions of consistently high phytoplankton and nutrient concentrations within Cockburn Sound; to undertake an integrated water quality monitoring method using periphyton growth; and to assess the suitability of reference sites located in Warnbro Sound.	The average nutrient and chlorophyll a concentrations in Cockburn Sound during the 2002 summer period were similar to those of recent years; indicating that water quality has changed little over the past decade. Chlorophyll a concentrations were higher in Cockburn Sound than in Warnbro Sound and exceeded the EPA (2001) draft criteria at the majority of sites. Higher concentrations of nutrients and phytoplankton populations were recorded along the eastern shore of Cockburn Sound. The water quality of the Northern Harbour of Jervoise Bay was significantly poorer than at any other location. The water quality at Careening Bay, Garden Island, was comparable to Warnbro Sound.	CSMC
Health Department of Western Australia and Fisheries Western Australia (2001) *Western Australian Shellfish Quality Assurance Program – Operations Manual,* Perth Western Australia	**Kwinana Grain Terminal (KGT)** Five routine monitoring points for bacteriological water quality are positioned around KGT (KGT1-5). Six additional monitoring points are used in assessing the impact of severe adverse conditions: three sites across the middle of the lease perpendicular with the shoreline (KGTA, KGTB and KGTC) and three shoreline water samples (SL1, SL2 and SL3). A 10 L phytoplankton sample is taken from KGT3 (see Figure 1). Live mussel samples are taken from within lease areas located north and south of the Grain Terminal. The sampling site for the live mussels may vary slightly according to harvesting regimes. **Southern Flats (SF)** Five routine monitoring points for bacteriological water quality include two	A WASQAP Operations Manual was released in 1999 and revised in 2001 and 2004. This manual includes organisation and contact details, growing areas and sample points, sampling and analytical protocols and procedures, and the procedures for food recalls when contaminated product may have reached the market place. The manual also outlines adverse environmental conditions under which harvesting of shellfish should not occur, and provides flow charts and predictive models for the shellfish growing areas at Oyster Harbour and Cockburn Sound. An algal biotoxin management plan is also described. All shellfish growing areas in Western Australia have WASQAP sampling programs, developed by WASQAP staff and designed to ensure that all shellfish harvested from these growing areas are safe to eat. The sampling program involves analysis of water and meat samples for faecal bacterial contamination, analysis of water samples for phytoplankton, and analysis of meat samples for algal biotoxins and chemicals, including pesticide residuals, heavy metals and polychlorinated biphenyls. Whilst the Cockburn Sound and Oyster Harbour growing areas fall under the auspices of the WASQAP, these areas have also been approved for export by the Australian Quarantine Inspection Service (AQIS). Maintenance of AQIS approval to export is subject to an annual audit of the procedures and processes associated with the operation of the lease areas. An annual sanitary survey update report is prepared for the lease area as part of the audit process. This report focuses particularly on the results of two investigations. Firstly, an updated shoreline survey is carried out to identify new and existing point sources of contamination likely to impact on the shellfish growing area. Such sources of contamination may include a sewage treatment plant, residential areas using septic tanks or on-site sewage disposal, industrial effluent from overflows or outfalls, stormwater drains and/or oil/chemical spills from port activities or boating activities. The audit report also summarises the results and statistical analyses of a sampling program to routinely measure levels of faecal bacteria (monthly) and phytoplankton (fortnightly) in the water column, and faecal bacteria (monthly) and heavy metals and/or chemicals (annually) in the shellfish flesh. Trained industry personnel take samples and organise transportation of samples to analytical laboratories. The cost of the analyses is significant and is borne by the shellfish industry.	CSMC & <http://www.fish.wa.gov.au/docs/pub/WAShellFishQAManual/index.php?0308> Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	in close proximity to the lease area (SF9 and SF11), one midway between the Southern Flats lease and the Kwinana Grain Terminal site (SF10), one near the Garden Island Bridge on the Rockingham side of the bridge (SF6) and one midway between Collie Head on Garden Island and John Point on Cape Peron (SF8). A 10 L sample for phytoplankton is taken from SF11 (see Figure 1). Live mussel samples are taken from within the lease area. The sampling site for the live mussels may vary slightly according to harvesting regimes.		
James Point Pty Ltd (2001) *James Point Port: Stage 1 James Point, Cockburn Sound – Response to Submissions Assessment No. 1353,* Perth Western Australia	To respond to submissions received regarding the proposal to construct a port facility at James Point, Cockburn Sound.	The report presents all concerns and issues raised in submissions and provides detailed responses.	CSMC
John Cleary Planning (2001) *Development of Draft Aesthetic Criteria for Cockburn Sound,* A working document prepared for the Cockburn Sound Management Council, Western Australia	To summarise background information related to aesthetics and suggest criteria for determining the aesthetic values of Cockburn Sound.	The report suggests aesthetic criteria and scenarios for measuring/ monitoring aesthetic values and makes recommendations for implementing aesthetic criteria within the bounds of a policy.	CSMC
Molloy E (2001) *Seiching in Cockburn Sound,* Department of Environmental Engineering, University of Western Australia	To investigate the occurrence of seiching in Cockburn Sound. *[A seiche is a hydrodynamic oscillating response of an enclosed or semi-enclosed water body to external forcing, i.e. a change in water level].*	Changing wind direction is the primary cause of seiches in Cockburn Sound. Various factors, such as wind speed, atmospheric pressure and total water level, will influence the magnitude of the seiches generated. A change in wind speed of at least 2 m/s may also change the water level oscillations. During spring and summer, when there is a diurnal wind pattern, the seiches vary diurnally in amplitude. They may also be influenced by the diurnal variation in total water level associated with tides. Data from other locations in Perth area indicated that the seiches generated propagate up the coast from Mangles Bay at least to Two Rocks Marina, and up the Swan River to at least Barrack Street Jetty. The celerity of the seiche was calculated to be 9.5 m/s. The seiche was expected to have a node (a point of equilibrium) at Fremantle. However, this was not observed. Further work is required to determine the mode and limits of the seiche that travels along the west coast of Western Australia.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Murdoch University (2001) *Southern Harbour Construction Jervoise Bay, Western Australia – Seagrass Monitoring Associated with Dredging for the Jervoise Bay Development – Draft Progress Report II,* Prepared for DA Lord & Associates Pty Ltd, by Marine & Freshwater Research Laboratory, Western Australia	To present the outcomes of a seagrass monitoring survey intended to determine any possible changes to shoot and leaf densities over time.	No significant change in shoot density or leaf density within the *Posidonia sinuosa* meadow. No significant change in shoot density or leaf density within the *Posidonia australis* meadow.	CSMC
O'Connor R (2001) *Aboriginal Heritage in Cockburn Sound,* Prepared for Cockburn Sound Management Council, Western Australia	To present information about Aboriginal heritage within the Cockburn Sound Management Council boundary.	'Beeliar' is the name given to the area between the Canning River and the northern extremity of the Murray River. The Aborigines of Beeliar were referred to as the Mangles Bay tribe. An Aboriginal pad (track) extended from the Swan River passing from Fremantle through North Lake, Bibra Lake and the chain of freshwater lakes leading to Mandurah. A pad also led from this to the present Rockingham area. Two Native Title Claims exist over the CSMC area and there are thirty-five Aboriginal heritage sites. It is expected that more sites may be found over time.	CSMC
Smith AJ & Hick WP (2001) *Hyrdogeology and Aquifer Tidal Propagation in Cockburn Sound, Western Australia,* CSIRO Land and Water Technical Report 06/01	Intercomparison experiment to assess different techniques for estimating submarine groundwater discharge to the near-shore marine environment	During a two-week period from 24 November to 8 December 2001, CSIRO Land and Water hosted an intercomparision experiement to assess different techniques for estimating SGD to the nearshore marine environment; it was conducted in Cockburn Sound and is the first of five SGD intercomparisons being planned and coordinated by the SCOR/LOICZ working group 112. This report presents the calculation of tidal efficiencies and lags for the intercomparison monitoring bores and describes the application of a tidal method to estimate the diffusivity of the shallow coastal aquifer at the study site.	CSMC <www.clw.csiro.au/publications/technical2001/tr06-01.pdf>
URS (2001) *Magnetic Treatment Facility Post-dredging Survey of Seagrass,* Prepared for Department of Defence	To determine the impact on seagrass and to serve as the baseline for monitoring future recolonisation.	This study compared the pre-1976 and post-dredging 1999 aerial photographs which indicated that there have been changes in the distribution of seagrass within Careening Bay at a bay-wide scale, especially in the shallow. These changes are particularly noticeable to the south and beyond the potential zone of influence of the MTF (Magnetic Treatment Facility). Assessment of changes in the distribution of seagrass at a greater depth was not possible. Also it was not possible to determine the scale of localised change in seagrass distribution at the margins of the dredging area from the effects of the dredging, due to the absence of pre-survey video records. It was concluded that there is no evidence of recent loss of seagrass on the floor or on the slope of the MTF dredged area as a result of dredging. Therefore there is no need for ongoing monitoring of seagrass specific to the MTF dredged area. Defence should consider wider seagrass monitoring/studies in Careening Bay to address the causes of widespread seagrass decline in the Bay.	HMAS Stirling
Walker DI, Hillman KA, Kendrick GA & Lavery P (2001) 'Ecological significance of seagrasses: assessment for management of environmental impact in Western Australia*', Ecological Engineering* 16:323-330	To determine the ecological significance of seagrasses in Owen Anchorage, Western Australia, to allow government to assess the effects of dredging proposals that result in the removal of seagrasses. Ecological significance was broadly defined to include physical, chemical, biological and cultural attributes.	This study advanced the understanding of the seagrass communities on Success Bank and their interactions. Research has established significant differences between the three seagrass habitats in the biomass and production of their above-ground and below-ground seagrass components; their epiphyte biomass and production; and the number and type of different species of epiphytes present. Results for fish and invertebrates indicated that differences between the three seagrass habitats were less pronounced in terms of the species present, but there were significant differences between vegetated habitats, i.e. seagrass meadows in general, versus shallow and deep unvegetated habitat. Invertebrate density, biomass and production were generally substantially higher in seagrass habitats than shallow unvegetated habitat, whereas the species composition, abundance and biomass of fish in deep unvegetated habitat differed significantly from all the shallow habitats, but there was less difference between seagrass habitat and shallow unvegetated habitat.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Water and Rivers Commission (2001) *Managing the Water Resources of the Cockburn Groundwater Area, WA – Interim Allocation Strategy,* Policy and Planning Allocation Branch, Perth Western Australia	To report on the issues and topics related to the management of the groundwater resources in the Cockburn Groundwater Area, focusing on the allocation and use of groundwater that can be sustained in the long term.	The Cockburn Groundwater Area has been subdivided into four new sub-areas to better reflect the geological and hydrogeological features of the area. A review of the recharge characteristics have allowed new and improved interim allocation limits to be set for each sub-area taking into consideration vertical recharge plus a component of throughflow.	CSMC
Western Australian Planning Commission (2001) *Metropolitan Region Scheme Amendment No. 1010/33 (Port Catherine) Amendment Report,* Perth Western Australia	This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment and Heritage on the proposed Metropolitan Region Scheme (MRS) Amendment 1010/33 – Port Catherine. The Port Catherine MRS Amendment was initiated by the Western Australian Planning Commission (WAPC) to facilitate the redevelopment of the former South Coogee industrial area into the Port Catherine marina and residential estate.	This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment and Heritage on the proposed Metropolitan Region Scheme (MRS) Amendment 1010/33 – Port Catherine. The Port Catherine MRS Amendment was initiated by the Western Australian Planning Commission (WAPC) to facilitate the redevelopment of the former South Coogee industrial area into the Port Catherine marina and residential estate. MRS Amendment No. 1010/33 – Port Catherine was initiated by the WAPC in February 1999 and referred to the EPA in accordance with section 33E of the *Metropolitan Region Town Planning Scheme Act 1959*. After considering the number of significant environmental issues raised by the proposal, including soil contamination, coastal impacts, remnant vegetation and seagrass meadows, the EPA set a level of assessment on the amendment proposal of 'Scheme Assessed – Environmental Review Required' in March 1999. An Environmental Review document was prepared by the WAPC (*Port Catherine Environmental Review* (Western Australian Planning Commission 2001)) and released for public comment from 20 November 2001 to 1 March 2002. Although approximately 350 submissions raised issues of a general environmental nature, 62 submissions raised environmental issues for which a response was warranted. Appendix 5 contains a summary of submissions and the response to these submissions from the WAPC. The summary of submissions and responses is included as a matter of information only and do not form part of the EPA's report and recommendations. Issues arising from this process that have been taken into account by the EPA, appear in the report itself. In compiling this report, the EPA has considered the environmental factors associated with the proposed scheme amendment; issues raised in the public submissions; specialist advice from the Department of Environmental Protection (DEP) and other government agencies; the response to submissions prepared by the WAPC; and the research and expertise of EPA members. Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the environmental factors relevant to the proposal. The Conditions to which the proposed scheme amendment should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides Other Advice from the EPA, Section 6 presents the EPA's conclusions and Section 7 the EPA's Recommendations.	CSMC & @ <http://www.epa.wa.gov.au/docs/1364_B1060.pdf>
Wesfarmers CSBP Limited (2001) *Remediation Action Plan Arsenic in Groundwater Kwinana Works,* Prepared for the Department of Environmental Protection and Water and Rivers Commission for project approval, Kwinana Western Australia	To summarise the known extent of arsenic impact below the Ammonia Plant at Wesfarmers CSBP's Kwinana works and present the proposed remedial strategy to address soil and groundwater impacts and define remediation targets which are based on future site usage and potential future impacts.	Priority has been given to the remediation of arsenic in soil and groundwater despite potential arsenic impacts to Cockburn Sound having a lower priority than nutrient impacts. An estimated 2730 kg of arsenic is within the aquifer below the ammonia plant. Recovery of dissolved arsenic will be achieved with two recovery bores located in the former Vetrocoke Area, at the inferred source area, where the highest concentrations of arsenic occur. Abstracted groundwater will be treated utilising a ligand-based process to remove arsenic, a nitrate ion exchange process to remove nitrate nitrogen, and a chlorine oxidation step for the removal of ammonium nitrogen. Treated water will be infiltrated back into the aquifer. Arsenic impacted soil will be excavated and disposed to landfill.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Appleyard SJ (2002) 'Submarine groundwater discharge as an environmental agent in the Perth Region, Western Australia', Conference Paper presented in Darwin, Northern Territory	To review the current state of knowledge of the discharge of nitrogen by groundwater to the ocean in Perth; To examine the environmental effects of this discharge; and To show some of the management measures currently being implemented to deal with the issue.	Submarine groundwater discharge can be a significant source of nitrogen for coastal marine environments. In the Perth region, groundwater contamination by nitrogen from excessive fertiliser use and poorly managed industrial sites is contributing to the loss of seagrass meadows, leading to a loss of biodiversity on fringing reefs, and triggering algal blooms. Currently, about 1600 tonnes of nitrogen is applied annually to lawn areas in Perth, and up to 10 tonnes per kilometre of coastline is discharging to the ocean in residential areas. The effects are most severe in Cockburn Sound where groundwater contributes 200–300 tonnes of nitrogen from industrial, rural and urban sources to the marine environment, or about 70% of the total nitrogen input to Cockburn Sound. Management of discharge of nitrogen by groundwater is complicated by the difficulty in accurately determining mass fluxes and by the combination of local point sources and regional diffuse sources of nitrogen contamination. Effective management of the issue requires a combination of local engineered solutions and regional catchment management initiatives.	CSMC
Cannell BL (2002) *Little Penguins on Garden Island: A Study of their Annual Cycle and Recommendations for Management,* Prepared for HMAS Stirling, Garden Island Western Australia	To: • Assess penguin population size and breeding success; • Determine the relationship to Penguin Island colony; • Determine current or potential threats to the colony; • Make recommendations (where possible) for immediate and longer term management of the colony; and • Make recommendations for longer term studies.	It appears that the penguins on Garden Island follow a similar annual cycle to the colony of Penguin Island, breeding from May-November/ December and moulting in November-January. Garden Island colony moults earlier than Penguin Island colony. The sample size was too small to make a conclusion about the morphometrics of this colony in comparison with Penguin Island. With the majority of penguins from Garden Island returning in the early twilight, it is presumed that they are foraging nearby, probably in Cockburn Sound. Nearby foraging would result in a higher breeding success, a greater probability of raising two clutches and perhaps a shorter interval between clutches. This was evident within the colony at Garden Island. Penguins have been sighted along the eastern shore and shelf edge of Cockburn Sound from September 2000 to March 2001. The population is estimated to be 100–120 birds using 70 burrows. Management of Little Penguins is mainly concerned with controlling mammalian predators (i.e. cats, dogs and foxes), protecting nesting habitats and minimising various kinds of human disturbance, including tourism, boat use, fire, oil spills and floating plastics.	CSMC
City of Cockburn (2002) *Local Emergency Management Plan,* Prepared by the Cockburn Local Emergency Management Advisory Committee (LEMAC), Western Australia	The aim of this document is to detail arrangements to prepare for and counter the impact of emergencies within the City of Cockburn.	The City of Cockburn follows the general emergency management principles promoted by Emergency Management Australia (EMA) Canberra and detailed in the State Emergency Management Advisory Committee (SEMAC) Policy Statement Nos 3 and 7. These principles involve four distinct considerations for each identified hazard. These are: a) Prevention b) Preparedness c) Response d) Recovery.	CSMC saved to disk & @ <http://www.cockburn.wa.gov.au/documents/councildoc/lemac website copy feb 03.doc>
Cockburn Sound Management Council (2002) *Interim Environmental Management Plan for Cockburn Sound and its Catchment,* Prepared for the Environmental Protection Authority, Perth Western Australia	To coordinate environmental planning and management of Cockburn Sound and its catchment.	Explains the management context and states the principles used to guide the development of the plan. Makes a large number of recommendations which aim to achieve the five point plan of action: • Protect the environmental values of Cockburn Sound • Facilitate multiple use of Cockburn Sound and its foreshore • Integrate management of the land and marine environments • Coordinate research and investigations • Monitor and report on performance.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Connard M, Dunlop JN, Goldberg J (2002) *The Population Ecology and Control of Feral Pigeons* Columbia livia *in the Kwinana/ Rockingham Region,* Prepared for the Rockingham Regional Environment Centre Feral Pigeon Control Group	To gather the biological information necessary to implement an integrated control program through determining: • the nature and location of sources of food, water and breeding sites; • patterns of movement by pigeons within the Rockingham/ Kwinana region; • population size and survivorship of pigeons inhabiting the Shoalwater Islands; • seasonal chronology; and • the efficacy of conditioned site aversion as an alternative control method.	The feral pigeon population has been growing in Rockingham/Kwinana area for at least the last two decades in association with expanding urbanisation and industrialisation of the region. Colonisation of the Shoalwater Islands occurred in the early eighties. The highest aggregate monthly count for the mainland stations was 2571 in May. Culling programs would have to be thorough and efficient to produce any significant reduction in these populations. Wheat was not an abundant seed type in bird crop contents.	CSMC
DA Lord and Associates (2002) *Fremantle Port Authority Outer Harbour Development – Cockburn Sound – Preliminary Environmental Impact Assessment,* Prepared for Fremantle Port Authority Fremantle Western Australia	To provide a preliminary assessment of impacts of the FPA development and the extent to which it may add to the effects of other proposals.	The assessment of cumulative impacts in Cockburn Sound is potentially complex. There is a legacy of anthropogenic impacts associated with past practices; the Sound is not in a pristine state. Hydrodynamic modelling reviewed three options for port configuration. The layout which allowed best flushing times was selected to assess the impact of the port and its effects. It was found that the physical scale of the FPA development is likely to modify the geometry of the main wind driven gyres in the northern and southern parts of the Sound. Further modelling was recommended to better quantify the impact of the port on the residence time of the Sound on a season and annual average basis. It was found that deepening the port to 14 m will reduce the frequency of vertical mixing within the port. Currently waters in the area are well mixed. The predicted mean increase in chlorophyll a in the FPA port is unlikely to be reflected in an increased frequency of outbreaks of local algal blooms or changes in the phytoplankton species assemblage from that currently found in the region. In relation to EPA objectives: the port will not 'maintain or improve water quality' in the Sound, but then neither will many recreational activities such as boating, fishing or horse exercising. The water quality in the port will be substantially better than that found in the Jervoise Bay Northern Harbour. In terms of EPA objectives: • the development does not result in the loss of existing seagrass meadows; • the concept design has minimised impacts on water quality; and • it appears that there are negligible impacts on surrounding developments. The impact on Cockburn Sound scale circulation requires further work to quantify, however it is expected to be minor.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
DA Lord & Associates (2002) *Independent Turbidity Monitoring Consultant- Quarterly Report No. 2 – Jervoise Bay Southern Harbour Dredge Monitoring,* Prepared for Department of Industry and Technology, Report No. 01/207/1	To present the results of the second and final quarterly monitoring report covering the period 4 July 2001 to 30 December 2001.	The simultaneous activities of three marine construction contracts for the Jervoise Bay Southern Harbour project in the period July 2001 to the end of December 2001 had the potential to produce marine turbidity which could adversely impact light-sensitive seagrass habitats in Cockburn Sound. These three contracts were: • island breakwater construction – core construction/armouring and the removal of the northern access section of the breakwater; • dredging works – dredging harbour basin and access channel; and • civil and marine works – construction of the perimeter wall prior to the bulk earthworks for land reclamation. Survey results showed that the seagrass at one site was most impacted by dredging but that the seagrass received adequate light for net growth. Monitoring of leaf and shoot density shows there has not been a significant impact on seagrass health to date.	CSMC
DA Lord & Associates (2002) *Independent Turbidity Monitoring Consultant- Quarterly Report No. 3 – Jervoise Bay Southern Harbour Turbidity Monitoring Programme and Southern and Northern Harbour Water and Sediment Quality Monitoring,* Prepared for Department of Industry and Technology, Report No. 02/207/3	To present the results of the third quarterly monitoring report for the period 30 December 2001 to 30 March 2002.	The simultaneous activities of three marine construction contracts for Jervoise Bay Southern Harbour Project in the period July 2001 to the end of March 2002 had the potential to cause turbidity to the extent that seagrass habitats in Cockburn sound could be impacted. The results of this study suggest that dredging and land reclamation activities have not impacted upon the seagrass. However, a short-term detrimental impact appears to have occurred on the seagrass at one site by way of interference with the sexual reproductive cycle of the *Posidonia australis* at this site. The seagrass parameters monitored during this study may not be adequate to comprehensively assess seagrass responsiveness to changes in light climate in the long term.	CSMC
DAL Science & Engineering (2002) *Benthic Habitat Mapping for 2002 of Selected Areas of Cockburn Sound,* Report prepared for the Cockburn Sound Management Council, Report No. 02/273/1	To present mapping of seagrass in two selected regional of Cockburn Sound: Southern Flats and Eastern Shoal.	The study mapped the coverage of benthic habitats using rectified aerial photography. Reference was made to previous groundtruthed studies. Light penetration through the water column in the Southern Flats area resulted in aerial interpretation being considered highly reliable. The area of seagrasses on the Southern Flats has increased from 1981 to 2002 by 33.7 ha. Due to moderate levels of turbidity in the water column in the Eastern Shoal region mapping was considered to have a medium level of reliability. Since 1981, the area of vegetated habitat appears to have remained relatively constant on the Eastern Shoal.	CSMC
Department of Fisheries (2002) *State of the Fisheries Report 2001/02,* Perth Western Australia	To provide a Statewide overview of the state of commercial and recreational fisheries for 2001–02.	In relation to Cockburn Sound the following was discussed: • A managed commercial crab fishery with 11 fishers operates in Cockburn Sound. This fishery contributed 212 t, just over a quarter of total State catch. • The commercial catch of garfish and herring has been rising steadily since 1970s. This is a concern for the recreational fishers. This fishery has been approved for a voluntary fishery adjustment scheme. • Wild capture is low due to energy being directed toward aquaculture. • There are 24 licensed line and pot fishers, although not all licensees exercise their fishing entitlement. • The herring catch in Cockburn Sound has declined since 1994 with 20 tonnes caught in 2001. The garfish catch has declined since 1999.	CSMC

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Department for Planning and Infrastructure (2002) *Kwinana Beach: Erosion protection and ongoing management works,* DPI Report No. 419, Prepared by Portfolio Management, Coastal Asset Management, Fremantle Western Australia	To investigate the progression of beach and dune erosion from the time leading up to the first installation of the rock revetment until the present, sufficient to identify: • the probable main causes of the erosive process; and • the average rate of sand volume loss over time. To review available options for halting the erosion and restoring the beach for recreational use.	The cause of erosion is the starving of the downstream beach by the *Kwinana* wreck at the northern end of Kwinana Beach, and the tombola that has formed onshore of the wreck. Since the construction of the Garden Island Causeway the southerly drift of sand along this section of Cockburn Sound has been interrupted by the tombola, and is unable to supply Kwinana Beach. The seawall enhances the erosion. Presents five management options and the pros and cons of each option. The recommended management option is to construct a series of crest armoured groynes and undertake nourishment to provide a recreational beach. The cost of this option (at the time of writing) was $887,151 over 30 years.	CSMC
Environment Protection Authority (2002) *The Big Picture: managing the Cockburn Sound Environment,* An explanatory document for the Environmental Protection (Cockburn Sound) Policy (revised draft, 2002) and related documents, Perth Western Australia	To outline what's involved in implementing the Environmental Protection Policy for Cockburn Sound and the accompanying Environmental Management Plan; To explain how the Environmental Protection Authority and the Cockburn Sound Management Council are providing a framework for the community and various industries/ operators to protect the Sound for present and future users.	No complete outcomes. EPP was not developed. The State Environmental (Cockburn Sound) Policy 2005 was developed instead.	CSMC
Environmental Protection Authority (2002) *Perth Metropolitan Desalination Proposal- Report and Recommendations of the Environmental Protection Authority,* Proposal submitted by Water Corporation, Bulletin 1070, Perth Western Australia	To provide the EPA's advice and recommendations to the Minister for Environment and Heritage on the environmental factors relevant to a proposal by Water Corporation of Western Australia to develop a 30 gigalitre per annum desalination plant at Kwinana.	The EPA considers that the proponent has demonstrated, in the Environmental Protection Statement submitted to it, that the proposal can be managed in an environmentally acceptable manner.	CSMC
Environmental Protection Authority (2002) *Metropolitan Region Scheme Amendment No. 1010/33- Port Catherine: Report and recommendations of the Environmental Protection Authority,*	To provide advice and recommendations to the Minister for the Environment and Heritage on the scheme amendment for the development of the former South Coogee Industrial Area.	The EPA notes that if the proposal is implemented, there will be requirements for the preparation of detailed environmental management plans to meet environmental objectives for terrestrial flora, soil and groundwater contamination, noise from railway transport and landscape amenity. The EPA also notes that vigilant ongoing environmental management of coastal processes (beach and seabed) and marine water and sediment quality will be necessary to meet environmental objectives. The EPA has concluded that implementation of the proposed Port Catherine MRS Amendment would be unlikely to compromise EPA objectives, provided that there is satisfactory implementation of the recommended environmental conditions.	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page Proposal submitted by Western Australian Planning Commission, Bulletin 1060, Perth Western Australia			
Environmental Protection Authority (2002) *James Point Stage 1 Port, Kwinana: Report and recommendations of the Environmental Protection Authority,* Bulletin 1076, Perth Western Australia	To provide advice and recommendations of the Environmental Protection Authority to the Minister for Environment and Heritage on the environmental factors relevant to the proposal by James Point Pty Ltd to construct and operate Stage 1 of a private container and general cargo Port to the north of James Point in Cockburn Sound.	James Point Pty Ltd proposes to construct and operate Stage 1 of a private container and general cargo port, consisting of a reclaimed land-backed cargo wharf, associated cargo handling facilities and an offshore breakwater to the north of James Point. The EPA decided that the following environmental factors relevant to the proposal required detailed evaluation in the report: marine biota and habitat, coastal processes, odour, noise, marine water and sediment quality, and coastal access and coastal activities. In summary, the EPA has concluded that it is unlikely that the EPA's objectives would be compromised provided there is satisfactory implementation by the proponent of the proponent's commitments and the recommended conditions set by the EPA.	CSMC
Environmental Protection Authority (2002) *Commercial HIsmelt Plant, Kwinana WA: Report and recommendations of the Environmental Protection Authority,* Bulletin 1068, Perth Western Australia	To provide the EPA's advice and recommendations to the Minister for Environment and Heritage on the environmental factors relevant to the proposal.	The EPA is aware of the various management measures that will be implemented by both the proponent and Fremantle Ports at Kwinana Bulk Berth No. 2 to mitigate any potential impacts on the marine environment. The EPA acknowledges that the proponent will ensure that shipping activities relating to the project will comply with the Draft Cockburn Sound Environmental Protection Policy and Environmental Management Plan, and that they will select reputable shipping contractors. The EPA decided that the following environmental factors were relevant to the proposal: atmospheric emissions; waste management; greenhouse gas emissions; surface and groundwater; noise and vibration; marine environment and water supply. Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by HIsmelt (Operations) Pty Ltd to construct and operate a commercial scale HIsmelt Process Plant at Kwinana is approved for implementation.	CSMC
Fremantle Ports (2002) *The Management of Tributyltin (TBT) Anti-foulants in Western Australia,* Environmental Fact Sheet No. 1	Regulations controlling the use of TBT paints have been introduced in WA by the Department of Environmental Protection (DEP). The DEP conducted a formal investigation into the impact of TBT paints on the marine environment, releasing a report titled 'The Environmental Impact of Organotin Anti-fouling Paints in Western Australia' which led to the introduction of legislation in 1991. The DEP also licenses ship maintenance facilities to ensure any toxic residues and discharges from hull cleaning activities are collected and disposed of at approved landfill facilities.	In 1998 Fremantle Ports introduced a ban on in-water hull cleaning in port waters, consistent with the ANZECC Code of Practice. This complemented the regulatory controls introduced by the DEP and was further enhanced by the closure of the slipways located in the Fremantle Inner Harbour. A recent comprehensive sediment survey conducted by DA Lord & Associates on behalf of the Kwinana Industries Council determined that 28 of the 31 sites sampled had TBT levels less than the suggested ANZECC screening guideline level of 5 µg TBT kg. This means there were only 3 locations, typically those associated with extensive hull cleaning operations in the past, with elevated TBT levels at which further investigation for potential environmental impacts should be undertaken. All measured TBT levels were significantly lower than those reported in the Department of Environmental Protection's 1996 report 'Southern Metropolitan Coastal Waters Study', indicating that the controls on TBT use and ship maintenance activities have been very effective in reducing TBT entering the marine environment and that degradation is occurring at a faster rate than accumulation. Additional work conducted by Fremantle Ports also shows that the elevated levels of TBT in the area of the old slipways in the Inner Harbour have been declining steadily since the slipways were taken out of service.	CSMC & <http://www.fremantleports.com.au/EnvironmentSafety/Caring/fact_sheets_1.pdf>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	Monitoring within port waters will continue as part of Fremantle Ports' Marine Quality Monitoring Program and the Kwinana Industries Council water quality monitoring programs to confirm the downward trend in TBT levels.		
Hercock M (2002) 'Profile: Integrating Local Environmental Management and Federal/State Interests through Governance: The case of the Garden Island Environmental Advisory Committee', *Environmental Management* Vol. 30 3:313-326	To contribute to the notion that the advisory committee is a useful tool to integrate the management of diverse environmental uses in a federal political system where the different levels of government have various administrative roles and responsibilities.	The case of Garden Island, Western Australia illustrates how public land can be administered for the multiple uses of national defence, public, recreation, conservation and scientific research. The island manager, the Royal Australian Navy, under the federal Department of Defence, takes an integrated approach to the use of its public lands in Australia. The development of the Garden Island Environmental Advisory Committee (GIEAC) provides for an integrated approach to environmental management of the island and activities occurring upon it. It could be argued that because the priorities of the Navy ultimately override those of nature conservation or wildlife management that environmental concerns are not met. However, the different interests represented on the GIEAC bring a range of knowledge that enables the development of different solutions to such problems.	HMAS Stirlng
Kendrick GA, Aylward MJ, Hegge BJ, Cambridge ML, Hillman K, Wyllie A, Lord DA (2002) 'Changes in seagrass coverage in Cockburn Sound Western Australia between 1967 and 1999', *Aquatic Botany* 73:75-87	Changes in seagrass coverage in Cockburn Sound from 1967 to 1999 were assessed from aerial photographs using modern mapping methods with the aim of accurately determining the magnitude of change in hectares of seagrasses between 1967 and 1999 and to set up a baseline for future monitoring of seagrass loss in Cockburn Sound.	Changes in seagrass coverage in Cockburn Sound from 1967 to 1999 were assessed from aerial photographs using modern mapping methods with the aim of accurately determining the magnitude of change in hectares of seagrasses between 1967 and 1999 and to set up a baseline for future monitoring of seagrass loss in Cockburn Sound. Firstly, coverage and assemblages of seagrasses in Cockburn Sound were mapped using the best available aerial photographs from 1999, rectified to a common geodesic base with comprehensive groundtruth information, and with a semi-automated mapping algorithm. Then the same technique was used to map historical seagrass coverage in Cockburn Sound from aerial photographs taken in 1967, 1972, 1981 and 1994. The seagrass coverage in Cockburn Sound has declined by 77% since 1967. Between 1967 and 1972, 1587 ha of seagrass were lost from Cockburn Sound, mostly from shallow subtidal banks on the eastern and southern shores. By 1981, a further 602 ha had been lost. Since 1981, further seagrass losses (79 ha) have been restricted to a shallowing of the depth limit of seagrasses, and localised losses associated with port maintenance and a sea urchin outbreak on inshore northern Garden Island. There has been no recovery of seagrasses on the eastern shelf of Cockburn Sound after nutrient loads were reduced in the 1980s, suggesting that this shallow shelf environment has been altered to an environment not suited for large-scale recolonisation by *Posidonia* species.	Link @ <http://linkinghub.elsevier.com/retrieve/pii/S0304377002000050>
Kwinana Industries Council (2002) *Kwinana Industrial Area Economic Impact Study, Part A,* Kwinana Western Australia	This is a report on the Kwinana Industrial Area (KIA), commissioned by the Kwinana Industries Council (KIC) and the Chamber of Commerce and Industry of WA (CCI) [in association with the Department of Mineral and Petroleum Resources, the Department for Planning and Infrastructure and LandCorp] and prepared by Sinclair Knight Merz. Environment Australia also partly funded this study. This report looks at financial, social, material and energy information and: measures the direct (and indirect) economic	This report was commissioned by the Kwinana Industries Council (KIC) and the Chamber of Commerce and Industry of WA (CCI), and supported by government agencies, to provide an enhanced update of the 1990 economic impact study, to collate financial, scoial, material and energy data related to the KIA and to provide the following outputs: to quantify the direct and indirect economic and social importance of Kwinana industries to the local, Western Australian and Australian communities; to identify innovative development options, and to quantify the benefit of additional industrial and port development, subject to new planning initiatives and land availability; to identify positive community impacts which flow from the KIA, such as training and educational schemes; and to determine opportunities for sustainable industrial development through a review of the current interactions between industries and the identification of potential new resource saving and pollution prevention opportunities for integration. This report will be used for a number of purposes including: to promote the importance of the KIA; to serve as a reference document for CCI/KIC submissions; to provide an overview of social and environmental issues to the public; to assist in communication between existing industries; to provide an input/output database so that a wider audience can identify opportunities for synergy between industries;to inform potential new industries; and to provide an important reference for State government.	Link @ <http://www.kic.org.au/documents/Part%20A%20-%20Economic%20Impact%20Study.pdf>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	and social importance of Kwinana industries to local, West Australian and Australian communities; measures the benefit of additional industrial and port development (subject to new planning initiatives and land availability) and identifies these options; recognises positive community impacts (such as training and educational schemes); and ascertains opportunities for sustainable industrial development (through a review of industry interaction) and identifies new resource saving, and reuse and recycling opportunities. This report is based on the responses from 28 (out of 35) Kwinana industries surveyed and data and opinion from Kwinana industries, support industries, government planning bodies and other interested parties.		
Middle G (2002) 'Managing competing interests in Cockburn Sound: Have Western Australian policy makers learnt from past mistakes? Presentation to Coast to Coast Conference 2002	To present the initial results of research that critically examines the policy approach planned for Cockburn Sound within the context of the existing Western Australia coastal policy framework.	The policy and management framework to be adopted for Cockburn Sound appears to overcome some of the problems associated with existing arrangements. The Cockburn Sound Management Council offers a representative forum through which issues could be resolved. All the key stakeholders, including community and industry groups, have stated their willingness to support the above policy and management framework for the time being and to use the Council as a forum to have their concerns addressed. This framework, therefore, provides a useful model for regional coastal planning and management in the State, provided adequate resources are made available to address stakeholder concerns.	CSMC
Ministry for Planning and Infrastructure (2002) *Freight Network Master Plan,* Perth Western Australia	To strategically examine the metropolitan freight system in order to identify actions to achieve greater sustainability.	The Perth metropolitan area contains 74% of the State's population and has a major influence on the generation and movement of freight. A significant proportion of freight movement within the metropolitan area is generated by residential and industrial uses. Port facilities at Fremantle and Kwinana handle bulk commodity freight such as grain, fuel, alumina and bauxite, and fertilisers, as well as containers, livestock and motor vehicles. Many of these bulk freight items originate in or have destinations in regional WA and are transported to and from Fremantle or Kwinana by road and rail. The bulk of sea freight passing through Fremantle Ports (78%) is handled through the Outer Harbour at Kwinana. Freight movement is an essential part of the way we live and information indicates that the freight task is expected to grow significantly in the future. This growth will occur in parallel with the growth of transport demand overall and therefore there will be increased competition for use of an increasingly congested transport network. There are a number of options for meeting freight and general transport demand including the provision of new infrastructure. However, this can be expensive so there is a need to ensure the current transport system is functioning as efficiently as possible.	CSMC

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PPK Environment and Infrastructure (2002) *Jervoise Bay Recovery Bores Monitoring Review No. 3 – August to November 2001,* Prepared for Department of Industry and Technology, Perth Western Australia	To report on the outcomes of the groundwater recovery scheme for Jervoise Bay, Northern Harbour.	The Department of Industry and Technology has constructed a groundwater recovery scheme to reduce the amount of nitrogen-rich groundwater discharging into the Northern Harbour. The recovered groundwater is pumpled to the effluent pumping station at the Woodman Point Wastewater Treatment Plant and discharged into the Sepia Depression off Cape Peron at Rockingham. The scheme, with a licence to recover and dispose of groundwater to a maximum average flow of 4100 kL/day, commenced operation in December 2000. In general, measured values for dissolved inorganic nitrogen in the recovery bores have been variable, which makes it difficult to gauge the success of the nitrogen recovery program. However, the average DIN concentrations over the past 3 months are significantly lower than the concentrations observed in the harbour over the past 3 years.	CSMC
PPK Environment and Infrastructure (2002) *Jervoise Bay Recovery Bores Monitoring Review No. 4 – Dec. 2001 to March 2002,* Prepared for Department of Industry and Technology, Western Australia	To report on the outcomes of the groundwater recovery scheme for Jervoise Bay, Northern Harbour.	As above, with the addition of concerns over EC levels. It is recommended that if EC levels continue to rise, recovery should cease until the aquifer can be replenished by winter rainfall.	CSMC
PPK Environment and Infrastructure (2002) *Jervoise Bay Recovery Bores Monitoring Review No. 5 – April to July 2002,* Prepared for Department of Industry and Technology, Western Australia	To report on the outcomes of the groundwater recovery scheme for Jervoise Bay, Northern Harbour.	As above, with the addition that it appears that the efficiency of pumping two of the coastal recovery bores is greatly reduced during the summer months when the seawater wedge has migrated inland and is most efficient during the winter months when pumping draws in predominantly inland nitrogen-rich brackish water.	CSMC
Smith AJ & Hick WP (2002) *Nutrient Survey of Submarine Porewater along Rockingham Foreshore,* Prepared for Cockburn Sound Management Council by CSIRO Land & Water, Perth Western Australia	To undertake a nutrient survey of submarine porewater along the Rockingham foreshore to establish whether groundwater discharging from the Rockingham aquifer into Cockburn Sound was significantly enriched with nutrients.	Approximately 80 porewater samples were collected between Woodman Point and Palm Beach. Samples were collected from depths of approx. 0.5–0.5m below the seabed and within 10 m of the shoreline using an EC probe to locate the freshest porewater. Large nutrient concentrations were detected along the shoreline south of James Point. Very large nitrogen concentrations were detected along a short 40 m section of shoreline north of James Point. Slightly elevated nitrogen concentrations were detected along a short section of shoreline north of Challenger Beach. A potential inadequacy of the porewater survey was the close proximity of sampling locations to the shorelines and lack of knowledge regarding where groundwater discharges.	CSMC
Pattiaratchi C (2002) *Field Measurements of Current Flows through the Causeway and Mangles Bay,* Prepared for Cockburn Sound Management Council, Centre for Water Research, University of Western Australia, Ref: WP1772CP	To determine the dominant forcing mechanisms of flow through the Causeway and in Mangles Bay, and facilitate numerical modelling of the flow regimes in the region.	**Currents through the Causeway** Over the time-period of measurement there was a net flow from the ocean into Cockburn Sound. This is opposite to that found in autumn/ winter where the dominant flow was from Cockburn Sound to the ocean (Rose 2001). The maximum currents were of the order of 30 cm/s with low frequency and wind and seiche induced currents dominating the system. There is a strong correlation between the currents and wind; the currents respond to changes in wind almost immediately. When the mean sea level in Mangles Bay is increasing there is an outflow of water from Cockburn Sound to the ocean and vice versa. Seiche currents are present at all times. **Currents in Mangles Bay** The maximum currents were of the order of 28 cm/s at the surface with the wind induced currents dominating the system. The currents respond to changes in wind with a time lag, which also varies with depth. The surface currents respond with a time lag of 2 hours, which increases through the water column to be 6 hours near the bed.	CSMC

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Sinclair Knight Merz (2002) *Kwinana Industrial Area Economic Impact Study: an example of industry interaction,* Prepared for Kwinana Industries Council, Chamber of Commerce and Industry WA, Western Australian Planning Commission, LandCorp, Department of Mineral and Petroleum Resources and Environment Australia, Perth Western Australia	To present the financial, social, material and energy data and provide a realistic and conservative view of Kwinana industries.	The Kwinana Industrial Area: • is a major source of revenue for the State and Australian economies with direct sales of $4.35b per annum; • is the State's largest industrial area and accounts for 22% of the WA manufacturing sector's total factor income of $1275m; • has annual output work of $8.7b with employee earnings of $600m and 24,400 direct/indirect jobs; • employs 3636 people directly and pays $207m in annual salaries and wages; • contributes a high degree of social benefit to employees and the community; • has grown significantly since its inception in 1952 and represents a unique blend of connecting heavy, support and infrastructure industries; • plans for capital expenditures of $812m over the next five years, and an additional $1212m for the subsequent five years.	CSMC
Tunbridge D (2002) *Seagrass Monitoring Associated with Dredging for the Jervoise Bay Development,* Prepared for DAL Science and Engineering by Marine and Freshwater Research Laboratory, Murdoch University	To provide an assessment of seagrass condition in relation to the Jervoise Bay development.	There was no significant change in shoot density from July 2001 to March 2002, nor a significant change in leaf density at either site from July to December 2001. There was however a significant difference in leaf density at both sites from December 2001 to March 2002. Seagrass flower development was observed as compromised at one site, with a considerable amount of amphipod tube burrows and macroalge located within the flower structures thought to have been the cause.	CSMC
URS Australia Pty Ltd (2002) *Management of Hull Fouling and Fouling Control Coatings on Collins Class Submarines at Fleet Base West: with further consideration of marine pest risks represented by ballast water and hull fouling in all FBW fleet units, and the environmental acceptability of in-water maintenance of antifouling coatings in Careening Bay,* Prepared for Department of Defence, Perth Western Australia	To report upon the management of hull fouling on Collins class submarines and to examine the amenity of submarines to act as hosts for fouling organisms and introduce them to Garden Island or surrounding waters; To examine options to limit the recruitment and growth of hull fouling, including growth limitation and suppression measures and hull cleaning procedures.	Hull fouling presents particular problems for submarines because of their design and operations, and the engineering features and operational profiles of submarines also present unique problems to be overcome when managing fouling. *Intersleek* currently represents the only realistic alternative fouling control system for anechoic tiled areas of Australian submarines, unless acceptable performance of copper-based paint systems can be proved; however they have proven less than satisfactory. *Intersleek* surfaces can be cleaned in-water without risk of environmental pollution. Special procedures and techniques need to be developed to ensure effective control of fouling biota which occur within not easily accessible areas of the submarine. Recommendations are made on protecting the environment from fouling organisms.	HMAS Stirling Environment Office
Welker Environmental Consultancy (2002) *Drought Emergency Response Plan: Perth metropolitan desalination proposal – Environmental Protection Statement,* Prepared for the Water Corporation, Perth Western Australia	To present environmental considerations for three location options for the Perth Seawater Desalination Plant.	The report presents three proposed locations for a seawater desalination plant: Woodman Point, East Rockingham and the Kwinana Power Station, and provides information about the suitability of those sites for development.	CSMC

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Asia Pacific Applied Science Associates (2003) *Assessment of the Turbidity and Deposition Patterns Associated with Dredging Works at the Garden Island Naval Base Armaments Jetty, Cockburn Sound,* Prepared for Department of Defence, Perth Western Australia	To document the modelling methods and findings for dredging operations planned for the shipping basin on the southern side of the armaments jetty of the HMAS Stirling Naval Base.	In general, results suggested that some material could spread up to 6 km or more from the discharge site before settling out. Most material is expected to settle out closer to the discharge site so that only a light sprinkling of material (1–10 µm) should occur further than 2 km from the discharge point. Seagrass beds were predicted to receive some sediment discharged at the disposal area, irrespective of the sediment grain size mixture, although average thickness was predicted to be < 1000 microns (1 mm). Plumes were predicted to sink within 12–18 hours following cessation of disposal and the plume position was also predicted to change over time.	HMAS Stirling Environment Office
ATA Environmental (2003) *City of Rockingham Urban Wetlands and Drainage Swale Study,* Report No. 2001/152, Prepared for City of Rockingham Western Australia	To prepare an inventory of urban wetlands and drainage swales and their characteristics; identify environmental problems that have occurred in the identified urban wetlands and drainage swales; identify the characteristics of the urban wetlands and drainage swales that contribute to environmental problems; and provide guidelines that will help in the ongoing management of existing constructed wetlands and drainage swales and in the design of future wetlands and drainage swales.	Residential development is often accompanied by modification of the natural environment to create wetlands and low-lying features to accommodate stormwater or provide aesthetic appeal. The City of Rockingham has experienced ongoing management problems, such as excessive algal growth, bird deaths, odour and poor infiltration with some of the wetlands and drainage features in urban areas. A total of 73 urban wetlands and drainage basins were identified and assessed. Of the 73, 27 are experiencing or have previously experienced management problems, primarily relating to flooding and poor infiltration, algal growth and mosquito breeding. Based on the results of this study combined with knowledge of wetland systems, generic management responses were formulated for each urban wetland and drainage swale to assist the City of Rockingham in undertaking remedial measures.	City of Rockingham
Campbell RA (2003) *Demography and Genetic Population Structure of the Australian Sea Lion (*Neophoca cinerea*),* PhD Thesis, University of Western Australia	The Australian sea lion, *Neophoca cinerea*, is Australia's only endemic pinniped, and one of the rarest sea lions in the world. This species suffered localised extinction events, and a probable population decline during the commercial sealing era of the 18th to 20th centuries.	The Australian sea lion, *Neophoca cinerea*, is Australia's only endemic pinniped, and one of the rarest sea lions in the world. This species suffered localised extinction events, and a probable population decline during the commercial sealing era of the 18th to 20th centuries. This species has a unique reproductive cycle and breeding system compared with all other pinnipeds. Unlike the usual annual, synchronous cycle, this species has a 17.5 month breeding cycle which is asynchronous across its range. Small groups of proximate colonies appear to breed synchronously, but otherwise the timing appears randomly distributed. It was proposed that this system is endogenously controlled and maintained by exclusive female natal site fidelity (Gales *et al*. 1994). This would have a discernible impact on the population's genetic structure, and would be directly applicable to conservation management practices. Investigation of population genetic structure of the Australian sea lion using mtDNA and microsatellite markers revealed a highly subdivided population that showed strong patterns of sex-biased dispersal, and strong regional divisions. The level of female natal site fidelity was extreme, resulting in very high levels of genetic differentiation, unparalleled in other marine mammal populations. Significant divisions existed across both macro and micro geographic scales, with fixed differences occurring between colonies separated by as little as 20 kilometres. Strong phylogeographic patterning suggested that divisions between populations are of some antiquity. High levels of fixation in mtDNA markers among the many small colonies in Western Australia were attributed to the high rate of genetic drift in small populations, especially for these markers. Genetic subdivison, as measured by microsatellite markers, revealed a male-biased dispersal pattern. Levels of male dispersal were sufficient to overcome the female natal site fidelity and render small groups of colonies	CSMC & @ <http://theses.library.uwa.edu.au/adt-WU2005.0058/>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		effectively panmictic. However, the range of male dispersal was limited to approximately 200 kilometres and resulted in a regional population structure best defined by geographic distance. This level of subdivision was perhaps greater than expected given the dispersal capabilities of this species, and suggested that some behavioural processes may limit dispersal. Historical processes of extinction and colonisation are thought to have had a strong influence on the current pattern of population subdivision as well.	
City of Rockingham (2003) *Report Card: State of the Environment Report and Environmental Action Plan,* Rockingham Western Australia	To provide an assessment of the state (health) of the local environment; describe the pressures on the environment and assess the extent of those pressures; and propose a series of management and policy responses that will address the key pressures and improve the health of the environment.	Makes recommendations for City of Rockingham involvement in the management of: • coastal waters • inland waters • coastal foreshore • bushland • atmosphere • waste • noise • land degradation (salinity and erosion) • heritage	CSMC
Cockburn Sound Management Council (2003) *Sampling and Analysis Plan – Zinc, Nitrogen and Phosphorus measurements in the water and sediments of the Lake Richmond drains and Mangles Bay, and in the waters of Lake Richmond,* Rockingham Western Australia	To describe the procedures for sampling and analysis of representative samples of water and sediment at selected points of Lake Richmond, Mangles Bay and the drain between the two water bodies.	This sampling analysis plan was formulated in partnership with the Department of Environment's Aquatic Sciences Branch and the Naragebup Regional Environment Centre. Responsibility for implementation was shared among the groups, with primary responsibility being with Cockburn Sound Management Council.	CSMC
Corporate Environmental Consultancy (2003) *Groundwater (Protection) Management Plan – HIsmelt Commercial Plant,* HIsmelt Operations, Perth Western Australia	To present a groundwater (protection) management plan for the Commercial HIsmelt Plant in Kwinana, Western Australia, prior to its construction.	The objectives of the Groundwater (Protection) Management Plan for the construction phase of the project are to: develop management measures that are to be implemented to ensure that construction activities do not adversely impact on groundwater under the site; and document the groundwater monitoring program that is to be undertaken prior to and during the construction phase. The plan outlines the responsibilities of officers of the company and monitoring requirements of bores.	CSMC
'Aquatic locomotion and behaviour in two disjunct populations of Western Australian tiger snakes, *Notechis ater occidentalis'*, *Aust Journal of Zoology*, 2004, 42, 357–368	Behavioural and locomotion study of tiger snake populations on Carnac Island.	Adaptive phenotypic plasticity can be viewed as an evolutionary strategy that enables organisms to match their phenotypes to local conditions. Two neighbouring populations of amphibious freshwater tiger snakes from Western Australia were studied. One mainland population occurs around a lake, feeds primarily on frogs and is under strong predation pressure, whereas the second population inhabits a small offshore island (Carnac) with no standing water and no known predators, and feeds primarily on chicks. This study suggests strong behavioural flexibility in tiger snakes depending on habitats.	CSMC & <www.bio.usyd.edu.au/Shinelab/staff/fabien/3aquaticloco.pdf>

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CSIRO (2003) *Quantifying Submarine Groundwater Discharge and Nutrient Discharge into Cockburn Sound, Western Australia,* A technical report to Coast and Clean Seas Project WA 9911: Quantifying Submarine Discharge and Demonstrating Innovative Clean-up to Protect Cockburn Sound from Nutrient Discharge, Technical Report No. 1/03	The objective of this study was to use an integrated approach involving a range of measurements and techniques to estimate groundwater nutrient loadings and identify major inputs into Cockburn Sound.	The waters of Cockburn Sound are the most intensively used marine system in WA. Decline in the health of seagrass in Cockburn Sound first became apparent in the 1950s and by the mid 1990s approximately 80% of the original meadows had been lost. A major study in the late 1970s attributed seagrass death to eutrophication and smothering of plants by epiphytic algae, which were thriving in the nutrient-enriched waters. Waste disposal by major industries, ocean discharge of sewerage effluent, and inshore contamination of groundwater that is known to discharge via submarine groundwater discharge into Cockburn Sound were identified as the main factors contributing to nutrient enrichment. Management responses to reduce nutrient inputs appeared initially to have been successful and measurable improvements ini marine water quality had occurred by the early 1980s. However, by the 1990s chlorophyll a concentrations had re-deteriorated and were close to the worst levels experienced in the 1970s. In addition, episodic marine algal blooms have been observed.	CSMC & @ <http://www.clw.csiro.au/publications/technical2003/tr1-03.pdf>
DAL Science and Engineering (2003) *The Influence of Garden Island Causeway on the Environmental Values of the Southern End of Cockburn Sound,* Report prepared for the Cockburn Sound Management Council, Report No. 02/247/2	To model the water circulation and exchange in Cockburn Sound, with a specific focus on the nature of water movements in Mangles Bay; To apply the model to identify how water circulation and exchange in Mangles Bay may change under different design options of the Garden Island Causeway; To identify the positive and negative impacts of each scenario on the ecology, coastal processes, existing and future uses of Mangles Bay.	Causeway configurations examined through modelling were as follows: • existing causeway openings; • double the size of the existing causeway openings; • additional causeway openings, comprising removal of the portion between the southern opening and the mainland, and three additional openings each 200 m wide; and • no causeway present. The study acknowledges the limitations on modelling outcomes given the variability in circulation, nutrient levels and locations, and ocean exchange. Study estimates indicated the causeway reduced natural flushing by up to 40%. Modelling found that the removal of the causeway produced the optimal level of increased flushing times in Mangles Bay, and in the southern basin of the Sound. It was inferred that removal of the causeway should result in a considerable improvement in water quality in the Mangles Bay deep basin, small improvements in the shallows of Mangles Bay/ Rockingham/Kwinana, and little change elsewhere. Removal of the causeway should result in improvements in water quality that improve the health and extent of seagrass meadows at their depth limit in the Mangles Bay area. A feature of the species of seagrass found in Cockburn Sound appears to be that, once lost, they do not always readily re-establish even if conditions are suitable. The removal of the causeway would be expected to change littoral transport of sediment, due to an increase in wave energy, causing a change in beach profile at Mangles Bay and further a field. There is the possibility that sediment may deposit on the nearshore seagrass meadows. Any removal/alteration of the causeway is likely to cause considerable disruption to the operation of the Naval Base on Garden island. Nor could the causeway be removed before a new bridge was in place. The Point Peron boat ramp would still require a structure in place to protect it from the influence of north-easterly, easterly and south-easterly winds and the jet/water ski area would lose protection. It could be expected that mussel aquaculture near the causeway and CBH may be influenced by a reduction in phytoplankton levels resulting from improved flushing. The proposed Mangles Bay Marina design will need to achieve sufficient dilution of marina water to avoid adverse environmental impacts in Mangles Bay, irrespective of the presence/absence of the causeway.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
DAL Science and Engineering Pty Ltd (2003) *HMAS Stirling Naval Base – Dredging of Armaments Jetty (WA990865) Environmental Impact Assessment and Dredging Environmental Management Plan,* Prepared for the Department of Planning and Technology, Report No. 274/1	To document environmental impacts of dredging the Armaments Jetty at Garden Island.	The Department of Defence is proposing to deepen the existing berth pocket to the south of the Armaments Jetty by July 2003 to meet operational commitments. The Armaments Jetty is used exclusively for the loading and unloading of ordinance from naval vessels. There has been no maintenance of dredging at this site since construction in 1972. Disposal of the dredged material is discussed and options presented. Environmental impacts are expected to include: elevated turbidity levels and sedimentation; dune vegetation removal; shoreline instability; sediment contaminants; fish disturbance.	HMAS Stirling
DAL Science & Engineering Pty Ltd (2003) *Jervoise Bay Marine Monitoring Programme – Water Quality Monitoring Annual Report 2002,* Report No. 284/1, Prepared for Department of Industry and Technology, Perth Western Australia	To present the water quality and seagrass monitoring work undertaken by DAL Science and Engineering since the completion of the Independent Turbidity Monitoring Consultant Quarterly Report No. 3 (2002)	The water quality within the Jervoise Bay Northern Harbour continues to be significantly impacted by the influx of nitrogen rich groundwater, however, the implementation of the Jervoise Bay Groundwater Recovery Scheme has been followed by a definite improvement in nutrient related summer water quality within the Northern Harbour. It is still considered unlikely that water quality in the Northern Harbour will ever meet the Environmental Quality Guidelines and Environmental Quality Standards prescribed for chlorophyll a and light attenuation coefficient. It appears that any increase in productivity in the Southern Harbour has been minor and at a similar level of increase above background to that predicted in the Environmental Impact Assessment documentation. The post-construction seagrass health monitoring strongly suggests that the seagrass in the vicinity has recovered from any potentially detrimental influences due to the dredging and construction activities associated with the development of the Southern Harbour. There is considered to be no need for further seagrass health monitoring.	CSMC
DAL Science and Engineering Pty Ltd (2003) *Refurbishment of Stage C Cooling Water Canal at Kwinana Power Station – Referral Application,* Report No. 315/1, Prepared for Western Power, Perth Western Australia	To provide a detailed assessment of the environmental impacts of the project and the proposed management of these impacts.	Western Power has evaluated the condition of the cooling water canal structures at Kwinana Power Station. The canal system returns seawater to the ocean after it has been used to cool steam used in electricity generation. The cooling water canal has been operating in excess of 26 years. Engineering surveys of the canal have found that corrosion to the bracing and steel sheet piling has resulted in degradation to the overall structure and its strength. The refurbishment work will involve the installation of prefabricated concrete U-section box culverts to be placed within the existing steel sheet piling, allowing the base of the culverts to form a concrete floor on the seabed.	CSMC
DAL Science and Engineering Pty Ltd in conjunction with DPI (2003) Cockburn Sound Profile Monitoring, Prepared for Defence Estate Organisation		A series of 60 beach profiles were established around the shorelines of Cockburn Sound in 1974. These profiles have been surveyed in 1974, 1975, 1979, 1979, 1980 and 1990. This survey occurred in 2003. 11 new profiles were added. Data provided on CD ROM.	
Department of Conservation and Land Management (2003) *Rockingham Lakes Regional Park: Draft Management Plan 2003–2013,* Perth Western Australia	To provide direction for the protection and enhancement of the conservation, recreation and landscape values of Rockingham Lakes Regional Park and to outline strategies aimed at conserving features of the Park and providing for community requirements.	Regional parks are areas of regional open space that have been identified through planning processes as having regionally significant conservation, landscape and recreation values. Regional parks may comprise lands with a variety of tenures and reserve purposes, drawn together for coordinated management by the Department of Conservation and Land Management. Rockingham Lakes Regional Park is one of eight regional parks in the Perth metropolitan area. The Park covers 4270 hectares and consists of coastal areas, wetlands and remnant bushland areas.	CSMC

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Department of Fisheries (2003) *State of the Fisheries Report 2002/03,* Perth Western Australia	To provide a Statewide overview of the state of commercial and recreational fisheries for 2002–03.	In relation to Cockburn Sound the following was discussed: • A managed commercial crab fishery, with 11 fishers, operates in Cockburn Sound sharing a total of 840 crab traps. This fishery contributed 104 t, about one seventh of total State catch. This catch was the lowest in eight years and well below the accepted range of 200–350 t. Effort in Cockburn Sound decreased considerably in 2001–02, with only three fishermen operating past March as the available commercial stock was substantially depleted well before the end of the season. • Surveys quantifying recreational catch are currently being conducted in Cockburn Sound. • The commercial catch of garfish and herring has been rising steadily since 1970s. This is a concern for the recreational fishers. One licence was withdrawn from this fishery. • Two licences exist for mussel collection and aquaculture, although wild capture was very low due to the integration of the fishery with the mussel aquaculture operations. • There are 25 licensed line and pot fishers, although not all licensees exercise their fishing entitlement. Commercial landings of King George whiting, western sand whiting, squid and octopus have declined in recent years. The underlying reasons for this are yet to be revealed. • The herring catch in Cockburn Sound was 22 tonnes. The garfish catch has continued to decline since 1999–2000. • Catch and effort data collected as a part of a recreational shore and boat based fishing survey reported 57 finfish species and 6 invertebrate species in Cockburn Sound and Owen Anchorage, the key recreational finfish being 31 t of herring, 19 t of whiting and King George whiting, 5 t of tailor, 4 t of pink snapper, 4 t of garfish, 3 t of skipjack trevally and 2 t of silver bream.	CSMC
Environmental Protection Authority (2003) *Kwinana Ammonia Project, Kwinana Industrial Area: change to environmental conditions to allow ammonia export*, Section 46 Report and Recommendations of the Environmental Protection Authority, Proposal submitted by Wesfarmers CSBP Ltd, Bulletin 1094, Perth Western Australia	To provide advice and recommendations to the Minister for the Environment and Heritage on the environmental factors, conditions and procedures relevant to the proposal.	The EPA supports CSBP's request to export ammonia from its facilities at Kwinana subject to ammonia transfers (imports and exports) being limited to no more than nine per year. The EPA is satisfied that CSBP and the relevant authorities have established procedures in place to manage the public risk associated with ammonia importation and that the procedures will be updated as required to incorporate ammonia export, prior to the commencement of export operations. The EPA is satisfied that the off-site individual fatality risk for ammonia export is similar to the risk for the currently approved ammonia importation.	CSMC
Fremantle Ports & Department for Planning and Infrastructure (2003) *Port Expansion Planning History – Perth Metropolitan Region Revision A,* Perth, Western Australia	To present the planning history for the proposal to develop an outer port facility.	Since the 1800s the Outer Harbour has been recognised by the shipping industry as a safe and protected site for port facilities. Planning for expanded port facilities to supplement the Inner Harbour of Fremantle has been ongoing since the 1940s. Planning work to date has generally arrived at the same conclusions: that an expanded port facility is required in the Perth Metropolitan Region and that Cockburn Sound is the appropriate location for an expanded port facility.	CSMC

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Government of Western Australia (2003) *Statement of Planning Policy No. 2.6 – State Coastal Planning Policy,* Prepared by the Western Australian Planning Commission	The policy provides high order guidance for decision-making on coastal planning matters and applies Statewide.	The policy requires strategic plans to guide local planning, development setbacks for protection against coastal processes such as erosion and storms, and the provision of coastal foreshore reserves. Guidance is provided on determining setbacks. The preparation of coastal planning strategies or coastal foreshore management plans in partnership with the broader community is also strongly advocated. The policy provides high order guidance for decision-making on coastal planning matters and applies Statewide. Implementation will be through local government town planning schemes, and regional and local strategies. The objectives of this policy are to: protect, conserve and enhance coastal values, particularly in areas of landscape, nature conservation, Indigenous and cultural significance; provide for public foreshore areas and access to these on the coast; ensure the identification of appropriate areas for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities; and ensure that the location of coastal facilities and development takes into account coastal processes including erosion, accretion, storm surge, tides, wave conditions, sea level change and biophysical criteria.	Link @ <http://www.wapc.wa.gov.au/Publications/Downloads_GetFile.aspx?id=139>
HIsmelt (Operations) Pty Ltd (2003) *Commercial HIsmelt Plant,Kwinana Western Australia: Environmental Management Plan – Plant Construction*	To ensure that: • Environmental impacts during construction are minimised; • Construction activities comply with the State Legislation, Ministerial Conditions and Works Approval Conditions that are relevant to the project.	The Stage 1 Plant will be designed to process around 1.3 Mtpa of iron ore and 560,000 tpa of coal to produce around 820,000 tpa of pig iron using the HIsmelt Process. The process is a direct smelting process that produces liquid iron by the smelting of iron ore or any other appropriate ferrous feed material. The smelting is undertaken in a molten iron bath using coal as the reductant and energy source. The molten iron is cast into solid pig iron for export. This plan sets out the responsibilities of officers of the company, a description of the regional environment, and general environmental management activities.	CSMC
Houghton DS, Eliot IG, Eliot M (2003) *Use of Beaches on the Perth Metropolitan Coast between Rockingham and Ocean Reef,* Prepared for the Department for Planning and Infrastructure by the School of Earth and Geographical Sciences, University of Western Australia	To provide a basis for compilation of a long-term time-series describing change in use of the metropolitan beaches.	**Coogee Beach:** ~250 users on a summer day in 1999. Parking appears to exceed demand. **Rockingham Beach:** < 250 users on a summer day in 1999. This report presents little information for beaches adjacent to Cockburn Sound and Owen Anchorage.	CSMC
LandCorp (2003) *Environmental Review – Hope Valley Wattleup Redevelopment Project,* Perth Western Australia	To describe the existing environment and the potential environmental impacts, together with a description of management strategies.	The following environmental factors have been addressed: sustainability; land use compatibility; catchment management; flora; fauna; wetlands; surface water and groundwater; conservation areas; air quality; water quality; soil quality; noise; potential pollutants; and risk.	CSMC
Lavery P & Westera M (2003) *A Survey of Selected Seagrass Meadows in the Fremantle-Warnbro Sound Region,* Report No. 2003-00 Centre for Ecosystem Management, Edith Cowan University	To present the outcomes of a rapid assessment of seagrass 'health' at a number of locations between Stragglers Rocks and Warnbro Sound in the Perth metropolitan waters.	Overall, the results indicate that there were no significant region-wide changes in the status of seagrass meadows at the sites surveyed between 1998 and 2003. However, there are some notable site specific trends, namely: • Southern Flats, Stragglers Rocks and Woodman Point showed inter-annual changes but generally remained stable over the 1998–2003 period. • Kwinana compared poorly with other areas when spatial comparisons were conducted (1999–2000) and showed evidence of stress over the period of 1998–2000 but showed no signs of further deterioration in 2001–03.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		• At Carnac Island, the cover of *Posidonia sinuosa* appears to be decreasing relative to other species, perhaps due to competition with *Amphibolis griffithii, Posidonia coriacea* and *Posidonia australis* that now dominate the site. • Seagrass above-ground biomass has decreased at Garden Island 7 m and Fish Rocks. At Fish Rocks the cause of this decrease is difficult to discern, given the low epiphyte cover and the lack of any obvious anthropogenic impacts. At Garden Island 7 m, differences were significant over the 5 years of sampling and dead rhizome mat was recorded in the sediment. • The Garden Island Settlement site appears to be showing signs of stress with the upper half of the leaves dead and highly epiphytised. There was also dead rhizome material in the sediment. • Mangles Bay remains highly stressed. Recommendations are made for future monitoring.	
Naragebup Regional Environment Centre (2003) *Lake Richmond Drain Outlet Water Quality 2002: Compilation of water sample results for winter runoff from Lake Richmond to Mangles Bay,* Prepared for the Cockburn Sound Management Council, Rockingham Western Australia	To present the results of monitoring runoff from Lake Richmond outlet drain and determine the contribution of nutrients to Mangles Bay and Cockburn Sound from Lake Richmond during the winter runoff period of 2002.	This project is part of the Cockburn Sound Management Council's commitment to recommendation No. 11 in the Interim Environmental Management Plan for Cockburn Sound and its Catchment (CSMC 2002) to 'develop and implement a nutrient management strategy'. Results show that water exiting Lake Richmond contributes a considerable amount of nutrients to Mangles Bay and is impacted by urban runoff from surrounding areas and stormwater inputs to the lake. Although the areas tested were for the most part not unusual, further investigation is recommended for zinc levels and nutrients and continued monitoring is recommended for all other environmental quality criteria.	CSMC
Naragebup Regional Environment Centre (2003) *Lake Richmond Drain Outlet Water Quality 2003, Draft: Compilation of water samples results for winter runoff from Lake Richmond to Mangles Bay,* Prepared for Cockburn Sound Management Council, Rockingham Western Australia	To present the results of monitoring runoff from Lake Richmond outlet drain and determine the contribution of nutrients to Mangles Bay and Cockburn Sound from Lake Richmond during the winter runoff period of 2003.	This project is part of the Cockburn Sound Management Council's commitment to recommendation No. 11 in the Interim Environmental Management Plan for Cockburn Sound and its Catchment (CSMC 2002) to 'develop and implement a nutrient management strategy'. Results show that Lake Richmond is impacted by urban runoff from surrounding areas and stormwater inputs to the lake, and may contribute a considerable amount of nutrients to Mangles Bay. Although the parameters tested were for the most part not unusual, further investigation is recommended for zinc levels, and oil and grease levels.	CSMC
Parsons Brinckerhoff (2003) *Australian Marine Complex Common User Facility – Environmental Management Plan for Operations* ,Prepared for JBFM Babcock, Perth Western Australia	To present a plan for the management of overarching environmental responsibilities of the CUF manager (JBFM Babcock) which will, where applicable, form mandatory parts of the User Plans.	The following key environmental issues that have been identified are based on likely activities that will occur at the site and which have an impact on the CUF in general and which could therefore affect multiple users: spill management (i.e. oil, chemicals, cargo); tributyltin management; ballast water management; dust management; noise management; litter management; ship sewage disposal; and ship garbage disposal.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Parsons Brinckerhoff (2003) *Jervoise Bay Recovery Bores, Monitoring Review No. 6, August to November 2002,* Prepared for the Department of Industry and Technology, Perth Western Australia	To report on the outcomes of the groundwater recovery scheme for Jervoise Bay Northern Harbour.	The groundwater recovery scheme has been in operation for approximately. 24 months. The total borefield production to date is 2,041,609 kL. The Jervoise Bay groundwater recovery system comprises four recovery bores, 27 coastal monitoring bores and 8 inland monitoring bores. The dissolved inorganic nitrogen concentrations of the recovery bores in the southern plume have remained relatively constant during the past 4 month period but have varied in the range 30–120 mg/L DIN at other times over the past two years. The highest concentration of DIN have generally occurred in springtime when groundwater gradients have been highest. The concentration of DIN of the bores in the northern plume has remained relatively steady throughout the year at 20–40 mg/L. Approximately 90 tonnes of nitrogen has been recovered and disposed of to Sepia Depression over the past 23.5 months. Monitoring of the marine waters inside and outside the Northern Harbour over the past 5 years indicates a 23–29% drop in total nitrogen levels in the harbour since the groundwater scheme was implemented.	CSMC
Parsons Brinckerhoff (2003) *Jervoise Bay Recovery Bores, Monitoring Review No. 7, December 2002 to March 2003,* Prepared for the Department of Industry and Technology, Perth Western Australia	To report on the outcomes of the groundwater recovery scheme for Jervoise Bay Northern Harbour.	The water levels measured within the coastal and inland monitoring bores have remained steady over the current review period. There has been no evidence to indicate that the operation of the groundwater recovery scheme has influenced water levels and EC values of the coastal bores, inland monitoring bores and Lake Coogee market garden irrigation wells. The dissolved inorganic nitrogen concentration of the recovery bores have generally declined during the past 4 month review period. This decline is attributed primarily to seasonal effects with groundwater recovered from more saline water containing lower levels of nitrogen. The highest concentrations of dissolved inorganic nitrogen have generally occurred in springtime when groundwater gradients have been highest. There has been no decrease in the nitrogen levels of the monitoring bores approximately 50 metres from the nitrogen sources of the northern and southern plumes.	CSMC
Valesini FJ, Clarke KR, Eliot I & Potter IC (2003) 'A user-friendly quantitative approach to classifying nearshore marine habitats along a heterogeneous coast', *Estuarine, Coastal and Shelf Science* 56:1-15	A scheme which can be readily used by fisheries and environmental managers and ecologists has been developed for quantitatively classifying the different habitats found in nearshore marine waters along the heterogeneous lower west coast.	A scheme which can be readily used by fisheries and environmental managers and ecologists has been developed for quantitatively classifying the different habitats found in nearshore marine waters along the heterogeneous lower west coast of Australia. Initially, 25 beach sites, representing a wide range of nearshore environments, were separated into six a priori habitat types on the basis of characteristics that could readily be observed and were likely to influence the extent to which a particular (fish) species occupies a particular habitat. Focus was thus placed on such features as the degree of exposure to wave activity and whether or not seagrass and/or reefs were present in the nearshore vicinity. Subsequently, quantitative data for 27 environmental variables, considered likely to characterise the six habitat types, were obtained for each of the 25 sites from readily accessible sources. When the latter data were subjected to multidimensional scaling (MDS) ordination, the points for the sites representing only three of those six habitat types formed discrete groups. The routine in the v5.0 statistical package (Clarke & Gorley, Primer v5.0: User Manual/Tutorial, Primer-E Ltd, Plymouth, 2001) was thus used to select a subset of the 27 environmental variables that would provide a better resolution of the six a priori habitat types. This process involved matching the distance matrix constructed from the quantitative environmental data with a matrix constructed from scored data that reflected the criteria for the initial a priori classification scheme. A subset of seven environmental variables gave the best correlation between the two matrices (ρ=0.823), and thus provided the optimal set of quantitative data for discriminating between the six a priori habitat types. These variables comprised both the direct and north-westerly fetches, the minimum distance from the shoreline to the 2 m depth contour, the distance from the shoreline to the first offshore reef chain along a south-westerly transect, and the relative contributions of bare sand, subtidal reef and seagrass. Data for these characteristics at any nearshore site along the coastline can readily be recorded by managers and ecologists and subjected to the 'nearest-replicate' classification procedure developed in this study to	Link @ <http://scholar.google.com/scholar?q=a+user-friendly+quantitative+approach+to+classifying+nearshore+marine+habitats+along+a+heterogeneous+coast&hl=en&cr=countryAU&um=1&ie=UTF-8&oi=scholart> Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
...Continued from previous page		ascertain the habitat type to which that site should be assigned. Current work is using MDS ordination, in conjunction with associated statistical tests and the routine, to elucidate the extent to which the compositions of assemblages of fish, benthic macroinvertebrates, meiofauna and zooplankton in nearshore waters along the lower west coast of Australia are related to habitat type(s).	
Vanderklift MA & Jacoby CA (2003) *Patterns of Fish Assemblages 25 Years after Major Seagrass Loss,* Marine Ecology Progress Series 247:225-235	To determine if loss of seagrass causes predictable changes in fish assemblages from the same habitat at localities where seagrass was lost by the early 1970s.	This study provided limited evidence for differences in species composition related to presence or absence of seagrass. However, it seems likely that some species were adversely affected by the reduced supply of drift that must have followed the loss of >3000 ha of seagrass in Cockburn Sound.	CSMC
Water Corporation of Western Australia (2003) *Use of Cape Peron Outlet Pipeline to Dispose of Industrial Wastewater to Sepia Depression Kwinana – Public Environmental Review,* Perth Western Australia	To meet the 1982 request of the Environmental Protection Authority to assess any intention to use the Sepia Depression Ocean Outlet Landline (SDOOL) to discharge industrial water to the Sepia Depression Ocean Outlet.	The Water Corporation has assessed the potential environmental impacts of the project, and regards the proposal as not being environmentally significant as long as it is managed in accordance with the management framework proposed for governance of this project. The project will result in small changes to the volume and quality of water discharged from the SDOOL, and offers the combined benefits of responsible wastewater reuse and an overall reduction in environmental impact on Cockburn Sound.	CSMC
Wilson C & Paling EI (2003) *Water Quality of Cockburn and Warnbro Sounds (Dec. 2002 to March 2003),* Report to Kwinana Industries Council, Report No. MAFRA 03/3, Marine and Freshwater Research Laboratory Environmental Science, Murdoch University	To compare the water quality indicators measured during summer 2003 with previous years; to determine if there were any regions of consistently high phytoplankton and nutrient concentrations within Cockburn Sound; and to compare these to reference sites in Warnbro Sound.	Temperature, salinity, dissolved oxygen and secchi depth were measured *in situ,* and samples were collected for the determination of ammonium, nitrate-nitrite, total nitrogen, phosphate, total phosphorous and chlorophyll a. The survey indicated that water quality has changed little over the past decade. Chlorophyll a concentrations were higher in Cockburn Sound than in Warnbro Sound, and the median values exceeded the EPA (2002) revised criteria at sites in the moderate protection zone and equalled the criteria for sites in the high protection zone. The distribution of nutrients and phytoplankton was not even across Cockburn Sound. Higher concentrations of nutrients and chlorophyll a were recorded at sites along the eastern shore than in the centre. The water quality of the Northern Harbour of Jervoise Bay was significantly poorer than at any other location for many parameters. The water quality of three Garden Island samples sites was comparable to that of the reference sites in Warnbro Sound.	CSMC
Bennet Environmental Consulting Pty Ltd (2004) *Flora Assessment of Proposed Perth Seawater Desalination Plant Kwinana,* Unpublished report for Water Corporation, Western Australia	Bennet Environment Consulting was contracted to undertake a flora and fauna survey of the proposed area for the establishment of a desalination plant in Kwinana.	There were two contractual areas in this survey, flora and fauna. The flora survey was undertaken to identify any flora sensitivities on the proposed Perth desalination water plant located at Kwinana.	Link @ <http://watercorporation.com.au/_files/Desalination_Flora.pdf>
Blackweir DG & Beckley L (2004) *Beach Usage Patterns along the Perth Metropolitan Coastline during Shark Surveillance Flights in Summer 2003/04,* Hons Thesis, School of Environmental Science, Murdoch University	To present the detailed results of instantaneous beach usage counts at the 43 beaches along the Perth metropolitan coast, inclusive of Coogee, Woodman Point, Challenger, Rockingham and Palm Beach.	**Coogee Beach:** The highest number of people recorded on the beach during the study was 283 on a weekend, and 141 on a weekday. Sunbathing was the most regularly observed activity. There were a high number of beach walkers in November. More people seemed to swim on weekdays than weekends. **Woodman Point Beach:** The highest number of people recorded on the beach during the study was 247 on a weekend and 223 on a weekday. Overall, more people used the beach on weekends than weekdays. Walking was the most common activity, followed by sunbathing and swimming. **Challenger Beach:** The highest number of people recorded on the beach during the study was 75 on a weekend and 44 on a weekday. Most people sunbathed on a weekend, with walkers being a high proportion of users.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		**Rockingham Beach:** The highest number of people recorded on the beach during the study was 511 on a weekend and 203 on a weekday. Overall more people used the beach on weekends than weekdays. Walking was the most popular activity followed by sunbathing and swimming. **Palm Beach:** The highest number of people recorded on the beach during the study was 30 on a weekend and 17 on a weekday. Sunbathing was the most popular activity followed by swimming and walking.	
Cannell BL (2004) *Distribution of the major fauna in Perth Metropolitan area (Yanchep to Mandurah),* Technical Report: MMS/CWC, LNE/MMP, SEMP, SIMP-79/2004 for Marine Conservation Branch Department of Conservation and Land Management, Swan Catchment Council and Natural Heritage Trust, Western Australia	Supplements the previously poorly documented knowledge of the spatial and temporal distributions of the major marine fauna of the Perth metropolitan area and highlights their important biological features—cetaceans, Australian Sea Lions, seabirds, and migratory waders.	The report provides a broad overview of three marine fauna groups and three specific species: whales, seabirds, migratory waders, Bottle-nose Dolphins, Australian Sea Lions and Little Penguins. There is little specific information regarding Cockburn Sound and Owen Anchorage. However the following is presented in regard to these areas: **Bottle-nose Dolphins:** Around 200 Bottle-nose Dolphins have been photo-identified within Cockburn Sound and Owen Anchorage. Dolphins are found in all the main habitat types present in the Sound, i.e. seagrass beds, the silty deep basin, the shallow sandy bottom of Kwinana Shelf, and the shelf edge (the interface between the shelf and basin). In Cockburn Sound, dolphins most intensively use the shallow sandy bottom of the Kwinana Shelf and eastern basin. The dolphins are often observed to forage on pilchards and other baitfish, and squid. Mother-calf pairs make up approximately 20% of the population of dolphins in Cockburn Sound. Therefore, Cockburn Sound may be significant as a dolphin nursery area, with habitats that are in some way important for nursing mothers or their calves. The shelf is a critical feeding area for mothers and calves. This population is higher than others studied in the world whose age-sex structure is known. Dolphins have a high site fidelity, remaining in the same general location year round. **Australian Sea Lion:** Near Perth, sea lions haul out on Seal, Carnac, Penguin, Dyer and Little Islands and Burns Rock. The sea lions are almost exclusively sub-adult and adult males. There is no information on where sea lions feed in the Perth metropolitan area or how far they travel to obtain food. **Seabirds:** Seabirds use a number of islands in the Perth metropolitan area. Seabirds forage in Cockburn Sound and Owen Anchorage, particularly in shelf areas. **Little Penguins:** Little Penguins breed on Penguin Island, Garden Island, and Carnac Island.	CSMC
Cannell BL (2004) *Little Penguins,* Eudyptula minor*, on Garden Island 2001–2003: A final report on their ecology and recommendations for management,* Prepared for Royal Australian Navy HMAS Stirling Western Australia	o assess the population size and breeding success of the Little Penguin population of Garden Island; To determine differences in the annual cycle of the penguins, and the relationship to the Penguin Island colony; To determine the current or potential threats to the colony; To make recommendations for immediate and long-term management of the colony.	Over three years (2001–2003) the number of burrows found used by penguins for breeding, non-breeding attendance and moulting increased from 80 to 116. The breeding cycle was typical of Penguin Island (May to Nov-Dec), however eggs can be laid as early as April. The Garden Island population is estimated to be at least 160 birds. The Penguin Island penguins monitored were not as successful in their breeding attempts and a greater proportion only laid one clutch. Only 3% of the breeding population successfully raised two clutches on Penguin Island compared to 41% on Garden Island. Butylins have been found in several penguin carcasses from Garden Island and elsewhere in Perth area. However, there is no clear trend. Threats offshore to the colony are food availability, watercraft use, plastic pollution, Tributyltins, other toxic substances and noise occurring at the Small Boats Handling Facility, commercial fishing, and nutrient enrichment in Cockburn Sound which would affect seagrass beds and therefore impact on food availability and oil spills. Threats on Garden Island include disturbance to nesting sites, introduced predators and fire. Natural threats include El Nino Southern Oscillation and Leeuwin Current, storms and natural predators.	HMAS Stirling Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		Recommendations for management of the penguin colony include raising personnel awareness of the colony to increase protection; ensuring that all personnel are aware that fishing is prohibited in the Small Boats Harbour; removal of plastic pollution from the site of the burrows; restricting movement of vessels in the bay during departure and arrival times of the penguins (an hour before dawn and an hour after and before dusk); ensuring boats are travelling at a low speed in the Small Boats Harbour; and monitoring the population at Colpoy's Point to ensure it is not being threatened.	
Cockburn Sound Management Council (2004) *Local Planning Policy for the Cockburn Sound Catchment – a cooperative response for the protection of Cockburn Sound through the management of land use impacts within the Cockburn Sound catchment,* Department of Environment, Town of Kwinana, City of Rockingham and City of Cockburn Western Australia	To develop a local planning policy to provide for a cooperative response for the protection of Cockburn Sound through the management of land use impacts within the Cockburn Sound catchment.	Defines the role of each relevant organisation in land use decision making for Cockburn Sound and its catchment.	CSMC
Cockburn Sound Management Council (2004) *Assessment of zinc, nitrogen and phosphorus in the water and sediments of the Lake Richmond drains and Mangles Bay, and in the waters of Lake Richmond, November 2003,* Rockingham Western Australia	To assess if zinc contamination is an issue of concern throughout the Lake Richmond and Mangles Bay drainage network and, if so, identify possible sources of contamination; To investigate the amount of nitrogen and phosphorus present in the sediments, and the possible impacts nutrients may have on the seagrass beds of Mangles Bay.	The assessment showed that zinc contamination was not an issue at the time of the sampling. However, zinc concentrations were generally higher in the sediments of the outlet drain compared to that of the two inlet drains. The assessment showed that nutrient levels (total nitrogen and total phosphorus) in the sediments of the drains and Mangles Bay were high.	CSMC
DAL Science and Engineering, Coastal CRC, University of Western Australia (2004) *Benthic Habitat Mapping of the Eastern Shelf of Cockburn Sound,* Prepared for the Cockburn Sound Management Council WA, Report No. 321/1	To present the findings of detailed surveys which were undertaken to accurately map the benthic coverage and assemblages of the Eastern Shelf, Cockburn Sound, for summer 2004, using sidescan sonar and extensive groundtruthing.	Habitat types identified are: • *Posidonia* sp. seagrass beds • patchy *Posidonia* sp. seagrass beds • mixed seagrass and reef • *Halophila* sp. seagrass beds • high relief reef • pavement reef • cobble reef • wrack • soft sediment and • (other)vegetated area. Soft sediment was found to be the dominant benthos.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Department of Fisheries (2004) *Quantification of Changes in Recreational Catch and Effort on Blue Swimmer Crabs in Cockburn Sound and Geographe Bay,* FRDC project 2001/067, Fisheries Research Report No. 147, Prepared by Sumner NR & Malseed BE	To estimate the boat-based and shore-based recreational catch, fishing effort and size composition for blue swimmer crabs in Cockburn Sound and Geographe Bay during 2001–02; To report on the relative recreational and commercial catch shares for 2001–02 and to compare the results with earlier years; To quantify and evaluate changes in the recreational catch, catch rates and fishing effort following resource-sharing changes since the previous survey in 1996–97; To compare the length frequency data of the recreational catch of blue swimmer crabs relative to commercial catches in these areas.	The estimated recreational catch of blue swimmer crabs from Cockburn Sound and Owen Anchorage for the period from September 2001 to August 2002 was 18.5 tonnes. The recreational fishing effort for blue swimmer crabs was 19,100 fisher days from boat-based fishers. The catch and effort from shore-based fishers was negligible. The proportion of the total catch taken by recreational fishers has increased from 8% (28.4 tonnes of 357.1 tonnes) in 1996–97 (Sumner *et al*. 2000) to 15% (18.5 tonnes of 122.1 tonnes) during 2001–02. Most (94%) of the recreational catch was taken between January and March. The commercial catch has shown a declining trend over the past five years, decreasing from 328.7 tonnes in 1996–97 to 103.6 tonnes during 2001–02, due to lower levels of effort and variable recruitment into the fishery. The size composition of the recreational and commercial catch was similar. However, the recreational catch comprised predominantly male crabs (97%) and the commercial catch comprised more female crabs (57%) due to the differences in the spatial and temporal nature of fishing activities for the two sectors. Information on the size of the recreational catch was required to address resource allocation issues between recreational and commercial crabbers in Cockburn Sound and Geographe Bay. Management measures designed to allocate more of the catch to the recreational sector were put in place prior to this study at both locations. Estimates of the recreational catch were required to evaluate the effectiveness of these new management measures by comparing the catch shares with a survey conducted in 1996–97. A 12-month creel survey of recreational boat-based and shore-based crabbing in Cockburn Sound was conducted between September 2001 and August 2002 and in Geographe Bay between September 2001 and November 2002. During the surveys 1235 interviews were conducted at boat ramps in Cockburn Sound and 929 in Geographe Bay. An additional 619 shore-based fishing parties were interviewed in Cockburn Sound and 444 in Geographe Bay. The bus route method, where a survey interviewer visits all boat ramps in a pre-determined area on the one day, was used to estimate the total catch and fishing effort for persons crabbing from recreational trailer boats launched at boat ramps. A roving creel survey was used to estimate the catch and fishing effort from shore-based crabbers using drop nets or wire scoop nets from the shore. Both the recreational and commercial catch of blue swimmer crab from Cockburn Sound was lower in 2001–02 than 1996–97 due to a lower level of recruitment. Recreational and commercial catch rates and effort were also lower. The increased size limit of 130 mm for commercial crabbers resulted in 16.6 tonnes of crabs being returned by commercial fishers to be potentially available to the recreational sector. However, results show that only 2.2 tonnes of crabs kept by recreational boat-based fishers have a CW of 127–129 mm, which is less than the commercial minimum size of 130 mm. Since the recreational and commercial sectors have different spatial and temporal fishing activities it is unlikely that the recreational sector benefited substantially from the higher size limit for commercial fishers.	CSMC & @ <http://www.fish.wa.gov.au/docs/frr/frr147/frr147.pdf>
Department of Fisheries (2004) *State of the Fisheries Report 2003/04,* Perth Western Australia	To provide a Statewide overview of the state of commercial and recreational fisheries for 2002/03.	In relation to Cockburn Sound the following was discussed: • A managed commercial crab fishery recorded a catch of 231 tonnes. Large fluctuations in blue swimmer catches from Cockburn Sound are common. Recent surveys produced recreational catch estimates for Cockburn Sound of 18.2 t and 23 t, for the 2002 and 2003 calendar years respectively. Over 98% of the catch was male crab. • The Cockburn Sound line and pot and fish net fisheries are managed through input controls in the form of limited entry, gear restrictions and closed areas. Over the past 10 years the number of licences in the two fisheries has been reduced from 42 to 14. • The annual finfish catch has generally declined since the peak catch of 165 t in 1992. In 2003, the catch of 52 t is a decrease of 10 t from 2002 figures. The majority of catch is herring, garfish, pink snapper, maray and skates and rays.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
...Continued from previous page		• The total catch of herring was 17 t; with the exception of 14 t in 2000, this is the lowest catch recorded since 1983. • As at April 2003 there is one licensee in the fish net fishery and 13 licensees in the line and pot fishery. • The recreational fishery is estimated to have taken approximately 56% of the combined recreational and commercial catch of finfish. • Mussel farms are found mainly in Cockburn Sound and Warnbro Sound. Production has commenced in the Southern Flats area of Cockburn Sound where mussel farmers now have more secure access to growing areas. • Large pink snapper that aggregate in Cockburn Sound to spawn are attracted to the mussel farms in some years and are thought to consume significant amounts of mussels.	
Department of Fisheries (2004) *Quantification of Changes in Recreational Catch and Effort on Blue Swimmer Crabs in Cockburn Sound and Geographe Bay,* FRDC Project No. 2001/067, Report No. 147	To estimate the boat-based and shore-based recreational catch, fishing effort and size composition for blue swimmer crabs in Cockburn Sound and Geographe Bay during 2001–2; To report on the relative recreational and commercial catch shares for 2001–2 and to compare the results with earlier years; To quantify and evaluate changes in the recreational catch, catch rates and fishing effort following resource-sharing changes since the previous survey in 1996–97; To compare the length frequency data of the recreational catch of blue swimmer crabs relative to commercial catches in these areas.	Information on the size of the recreational catch was required to address resource allocation issues between recreational and commercial crabbers in Cockburn Sound and Geographe Bay. Management measures designed to allocate more of the catch to the recreational sector were put in place prior to this study at both locations. Estimates of the recreational catch were required to evaluate the effectiveness of these new management measures by comparing the catch shares with a survey conducted in 1996–97. A 12-month creel survey of recreational boat-based and shore-based crabbing in Cockburn Sound was conducted between September 2001 and August 2002 and in Geographe Bay between September 2001 and November 2002. During the surveys 1235 interviews were conducted at boat ramps in Cockburn Sound and 929 in Geographe Bay. An additional 619 shore-based fishing parties were interviewed in Cockburn Sound and 444 in Geographe Bay. The bus route method, where a survey interviewer visits all boat ramps in a pre-determined area on the one day, was used to estimate the total catch and fishing effort for persons crabbing from recreational trailer boats launched at boat ramps. A roving creel survey was used to estimate the catch and fishing effort from shore-based crabbers using drop nets or wire scoop nets from the shore. Both the recreational and commercial catch of blue swimmer crab from Cockburn Sound was lower in 2001–02 than 1996–97 due to a lower level of recruitment. Recreational and commercial catch rates and effort were also lower. The increased size limit of 130 mm for commercial crabbers resulted in 16.6 tonnes of crabs being returned by commercial fishers to be potentially available to the recreational sector. However, results show that only 2.2 tonnes of crabs kept by recreational boat-based fishers have a CW of 127–129 mm, which is less than the commercial minimum size of 130 mm. Since the recreational and commercial sectors have different spatial and temporal fishing activities it is unlikely that the recreational sector benefited substantially from the higher size limit for commercial fishers.	CSMC & <http://www.fish.wa.gov.au/docs/frr/frr147/frr147.pdf>
Department of Fisheries (2004) *Proposals for Community Discussion on the Future Management of Pink Snapper Fishing in Cockburn Sound and Surrounding Waters,* Fisheries Management Paper No. 187, Western Australia	To outline the current issues associated with the management of the metropolitan pink snapper fishery along with some options for future management.	Proposes: • That the waters of Cockburn Sound and Warnbro Sound be closed to the take of pink snapper from 1 October to 30 November; • That a maximum size of 60 cm (fork length) applies to any pink snapper landed in the metropolitan area (Two Rocks to Mandurah) between 1 Oct. and 30 Nov; • That a prohibition on the possession of pink snapper applies when fishing in Cockburn Sound during the closed season; and • Outside the closed areas the existing management arrangements of a daily bag limit of 4 and a minimum size of 41cm continue to apply. Submissions are invited.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Department of Fisheries & Department of Health (2004) *Western Australian Shellfish Quality Assurance Program (WASQAP): Operations manual*	To administer the sanitary controls for shellfish in accordance with the Australian Shellfish Quality Assurance Program.	Outlines the roles and responsibilities of the organisation involved in health risk management and quality assurance. Describes monitoring sites within Cockburn Sound at Kwinana Grain Terminal and Southern Flats. Monitoring involves sampling for bacteria and in some areas phytoplankton levels. Outlines annual monitoring for chemical contaminants such as arsenic, copper, zinc, cadmium, lead, mercury, organochlorin, organophosphate, pesticide and polychlorinated biphenyls. Tests may also be undertaken to determine Tributylin levels and algal toxins. Outlines the response should cessation of harvesting be recommended due to high levels of contaminants. Details the harvesting, transport and identification requirements for mussels and oysters. Outlines product recall procedures.	CSMC
Department of Planning and Infrastructure (2004) *Kwinana Beach – Erosion Protection and Ongoing Management Works,* Technical Report, Report No. 419, New Coastal Assets, Fremantle Western Australia	To investigate the progression of beach and dune erosion and the average rate of sand volume loss over time at Kwinana Beach; To review available coastal management options for halting the erosion and restoring the beach for recreational use.	The construction of the causeway may have negatively influenced sand movement at Kwinana Beach. The beaching and filling of the SS *Kwinana* changed sand movement. Report recommends that community consultation should occur in regard to choice of option. Sand renourishment will be required in all options.	CSMC
Doak C (2004) *Hydrodynamic Modeling of Snapper (*Pagrus auratus*) Eggs and Larvae in Cockburn Sound*, Honours Thesis for Bachelor of Engineering, Centre for Water Research, UWA	Cockburn Sound is a sheltered Indian Ocean inlet adjacent to the Perth metropolitan area. Due to this close proximity to the city, the protected waters of Cockburn Sound have a unique resource value, however the area is vulnerable to over-exploitation, particularly with regard to fisheries. Understanding the population structure and spatial distribution of harvested stocks of exploited species therefore becomes important in terms of stock assessment and implementation of effective fisheries management. Knowledge of the degree of connectivity between local populations of a species (if more than one exists) becomes paramount, i.e. whether the population is sustained by recruitment from external sources (hence classified as being open), or whether the population is sustained by recruitment from local production only (and hence classified as being closed) (Warner & Cowen	Snapper (*Pagrus auratus*) are an extremely popular target for both recreational andcommercial fishermen. This popularity heightens the susceptibility of the species to over-fishing, particularly in areas of high fishing pressure such as Cockburn Sound. Consequently, from a management point of view, it is important to understand the stock structure of the species over a fine spatial scale. Such an understanding can be gained with the use of a numerical hydrodynamic model, coupled with regional ichthyoplanktonic data. For the purpose of this study, results from ichthyoplankton surveys conducted in 2001 and 2002 during the snapper spawning period (September through December inclusive) were coupled with the 3-dimensional hydrodynamic model, HAMSOM, as well as a 2-dimensional lagrangian particle tracking program. Particle release points for each month were determined through examination of egg density maps, with locations chosen at the centres of areas where the highest densities occurred. Particles were tracked for a period of 10 days in the surface layer (0–5 m) and the bottom layer and as an average over depth with the use of monthly wind data recorded from Garden Island in 2002. Results show that surface particle transport is predminantly in the direction of the wind, with southerly winds typically transporting eggs and larvae northwards out of the Sound. Within the bottom layer particles are affected by the wind induced return flow that is characteristic of the Sound's hydrodynamics. Depth averaged transport was considered the most likely pattern of transportation, due to wind induced mixing of the water column, as well as possible vertical migration of the larvae. Coinciding with the peak in the snapper spawning (November and to a lesser extent December) depth averaged results show a counter-clockwise gyre within the Sound that may be responsible for the retention of eggs and larvae in this area. Other months, including May (which was modelled for seasonal comparison) show no significant sign of the gyre. These results indicate that while the snapper may use the gyre as a method to retain their eggs and larvae in the region, they exist within Cockburn Sound as a single open population.	CSMC & @ <http://www2.sese.uwa.edu.au/~pattiara/theses/Clint_Doak.pdf>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	2002). Ichthyoplanktonic sampling of eggs and larvae, coupled with some form of hydrodynamic modeling is often used to determine this classification.		
Environmental Protection Authority (2004) *Use of Cape Peron Outlet Pipeline to Dispose of Industrial Wastewater, Kwinana: Report and recommendations of the Environmental Protection Authority,* Proposal submitted by Water Corporation, Bulletin 1135, Perth Western Australia	To provide advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal by the Water Corporation to discharge wastewater, in addition to treated wastewater from the Woodman Point and Cape Peron wastewater treatment plants and water from the Jervoise Bay Groundwater Recovery Scheme, to the Sepia Depression via the Cape Peron outlet.	The Water Corporation proposes to discharge up to 30 megalitres per day of industrial wastewater, in addition to treated wastewater from the Woodman Point and Cape Peron wastewater treatment plants and water from the Jervoise Bay Groundwater Recovery Scheme, to the Sepia Depression. The EPA notes that, due to the cumulative discharge of industrial and treated wastewater from wastewater treatment plants, the proposal will result in a low ecological protection zone for toxicants within a 100 metre radius of the diffuser and, outside of this, a zone of high ecological protection. Industries currently operating will not be permitted to increase their load of toxicants discharged from current levels and any change to the load or character of their discharge will need to be referred to the EPA. The EPA has concluded that it is unlikely that the EPA's objectives would be compromised.	CSMC
Environmental Protection Authority (2004) *Hope Valley-Wattleup Redevelopment Project Master Plan: Report and recommendations of the Environmental Protection Authority,* Proposal submitted by Western Australian Land Authority (LandCorp), Bulletin 1133, Perth Western Australia	To provide advice and recommendations to the Minister for the Environment on the environmental factors relevant to the Hope Valley-Wattleup Redevelopment Project Master Plan, and the conditions to which the scheme should be subject.	The Hope Valley-Wattleup Redevelopment Project Proposed Master Plan has been prepared by LandCorp pursuant to the *Hope Valley-Wattleup Redevelopment Act 2000* to 'promote the orderly and proper planning, development and management of the redevelopment area, including any provision that may be made by a town planning scheme under the *Town Planning Act'*. The EPA notes that the site is in the groundwater catchment of Cockburn Sound where a significant issue is inputs of nitrogen and other contaminants via groundwater. The EPA considers that the proposed land use changes to regulated industrial and commercial developments should facilitate an improvement over time in the quality of groundwater exported from the redevelopment area. The Master Plan sets out objectives for the protection of Cockburn Sound, however the EPA considers that these need to be further developed to ensure the EPA's environmental objectives for Cockburn Sound are met.	CSMC
Environmental Protection Authority (2004) *Debottlenecking of Ammonia Plant from 650 tpd to 745 tpd, Kwinana Industrial Area, Change to Environmental Conditions: Section 46 report and recommendations of the Environmental Protection Authority,* Proposal submitted by CSBP Limited, Bulletin 1125, Perth Western Australia	To respond to the Minister for the Environment's request that the EPA inquire into CSBP's proposed changes to the environmental conditions and report under section 46 (3) of the Environmental Protection Act.	The proposal is to increase the nominal capacity of the Ammonia Plant from 650 tonnes per day (tpd) to 745 tpd. CSBP are also seeking approval to allow access to alternative sources of water such as from the Kwinana Recycling Plant. The EPA notes that the debottlenecking of the Ammonia Plant raises no significant environmental matters.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Environmental Protection Authority (2004) *Perth Metropolitan Desalination Proposal, Amendment of Implementation Conditions by Inquiry: Section 46 report and recommendations of the Environmental Protection Authority,* Prepared for the Water Corporation of Western Australia, Bulletin 1137, Perth Western Australia	To provide advice and recommendations to the Minister for the Environment on the factors, conditions and procedures relevant to the amended Perth Metropolitan Desalination Proposal.	Water Corporation is proposing to upgrade the capacity of the Perth Metropolitan Desalination Proposal, from the originally approved 30 gigalitres per year to 45 gigalitres per year. The proposed changes include increasing the production of potable water, use of seawater and discharge of concentrated seawater, and the further option of combining intake seawater with cooling water discharged from Western Power's Kwinana Power Station. The EPA has considered the proposal and has concluded that it can be managed to meet the EPA's objectives for the relevant environmental factors. The EPA considers that the changes to the desalination proposal will not cause adverse impacts on the marine water quality and biota of Cockburn Sound and has the potential to reduce the amount of greenhouse gases generated by the proposal indirectly through the provision of gas-fired electricity.	CSMC
Environmental Protection Authority (2004) *Guidance for the Assessment of Environmental Factors: Benthic primary producer habitat protection for Western Australia's marine environment,* Guidance Statement No. 29, Perth Western Australia	To provide non-statutory advice to proponents, consultants and the public generally about the minimum requirements for environmental management which the EPA would expect to be met by proposals it considers during the environmental impact assessment processes.	The objectives of the Guidance Statement are to: • Protect the environment with a focus on State coastal waters in the context of activities which may directly or indirectly cause the loss of key benthic primary producer habitat (BPPH); • Express to development proponents who have proposals subject to EIA, and to the general public, the EPA's current thinking on activities which may directly or indirectly cause the loss of BPPHs; and • Provide guidance for the protection and maintenance of ecosystem integrity by applying a risk-based environmental protection framework which includes quantitative cumulative loss thresholds and which is linked to the ecological, conservation and social values of the environment, to assist the EPA's environmental assessment of proposals impacting BPPH in a consistent manner.	CSMC
Environmental Protection Authority (2004) *Revised Environmental Quality Criteria Reference Document (Cockburn Sound),* A supporting document to the Draft State Environmental (Cockburn Sound) Policy	To present the revised Environmental Quality Criteria for Cockburn Sound to support the *State Environmental (Cockburn Sound) Policy 2005.*	Details the environmental quality management framework for Cockburn Sound so as to maintain a level of environmental quality that will protect both the integrity and biodiversity of the marine ecosystems as well as current and projected future societal uses of the Sound from the effect of pollution.	CSMC
Environmental Protection Authority (2004) *Revised Manual of Standard Operating Procedures for Environmental Monitoring against the Cockburn Sound Environmental Quality Criteria,* A supporting document to the Draft State Environmental (Cockburn Sound) Policy	To provide the procedures that support the implementation of the State Environmental (Cockburn Sound) Policy.	Sets out the standard procedures for environmental monitoring, and includes other information on monitoring design, preparation, data management and data analysis for comparison against the Environmental Quality Criteria from the Revised EQC Reference Document.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Environmental Protection Authority (2004) *James Point Stage One Port, Kwinana: Report and recommendations of the EPA,* Bulletin No. 1141, Perth Western Australia	To provide the EPA's further assessment and advice to the Minister for the Environment on the conditions to be applied to the implementation of the proposal in order to address the matters raised in the Minister's appeal determination.	James Point Pty Ltd referred a proposal for Stage 1 Port to the EPA in December 1999. The EPA determined that the proposal should be assessed at the level of PER. The EPA reported on the proposal in 2002 and identified the environmental factors relevant to the proposal that required detailed evaluation in the report: marine biota and habitats; coastal oprocesses; odour; noise; marine water and sediment quality; and coastal access and coastal activities (EPA 2002 Bulletin 1076). Appeals were lodged against the EPA's report and recommendations to the Minister for the Environment. The Minister for the Environment considered the appeals, through the Appeals Convenor, and determined 'that while the proposal can be managed in an environmentally acceptable manner, a more robust and prescriptive set of conditions needs to be applied to the implementation of the proposal'.	CSMC
Environmental Resources Management Australia (2004) *Fremantle Ports Outer Harbour Expansion – Developing a Strategic Assessment Framework Report,* Reference 0010323, Prepared for Fremantle Ports and Department for Planning and Infrastructure, Perth Western Australia	To present a process for assessing the Fremantle Ports Outer Harbour project at Naval Base in Kwinana with the Outer Harbour Project Steering Committee.	Given there is not currently a formal assessment process in WA for undertaking assessments of this type, there is relatively little guidance on the most effective method. Concern over the Government being the proponent and the assessor has been raised and as such the assessment process must be clear and transparent. The project will be broken up into four phases: Phase 1:Preparation of a Project Inception Report containing all the detailed background and supporting information for the strategic assessment of the Outer Harbour location; Phase 2: Development of Draft and Final Assessment Guidelines open to community comment; Phase 3: Assessment of economic, social and environmental issues scrutinised by relevant government agencies and community, and presented to Cabinet for 'in principle' approval.	CSMC
Fremantle Ports & Department for Planning and Infrastructure (2004) *Fremantle Ports Outer Harbour Project – Inception Report,* Fremantle Western Australia	To introduce the proposed Outer Harbour Project to the Environmental Protection Authority and Western Australian Planning Commission.	Planning for the overflow port facilities has been underway for several decades. The history of this work dates back to the 1950s. Prior to 1981, Mangles Bay near Rockingham had been a focus of planning for additional port facilities for the Perth metropolitan region. In the 1980s further studies looked at other sites along the WA coast. It was found that locating dedicated container handling facilities outside the Perth metropolitan area would not be viable. In 1996, Cabinet endorsed Naval Base/Kwinana as the preferred site. Four options have been developed. It is recognised that the proposed Outer Harbour development is significant infrastructure of strategic importance to the State. Accordingly, the area of interest for project planning is wider than the land and marine areas directly impacted by the proposed development. The protected waters within the Outer Harbour development, in Cockburn Sound, will fall within the Moderate Ecological Protection Area (see SEP), with a smaller area within the High Ecological Protection Area. It is likely that approval for this project will require a consequent amendment to the State Environmental Policy.	CSMC
Government of Western Australia (2004) *Draft State Environmental (Cockburn Sound) Policy – Draft for Public Comment,* Perth Western Australia	To provide an opportunity for the public to comment on the policy prior to its finalisation.	Presents the environmental values, environmental quality objectives, environmental quality criteria and the reporting requirements of the Cockburn Sound Management Council. Presents the decision making scheme for monitoring.	CSMC
Government of Western Australia (2004) *Coastal Planning Program; Status of Coastal Planning in Western Australia,* Prepared by the Western Australian Planning Commission	Beyond the shoreline, two important existing plans are those covering the two marine parks, Marmion Marine Park and the Shoalwater Islands Marine Park. The parks cover an area of approximately 6545 hectares and contain the	Developed through the Coastal Zone Council, an advisory body to the Western Australian Planning Commission (WAPC) on coastal matters. The Coastal Planning Program assists in the development of important coastal plans to guide land use and management of the State's coastal resources. The coast of Western Australia is relatively well covered by a range of planning instruments, including regional strategies, structure plans and detailed coastal plans. However, plans always require review at the end of the planning horizon to ensure that they are specifically suited to current planning needs. Additionally, many parts of the coast, while covered by relevant strategies, have not had more detailed	CSMC & <http://www.wapc.wa.gov.au/Publications/Downloads_GetFile.aspx?id=252>

Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
...Continued from previous page	waters of Shoalwater Bay, Warnbro Sound and a part of Cockburn Sound off Cape Peron. Chronic erosion of the Shoalwater Bay foreshore has been the subject of an investigation which recommended sand renourishment be considered. Ongoing erosion at Palm Beach has reduced beach amenity and threatens the access road. A timber groyne has recently been installed and is supplemented by regular sand nourishment.	coastal plans prepared to assist with management. On behalf of the WAPC, the Department for Planning and Infrastructure (DPI) annually reviews the status and currency of coastal planning throughout the State, as the basis for implementation of a forward planning program based on agreed priorities. The results of this review form the basis of this status report.	
Harewood G (2004) *Proposed Perth Seawater Desalination Project Kwinana Fauna Assessment,* Unpublished Report for the Water Corporation, Western Australia	For the purpose of the fauna assessment it has been assumed that all remnant vegetation within the study area will be cleared or potentially cleared. The Water Corporation has defined the fauna assessment objectives as: conduct a desktop analysis and field survey to determine the fauna composition of the area; document the impacts on fauna as a result of the proposed works.	This report has been prepared in response to an invitation from the Water Corporation to carry out a fauna assessment over an area required for the proposed Perth Seawater Desalination Plant. The site is located near the existing Kwinana Power Station. The area assessed was limited to include all remnant vegetation located north of Barter Road within the proposed Kwinana Power Station site and along the coastal strip between the proposed desalination plant site and the beach. The remnant vegetation covers an area of about 2.7 ha.	CSMC & @ <http://www.sese.uwa.edu.au/__data/page/96394/Seah_2005.pdf>
Hyndes G (2004) *Fish Habitat in the Nearshore Regions of Cockburn Sound,* A summary paper prepared for the Cockburn Sound Management Council	To discuss the significance of sandy nearshore areas in Cockburn Sound as fish habitats, and to place them in the context of such habitats in the broader region of the south-west of Western Australia.	Shallow sandy areas in south-western Australia have been shown to provide important habitats for many fish species, including a number of commercially and recreationally important finfish species that are represented by juveniles. Consequently, the nearshore habitats can be considered as important nursery areas. It has been found that fish assemblages in Cockburn Sound, Safety Bay, Shoalwater Bay and along the sheltered areas of Rottnest Island differ from fish assemblages in areas that are more exposed to wind and wave activity. Cockburn Sound provides one of the few environments containing sheltered nearshore areas throughout a large area of the lower west coast of Western Australia, and particularly in the metropolitan region. The most comprehensive study carried out on fish fauna in Cockburn Sound is by Dybdahl (1979). Another study by Vanderklift and Jacoby (2003) concluded that declines in drift weed in Cockburn Sound, through seagrass loss in the area, have resulted in changes in nearshore fish assemblages. King George whiting, in particular, appear only to recruit to sheltered sites, with juvenile whiting being far more abundant at Mangles Bay than any other site. The juveniles subsequently migrate into the deeper waters of Cockburn Sound, where they are targeted by recreational anglers, and then outside of Cockburn Sound to their spawning areas. Reduction in available recruitment area may result in King George whiting being a species that could be impacted by reduction in nursery habitat. There is a clear and urgent need to provide a relevant data set that can identify impacts of these proposed developments on the fish communities in the various nearshore areas of Cockburn Sound.	CSMC

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Kailis GM (2004) *Testing the Limits: Cooperative mechanisms in multiple use management,* In IIFET 2004 Japan Proceedings on behalf of the Cockburn Sound Management Council, Perth Western Australia	To present information about the Cockburn Sound Management Council in the context of multiple use decision making and planning.	Even excluding political considerations the complexity of rights and interests in relation to use of coastal and marine resources makes it hard for governments to assess the optimum use.	CSMC
Lavery P & Westera M (2004) *A Survey of Selected Seagrass Meadows in the Fremantle-Warnbro Sound Region,* Report No. 2004-04, Centre for Ecosystem Management Edith, Cowan University, Western Australia	Reports on the results from the 2004 assessment and focuses on temporal changes at each monitoring site.	Overall, the results indicate that there were no significant region-wide changes in the status of seagrass meadows at the sites surveyed between 1998 and 2004. However, there are some notable site-specific trends, namely: • Southern Flats, Stragglers Rocks and Woodman Point showed inter-annual changes but generally remained stable over the 1998–2004 period. • Kwinana showed evidence of stress over the period 1998–2000 but showed no signs of further deterioration in 2001–2004. Shoot density had increased since 2000. • As previously reported (2003), the cover of *Posidonia sinuosa* at Carnac Island is decreasing relative to other species, most probably due to competition from other species. • Seagrass biomass decreased at the Garden Island 7 m site in the period 1999–2004 and dead rhizomes were recorded in the sediment. • In 2003 we reported a decrease in seagrass biomass at Fish Rocks over the duration of the study. The addition of 2004 data rendered this insignificant. However the southern edge of this meadow, adjacent to the sampling site, sappears to have receded. This may be due to Swan River outflow limiting light. • The Garden Island Settlement site continues to appear stressed. Upper half of leaves were dead and highly epiphytised. • Mangles Bay remains highly stressed. In 2004 seagrass biomass at the site was the lowest recorded in the seven years of monitoring. The report makes recommendations for future monitoring.	CSMC
Lavery P & Westera M (2004b) *A survey of selected seagrass meadows in the Fremantle-Warnbro Sound Region,* Report No. 2004–04, Centre for Ecosystem Management, Edith Cowan University, Western Australia	Presents the results from the 2004 assessment and focuses on temporal changes at each monitoring site.	Overall, the results indicate that there were no significant region wide changes in the status of seagrass meadows at the sites surveyed 1998–2004. However, there are some notable site-specific trends, namely: • Southern Flats, Stragglers Rocks and Woodman Point showed inter-annual changes but generally remained stable over the 1998–2004 period, and there was no evidence of any deterioration of seagrass health at Luscombe Bay and Jervoise Bay E3 over the three years sampled. • Kwinana showed evidence of stress over the period 1998–2000 but showed no signs of further deterioration in 2001–2004. Shoot density has increased since 2000. • Cover of *Posidonia sinuosa* at Cockburn Sound is decreasing relative to other species probably due to competition with other species. • Seagrass biomass decreased at the Garden Island 7 m site in 1999–2004 and dead rhizomes were recorded in the sediment. • The southern edge of Fish Rocks has receded probably due to the influence of the Swan River plume. • The Garden Island Settlement site continues to appear stressed. Upper half of leaves were dead and highly epiphytised.	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		• Mangles Bay remains highly stressed. In 2004, seagrass biomass at the site was the lowest recorded in the seven years of monitoring. The report makes recommendations for future monitoring.	
Lavery P & Westera M (2004c) *Monitoring of Seagrass Meadows on the Eastern Shore of Garden Island, Western Australia,* Centre for Ecosystem Management, Edith Cowan University, Western Australia	To present the results of annual monitoring of seagrass meadows on the eastern shore of Garden Island for the Department of Defence.	Comparisons between Settlement and Luscombe Bay seagrass health sites did not reveal any significant negative trend over the 4 years of monitoring (2001–2004). However, a number of factors may be cause for concern including: • The stability of the shoot density at the Settlement site compared with the continuing increase in shoot density at Luscombe Bay; • The presence of dead rhizomes at the Settlement site indicating seagrass loss; • The high visible epiphyte load; and • The top third of most leaves being necrotic. The report makes recommendations for future monitoring to be undertaken by the Dept. of Defence.	CSMC
Marine and Freshwater Research Laboratory Environmental Science (2004) *Water Quality of Cockburn and Warnbro Sounds (Dec. 2003 to Mar. 2004),* A report to the Kwinana Industries Council, Cockburn Sound Management Council and the Royal Australian Navy, Report No. MAFRA 04/3	To compare the current water quality in Cockburn Sound in summer 2004 with previous studies and to determine if there have been any significant changes; To locate any consistently high areas of nutrient and phytoplankton concentrations; To determine the water quality status of Cockburn Sound.	The average nutrient concentrations in Cockburn Sound during the 2004 summer period were similar to those of recent years; indicating that water quality has changed little over the past decade. There has been an improvement in chlorophyll *a* data in 2004 compared with the nineties and 2000–2001. Concentrations of inorganic and organic nutrients were higher than those of reference sites located in Warnbro Sound. Chlorophyll *a* concentrations were higher in Cockburn Sound than in Warnbro Sound. The distribution of nutrients and phytoplankton was not even across Cockburn Sound. Higher concentrations of nutrients were recorded at sites along the eastern shore than in the centre. The eastern shore sites have nitrogen influences both from industrial discharge and groundwater loads. Phytoplankton populations, as indicated by Chlorophyll *a* concentrations were significantly higher at eastern shore sites than in the centre of Cockburn Sound. The water quality of the Northern Harbour was significantly poorer than at any other location for many parameters. The water quality of the three Garden island sites was comparable to that of the reference sites in Warnbro Sound.	CSMC
Orsini JP (2004) *Human Impacts on Australian Sea Lions,* Neophoca cinerea*, Hauled out at Carnac Island (Perth Western Australia): Implications for wildlife and tourism management,* Masters Thesis, Murdoch University, Perth Western Australia	Carnac Island Nature Reserve is one of the main sites where people can view sea lions near Perth, either during recreational activities or on commercial tours. This study sought: (1) to investigate the potential impact of human visitors on Australian sea lions hauled out on Carnac Island; (2) to consider the implications of the results for the management of Carnac Island Nature Reserve; and (3) to examine under which conditions tourism and recreation involving sea lions can be sustained in the long term.	Over the last 15 years, pinniped tourism has experienced a rapid growth in the Southern Hemisphere, and particularly in Australia and New Zealand where at least four sites attract more than 100,000 visitors per year. Tourism focused on the Australian sea lion (Neophoca cinerea), a protected species endemic to Australia, occurs in at least nine sites in South Australia and Western Australia. Australian sea lions haul out on several offshore islands in the Perth region. Carnac Island Nature Reserve is one of the main sites where people can view sea lions near Perth, either during recreational activities or on commercial tours. This study sought: (1) to investigate the potential impact of human visitors on Australian sea lions hauled out on Carnac Island, (2) to consider implications of the results for the management of Carnac Island Nature Reserve, and (3) to examine under which conditions tourism and recreation around sea lions can be sustained in the long term. Sea lion numbers, rate of return to the site, behavioural response to human presence and incidents of disturbances of sea lions by visitors were recorded over a period of four months on Carnac Island. A survey of 207 visitors was also carried out. Findings indicated that there were two main types of human impacts on the sea lions: • A specific state of sea lion vigilance induced by low level, but ongoing, repetitive disturbances from human presence, sustained at various approach distances ranging to more than 15 m, vigilance that is different from the behaviour profile observed in the absence of human disturbance, Impacts resulting from incidental direct disturbances of sea lions by visitors from inappropriate human recreational activities or from visitors trying to elicit a more 'active' sea lion response than the usual 'sleeping or resting' behaviour on display; these impacts included sea lions retreating and leaving the beach, or displaying aggressive behaviour. Impacts on sea lions from these disturbances may range from a potential sea lion	CSMC & @ <http://wwwlib.murdoch.edu.au/adt/pubfiles/adt-MU20040520.154341/02Whole.pdf> Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
...Continued from previous page		physiological stress response to sea lions leaving the beach, a reduction in the time sea lions spend hauling out, and, in the longer term, the risk of sea lions abandoning the site altogether. Repeated instances of visitors (including unsupervised young children) approaching sea lions at very short distances of less than 2.5 m represented a public safety risk. Results also indicated that (1) the numbers of sea lions hauled out and their rate of return to the beach did not appear to be affected by an increase in the level of human visitation (although longer-term studies would be required to confirm this result); and (2) there appeared to be a high turnover rate of sea lions at the site from day to day, suggesting that there are frequent arrivals and departures of sea lions to and from Carnac Island. The visitor survey indicated that many visitors to Carnac Island had a recreational focus that was not primarily directed towards sea lion viewing ('incidental ecotourists'). Although many visitors witnessed incidental disturbance caused by humans to sea lions, they did not seem to recognise that they themselves could disturb sea lions through their mere presence. Visitors also seemed to have a limited awareness of the safety risk posed by sea lions at close range. Visitors expressed support for the presence of a volunteer ranger on the beach and for more on-site information about sea lions. Finally, visitors indicated that they greatly valued their sea lion viewing experience. It is anticipated that the continued increase in visitation to Carnac Island from recreation and from tourism will result in intensified competition for space between humans and sea lions. Long-term impacts of human disturbances on sea lions are unknown, but a physiological stress response and/or the abandonment of haulout sites has been observed in other pinniped species. The findings of this study highlight the need to implement a long-term strategy to reduce disturbance levels of sea lions by visitors at Carnac Island to ensure that tourism and recreation around sea lions can be sustained in the long term. Recommendations include measures to control visitor numbers on the island through an equitable allocation system between various user groups, the development of on-site sea lion interpretation and a public education and awareness program, the setting up of a Sea Lion Sanctuary Zone on the main beach, ongoing monitoring of sea lion and visitor numbers and other data, and a system of training and accreditation of guides employed by tour operators.	
Naragebup Rockingham Environment Centre (2004) *Palm Beach Rotary Park Excavations – Wildlife and Water Monitoring Report,* Prepared for the City of Rockingham Western Australia	To report on animal translocation and water quality during excavations of the Palm Beach Rotary Park wetland.	Results show that water in Palm Beach Rotary Park is impacted possibly by urban and road runoff from surrounding areas. Most tested parameters were found to be below ANZECC guidelines, pH levels were found to be above ANZECC trigger values for aquatic ecosystems; total nitrogen levels were above the ANZECC default guideline value for wetlands and estuaries and continued monitoring is recommended. Three adult turtles, several tadpoles and a motorbike frog were translocated to Lake Richmond. Recommendations are made for vegetation species to be used in rehabilitation of the wetland.	City of Rockingham
Oceanica Pty Ltd (2004) *Sediment Colour of Southern Perth Beaches – Field Observations and Data Report,* Prepared for Cockburn Cement Ltd, Western Australia	To present results from a preliminary investigation into the greying of sands along the Owen Anchorage coastline.	It has been reported that the greying of the beach sands in Owen Anchorage is a phenomenon which has been observed over the last two to three years. Three possible causes of the influx of grey sands are presented: dredging of Parmelia and Success Banks; South Beach dredging and nourishment works; animal and chemical industrial works. The Owen Anchorage shoreline has been subjected to unusually high storm activity over the last nine years. In the period of 1999–2003 three of the five years experienced higher than average storm activity. Beaches in Gage Roads and Cockburn Sound do not appear to be so affected by discolouration processes and are typically lighter, and more yellow-white in colour. Whilst the Owen Anchorage beaches appear to be affected by this discolouration phenomenon, the dune systems remain the lighter white sands. The direction of the net sediment fluxes in Owen Anchorage, in combination with the lateral extent of the presence of the grey sands, suggests that a combination of processes and activities within the Owen Anchorage region may be contributing to the discolouration of beach sediments. It is recommended that further detailed assessment of sands is undertaken to determine the origin.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Parsons Brinckerhoff (2004) *Performance Review to the Department of Environment; Industrial Infrastructure and Harbour Development, Jervoise Bay (Assessment 1091, Statement 490),* Prepared for LandCorp, Perth Western Australia	To document the outcomes, beneficial or otherwise; review the success of the goals, objectives and targets; and evaluate the environmental performance over the 3 years (2000–2003).	In summary the project has been completed in compliance with stated environmental commitments from the environmental management plans and performance compliance reports. All non compliances have been reported to the Department of Environmental Protection for comment and corrective actions approved. Furthermore, the development was completed in accordance with the State Environmental Protection Authority objectives and achieved the recommended environmental conditions.	CSMC
Parsons Brinckerhoff (2004) *Jervoise Bay Recovery Bores, Monitoring Review No. 9 October 2003-June 2004,* Prepared for Department of Industry and Resources	To present the ninth monitoring review for the recovery system and present the strategy options for future operations.	The Dept. of Industry and Resources has constructed a groundwater recovery scheme to reduce the amount of nitrogen-rich groundwater discharging in to the Northern Harbour and to reduce the potential for major algal blooms. The scheme commenced in 2000. The dissolved inorganic nitrogen concentration of groundwater has remained relatively constant for the bores in the northern plume but seasonally variable for the bores in the southern plume. Approximately 60% of the nitrogen was recovered from the southern plume and 40% from the northern.	CSMC
Parsons Brinckerhoff (2004) *Environmental Management Plan for Operations of Australian Marine Complex, Fabrication Precinct,* Prepared for LandCorp, Perth Western Australia	To assist the proponent of the Australian Marine Complex Fabrication Precinct, LandCorp, the Common User Facility Manager, Services Arrangers and Users meet the overall environmental objectives of the operational phase of this project.	Significant environmental issues identified in this plan include: impact on marine water quality; impact on marine sediment quality; incidents and emergency situations; seagrass research and rehabilitation; impact on public health and safety; impact on recreational fishing and boating values; impact on shoreline and seabed; impact on air quality; environmental impacts of generated wastes; and impact on commercial and recreational vessel movements. Management actions have been developed to meet each objective.	CSMC
Rose T, Morgan D & Gill H (2004) *Lake Richmond Fish Survey,* Unpublished Report.	To sample the fish community in Lake Richmond, particularly the shallow water fish community (< 1.0 m deep) with a small 40 m beach seine; To sample the deeper water fish community if time and equipment was available.	A total of 520 fish from four species were collected. An introduced decapod, *Cherax destructor*, was also captured. The observation of several size classes in the two most abundant fish species indicates that both the native Swan River Goby and mosquito fish are breeding successfully in Lake Richmond. It was concluded there was not enough temporal and spatial coverage of the lake to confidently define the fish community. Yabbies were observed coming out of holes within the thrombolites. The damage this feral species may be inflicting requires urgent attention.	CSMC
Skene D, Brooke B, & Ryan D (2004) *Coastal Water Habitat Mapping Project – Coastal Geomorphology and Classification Subproject,* Milestone Report CG3-02, Report on Cockburn Sound Field Survey, Australian Government, Geoscience Australia	Results of the analysis of the grab samples will be used to develop relatively high-resolution GIS maps of the physical character and spatial distribution of surface sediments in the Sound. The results of the vibracoring will be presented as graphic drill logs. The logs will be incorporated into three west-east oriented cross sections of the northern, central and southern areas of Cockburn Sound and one north-south	This report describes the field survey carried out in Cockburn Sound, Western Australia, by Geoscience Australia (GA) for the Coastal Geomorphology and Classification Subproject (CG) of the Coastal Water Habitat Mapping Project (CWHM). It documents the various sampling techniques and procedures used to collect surface and subsurface samples from the Sound; and details of the vibracores and grab samples recovered and the proposed analyses to be performed on these samples. The results of the analysis of the grab samples will be used to classify the various surface sediment types encountered as well as map their distribution within Cockburn Sound. The analysis and interpretation of the vibracores will allow the reconstruction of the stratigraphic framework of Cockburn Sound. This information will be used in conjunction with the findings of the other subprojects in the CWHM Project. For example, it will assist in groundtruthing the results of the single and multi-beam sonar surveys that have and are to be carried out within Cockburn Sound by Curtin University. It will also provide key substrate information for incorporation into a more comprehensive benthic habitat classification for the Sound.	CSMC & @ <http://www.coastal.crc.org.au/cwhm/pdf/Coastal_CRC_SH_Milestone_Rep_CG3-02_Final.pdf>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	cross-section in the middle of the Sound. The various depositional sedimentary units identified in the cores will be used to develop a stratigraphic framework and the geomorphological evolution of Cockburn Sound.		
Taylor Burrell Barnett (2004) *Port Coogee Local Structure Plan,* Prepared for Port Catherine Developments Pty Ltd, Perth Western Australia	To present the local structure plan for Port Coogee which will guide the development of the Port Coogee Development for a marina, marina residential, other water-based residential, dry land residential, highway commercial and retail, and public amenity uses.	In 1992 the State government accepted in principle a proposal from Consolidated Marine Developments (Australia) Pty Ltd to develop a residential marina development in the South Coogee locality. Since that time, the project has been the subject of substantial and protracted negotiation, consultation, research and design. The land is within the South Coogee locality, bounded by the power station site and railway line to the north. The report outlines environmental assessment and planning approval processes.	CSMC
URS Australia Pty Ltd (2004) *Report on Proposed Contamination Management – Henderson Shipyard,* Prepared for Tenix Defence Pty Ltd, Henderson Western Australia	To ascertain the cause of contamination, recommend site amelioration to reduce contamination and recommend management and monitoring measures based on industry best practice.	Current results do not indicate significant groundwater contamination at either of the sites tested. The data does show evidence of historical contamination and potential for future contamination of the groundwater by TBT, copper and zinc, and that there is a store of metals in the surface sediments of the infiltration basin. TBT, copper and zinc are also present in high concentrations in the marine sediments adjacent to the site. The origin of these is uncertain, but it is most likely from direct discharge into the marine environment at the shiplift. Remediation of the terrestrial portion of the site can be achieved by removal of the surface layers of sediment in the infiltration basin. Marine sediment could be excavated and disposed of in an appropriately licensed off-site landfill facility.	CSMC
Valesini FJ, Potter IC, Wildsmith MD, Hourston M, Platell ME, Coen NJ, Schafer LN, Seidel ST & Whitehead AL (2004) *The Importance to Fish Species of the Various Habitats in Nearshore Marine Waters of South-western Australia,* Project 2000/159, Final Report to the Fisheries Research Development Corporation, Murdoch University, Western Australia	The main objectives of the study are provided below. The more specific aims of each component of the study are provided in the subsequent chapters. 1) Develop a quantitative scheme that can be used to readily identify the different habitat types found in nearshore marine waters along the lower west coast of Australia; 2) Determine the compositions of the fish faunas in representative examples of the different habitat types, and thereby determine which habitat types are used most extensively by main commercial and recreational fish species; 3) Establish the suite of environmental characteristics that can be readily used to	This study has developed an approach that will enable fisheries and environmental managers to predict which fish species, and particularly those of recreational and commercial importance, are likely to be found at any site along the lower west coast of Australia. The first step thus involved developing a method whereby the main types of habitat in these waters could be readily and reliably identified. This method used rigorous multivariate statistical techniques to select the suite of quantitative and enduring environmental criteria that were most important for distinguishing among habitat types. Once this had been achieved, we were then able to sample regularly the fish faunas, and also their main invertebrate prey, at sites that had been selected to represent each of those habitat types. This then enabled us to determine the ways in which the densities, diversity and species composition of those faunas are related to habitat type. The predictive approach we have developed is crucial for enabling fisheries and environmental managers to develop appropriate plans for protecting those types of habitat that are most important for key fish species and/or for maintaining biodiversity. Six main habitat types were identified on the lower west coast of Australia on the basis of differences in the values for seven enduring environmental characteristics, namely direct fetch, north-westerly fetch, the minimum distance from the shoreline to the 2 m depth contour, the distance from the shoreline to the first offshore reef chain along a south-westerly transect, and the area of nearshore substrate covered by bare sand, subtidal reef and seagrass. Values for each of these characteristics were obtained from sources such as bathymetric charts and thus did not require measurements to be made in the field. Data for these characteristics were used to develop a quantitative method for enabling any site along this coastline to be assigned to its appropriate habitat type.	CSMC & @ <http://www.cffr.murdoch.edu.au/frdc/FRDC_2000-159.pdf>

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	determine the habitat type of any site in this nearshore region and thus predict the fish species that are likely to be found at that site; 4) Determine the compositions of the benthic macroinvertebrate faunas at the same sites at which fish are sampled to ascertain whether the extent of the relationship between a less mobile assemblage of fauna and the characteristics of the different habitat types differs from that with the highly mobile fish fauna.		
Walker DI, Campey ML & Kendrick GA (2004) 'Nutrient dynamics in two seagrass species, *Posidonia coriacea* and *Zostera tasmanica*, on Success Bank, Western Australia', *Estuarine, Coastal and Shelf Science* 60 (2): 251-260	*Posidonia* plant tissue at the west site had higher nitrogen than atthe east site in both summer and winter. Nitrogen concentrations increased in winter, particularly in sheath tissue, but there was little change in root nitrogen concentrations between sites or seasons.	Nutrient concentrations and seasonal differences in atomic ratios (N:P) in plant tissue of *Posidonia coriacea* Kuo and Cambridge and *Zostera tasmanica* Aschers (formerly *Heterozostera tasmanica* (Syst Bot 27 (2002) 468) were measured from multiple locations on Success Bank, south-western Australia, and used to infer nutritional constraints on seagrass vegetative growth, particularly by phosphorus. *Posidonia* plant tissue at the west site had higher nitrogen concentrations than at the east site in both summer and winter. Nitrogen concentrations increased in winter, particularly in sheath tissue, but there was little change in root nitrogen concentrations between sites or seasons. Nitrogen concentrations of leaf tissue were all less than median seagrass values reported by Duarte (Mar Ecol Prog Ser 67 (1990) 201). The seasonality in nutrient concentrations in plant tissues suggests greater nutritional constraints in summer, during periods of high growth. Vegetative growth of *Posidonia coriacea* was more nutrient limited than that of *Zostera tasmanica*. Translocation of nutrients along rhizomes to the apex may ensure that growing points are not nutrient limited and that growth can be maintained, and was more apparent in *Z. tasmanica* than *P. coriacea*. Sexual reproduction placed large demands on *P. coriacea* through the high investment of nutrients into fruit, resulting in reduced nutritional constraints on successful seedling recruitment by initially providing seedlings with nutrients.	CSMC & @ <http://linkinghub.elsevier.com/retrieve/pii/S0272771404000186>
Water Corporation (2004) *Perth's Seawater Desalination Plant – Frequently Asked Questions,* Perth Western Australia	To present concise answers to questions most frequently asked regarding the proposed seawater desalination plant.	Presents answers to questions such as 'What is desalination?', 'Why do we need a desalination plant?' 'Where will the plant be and what will it look like?', 'How much will it cost?', 'Is desalination water more expensive?', 'Is it safe to use seawater from Cockburn Sound?'.	CSMC
Western Australian Planning Commission (2004) *Fremantle Ports: Outer Harbour Project – Information Brochure,* Perth Western Australia	To present information regarding the expansion of the port of Fremantle.	A study on globalisation by the Department of Treasury and Finance found that 22 per cent of metropolitan income is dependent on exports. As a result, it is important to ensure that adequate port facilities exist in the Perth metropolitan area to cater for the continuing population and trade growth. Planning is now underway to obtain approvals for proposed additional container and general cargo port facilities in Fremantle Port's Outer Harbour at Naval Base/Kwinana to handle the overflow when Fremantle Port's Inner Harbour reaches capacity. This will be significant infrastructure of strategic importance to the State. Fremantle Port's container trade has grown by about 11 per cent each year in the past decade. Detailed research over the past decade has concluded that Kwinana/Naval Base is the appropriate location for the expanded port facility. The reasons this site has been defined as the preferred location include: separation between port and residential areas; compatibility with surrounding industrial land uses; maintenance of beach; minimised land based freight traffic impacts; minimised impact on seagrass; minimised impacts on water quality; noise, light and risk impacts minimised; minimised impacts on air quality; good shipping	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		access and manoeuvrability; good wind/wave protection; good freight transport links; good linkages with support industry; adequate land for port related uses; integration with existing industry; direct ship access from Cockburn Sound/integration of existing channels; siltation being unlikely; meeting ship operational requirements (navigation); no identified heritage impacts.	
360 Environmental (2005) *Dewatering management plan – Perth Seawater Desalination Plant,* Report Reference 19AN, in Water Corporation (2007) *Perth Desalination Plant Water Quality Management Plan: Licence Supporting Documentation*, Job CW-01603	To address impacts to terrestrial and marine water quality that may be generated during the course of construction and ongoing operations of the Kwinana Perth Desalination Plant including stormwater management; dewatering during construction excavation; construction of the discharge pipeline and intake; and seawater concentrate to Cockburn Sound.	Potential environmental impacts associated with the proposed excavation and dewatering operations include the following: off-site drawdown of the local watertable; saltwater intrusion into the superficial aquifer during dewatering; temporary disruption to local bore users; disruption to groundwater dependent ecosystems; and potential localised degradation of Cockburn Sound water quality following discharge.	CSMC
Cockburn Sound Management Council (2005) *Environmental Management Plan for Cockburn Sound and its Catchment,* Rockingham Western Australia	To coordinate environmental planning and management of Cockburn Sound and its catchment.	Explains the management context and states the principles used to guide the development of the plan. Makes a large number of recommendations which aim to achieve the five point plan of action: • Protect the environmental values of Cockburn Sound; • Facilitate multiple use of Cockburn Sound and its foreshore; • Integrate management of the land and marine environments; • Coordinate research and investigations; • Monitor and report on performance. Supports the implementation of the State Environmental (Cockburn Sound) Policy 2005.	CSMC
Cockburn Sound Management Council (2005) *State of Cockburn Sound,* Rockingham Western Australia	To report on monitoring outcomes and activities undertaken by the Cockburn Sound Management Council.	• Levels of phytoplankton biomass required action in Southern and Northern Harbours. • Levels of toxicants in sediment required investigation in Southern and Northern Harbours. • Levels of Thermotolerant coliforms required investigation at Palm Beach and Rockingham Beach. Levels of Enterococci bacteria required investigation at Palm Beach and Kwinana Beach. • Seagrass shoot density failed to meet the standard at Mangles Bay.	CSMC
Cockburn Sound Management Council (2005) *Report and Recommendations on the Exceedance of Environmental Quality Guidelines in Cockburn Sound 2005,* Prepared for the Environmental Protection Authority, Perth Western Australia	To provide an explanation of the exceedance of EQGs as noted in the 2005 Report Cards; To outline the actions of the CSMC in coordinating a response to the exceedance of EQGs for Cockburn Sound; To outline the results of investigations undertaken by relevant public authorities; and To provide recommendations in relation to the maintenance of environmental quality objectives for Cockburn Sound.	This report provides a summary of information presented in the State of Cockburn Sound 2005 report (see above) and makes 5 recommendations so that the environmental quality objectives for Cockburn Sound continue to be met.	CSMC

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Department of Environment (2005) *Background Quality for Coastal Marine Waters of Perth, Western Australia,* Technical Series 117, Western Australia	To describe the results of water quality surveys conducted in the coastal waters off Perth to determine the current background concentrations of selected metals, organic chemicals and radionuclides using analytical techniques that provide the lowest detection limits available in Australia.	The results demonstrate that the ANZECC and ARMCANZ (2000) guidelines are relevant for application to Perth coastal waters. Best estimates of natural background water quality for Perth coastal waters and ambient water quality for Cockburn Sound have been determined for several selected metals.	CSMC
Department of Environment (2005) *Background Quality for Coastal Marine Waters of Perth, Western Australia,* Technical Series 117, Perth Western Australia, Prepared by McAlpine KW, Wenziker KJ, Apte SC & Masini RJ	This report describes the results of water quality surveys conducted in the coastal waters off Perth to determine the current background concentrations of selected metals, organic chemicals and radionuclides using analytical techniques that provide the lowest detection limits available in Australia. The study involved two surveys; a pilot survey followed by a larger, more extensive main survey.	Water quality surveys were undertaken in Perth's coastal waters in February and June 2003 to determine dissolved concentrations of arsenic, aluminium, cadmium, chromium, cobalt, copper, lead, silver and zinc; total mercury concentrations; concentrations of a range of organic chemicals (polyaromatic hydrocarbons, organochlorine pesticides, organophosphate pesticides, phenols, petroleum hydrocarbons and the chemicals benzene, toluene, ethylbenzene and xylene [BTEX]) and radionuclides. This work was undertaken to gain an understanding of background concentrations for a range of contaminants in these marine waters, and to ascertain whether the guideline trigger values from ANZECC & ARMCANZ (2000) were relevant to the region. The results of this study indicate that the coastal waters of the Perth region were generally of very high quality. The concentrations of metals were low by world standards, with localised elevations of some metals in Cockburn Sound. Concentrations at the time of sampling met the environmental quality guidelines for a *very high* level of ecological protection (99% species protection) for all metals, except cobalt, throughout the sampled area. No organic chemicals were detected in any of the samples. Guideline values were available for five of the organic chemicals and the analytical reporting limits for these chemicals were well below the guideline trigger values recommended in ANZECC & ARMCANZ (2000) for a *very high* level of ecological protection. The findings of this study therefore suggest that the ANZECC & ARMCANZ (2000) 99% species protection guidelines are appropriate for application to the region for all the relevant contaminants except cobalt. For cobalt, the 95% species protection guideline is recommended for use.	CSMC & @ <http://portal.environment.wa.gov.au/pls/portal/url/item/F9B0C83BE490DB4FE03010AC6E05098D>
Department of Fisheries (2005) *State of the Fisheries Report 2004/05,* Perth Western Australia	To present an overview of the state of the fisheries throughout Western Australia.	In relation to Cockburn Sound the following was discussed: • There are three managed fisheries that operate wholly and two managed fisheries that operate partly within Cockburn Sound: fish net, line and pot, crab (all wholly), beat bait and purse seine (partly). • The Cockburn Sound line and pot and fish net fisheries are primarily managed through input controls in the form of limited entry, gear restrictions and closed areas. Over the past 10 years, as a result of Voluntary Fishery Adjustment Schemes, the number of licences in the two fisheries has been reduced significantly, from 42 to 13 line and pot licences and one fish net licence. • The annual finfish catch, excluding baitfish, molluscs and crustaceans, has generally declined since the peak catch of 165 t in 1992. The lowest catch of 45 t of finfish occurred in 2004, when compared with data over 20 years. Approximately 92% of the total 2004 catch consisted of Australian herring, sea garfish and pink snapper. • Australian herring catches showed a steady increase from 1980, but have declined to a lower level, fluctuating between 15 and 30 t per years. • Surveys, undertaken in 2000–01 and 2001–02 indicate that the finfish catch from Cockburn Sound is dominated by the recreational sector.	CSMC

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Department of Fisheries (2005) *Historical Distribution and Abundance of the Australian Sea Lion (*Neophoca cinerea*) on the west coast of Western Australia,* Fisheries Research Report No. 148, Prepared by Campbell RA	Interactions of commercial fishing operations and marine mammal populations are of considerable interest to researchers and fisheries managers alike (DeMaster *et al.* 2001). Monitoring of bycatch is an integral component of many fishing industries, and also can provide limited ecological data for the non-target species affected (e.g. Hookers sea lion in Woodley & Lavigne 1993). In Western Australia, one of the key fishing industries is for the western rock lobster, *Panulirus cygnus*, an industry worth between 200 and 400 million dollars annually. The fishery is based on pot catch along the southern half of the west coast, and low levels of bycatch of the Australian sea lion, *Neophoca cinerea*, have been reported (Gales & Wyre unpub. rep.; Mawson & Coughran 1999; Shaughnessy *et al.* 2003). The level and impact of this incidental mortality on the sea lion population is currently unknown.	Analysis of historical patterns of abundance of the Australian sea lion on the west coast of Western Australia suggests that the population size was greater prior to the impacts of colonisation and commercial sealing/whaling between the 18th and 20th centuries. In addition, it is evident that there has been a reduction in the number of breeding sites along the west coast, particularly around the greater Perth metropolitan area. There is limited evidence of the impact of Indigenous hunting on the abundance and distribution of this species. The major impacts on Australian sea lion populations were a combination of subsistence and commercial harvesting events from the 1700s to the 1920s. In more recent times, low levels of bycatch of Australian sea lions have been reported by a number of commercial fisheries, including the western rock lobster fishery (WRLF). Population surveys over the last three decades suggest that the west coast population is small but stable, though the impact of fishery-related mortality on this species is unknown. There is no evidence to suggest that commercial operations of the WRLF have had an adverse impact on populations of the Australian sea lion.	CSMC & @ <http://www.fish.wa.gov.au/docs/frr/frr148/frr148.pdf>
Department for Planning and Infrastructure & Fremantle Ports (2005) *Fremantle Ports Outer Harbour Project – Background to port planning and why Naval Base/ Kwinana has been selected for further strategic assessment,* Companion document to the Draft Strategic Assessment Guidelines, Fremantle Western Australia	To summarise why Naval Base/Kwinana has been selected for the proposed Outer Harbour expansion.	Fremantle Port is Western Australia's principal general cargo port. It is Western Australia's only dedicated container port and handles almost all of the State's container trade through its Inner Harbour terminals. Most of the container trade originates from or is destined for the Perth metropolitan area, and a study on globalisation by the Department of Treasury and Finance found that 22% of metropolitan income is dependent on exports. Several sites have been examined for their suitability for Port expansion including: Bunbury, Geraldton, Wilbinga, Breton Bay, North Fremantle, Catherine Point, Jervoise Bay, Wells Park, Mangles Bay and Naval Base/Kwinana. After lengthy research and analysis Naval Base/ Kwinana was identified as the preferred location for an overflow port facility. In summary, the reasons this site has been defined as the preferred location include: separation between port and residential areas; compatibility with surrounding land use; minimised impact on views; minimised land based freight traffic impacts on residential uses; mimimised impacts on seagrass; minimised impacts on water quality; minimised noise, light and risk impacts, minimised impacts on air quality; good shipping access; good ship manoeuvring; good wind/wave protection; good linkages with support industry; adequate land for port related uses; direct ship access from Cockburn Sound with existing channels; siltation is unlikely and there are no identified heritage impacts.	CSMC

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Department for Planning and Infrastructure & Fremantle Ports (2005) *Fremantle Ports Outer Harbour Project – Strategic Assessment Guidelines,* Fremantle Western Australia	To provide guidelines to facilitate the strategic assessment of the Outer Harbour options.	Four project options for a port facility at the Naval Base/Kwinana location are to be considered together with associated road and rail links. Each of the options, when fully developed, will have the same port capacity. Three of the four options are offshore designs and the fourth is a combined land backed and offshore design. These Guidelines set out the assessment methodology to be followed in preparation of the Strategic Assessment Report and the development of the Fremantle Ports and DPI response to the assessment, on which both EPA and WAPC will base their advice to Government. In order to facilitate a full understanding of the dimensions of each impact, and allow sensitivity analysis of the outcomes, the assessment of each identified impact will address: the aspect of the project giving rise to the impact; the significance of the impacts qualitatively, and where appropriate quantitatively; when the impact will arise; the spatial and temporal scale of the impact; cumulative impacts; whether the impact will result directly from the port/access projects or indirectly; the information on which the assessment is made, and confidence in that information; the level of certainty about the predicted impact; management strategies, and their likelihood of success; possible offsets and policies relevant to the impact.	CSMC
Environmental Protection Authority (2005) *Kwinana Gas-Fired PowerStation (Water Cooled Condenser): Report and recommendations of the Environmental Protection Authority,* Proposal submitted by NewGen Power Pty Ltd, Bulletin 1190, Perth Western Australia	To provide advice and recommendations to the Minister for the Environment on the environmental factors relevant to NewGen Power constructing and operating a nominal 320 megawatt base-load combined cycle gas turbine power station situated at Kwinana.	NewGen Power P/L proposes to construct and operate a natural gas-fired combined cycle gas turbine power plant with a nominal generation capacity of 320 megawatts on a site located off Leath and Barter Roads on the western edge of the Kwinana Industrial Area. The plant could provide approximately 2800 gigawatt hours of electricity annually into the electricity market. The power station requires approx. 158 gigalitres of seawater per year to be pumped from Cockburn Sound to cool and condense the superheated steam that drives the steam turbine. The EPA considers the proponent has demonstrated, in the Environmental Protection Strategy, that the proposal can be managed in an environmentally acceptable manner.	CSMC
Environmental Protection Authority (2005) *Manual of Standard Operating Procedures: for environmental monitoring against the Cockburn Sound Environmental Quality Criteria (2003–2004),* A supporting document to the State Environmental (Cockburn Sound) Policy 2005, Report 21, Perth Western Australia	To support implementation of the State Environmental (Cockburn Sound) Policy 2005 by setting out the standard procedures for environmental monitoring in Cockburn Sound.	Contains the standard operating procedures for physio-chemical, biological and aesthetic indicators specified in the EQC Reference Document for Cockburn Sound (EPA 2005).	CSMC
Environmental Protection Authority (2005) *Environmental Quality Criteria Reference Document for Cockburn Sound (2003–2004),* A supporting document to the State Environmental (Cockburn Sound) Policy 2005, EPA Report 20, Perth Western Australia	To present the Environmental Quality Criteria and decision schemes which support the implementation of the State Environmental (Cockburn Sound) Policy 2005.	States the Environmental Quality Criteria, Environmental Quality Guidelines and Environmental Quality Standards and details a process for decision making and monitoring.	CSMC

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Evans Michael (2005) *Nutrient Discharge to Cockburn Sound from a Subterranean Mixing Zone: a comparison of transport and reaction timescales*, Honours Thesis, Dept. of Environmental Engineering, Centre for Water Research	This thesis examines the assumption of conservative transport of nitrate in a shallow aquifer at Cockburn Sound, Western Australia, where ecosystem disturbance has the placed groundwater input of nutrients, particularly nitrate, under renewed scrutiny	At Cockburn Sound, Western Australia, initially successful management responses to minimise environmentally degrading levels of nutrients became less successful due to an apparent increase in the nutrient contribution of groundwater. A range of methods has been used to characterise the groundwater discharge into the Sound, and measurements of nitrate levels in the aquifer have been combined to estimate the magnitude of this input. These analyses assume the conservative transport of nutrients from the inland measurement point to the ocean, and are representative of other such studies carried out around the world. However, biogeochemical processes such as denitrification are capable of removing nitrate along this flow path. The degree to which such processes occur depends on many factors, including geochemical properties and residence time. The aim of this project is to test if the assumption that denitrification is an insignificant consideration in the formation of nitrate flux estimates from the aquifer to Cockburn Sound waters, is sensitive to seasonal variation in nitrate residence time. Therefore, the key objectives are to: • Form independent predictions of the seasonal variation in groundwater residence times; • Form estimates of the timescales required for denitrification to remove nitrate from the groundwater; • Compare nitrate transport timescales with reaction timescales and so assess the validity of the assumption of conservative transport for seasonal flows of nitrate.	CSMC & <www.sese.uwa.edu.au/__data/page/96394/Evans_2005.pdf>
Finn HC (2005) *Conservation Biology of Bottlenose Dolphins (*Tursiops *sp.) in Perth Metropolitan Waters,* PhD Thesis, Murdoch University	To examine two potential conservation problems for a residential sub-population of ~75 bottle-nose dolphins in Cockburn Sound.	The density of foraging dolphins varied significantly across habitats and foraging aggregations consistently occur in an area known as the Kwinana Shelf during the austral autumn-spring period. It is suggested that dolphins consistently utilise both low density prey species and high density prey species. These findings indicate that ecosystem-based conservations of the population should consider the conservation requirements of dolphin prey species and the ecological integrity of key foraging habitats like the Kwinana Shelf. Observations of the effects of unregulated dolphin feeding indicated that fed dolphins sustained increased higher rates of human-induced injury than non-provisioned dolphins and feeding was associated with substantial and enduring behavioural changes including changes in ranging and association patterns. The findings of this study indicate that population decline in Cockburn Sound could be induced by a reduction in the Sound's environmental carrying capacity or through mortality, injury and behavioural changes resulting from human interactions. Mitigation of direct human-dolphin interaction like illegal feeding requires an enforcement and education program to encourage more responsible human attitudes towards interactions with dolphins. Behavioural surveys of adult females over the duration of a 1993 study showed that females with young calves (<1 year old) utilised the Kwinana Shelf more frequently than females with older calves and spent more time off the shelf as calves matured. Female dolphins may be particularly vulnerable to reductions in per capita prey availability within Cockburn Sound and the Kwinana Shelf may represent an ecologically significant habitat for mother-calf pairs. Foraging results indicate that the Kwinana Shelf and its constituent habitat types may constitute a critical foraging habitat for dolphins in Cockburn Sound. Several factors suggest that the residential sub-population in Cockburn Sound may represent a distinct community: a) ecological differences between the residential sub-population and dolphins in other areas of the metropolitan waters of Perth; b) the relatively closed association network of the residential sub-population; and c) the long-term site fidelity of individuals within the residential sub-population. These considerations suggest that the Cockburn Sound sub-population should be considered as a distinct management unit until further research can resolve the extent to which genetic or demographic isolation occurs.	CSMC

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Government of Western Australia (2005) *State Environmental (Cockburn Sound) Policy 2005,* Western Australia State Environmental Policy Series 01, 30p	To establish the basis on which Cockburn Sound and the environment of adjacent land is to be protected.	Establishes a process for understanding monitoring outcomes and clearly establishes a reporting framework.	CSMC
Herring Storer Acoustics (2005) *Cumulative Noise Model of the Kwinana Industrial Area: 2005 update,* Prepared for Kwinana Industries Council, Perth Western Australia	The results of the 2005 Kwinana Industrial Area's noise propagation model indicate that there has been a net reduction in the noise immission levels to noise sensitive premises in the area. This net reduction ranges from 0.3 dB(A) in Hope Valley to 2.5 dB(A) in Medina and has occurred due to noise control programs undertaken by some industries, as well as the two new industries being designed to not significantly contribute to noise levels at residences. Whilst an instantaneous change of 3 dB(A) is just perceptible to the human ear, it does represent a 50% reduction in noise energy.	The Kwinana Industries Council (KIC) commissioned Herring Storer Acoustics (HSA) to update the data in the cumulative environmental noise propagation model developed for industries within the Kwinana Industrial Area (KIA). The model was initiated in 2001 and reported in November 2001, reference SVTAU/01/06/002 (2001 model) based on data current as of August 2001. The purpose of the brief was to assess any change in noise emission1 and immission2 levels that may have occurred since 2001. This could be due to the addition or subtraction of industries, expansion of existing industries or the result of noise control programs by industries. All relevant industries were contacted and reported any change or no change as the case may be. These details were incorporated in the computer model and noise immission levels calculated using the same methodology as the 2001 model. This report presents the results of incorporating the updated data and compares these to results of the 2001 study.	KIC/CSMC & @ <http://www.kic.org.au/documents/Final%20Approved%20Version%2025%20July%202005.pdf>
HLA-Envirosciences Pty Ltd (2005) *Stage 1 Environmental Investigation HMAS Stirling, Western Australia,* Prepared for the Department of Defence, Melbourne Victoria	To assess whether past or current activities at five identified potentially contaminated areas may have resulted in soil, surface water and/or groundwater contamination.	The available information does not enable a firm assessment of the environmental impacts from the facilities located at the site on the surrounding ecosystems. It is clear from the data that the groundwater beneath the site is impacted by nitrates arising from sewage treatment and disposal operations and petroleum hydrocarbons derived from fuel storage and spills. It appears that impacted groundwater is moving towards the east (Cockburn Sound) and towards the west (Indian Ocean). The total nitrate discharge is in excess of 1 tonne/year but the ultimate fate of the nitrate in terms of distribution to surrounding marine waters has not been fully delineated.	
LandCorp (2005) *Biodiversity Strategy (Preliminary release for stakeholder review and comment): Hope Valley Wattleup Redevelopment Project,* Perth Western Australia	To provide a guiding structure to ensure that environmentally sensitive areas are protected and where possible enhanced through identified plans and management strategies and to identify areas required for biodiversity conservation and enhancement and propose mechanisms for their protection and management.	Due to the highly fragmented and degraded nature of the remnant vegetation within the HVWRA and a large proportion of the HVWRA being allocated to extractive industries, the opportunity to retain areas of significant remnant vegetation and maintain a continuous ecological link through the HVWRA is very limited. The following strategic actions have been identified to assist in the local scale implementation of the Biodiversity Strategy: • Investigate and develop some form of mechanism to set aside land for future protection and conservation; • Develop a framework for the implementation, management and monitoring of potential areas identified for protection; • Develop an overall Landscape Plan; • In consultation with the Town of Kwinana and DEC, investigate options to incorporate Long Swamp within the Beeliar Regional Park.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Lavery P & Westera M (2005) *A Survey of Selected Seagrass Meadows in the Fremantle-Warnbro Sound Region,* Report No. 2005-02, Edith Cowan University, Western Australia	To report on results from the 2005 seagrass health assessment and focus on temporal changes at each monitoring site.	Overall results indicate that there were no significant region-wide changes in the status of seagrass meadows at the sites surveyed between 1998 and 2005. In 2003 a decrease in seagrass biomass at Fish Rocks was reported. In 2005 biomass was the lowest on record. This decrease should be investigated further. There was no evidence of any deterioration of seagrass at Jervoise Bay but species composition at the site appeared to be shifting to a dominance of *Posidonia australis*. Seagrass biomass was lowest at the *Posidonia sinuosa* sites. The Garden Island Settlement site continued to appear stressed with significant amounts of dead rhizome in the sediment and the upper half of leaves were necrotic and highly epiphytised. Mangles Bay remained stressed but did not appear to have deteriorated further in 2005. Epiphyte loads of filamentous species and large amounts of organic matter in the sediments imply that this continued to be a eutrophic site.	CSMC
MP Rogers & Associates (2005) *Southern Perth Metropolitan Coast Coastal Setback Study,* Prepared for the Department for Planning and Infrastructure, Perth WA	To complete a preliminary assessment of the appropriate setback to allow for the physical coastal processes along the southern metropolitan coast in line with the *State Coastal Planning Policy 2.6.*	**Island St groyne to Catherine Point groyne** (aka Northern Dog Beach): Catherine Point Groyne built ~1960. Island St Groyne built in 1964 and extended 60m in 1996. Recommended setback is 63 m. **Catherine Point groyne to old Power Station seawall:** Power Station Seawall built ~1940. Robb Road Groyne was constructed between 1942 and 1959. Recommended setback is 68 m. **Power Station to *Omeo* wreck seawall:** Suspected that natural rock lies behind seawall. Recommended setback is 50 m pending an investigation into the stability of the seawall. ***Omeo* to Woodman Point seawall:** Seawall on northern face of Woodman Point built in 1913–1918 as part of a proposed naval facility. Recommended set back is 80 m. **Woodman Point seawall (north) adjacent Cockburn Cement jetty:** Recommended setback is 50 m pending an investigation into the stability of the seawall. **Cockburn Cement jetty to Woodman Point groyne (south):** The Wapet groyne was built in the late 1960s. Recommended setback is 67 m. **Woodman Point groyne to Jervoise Bay boat harbour:** Significantly impacted by groyne construction, deposited sand from marine excavations. Recommended setback is 72 m. **Jervois Bay boat harbour to southern extent of natural rocky shoreline:** No setback recommended for Jervoise Bay as harbours and marinas are exempt. Recommended setback for natural rocky shoreline is 50 m. **Southern extent of natural rocky shoreline to northern side of James Point:** Recommended setback is 64 m. 150 m seawall located in this sector does not provide total protection for development. **900 m of sandy beach northern side of James Point:** Recommended setback is 89 m. **James Point to *Kwinana* wreck:** Recommended setback is 71 m. ***Kwinana* wreck to CHB jetty:** Extensive coastal engineering work has occurred around the *Kwinana* wreck since it was filled in 1959. Recommended setback is 160 m. **CBH jetty to Cruising Yacht Club:** Recommended setback is 98 m. **Cruising Yacht Club to Fisher St jetty:** Two seawalls are present in this sector at Churchill Park/Bell Park and in front of the yacht club. Recommended setback is 74 m. **Fisher St jetty to GI Causeway** – Two short seawalls are present in this sector at Hymus Street and the Mangles Bay Fishing Club. Recommended setback is 110 m.	CSMC

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Naragebup Environment Centre (2005) *The Diurnal Population of* Columbia livia*: Feral pigeons,* Report compiled for City of Rockingham	To assess how successful management practices for feral pigeons have been since a previous study in 2002.	Generally, pigeon numbers at all the study sites have dropped, some significantly and some only slightly but nowhere was it recorded that there were more pigeons than the 2001–2 survey. This indicates that culling methods have been effective or pigeons may have moved to other areas to avoid being culled.	CSMC
Oceanica Consulting Pty Ltd (2005) *Jervoise Bay Northern and Southern Harbours Summer Water and Sediment Quality: December 2004 to April 2005,* Prepared for Parsons Brinckerhoff Pty Ltd, Report No. 274/8	To present the results of summer water and sediment quality monitoring undertaken for the Jervoise Bay Northern and Southern Harbours from 3 December 2004 to 4 April 2005.	Water quality monitoring shows that elevated concentrations of nitrogen and chlorophyll a remain within Northern Harbour; while Southern Harbour, despite exceeding the Environmental Quality Guidelines at some sites for light attenuation coefficient and chlorophyll a does not exhibit markedly different water quality compared to waters outside the harbour. There is Tributyltin contamination within the sediments inside both harbours. However, significant decreases were recorded compared to summer 2003–04 concentrations.	CSMC
Oceanica Consulting Pty Ltd (2005) *Upgrade of Cockburn Cement's Wash Plant, Owen Anchorage,* Prepared for Cockburn Cement Ltd, Report No. 334/3, Western Australia	To provide a detailed assessment of the project, any environmental impacts and the management of these impacts, to be submitted to the EPA for a decision on whether a formal assessment is required.	• Cockburn Cement's wash plant is located close to shore on the north side of Woodman Point adjacent to Cockburn Cement jetty and facing into Owen Anchorage. The land on which the wash plant is located is leased by Cockburn Cement from the Department of Industry and Resources, with the tenure of the lease linked to Cockburn Cements State Agreement Act. Cockburn Cement must plan to process more sand, and sand that has higher fines content. As its groundwater allocation for the present washing process is already inadequate, it must also use water more efficiently. Cockburn Cement's proposed wash plant upgrade is intended to meet increased shellsand demand, produce a better washed shellsand product and use less wash water in the process. The proposed upgrade utilises much of the existing equipment. A wash plant throughput of 450 tonnes per hour of solids is required. This is sufficient to support shellsand demand for the next 10 years. There is to be no increase in the present level of noise generated on the wash plant premises.	CSMC
Oceanica Consulting Pty Ltd & Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management (2005) *Benthic Habitat Mapping – Owen Anchorage 2004,* Report No. 344/1, Prepared for Cockburn Cement Ltd, Western Australia	To provide for a continuation of previous seagrass mapping undertaken for Cockburn Cement.	Purpose-flown aerial photography captured in March 2004 was used to map benthic habitats within nine sub-regions of Owen Anchorage. Detailed and extensive groundtruth data were obtained via towed underwater video surveys. A total of 52 transects were obtained covering a total distance of 113 km. In 2004, vegetated habitat occupied 2236 ha of the approximately 7000 ha Owen Anchorage study area. The most common seagrass species mapped were *Amphibolis* spp., *Posidonia coriacea* and *P. sinuosa.* The mixture of species in Owen Anchorage is one of the most diverse for seagrass meadows in temperate waters, with many species co-occurring in extensive meadows. The percentage of vegetated habitat in the total study area has remained constant at 32% and there was effectively no loss or gain of vegetated habitat between 1999 and 2004.	CSMC
Parsons Brinckerhoff (2005) *Jervoise Bay Infrastructure Project: Performance and Compliance Report Year 4,* Prepared for LandCorp, Perth Western Australia	To document environmental outcomes; to determine and review the success of environmental management measures; and to demonstrate compliance with the Ministerial Conditions and Proponent's Commitments during the fourth year of the harbour project.	Construction of the Jervoise Bay Southern Harbour commenced in 2001 and initial development stage contracts were completed over two and a half years later in June 2003. The key environmental issues addressed over the past 12 months during the operational phase of the project were seagrass management, water and sediment quality of Jervoise Bay regional waters, public access management and disturbance to the environment associated with the operations of the Australian Marine Complex, Fabrication Precinct. During 2004–2005 the water quality within the Jervoise Bay Northern Harbour continued to exceed the environmental quality criteria for chlorophyll a and light attenuation in marine ecosystems with a moderate degree of protection. In contrast, the Southern Harbour did not exhibit markedly higher concentrations of nutrients and chlorophyll a within the harbour compared to outside the	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		harbour, suggesting that there are no significant sources of nitrogen within the harbour. Tributyltin concentrations appear to be recently introduced. The levels of arsenic in mussel tissue reported during 2005 represent a risk for human consumption and the posting of warning signs where the mussels were sourced requires further consideration and notification of the exceedances to the Department of Health is considered necessary.	
Pattiaratchi C (2005) *A Pilot Field Measurement Program to Define Dissolved Oxygen Dynamics in Cockburn Sound,* Prepared for the Water Corporation of Western Australia by the Centre for Water Research, University of Western Australia	To present results of a pilot survey of dissolved oxygen in currents in Cockburn Sound between 22 November and 1 December 2004 at two separate locations in Cockburn Sound using moored instrumentation.	Data indicated that for the strong, southerly and north-westerly wind conditions experienced during the field study, the column was well mixed and the currents had a southerly component. This implies that even during southerly winds the currents were directed southwards opposite to the wind direction; this is likely due to the sheltering effects of the land. Therefore, the brine discharge would be transported southward and flow through the Stirling shipping channel to the deeper regions of Cockburn Sound. The 'worst' period for vertical stratification of the water column would occur during the autumn months (April-May). It is recommended that a similar data collection period be undertaken to coincide with these months.	
Read DJ & Oldham CE (2005) *Sediment Oxygen Demand in the Cockburn Sound Deep Basin: Final report,* Centre for Water Research, University of Western Australia	To determine the natural sediment oxygen demand (SOD) in the deep basin of Cockburn Sound; To quantify the release of nitrogen species and iron upon achieving anoxia in the sediments.	14 core samples from the deep basin of Cockburn Sound did not become anoxic during a three week experiment. The sediment in Cockburn Sound is predominantly carbonate sand; anoxia is unlikely to result in the release of metals that is usually associated with the reduction of particulate iron hydrous oxides (and therefore the dissolution of a contaminant bound to that particulate phase).	CSMC
RPS Bowman Bishaw Gorham Environmental Management Consultants (2005) *Port Coogee Construction Management Program,* Prepared for Australand Holdings Limited, Report No. L04057, Subiaco Western Australia	To present management procedures and a monitoring program for the protection of marine water quality, flora and fauna within the vicinity of the marina including seagrass meadows; outline procedures for blasting during construction; plan for mitigation of loss of vegetation and the loss of portions of Beeliar Regional Park; plan for traffic management; plan contingency measures if monitoring reveals unacceptable impacts to marine flora and fauna; develop strategies for the management of changes to coastal processes in the vicinity of the marina during the construction phase; and develop strategies for management of dust, noise and vibration during construction.	Discusses potential risks to the marine environment and presents management plans for: • marine impacts • drilling and blasting management • vegetation management • traffic management • coastal processes management • dust, noise and vibration management • asbestos management.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
RPS Bowman Bishaw Gorham Environmental Management Consultants (2005) *Port Coogee, Waterways Environmental Management Program,* Prepared for Australand Holdings Ltd, Perth Western Australia	The aim of this report is to: Identify existing marine water and sediment quality; Identify factors affecting marine water and sediment quality; Establish Environmental Quality Criteria (EQC) that are to be maintained within the marina waterways; Provide for maintenance of marine water and sediment quality; Provide for ongoing monitoring and management including contingency measures if the EQC are exceeded; Provide for ongoing monitoring and management of changes to coastal processes within the vicinity of the marina including contingency measures for erosion or accretion; Present an oil spill contingency management plan; Present a landscape plan for recreation reserve; Provide details of staging and planning.	The report identifies risks to water and sediment quality within the marina and discusses: elevated nutrient concentrations in groundwater; potential contaminant inputs; turbidity from sand bypassing operations; and management of these risks. Water quality surveys will be conducted weekly for ten weeks from December to March for the first three years following construction. Sediments within and adjacent to the marina will be monitored annually for nutrients, metals and petroleum hydrocarbons. The proponents are required to work closely with the Department of Environment and Conservation in regard to contingency management should EQCs be exceeded. The report includes: Coastal Management Plan Emergency Response Plan Groundwater Intercept Plan Landscape Management Plan	CSMC
Seah S (2005) *Comparing the Functionality of theKwinana Desalination Plant with the South West Yarragadee Groundwater* *Development,* Thesis, Environmental Engineering Project 640.406, Centre for Water Research, University of Western Australia	There is a growing need for Western Australia to have new water sources to meet the increasing demand within the IWSS and the fast developing South West Region. At the moment, the Water Corporation is looking into several options for supply of water—firstly, the 45 gigalitres per annum desalination plant (targeted to be completed by October 2006).	The ready and secure supply of potable water is a pre-requisite for the economic development of Western Australia. This supply has to be well managed so that the development options of future generations are preserved. The Perth metropolitan area, City of Mandurah, the Goldfields and Agricultural Water Supply are being serviced by an integrated combination of surface and groundwater resource distribution system. It has been proven that seawater desalination is able to deliver significant quantities of potable water, independent of climate. The government of Western Australia has decided that the next major water source will be a 45 GL/year seawater Reverse Osmosis (RO) desalination plant to be built at Kwinana. Another source of water supply is development of the South West Yarragadee aquifer. It will consist of a well field, a filtration-based treatment plant and storage tank, transfer main pipelines from the head works to the Stirling Trunk Main at Harvey, pumping stations at Ravenswood and an adaptive approach to tone down any risk where necessary. In order to attempt to measure the functionality of these two systems, five system perspectives and their respective functions are defined and then appropriate indicators are used to measure these functions. In this project, the functionality of the two systems involved will be measured using relative values. This means that the value of the indicators will be compared to a benchmarked value. Eventually, these relative indicator values are added up and compared. The system with the higher value will be the one performing at a higher functionality.	Saved to Disk & @ <http://www.sese.uwa.edu.au/__data/page/96394/Seah_2005.pdf>

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Sinclair Knight Mertz (2005) *HMAS Stirling (Fleet Base West) Drainage Management Plan,* Prepared for Department of Defence, Perth Western Australia	To identify the characteristics of the existing drainage network of the Base; To broadly identify the effectiveness of the existing drainage network; To broadly identify any deficiencies with the existing drainage network; and To identify effective proprietary treatment methods.	The impacts of drainage discharge from the base are governed by levels of environmental protection identified in State and Commonwealth legislation for the marine waters around Garden Island, including Careening Bay. By inspection, the existing drainage collection and conveyance infrastructure generally appears in good condition and performs well. Six priority areas have been identified as having shortcomings in the capture and control of contaminants. These are in the areas of fuel handling, hazardous substance handling and the wharves. These areas present an unacceptably high risk to the environment, either marine or soil/groundwater. Three areas have been identified where minor improvements to the existing drainage collection and conveyance infrastructure would enhance surface runoff. Remaining areas of the base observed in this investigation represent a low risk of contamination to the receiving environment.	HMAS Stirling Environment Office
Skene D, Ryan D, Brooke B, Smith J & Radke L (2005) *The Geomorphology and Sediments of Cockburn Sound,* Australian Government, Geoscience Australia, Record 2005/10, 90pp	To characterise the sediment and geochemistry of a representative set of sediment grab samples from Cockburn Sound; characterise the sub-surface sedimentary units of Cockburn Sound using a representative set of vibracores; and develop a conceptual model of the recent evolution of Cockburn Sound (spanning the late Pleistocene and Holocene), based on new and existing data.	Cockburn Sound is a unique large, low-energy coastal waterway located on a moderate to high-energy carbonate coast. It has formed in an elongate depression that sits in the lee of a cemented Pleistocene shore-parallel dune ridge. The stratigraphy of Cockburn Sound reveals that much of the clay soil that formed on the original calcarenite land surface prior to the Holocene rise in sea level is preserved below the marine carbonate mud that has been deposited in the central basin. The central basin has only partially infilled and there is considerable accommodation space for the continued accumulation of muddy sediment.	CSMC
Stul T (2005) *Physical Characteristics of Perth Beaches, Western Australia,* Prepared for Centre for Water Research, University of Western Australia & Department for Planning and Infrastructure	To characterise the morphology of the Perth metropolitan beaches for one point in time, in the context of longshore variation in wave forcing and historic shoreline responses.	The information presented can be used to determine the influence of future coastal development, hazard mitigation and navigation works on the current sediment cells. Changing wave climate is likely to continue in the future with changing climatic patterns and sea level rise.	CSMC
Tonts M (2005) *Recreational Use of Perth Metropolitan Beaches – Component 3: Questionnaire survey of beach users, summer 2004–05,* Institute for Regional Development, University of Western Australia, Prepared for the Department for Planning and Infrastructure	To provide a better understanding of existing recreational and leisure use of fourteen Perth beaches, the adequacy of existing facilities and open space, and an estimate of future demands; To provide better and up-to-date data on which planning and management decisions can be confidently based for lands within and adjacent to Perth's coastal reserves.	Rockingham Beach and Challenger Beach were included in the survey which was undertaken over two days, a Sunday and Wednesday in early March 2005. Major findings: **Challenger Beach:** High proportion of 26–60+ year old users, with 26–45 years being majority; relatively even spread of male and female users; all surveyed users were beach users; Challenger Beach had the highest number of beach users in the study area and had the fourth highest number of dedicated users in the study area; beach use is highest between 10–11 am steadily decreasing through the day; users generally expected to stay more than 2 hours; most users lived within the local area; most users travelled by car; most users travelled less than 15 mins to reach the beach; people used Challenger Beach because of its proximity to home and the good swimming conditions; swimming and fishing were the most popular activities; most users were able to park within 100 m of the beach; conflict between boat users and beach users was noted; a common complaint was level of pollution and litter; most users would like to have shade provided.	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		**Rockingham Beach:** Even spread of age groupings, with 26–45 years being majority; relatively even spread of male and female users; a higher proportion of people surveyed were using grassed area; had the highest number of dedicated users in the study area; experienced particularly high levels of daily use in summer and winter; beach use is highest between 9–10 am and 11 am–12 pm declining sharply after this time until 3–6 pm; users generally expected to stay less than 2 hours; most users lived within 10 km; most users travelled by car; most users travelled less than 15 mins to reach the beach; people used Rockingham Beach because of its proximity to home; swimming and visiting café's were the most popular activities; car parking was not satisfactory; most users were able to park within 100 m of the beach; conflict between boats and beach users, and dog walkers and beach users was noted; most common complaint was pollution and litter; most users would like to see toilets upgraded.	
Van Senden D & Miller BM (2005) *Stratification and Dissolved Oxygen Issues in Cockburn Sound Pertaining to Discharge of Brine from Desalination,* WRL Technical Report 2005/03, Prepared for the Water Corporation by School of Civil and Environmental Engineering, University of New South Wales	To examine the likelihood of the diluted brine plume resulting in stratification and reduced oxygen levels in the deep (around 20 m depth) waters of Cockburn Sound.	Natural variability of the vertical stratification in the deep basin is driven by changes in the temperature and salinity fields within Cockburn Sound and surrounding waters. The residence time of deep waters appears to be generally less than 5 days with occasional events of longer duration occurring during calm periods in autumn and early winter. The temperature-salinity data indicate that the existing system is regularly mixed. Further, the wind mixing will most likely homogenise (fully mix) the dense brine discharge over the water column within a short distance of the outfall for much of the year. The tide and wind conditions will likely lead to complex intermittent flow of the diluted brine to the deeper basin predominately during calm autumn conditions. Based on the short duration of mid-range oxygen levels and there also being negligible ecological impact within this range, the discharge of brine to Cockburn Sound is highly unlikely to have any ecological impact through changed dissolved oxygen levels. Analysis of the available data and application of analytic models suggests that the effect of the proposed desalination discharge on the deep waters of Cockburn Sound will include some periods of increased stratification leading to slightly lower DO concentrations being offset by transport of oxygen-rich waters associated with the plume.	CSMC
Water Corporation & ProAlliance (2005) *Perth Seawater Desalination Project – Consultative Environmental Management Plan,* Doc. No. P2001-PMP-049, Perth Western Australia	To describe how the ProAlliance will manage the environmental aspects associated with the design, construction and operation of the Perth Seawater Desalination Plant; To ensure that any actual or potential environmental impacts and risks are minimised.	The report provides the environmental objectives to which the Perth Seawater Desalination Project will work. These are to: maintain the integrity of the ecosystems; maintain biodiversity; protect aquatic life, both from an ecological and aquaculture perspective; and minimise impact upon the aesthetic and recreational values of Cockburn Sound. The report is includes a: Water Quality Management Plan Flora and Fauna Management Plan Greenhouse Gas Management Plan Noise Management Plan Hazardous Materials Management Plan	CSMC
Water Corporation & ProAlliance (2005) *Perth Seawater Desalination Project – Nitrogen Discharge Management Plan,* Document No. P2001-PMP-048, Perth Western Australia	To support and comply with the EPA and Cockburn Sound Management Council objectives for managing the Cockburn Sound environment; To identify and comply with clear operational criteria, with respect to nitrogen discharge, for the design of the Perth Seawater Desalination Plant;	The report reviews the potential for nitrogen to be discharged to Cockburn Sound through the desalination process. The discharge from the Perth Seawater Desalination Plant that will result in a net increase in nitrogen load into Cockburn Sound will arise from the coagulation polymers and the biocide used intermittently on the membranes. As a worst case estimate, 10% of the polymer added to the process will discharge to Cockburn Sound. The Water Corporation has commenced operating the Kwinana Water Reclamation Plant that treats secondary treated effluent as a supply to industry. This wastewater will be discharged to Sepia Depression Ocean Outfall by the middle of 2006. In addition the Jervoise Bay Groundwater Recovery Scheme reduces nitrogen input to the Sound by 24 tonnes/annum. As a result there will be a net reduction of nitrogen discharge to Cockburn Sound of between 70 and 140 tonnes/annum.	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	To identify and implement management options to minimise the impact of the Perth Seawater Desalination Plant on the nutrient load in Cockburn Sound.	The net discharge of nitrogen to Cockburn Sound is therefore anticipated to be reduced significantly over the next few years.	
Wilson C & Paling EI (2005) *Water Quality of Cockburn and Warnbro Sounds Dec. 2004 to March 2005,* Prepared for Kwinana Industries Council, Cockburn Sound Management Council, The Royal Australian Navy, Fremantle Ports and Water Corporation by Marine and Freshwater Research Laboratory, Murdoch University, Report No. MAFRA 05/4	To compare the water quality indicators measured during summer 2005 with previous years, to determine if there were any regions of consistently high phytoplankton and nutrient concentrations within Cockburn Sound, and to compare these to reference sites located in Warnbro Sound.	There has been a significant improvement in chlorophyll a concentrations in 2005 compared with all years where data is available. Concentrations of inorganic and organic nutrients and chlorophyll a were higher in Cockburn Sound than in Warnbro Sound. Higher concentrations of nutrients and phytoplankton were recorded along the eastern shore. The water quality of the Northern Harbour Jervoise Bay was significantly poorer than at any other location for many parameters.	CSMC
Worley (2005) *Perth Desalination Plant Stratification and Dissolved Oxygen Issues,* Prepared for Water Corporation, Perth Western Australia	To present modelling results in regard to Dissolved Oxygen (DO) concentrations and salinity.	Results suggest that the impacts are likely to be within natural variations, and not contribute significantly to a reduction in DO concentrations in the deeper regions of Cockburn Sound. However, no detailed modelling of DO demand and replenishment has been undertaken by Worley. Assessment of the build-up of salinity did suggest a gradual increase over time; however, simulations were not of sufficient length to confirm the likely magnitude of the steady-state response. Longer simulations would be required for such an analysis. In general, the plume is expected to be dynamic, subject to strong mixing on the shallow Jervoise Bank region and periodic mixing in the deeper basin areas. The overall dilution of the discharge is predicted to be around 100 fold by the time the plume enters the deep areas, contributing to a density difference within natural variations. Some reduction in the number of full depth mixing events may result. Given the conservative nature of the model application, including simulations of possibly the calmest period over the past 11 years, these impacts may be relatively minor.	CSMC
360 Environmental (2006) *NewGen Kwinana Power Station, Sediment Sampling and Analysis Report, NewGen Kwinana Power Station Marine Works, Cockburn Sound, Kwinana*, Prepared for NewGen Kwinana, Report 200-AD, Western Australia	To provide information on the sediment quality and acid sulphate soil status of the sediment to be excavated.	NewGen Power Kwinana has been commissioned to construct a gas fired power station within the Kwinana Industrial Area at Kwinana Beach. Construction of the power station will involve the installation of cooling water outfall pipeline in Cockburn Sound. Installation will involve excavation of sediment from the pipeline alignment. The planned excavation works are anticipated to produce up to 6000 cubic metres of excavated sediment. Excavated sediment will be stored temporarily on the site before being taken offsite and used either as fill or taken to a licensed landfill. Site investigations indicate that the subsurface profile comprises predominately medium to coarse grained, calcareous sands with shell fragments. Settling rates for sediment sampled along the proposed dredge line indicated that the bulk of sediment resettled within 45 minutes of disturbance. Concentrations of chemical contaminants were below Environment Australia (2002) Screening Level Effects. Further testing is required to assess appropriate disposal options. No acidity exists in the system to allow the oxidation of sulphur to form acid sulphate soils.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
360 Environmental (2006) *Perth Seawater Desalination Plant: Dredging and backfilling Environmental management plan,* Prepared for ProAlliance, Report 058-AL	To develop effective strategies to protect the environment during dredging and backfilling operations, in accordance with environmental commitments and legislation; To detail measures to manage water quality during dredging and backfilling works, to protect the sensitive marine environment of Cockburn Sound via engineering design and appropriate environmental strategies.	This report outlines the roles and responsibilities of environmental managers involved in the development and operation of the desalination plant during dredging and backfilling of intake and outlet pipes, and describes environmental management measures to be implemented to protect the marine environment of Cockburn Sound.	CSMC
360 Environmental (2006) *Perth Seawater Desalination Plant Dredging and Backfilling Monitoring Close Out Report,* Prepared for ProAlliance, Perth Western Australia	To present the results of marine monitoring undertaken for the dredging and backfilling operations associated with the installation of the intake and outlet pipeline infrastructure as part of the Perth Seawater Desalination Plant, Kwinana.	Land based excavation commenced in December 2005 and marine dredging commenced in January with the arrival of the cutter suction dredge. A total of 48,250 cubic metres of sediment was dredged which comprised 39,980 cubic metres of bulk dredging and 8270 cubic metres of detailed dredging. Results at variance with the nominated trigger values were recorded for turbidity and light attenuation during the dredging and backfilling works. The principal management measure employed for the dredging and backfilling works was the use of silt curtains. Overall the works are considered to have had a negligible impact on the surrounding environment.	CSMC
Cockburn Sound Management Council (2006) *State of Cockburn Sound,* Cockburn Sound Management Council, Rockingham Western Australia	To provide an annual report to Parliament and the community on monitoring outcomes and activities of the CSMC.	Light attenuation was affected by chlorophyll a levels which could not be explained. Chlorophyll a levels were beyond standards in Northern Harbour Jervoise Bay. TBT levels were found to be high at Careening Bay, James Point and Jervoise Bay. Thermotolerant coliforms were above guidelines at three sites at Rockingham Beach. Bacterial *enterococci* were found to be high at one site at Rockingham Beach.	CSMC
Department of Conservation and Land Management (2006) *Beeliar Regional Park Final Management Plan,* Prepared by Thompson Palmer Pty Ltd, Perth Western Australia	To provide broad direction for protection and enhancement of the conservation, recreation and landscape values of Beeliar Regional Park.	The park comprises 19 lakes and many other associated wetlands in two main chains located parallel to the coast. Coastal limestone cliffs along the Henderson foreshore are also contained within the Park. Much of the Park has high nature conservation value due to its rich diversity and complexity of ecosystems which are limited in distribution across the Swan Coastal Plain. Even though the wetlands within the Park are by no means pristine, they form one of the most important systems of wetlands remaining within the Perth metropolitan region. The vegetation communities found within the Park were once widespread on the Swan Coastal Plain but which are now cleared. The Park has significant cultural value to Aboriginal and colonial heritage and has high recreational and educational value.	CSMC
Department of Defence (2006) *An Overview of the Engineering and Environmental Performance of the Garden Island Causeway, Cockburn Sound, Western Australi,* Prepared by Peter Waterman, University of Sunshine Coast	To outline of the historic context of the Garden Island Causeway and the need for a maritime engineering structure that would accommodate the plans of the Commonwealth and the WA Governments for port and related facilities in the southern end of Cockburn Sound;	The physical integrity of the Garden Island Causeway (GIC) rubble-mound rock wall structure is assessed as being sound and the wall is performing as planned and constructed. The seabed along the structure is assessed as being stable. There was no evidence of recent seabed scouring and the rock material placed in the 1980s to stabilise the seabed is now characterised by a diverse suite of marine plant and animal species. In 2005, Department of Defence Corporate Services and Infrastructure found that there were no major unpredicted environmental effects of the Garden Island Causeway and the infrastructure appears to be performing better than predicted in terms of the exchange of water between the open sea and Cockburn Sound. The exchange between the Sound and sea through the southern opening were not as great	HMAS Stirling

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page	To provide an overview of the original design philosophy for the causeway and bridges and the engineering parameters for a structure that was to serve the phased development of HMAS Stirling and associated Defence infrastructure on Garden Island. A summary retrospective assessment of the environmental and engineering performance of the GIC in terms of the durability of the structure, water circulation, the viability of the marine habitats and ecosystem complex and the stability of the adjacent shoreline.	as originally expected. By mid 80s seagrass species were observed to be colonising the high energy western flank of the causeway. By December 2004 *Posidonia* and *Amphibolis* species were observed to be well established on the rock-blanket which underlies the structure. Seagrass colonisation has also been observed in the Minstrel Channel and in the old blow outs on the eastern flank. In these locations the slow process of colonisation is evidence of the improved water quality and reduced energy conditions in the lees of the structure. The causeway has become a huge artificial reef and is fished commercially for rock lobster. It has been concluded that the GIC has not had any unpredicted impacts on the marine ecosystem adjacent to the structure. There is a need to remove sand from the beach line to prevent it from infilling the marina area from the boat ramp, and mooring area to the west of the southern abutment of the causeway. A groyne has been built to accumulate sand moving east, with removal of the sand from the shoreline and dredging of the mooring area basin. Also there has been a readjustment of the large sand bar that used to extend north-west from Point Peron shoreline. Materials from the bar together with ongoing ingress have migrated to the east as a new equilibrium beach plan-form takes place.	
Department of Environment and Conservation and Marine Parks and Reserves Authority (2006) *Shoalwater Islands Marine Park Draft Management Plan,* Perth Western Australia	The management plan provides a detailed description of the ecological and social values of the area, management objectives, strategies and targets. The goal of the management plan is to facilitate the conservation of the marine biodiversity of the area and to ensure that the existing and future pressures on the marine park's values are managed within an ecologically sustainable framework. The management plan also provides mechanisms for the community and visitors to actively participate in the day-to-day management of the marine park.	The Shoalwater Islands Marine Park (the marine park) is located within the Perth metropolitan area, adjacent to the City of Rockingham (CoR). Its wide diversity of habitats and close proximity to Perth makes the area a valuable and important ecological and social resource. The marine park was gazetted on 20 May 1990 and in 1994 a planning team was established, which included representatives from State and local governments as well as the Recreation Camps and Reserves Board. The planning team, using contributions from community groups and individuals via meetings and workshops, released a draft management plan for a two-month public comment period in 1995. Most public comment received on the 1995 draft management plan was in relation to the lack of sanctuary zones in the proposed zoning scheme. Further community consultation was undertaken to facilitate the development of a zoning scheme which would better achieve conservation objectives while minimising impacts on user groups. In 2004–2005, the draft management plan was reviewed and adopted an outcome-based approach. In February 2006 a focus group was established, representing a range of community interests, to provide input into the draft management plan. The draft management plan was released for a statutory three-month public consultation period from 22 July to 27 October 2006, and amendments were made to the draft management plan based on submissions received. The *Shoalwater Islands Marine Park Management Plan 2007–2017* (the management plan) was released following approval by the Minister for the Environment.	CSMC & @ <http://www.naturebase.net/index.php?option=com_docman&task=doc_download&gid=1973>
Department of Fisheries (2006) *State of the Fisheries Report,* Perth Western Australia	To prevent an overview of the state of the fisheries throughout Western Australia.	In relation to Cockburn Sound the following was discussed: • The commercial catch for the 2004–05 season from dedicated crab fishers in Cockburn Sound was 84 t, representing 47% decrease from 2003–04. Analyses are currently underway to identify correlations between commercial catches of blue swimmer crabs in Cockburn Sound and inter-annual variations in environmental variables such as wind, rainfall and temperature. • Recent surveys produced recreational catch estimates for Cockburn Sound of 18 t, 23 t and 18 t for 2002, 2003 and 2004 respectively. • There has been a successive decline in catch in the crab fishery in the last two seasons and catches have been below the minimum acceptable catch range of 200–350 t for the last four seasons. The current low stock levels warrant further research and management attention. • There are three managed commercial fisheries that operate wholly and two managed commercial fisheries that operate partly within Cockburn Sound.	CSMC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		• Herring is one of the main finfish caught in Cockburn Sound. Reassessment of the status of herring stock is currently underway. One of the sampling sites is within Cockburn Sound as this is an important nursery ground. • The total annual finfish catch in Cockburn Sound has shown a declining trend since peaking at 165 t in 1992. In 2005 the finfish catch was 40.4 t, which was the lowest catch recorded since the 1970s. • In 2005, the herring catch was slightly higher than in the previous year and was only slightly below the 10-year average for the period 1995–2004. • Surveys indicate that the finfish catch from Cockburn Sound is primarily caught by the recreational sector.	
Department for Planning and Infrastructure & Fremantle Ports (2006) *Fremantle Ports Outer Harbour Project – Recommended Report on Preferred Option*	To present the preferred option for the development of the proposed Fremantle Ports Outer Harbour.	Four port options have undergone a Strategic Assessment against environmental, social and economic factors. The purpose of this assessment was to distinguish between the options rather than provide an absolute assessment of each option, and to identify potentially significant impacts of the options in order to identify one preferred option that will ultimately achieve an optimal outcome for the State. The preferred option is a refinement of Option 1 developed after taking into consideration the outcomes of the triple bottom line multi-criteria analysis, sensitivity studies and input from the Steering Committee, Technical Advisory Group, Fremantle Ports Outer Harbour Community Liaison Group and a community workshop.	CSMC
Department of Water (2006) *Toxicants in Sediment Survey Report 2006- Cockburn Sound and Owen Anchorage,* Prepared for Cockburn Sound Management Council by Aquatic Science Branch, Perth Western Australia	To present results from sediment surveys undertaken as required by the Environmental Quality Monitoring Program coordinated by the Cockburn Sound Management Council, and as required by the *State Environment (Cockburn Sound) Policy 2005.*	The Cockburn Sound Management Council commissions monitoring of toxicants in sediment at a frequency of 3–5 years. The data from this survey is compared against the Environmental Quality Criteria in the *State Environmental (Cockburn Sound) Policy 2005*. The levels of contaminates in the sediments analysed in this survey were generally low with very few environmental quality guidelines exceeded. Exceedance of guidelines for mercury in the sediment of Kwinana Bulk Jetty was likely to be in non-bioavailable forms and therefore of little environmental concern. TBT exceeded the guidelines and environmental quality standards at Careening Bay, signifying an unacceptable risk to the environmental values of this region of Cockburn Sound.	CSMC
Environ Australia Pty Ltd (2006) *Hydrogen Sulphide Plant Replacement Kwinana Nickel Refinery BHP Billeton – Environmental Referral/Works Approval Application,* Prepared for BHP Billeton, Perth Western Australia	To satisfy the requirements of an environmental referral and a Works Approval Application.	The key environmental issues associated with the Project relate to: air quality; greenhouse gas emissions; noise; and risk management.	City of Rockingham
Environmental Protection Authority (2006) *Environmental Offsets,* Position Paper No. 9, Perth Western Australia	To provide the community, government agencies, industry, developers, consultants, business and other key stakeholders with overarching advice about the intent and appropriate use of environmental offsets.	Where environmental impacts must occur, environmental offsets represent the 'last line of defence' for the environment. Environmental offsets aim to ensure that significant and unavoidable adverse environmental impacts are counterbalanced by a positive environmental gain, with an aspirational goal of achieving a 'net environmental benefit'. The EPA recognises that various offset policies and approaches are being developed and used without common overarching principles and acknowledges that there is the potential for inconsistent messages to be given. In addition, there is some concern from the community about what offsets should and shouldn't be. In view of this, and other issues, the EPA has developed this position paper to provide overarching guidance and to establish a consistent policy approach on the matter. This position statement provides some clarification on the options for industry, developers, environmental consultants, specialist scientists and community groups who may be involved in developing or reviewing	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		options for environmental offsets. Offsets are not a substitute for normal environmental management responsibilities. These are required as part of normal environmental approvals processes under the *Environmental Protection Act 1986.*	
Environmental Protection Authority (2006) *Fremantle Ports Outer Harbour Project: Advice to the Minister for Environment from the EPA under section 16 (e) of the* Environmental Protection Act 1986*,* Proposed by Fremantle Ports and Department of Planning and Infrastructure, Bulletin 1230, Perth Western Australia	To provide advice to the Minister for the Environment under section 16 (e) of the *Environmental Protection Act 1986* and the Western Australian Planning Commission on the proposal by Fremantle Ports and the Department of Planning and Infrastructure to develop a new port facility and related transport infrastructure for container trade and general cargo in Cockburn Sound.	Four project options for a port facility at Naval Base/Kwinana have been evaluated, together with associated road and rail links. Following consideration of all of the port and transport infrastructure options, the proponents have selected a refined Option 1 as their preferred outer harbour development. The EPA notes that the majority of comments received by the proponents on the preferred option were in relation to concerns over the choice of site location within Cockburn Sound rather than the preferred option itself. Development of an island port in Cockburn Sound like that proposed by the Fremantle Ports and Department of Planning and Infrastructure would be a substantial undertaking. On the basis of information currently available, the EPA does not express a preference for any particular port option. Detailed assessment will be required, in the formal environmental impact assessment stage, to determine the full extent of impacts. The EPA is also concerned that cumulative pressures along the eastern margin of Cockburn Sound will increase the threat to the improvements in the condition of Cockburn Sound which have been achieved through strong action by Government, industry and the community in recent decades.	CSMC
Green J (2006) Survey of the Port Coogee Development Area, Prepared for Department of Maritime Archaeology, Western Australian Museum, No. 213	To locate and precisely delineate sites of the wrecks of the *James*, *Diana*and *Omeo*; To survey the area of the Port Coogee development that will either cover the sea bed or be affected by dredging for cultural remains; and to establish datum points in the *James* and *Diana* site area and on the *Omeo* so that changes in the level of the sea bed and movements of the wrecks can be monitored in the future; To attempt to identify the location of other material that may have been located in the area.	The Port Coogee Development involves the construction of breakwaters and dredged channels in an area approximately 00 m offshore extending from latitude 32.096718°S longitude 115.759217°E south to the 32.104926°S 115.671788°E (note all latitude and longitude are given in decimal degrees and in WGS1984 datum); a distance of about 1000 m (see Figure 1). At the north end of the development the position of two important wreck sites are known: *James* (1830) and *Diana* (1878); at the south end of the development the remains of the iron steamship *Omeo* (1905) are still visible (for the background history of these three vessels see Appendix 1). Since the development is in an important historical anchorage area, Owen Anchorage, there is a possibility that other, undiscovered wreck sites exist in the area of the development. It was, therefore, a requirement under the *Historic Shipwrecks Act 1976* that the area be investigated for underwater cultural heritage material.	CSMC <www.museum.wa.gov.au/collections/maritime/march/documents/No.%20213PortCoogee_001.pdf>
Horn LE (2006) *The Measurement of Seagrass Photosynthesis using Pulse Amplitude Modulated (PAM) Fluorometry and its Practical Applications, Particularly in Regard to Transplantation*, PhD Thesis, Murdoch University, April 2006	Photosynthetic activities of three types of seagrasses within Cockburn Sound were studied using PAM. The aim of the study was to determine the causes and levels of stress to seagrasses during transplantation and identify ways to reduce stress during transplantation.	Changes in photosynthetic activity were monitored to determine seagrass stress during and after transplantation within Cockburn Sound.	CSMC

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LandCorp (2006) *Water Management Strategy – Hope Valley Wattleup Redevelopment Project,* Perth, Western Australia	To plan and guide land use, land use practices, water supply, stormwater and wastewater management within a total water cycle context, so as to protect and optimise the integrity, functions and environmental values of natural catchments, hydrological systems and wetlands within and adjacent to the redevelopment area.	Apart from the mechanisms provided to ensure the local scale implementation of the Water Management Strategy, the following strategic actions have been identified in order to assist the implementation of the Water Management Strategy and meet current government policy at the State, regional and local level: • Facilitate planning which will support the development of industrial ecology within the site; • Investigate the opportunities and carry out feasibility investigations to determine the practicality of providing industrial water supply from the Kwinana Water Reclamation Plant for use in the HVWRA; • Investigate the feasibility of using secondary treated wastewater to facilitate industrial growth in the HVWRA; • Develop a groundwater monitoring strategy for the HVWRA; • Liaise with the DoE (DEC) in their continued review of the sustainable limits as new data and information becomes available; • Establish a target to phase out horticultural land uses to protect groundwater resources; • Facilitate clean-up of contaminated groundwater; • Develop and establish a framework to guide future development towards implementation of an integrated water management approach; • Develop and implement assessment guidelines for the evaluation of future development proposals and their compliance with the objectives of the Water Management Strategy.	CSMC
Lavery P & McMahon K (2006) *A Survey of Selected Grass Meadows in the Fremantle-Warnbro Sound Region 2006,* Prepared by Edith Cowan University Centre for Ecosystem Management, Report No. 2006-004	To report on results from the 2006 assessment and focuses on temporal changes at each monitoring site.	Overall, the results indicate that there were no significant region-wide changes in the status of seagrass meadows at the sites surveyed between 1998 and 2006. Kwinana and Mangles Bay showed the same or increased shoot densities in 2006 compared to 2005. Despite this, they continue to have the lowest shoot densities of the *P. sinuosa* sites monitored. Characteristics at the sites indicate that while the seagrass meadows are stable, they are subject to long-term light limitation and are among the most susceptible to any deterioration in water quality. Garden Island Settlement and Woodman Point sites both showed stable shoot densities but declining canopy cover. At both sites seagrasses had relatively high cover of filamentous epiphytic algae and at Woodman Point the water column had a noticeable particulate load on the day of sampling. The southern edge of the meadow at Fish Rocks continues to recede and is now impacting directly on sampling site.	CSMC & HMAS Stirling Environment Office
Lavery P & McMahon K (2006) *Monitoring of Seagrass Meadows on the Eastern Shore of Garden Island, Western Australia,* Prepared by Edith Cowan University, Centre for Ecosystem Management, Report No. 2006-07	To present the results of annual monitoring of seagrass meadows on the eastern shore of Garden Island in 2006.	Monitoring was undertaken on 10 and 25 January 2006. Seagrass health was surveyed at two sites in 2 metres water depth, applying the methods used for the Department of Environment seagrass health monitoring. There is no evidence that the Settlement has different shoot density to other reference sites, and proximity to Defence facilities does not appear to have resulted in lower shoot densities. However the Settlement had a high load of filamentous algae compared to other sites, which is typically associated with eutrophic conditions in Cockburn Sound.	HMAS Stirling Environment Office
NewGen Power Pty Ltd (2006) *NewGen Power Station Kwinana: Final diffuser location and design management plan,* Perth Western Australia	To present management procedures for disposal of heated effluent from the NewGen Power Station.	The power station will utilise approximately 158 gigalitres of seawater per year to cool and condense the superheated steam that drives the steam turbine. When the water is heated it is piped offshore and passed through a diffuser located on the seabed to achieve rapid dilution with ambient seawater. Approximately 430,000 cubic metres/day of seawater is returned to Cockburn Sound at increased temperatures and has the potential to adversely affect environmental values and adjacent industrial users. Cooling water outflow temperatures will be monitored on a continuous basis at the outflow from the condenser. Monitoring results will be compared to the instantaneous and daily average cooling water outflow temperatures used in the pipeline and diffuser design studies.	CSMC

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Oceanica Consulting Pty Ltd (2006) *Investigation into Tributyltin (TBT) Contamination in Cockburn Sound,* Prepared for Cockburn Sound Management Council, Report 457/1, Rockingham Western Australia	To provide an up-to-date description of the state of TBT contamination in Cockburn Sound, of the pressure on the resource base, and of the current management response; To identify the gaps in the current management responses and indicate management strategies to address these gaps; and To detail, and undertake where necessary, a research and investigation program to improve the information and knowledge base for future decision making.	Only sediments within Jervoise Bay Southern Harbour exhibited TBT contamination in exceedance of Environmental Quality Guidelines. All other sediment samples, with the exception of those from Northern Harbour and one replicate from Colpoys Point on Garden Island, exhibited TBT concentrations below the reporting limit. The report recommends stricter controls on ship maintenance facility operations to ensure that pathways for TBT into the marine environment are appropriately managed, record any decreases in contamination through time, coordinate periodic imposex surveys to record the severity of impacts from TBT contamination; and consider site remediation if identified TBT 'hot spots' persist. Surveys involving *Thais orbita* should be kept to a minimum as population appears to have reduced and may or may not be linked to previous collection effort.	CSMC
Oceanica Consulting Pty Ltd (2006) *Groundwater Discharges into Owen Anchorage – Desktop Study,* Prepared for Cockburn Cement Ltd and Cockburn Sound Management Council, Report No. 346/1, Perth Western Australia	To review the information available on previous land use activities and the historical and current contamination of groundwater in the area, and to estimate nutrient and contaminant loads entering Owen Anchorage based on the best available information.	This study identified a lack of recent (post 2000) data on the groundwater quality in the region adjacent to Owen Anchorage and that little consistent monitoring of groundwater is currently being carried out. Recent data, along with groundwater flow estimates from Martinick & Assoc. (1993), indicate present groundwater inputs to Owen Anchorage of 12–16 tonnes/annum nitrogen and 0.245 tonnes/annum of phosphorous. This is at least an order of magnitude lower than present estimates of groundwater inputs to Cockburn Sound, and is likely to represent <5% of the total annual nutrient load to Owen Anchorage. Owen Anchorage is far better flushed with seawater than Cockburn Sound. Groundwater nutrient inputs to Owen Anchorage may therefore cause slight, localised increases in water column chlorophyll levels during calm conditions, but are not sufficient to have a major impact on nutrient-related water quality. Inputs of groundwater nutrients into Owen Anchorage should decrease with ongoing land use changes in the catchment: areas of market gardens are declining and sewered residential developments increasing.	CSMC
Oceanica Consulting Pty Ltd (2006) *Jervoise Bay Northern and Southern Harbour Monitoring Program: Summer 2005/2006 data report,* Prepared for Parsons Brinckerhoff, Report No. 274/9	To present the results of the summer monitoring program conducted for the Jervoise Bay Northern and Southern Harbours from Dec. 2005 to March 2006.	The water quality indicated elevated levels of nitrogen and chlorophyll a within the Northern Harbour; however there does not appear to be any impact on the water quality of sites located outside the Northern Harbour. Conversely, there was very little difference in water quality measured at sites within, at the entrances or outside of the Southern Harbour. The inner Northern Harbour sites exceeded the Environmental Quality Guidelines (EQG) for both nutrient enrichment and phytoplankton biomass. All Southern Harbour sites exceeded the nutrient enrichment EQG—primarily due to exceedences of the light attenuation criteria rather than the cholophyll a criteria. The complete sediment quality survey conducted this summer indicates low levels of heavy metals, poly aromatic hydrocarbons, nutrients and organic matter in the Northern and Southern Harbour sediments. Elevated levels of organotin concentrations remain within both the Northern and Southern Harbours; however a decreasing trend has been apparent since summer 2003–4. The mussel samples deployed within the Northern and Southern Harbours showed no heavy metal accumulation, with all concentrations well below the specified EQG levels for safe seafood consumption.	CSMC
Oceanica Consulting Pty Ltd (2006) *Shoreline Monitoring Plan – 2003 Synthesis Report: Review of shoreline change in Cockburn Sound,* Prepared for Cockburn Cement Ltd, Report No. 342/1, Western Australia	To present a synthesis report on the history of shoreline movement in Cockburn Sound, thereby providing a source of comparison for future monitoring.	As a consequence of the development of Cockburn Sound, numerous coastal structures have been constructed since the early 1900s. These structures have the potential to significantly influence the local hydrodynamics and sediment movement patterns. Over 70 structures have been identified including groynes, outfalls, ramps, jetties and breakwaters, with the earliest works beginning in 1913. A number of dredging and nourishment operations have also been conducted in Cockburn Sound since the 1960s. The long-term trend in shoreline movement appears to be a pattern of accretion along the majority of the Cockburn Sound coastline. However, pockets of erosion exist at James Point and the area between Railway Terrace and the Causeway. Erosion has occurred in the Mangles Bay area since the Causeway was constructed.	CSMC

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Parsons Brinckerhoff (2006) *Jervoise Bay Recovery Bores, Monitoring Review No. 11, April 2005 to March 2006,* Prepared for Department of Industry and Resources and LandCorp, Perth Western Australia	To report on the outcomes of the groundwater recovery scheme for Jervoise Bay Northern Harbour.	The groundwater recovery scheme commenced in December 2000 and has been in operation for approx. 63 months to the end of March 2006. Approximately 150 tonnes of nitrogen has been recovered to date. The scheme has met the objective of reducing the amount of nitrogen entering the Northern Harbour by more than 50% and as a result the water quality of the Northern Harbour and Jervoise Bay has improved significantly. The initial objective of the scheme as approved by the Department of Environment has been met and a case should be prepared for the 'closing out' of the operation as a Ministerial Condition and Proponent Commitment for the Southern Harbour Initial Development Project. However the State Environmental (Cockburn Sound) Policy criteria for phytoplankton biomass have not been met and a management response for reducing the amount of nitrogen entering the harbour with groundwater remains an environmental issue.	CSMC
Parsons Brinckerhoff & Oceanica (2006) *Options for Reducing Nitrogen Levels in Northern Harbour, Jervoise Bay,* Prepared for LandCorp, Department of Industry and Resources and Water Corporation, Perth Western Australia	To provide a management response to exceedences of environmental quality guidelines and standards in regard to chlorophyll a levels in Northern Harbour, Jervoise Bay.	Algal blooms caused concern within the Northern Harbour immediately after completion of construction of the northern breakwater (1997) and the blooms continued until 2001 during summer months. The water quality of the Northern Harbour has improved with reduction by approximately 50% of the nitrogen flux into the harbour from groundwater. The frequency of major algal blooms has been substantially reduced with less overall variability in chlorophyll a levels in the harbour. However, chlorophyll a Environmental Quality Guidelines and Environmental Quality Standards for phytoplankton biomass at the Northern Harbour sampling sites were exceeded in 2004–5 and 2003–4, triggering the requirement for the proponent to respond to the Cockburn Sound Management Council on the management measures to be undertaken to address these exceedences. The proponents proposed three management responses to chlorophyll a nutrient enrichment and phytoplankton biomass: (1) natural attenuation and review of environmental quality guidelines; (2) operation of the northern bores for 4 more years; (3) operation of the Groundwater Recovery Scheme over 7 years.	CSMC
RPS Bowman Bishaw Gorham Environmental Management Consultants (2006) *Port Coogee Marina Construction Management Program,* Vol.1, *Management of Marine Impacts,* Prepared for Australand Holdings Limited, Western Australia	To present management procedures and a monitoring program for the protection of marine water quality, flora (seagrass meadows) and fauna in the vicinity of the marina.	The construction phase will involve disturbance of sediments, construction of breakwaters and turbidity (as light attenuation) in excess of what would normally occur in this area. The primary objective of management of breakwater construction will be to minimise the attenuation of light over light-sensitive habitats, specifically the seagrass meadows to the south.	CSMC
Standing Committee on Environment and Public Affairs (2006) *Report 7: A petition into the proposed marina at Point Peron,* Western Australian Legislative Council, Western Australia	To seek a government response to a petition tabled by Hon. Giz Watson containing 2145 signatures opposing the construction of a marina at Point Peron.	The committee reviewed information relevant to the proposal for a marina at Point Peron and recommended the Government respond to thirteen recommendations in relation to the proposal including issues related to the Bush Forever site, Rockingham Lakes Regional Park, Lake Richmond, Causeway influence and flushing, and water quality monitoring.	CSMC
Strategen (2006) *Strategic Environmental Review: Cape Peron Tourist Precinct Project,* Prepared for Cape Peron Tourist Precinct Steering Committee, Rockingham Western Australia	To present a strategic environmental review for the Cape Peron Tourist Precinct Project for the consideration of the Environmental Protection Authority to enable it to give advice requested by the Minister for the Environment under section 16 (e) of the *Environmental Protection Act 1986.*	The redevelopment of the Mangles Bay areas has been the subject of a number of previous proposals since the 1970s that have included both sea-based marinas and land-based marinas. Early project proposals were abandoned due to high costs and downturns in the real estate market. Loss of seagrass was identified as an issue in 1993 and 1998. The Cape Peron area includes areas of upland coastal vegetation communities on Quindalup Dunes interspersed with cleared land associated with roads and informal tracks. There are no wetlands within the development areas. All land within the project area south of Point Peron Road is within Bush Forever Protection Area 355 and Rockingham Lakes Regional Park. Lake Richmond, adjoining but outside the project area, is also a Bush Forever site (358) and within	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		the Regional Park. The shallow sheltered waters of Cockburn Sound (Mangles Bay) support extensive seagrass meadows and a wide range of marine fauna.	
Trefry MG, Davis GB, Johnston CD, Gardiner AG, Pollock DW & Smith AJ (2006) *Status of Groundwater Quality in the Cockburn Sound Catchment,* Prepared by CSIRO Land and Water for Cockburn Sound Management Council, Rockingham Western Australia	To inform the Council on the current state of groundwater contamination in the Cockburn Sound catchment and on opportunities for improving the environmental management practices for the Sound. It highlights the difficulties involved in gaining a thorough understanding of aquifer and groundwater characteristics given the level of development that has already occurred throughout the catchment. Much of the data sourced for this study was volunteered by industry along the shores of Cockburn Sound.	The report highlights the difficulties involved in gaining a thorough understanding of aquifer and groundwater characteristics given the level of development that has already occurred throughout the catchment. Much of the data sourced for this study was volunteered by industry along the shores of Cockburn Sound. Known major point sources of pollution are listed and information on current management is given. Known pollutants within groundwater include: nutrients, saline species, metals, fluorides, petroleum hydrocarbon liquids, pesticides/herbicides and caustic solutions.	CSMC
Umwelt (Australia) Pty Ltd (2006) *Proposed Kwinana Ethanol Bio-Refinery,* Prepared for Primary Energy	To present information regarding the proposal to construct and operate an ethanol bio-refinery.	In summary, the proposed bio-refinery process utilises wheat that has been grown using soil nutrients, water and solar energy. The wheat is converted into 'beer' which is subsequently turned into fuel grade ethanol. By-products from ethanol production are then converted into biogas (methane) which will be used to produce green electricity and heat. The heat will be used to dry the sludge that will be a by-product of biogas production and combine this with other input materials to produce fertiliser. Process water will be recycled on the site with salts and trace elements that are removed from the recycled water incorporated into the fertiliser. As a result, there will be no waste products from the proposed bio-refinery process. Environmental impacts are expected to be minimal, social and economic benefits are considered to be significant.	City of Rockingham
Underwater Explorers Club (2006) *Cockburn Sound Coral Survey,* Prepared for Cockburn Sound Management Council and Swan Catchment Council, Western Australia	To increase awareness of the presence of coral within Cockburn Sound.	Two coral colonies were found at Kwinana Reef and forty-eight at 'Spoil Site'. Survey of other areas is recommended. Coral sites will be monitored annually as resources allow.	CSMC
Valesini F (2006) *Identifying the Impact of Four Fremantle Ports Outer Harbour Options on the Nearshore Habitat Type and Fish Fauna in Cockburn Sound: Preliminary report,* Prepared for Oceanica Consulting Pty Ltd, Perth Western Australia	To review the impact on fish and fish habitat of the proposed Outer Harbour options.	Habitat type classification of each nearshore site for the unaltered and four altered states of the coastline are reviewed. The types of fish that would be expected to be present in each of six habitats are listed. The results of the habitat classification procedure demonstrate that all four outer harbour options result in a change to the habitat type, and thus the characteristic fish fauna, of at least five nearshore sites in the study area. Furthermore, Options 1.3 & 4 each result in the complete loss of one nearshore site due to the construction of either a causeway or harbour terminal. On the basis of these results, the outer harbour options may be ranked from least to greatest impact on the nearshore sites and their fish faunas as follows: Option 2, Option 1, Option 4 and then Option 3. Option 2 leads to a change in the habitat type of the least number of nearshore study sites and does not result in the reclamation	CSMC

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Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		of any site. However, Option 3 leads to the alteration of the habitat types of seven nearshore sites, including one that is fully reclaimed as land. The differences in the impact of Options 1 and 4 are marginal, though the latter leads to a greater shift in habitat type from the unaltered state at one of the study sites. **Disclaimer: *Predictions on changes to the habitat type and thus fish fauna of nearshore sites in Cockburn Sound due to construction of any of the four outer harbour options, and the subsequent ranking of the impact of those options, are preliminary, due to the lack of quantitative data from Oceanica Consulting Pty Ltd.***	
Wilson C & Paling E (2006) *Water Quality of Cockburn and Warnbro Sounds (Dec. 2005 to March 2006),* A report to Cockburn Sound Management Council, Kwinana Industries Council and the Royal Australian Navy, Prepared by the Marine and Freshwater Research Laboratory, Murdoch University, Report No. MAFRA 06/2, Perth Western Australia	To compare the current water quality in Cockburn Sound in summer 2006 with previous studies and to determine if there have been any significant changes; To locate any consistently high areas of nutrient and phytoplankton concentrations; and To determine the water quality status of Cockburn Sound.	Eighteen sites are monitored (15 in Cockburn Sound, 1 between Cockburn and Warnbro Sounds, and 2 in Warnbro Sound). The inorganic nutrients ammonium, nitrate-nitrite and filterable reactive phosphorous have not changed significantly since the early 1990s. There has been a significant improvement in chlorophyll a concentrations and light attenuation in 2005 and 2006. Concentrations of inorganic and organic nutrients were equal to those of reference sites in Warnbro Sound, with the exception of total nitrogen. Chlorophyll a was higher in Cockburn Sound but within Environmental Quality Guidelines for moderate and high protection zones. Higher concentrations of nutrients and chlorophyll a were recorded at sites along the eastern shore than in the centre. The water quality at Jervoise Bay Northern Harbour was significantly poorer than at any other location for all parameters except PO_4-P. The water quality of the Garden Island sites was comparable to the Warnbro Sound reference sites.	CSMC
360 Environmental & Environmental & Licensing Professionals Pty Ltd (2006) *NewGen Power Station Kwinana: Marine works construction environmental management plan,* Prepared for NewGen Power Pty Ltd, Perth Western Australia	To detail measures to mitigate any potential impacts on the marine environment, beach and foredune areas associated with the construction, installation and maintenance of the outfall pipeline and diffuser; To provide a framework for the marine construction works to be implemented in accordance with Ministerial Statement 698, environmental commitments and legislation; To protect the long-term values of ecosystem health, seafood safety, aquaculture, recreation and aesthetics, and industrial water supply within Cockburn Sound as set out in the *State Environmental (Cockburn Sound) Policy 2005.*	Construction works associated with the installation of the cooling water outfall pipeline for the NewGen Kwinana Power Station will involve trenching and backfilling the reinforced concrete pipeline in relatively short (less than 20 m) lengths contained within temporary sheet piled cofferdams. Construction will take place from a purpose-built temporary jetty. The report discusses potential environmental risks and presents strategies for dealing with those risks in the areas of: marine water quality; marine flora and fauna; surface water quality; air quality; noise; erosion control; terrestrial flora and fauna; environmental incident prevention and response; staff induction; waste management; cultural heritage; traffic; and complaints.	CSMC
Department of Planning and Infrastructure (2007) *Perth Recreational Boating Facilities Study – Planning for Future Needs,* Technical Report No. 444, Prepared by New Coastal Assets Branch, Western Australia	To examine the recreational boating facility needs of the Perth metropolitan area to 2025 and propose a schedule of development options to meet growing demand.	Perth's population is predicted to increase by 29% from 2006 to 2025. The number of recreational boats over the same period is predicted to increase by 77% under a medium growth scenario. Many existing facilities are currently fully utilised on good boating days. This study identifies a need to provide a further 3564 boat moorings (including stackers) and 31 boat ramp lanes strategically across the Perth metropolitan area within the next two decades. 90% of Perth's registered recreational boats are under 7.5 m and therefore are generally kept on trailers requiring access to boat launching facilities. In relation to Cockburn Sound the following options have been identified:	CSMC

Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
...Continued from previous page		Short term (to 2012) • Expansion of facilities at the Jervoise Bay (Woodman Point) recreational boating precinct • Formalisation and expansion of the swing moorings in Mangles Bay • Development of a private marina at Port Coogee Medium term (to 2018) • Development of a marina in Mangles Bay (Stage 1) Long term (2025) • Expansion of the ramps at the Cape Peron boat launching harbour • Marina in Mangles Bay (Stage 2).	
Department of Water (2007) *Cockburn Groundwater Area Water Management Plan*, Water Resource Allocation and Planning Series, Report No. WRAP 18	The Department of Water has developed the Cockburn Groundwater Area Water Management Plan (the plan) to guide the management of groundwater resources of the Cockburn Groundwater Area (CGA) and support: • sustainable water allocation and development for current and future users; • protection of ecosystems dependent on groundwater. The plan provides the policies, principles and strategies that will be used to manage the groundwater resources of the CGA.	A Cockburn Groundwater Area Management Plan was developed in 1993 by the Water Authority of Western Australia to address the importance of groundwater resources and future demand for these resources. In recognition of the need to manage the demand for water in the Cockburn Groundwater Area (CGA), the Department of Water reviewed the 1993 plan and produced a new management plan. This new plan will continue to promote sustainable water allocation for current and future users and the protection of groundwater dependent ecosystems. Significant wetlands, with national and international protection status, are located in the CGA including the Coastal Plain Lakes; Environmental Protection Policy lakes; Bush Forever sites; conservation, resource enhancement and multiple use reserves; and the geomorphic wetlands of the Swan Coastal Plain. All wetlands and phreatophytic vegetation are groundwater dependent, and excessive groundwater abstraction may adversely affect these sensitive environments.	CSMC & <www.portal.water.wa.gov.au/.../PlanningWaterFuture/AllocationPlanning/Content/pdf/Cockburn_GWA_WMP_080125.pdf>
Ecoscape (Australia) Pty Ltd (2007) *North Coogee Foreshore Management Plan: Final DRAFT,* Prepared for Stockland and LandCorp, Fremantle Western Australia	To identify the major environmental issues that are relevant to the foreshore's natural, cultural and recreational values and to recommend strategies that can be implemented to improve the amenity of the area.	The North Coogee Foreshore is part of the Cockburn coast which represents an area with a rich and diverse natural and cultural character. Typically associated with the industrial activities of the past, the area is now being returned to the community as an area with recreational and cultural values. The study area is bound by Island Street groyne to the north, Railway Reserve to the east, low water mark of the Indian Ocean to the west, and Catherine Point groyne to the south. The foreshore management plan proposes a dual use path, commuter cycle path, boardwalk, pedestrian rail crossing, beach access paths, universal access to the groyne, lookout and stair, toilet and shower, car park expansion, picnic shelters, seats, artwork, accessible playground, jetty and floating pontoon and planting.	CSMC
NewGen Power Pty Ltd (2007) *NewGen Power Station Kwinana: Marine environment temperature elevation management plan,* Perth Western Australia	To specify and ensure that upper limits of instantaneous and daily average cooling water effluent temperature are not exceeded; To ensure that the near-field mixing performance of the cooling water outflow diffuser is as predicted; and To ensure the requirements of the *State Environmental (Cockburn Sound) Policy 2005* (SEP) are met.	The dilution performance of the cooling water outflow diffuser will be assessed on two sampling occasions during commissioning of the station and once per annum thereafter. The results will be compared against the predicted near-field mixing performance of the diffuser. Surface drogues will be deployed on both sampling occasions to determine the direction and speed of the prevailing current. The temperature depth profiles of the water column will be measured using a CTD probe in accordance with the Manual of Standard Operating Procedures for Cockburn Sound (EPA 2005). The results will be reported to the Department of Environment and Conservation in the post-commissioning compliance report and annually thereafter. A contingency plan is in place should non-conformance occur.	CSMC

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
Oceanica Consulting Pty Ltd (2007) *The State of Owen Anchorage – A Pressure-State-Response Report,* Prepared for Cockburn Sound Management Council, Report No. 508/1	To improve the understanding of issues affecting Owen Anchorage.	Key pressures identified were: • coastal structures have significantly altered natural coastal processes • past and present dredging for shipping channel and shellsand • nutrient and contaminant input • increasing commercial and naval shipping • increasing commercial and recreational fishing. Owen Anchorage was found to be in relatively good condition overall in regard to sediment and water quality, and seagrass cover had increased since 1965. Grey sands on beaches were identified as a community concern.	CSMC
Oceanica Consulting Pty Ltd (2007) *Perth Seawater Desalination Plant Water Quality Monitoring Programme Baseline Component Autumn 2006 Data Report (March to May 2006),* Prepared for Water Corporation of Western Australia, Report No. 445/7	To present the results of the autumn 2006 sampling for the Perth Seawater Desalination Plant in Cockburn Sound.	Physical, chemical and biological measurements did not indicate abnormal conditions within Cockburn Sound during the reporting period.	CSMC
Oceanica Consulting Pty Ltd (2007) *Perth Seawater Desalination Plant Water Quality Monitoring Programme – Baseline Component Winter 2006 Data Report (June 2006-August 2006),* Prepared for Water Corporation of Western Australia, Report No. 445/9	To present the results of the winter 2006 sampling for the Perth Seawater Desalination Plant in Cockburn Sound.	In general, all physical, biological and chemical observations fell within similar ranges to those reported previously in this baseline monitoring program and did not suggest any abnormal conditions.	
Sinclair Knight Mertz (2007) *Kwinana Industrial Area Integrated Assessment,* Prepared for Kwinana Industries Council, Perth Western Australia	To report on financial, social, material and energy data and provide a realistic and conservative view of Kwinana industries.	The Kwinana Industrial Area; • Is a major source of revenue for the State and Australian economies (with direct sales of $8.51 billion per annum where $3.31 billion relates to export markets, and a further $680 million to 'exports' to other Australian States); • Is the State's largest industrial area and has a total factor income (sum of wages, salaries and gross margin before tax or depreciation) of $2995 million. This accounts for 3.3% of Western Australia's total factor income, compared to the agricultural sector which accounts for 4.5% of the State's total); • Has annual output worth $15.77 billion with employee earnings of $1372 million and 26,000 direct and indirect jobs that could be lost if industries disappeared and were not replaced; • Employs 4804 people directly (64% live locally) and pays $424 million in annual salaries and wages. When also considering indirect effects of the KIA, 26,000 are employed;	CSMC KIC Continued on next page…

Reference	Document Purpose	Abstract/Summary of Major Outcomes	Holder of Doc.
…Continued from previous page		• Contributes a high degree of social benefit to employees and the community, with a high level of employee services and at least half of community activities funding spent locally. Most companies are either involved in direct consultation with the community, or do so via the Kwinana Industries Council's Communities and Industries Forum; • Has grown significantly since its inception in 1952 and represents a unique blend of connecting heavy, support and infrastructure industries. The study identifies 216 customer/supplier transactions between pairs of industries and a further 87 possible transactions; • Plans for capital expenditure of $1467 million over the next five years, and an additional $1093 million for the subsequent five years. Most companies which participated in this study have in place or are working towards the preparation of Environmental Management Systems, Environmental Improvement Plans and accreditation to ISO 14001 standards.	
Wakefield CB (2008) *Latitudinal and temporal comparisons of the reproductive biology and growth of snapper,* Pagrus auratus *(Sparidae), in Western Australia*, PhD Thesis, Murdoch University	An intensive sampling regime for eggs and spawning individuals of *P. auratus* was conducted in Cockburn Sound, a large marine embayment in the Perth region at ca 32˚ S. The resultant data were used to elucidate where and when spawning occurs in this large marine embayment and to determine more precisely the factors that influence the timing of spawning.	This study focused on obtaining sound quantitative data on the reproductive biology, length and age compositions and growth of the snapper *Pagrus auratus* in the waters off Carnarvon at ca 25˚S and Perth at ca 32˚S on the west coast of Australia and at ca 34˚S on the south coast of Western Australia. Sampling thus encompassed both sub-tropical and temperate waters and the geographical range within which this species is abundant in Western Australia. The resultant data were used to explore the ways in which the biological characteristics of *P. auratus* differ with latitude and thus water temperature. An intensive sampling regime for eggs and spawning individuals of *P. auratus* was conducted in Cockburn Sound, a large marine embayment in the Perth region at ca 32˚S. The resultant data were used to elucidate where and when spawning occurs in this large marine embayment and to determine more precisely the factors that influence the timing of spawning. The implications of the results presented in this thesis for the management of *P. auratus*, a species that has been subjected to very heavy fishing pressure in recent years, are discussed.	CSMC
UNKNOWN DATES			
Department of Fisheries (200?) *Status of the Blue Swimmer Crab Fishery in Cockburn Sound,* Presentation prepared by N. Caputi, Supervising Scientist, Perth Western Australia	To present information on the biology, status and distribution of blue swimmer crabs in Cockburn Sound.	Blue swimmer crab eggs are released in the deeper waters (15–21 m) of Cockburn Sound and rapidly hatch into zoea between November and January. Zoea rely on currents to carry them to nearshore areas where they metamorphose into megalopae and live on seagrass. The megalopae change to juvenile crabs within one week of settlement. The juveniles grow very rapidly and remain in nearshore waters. During this period they are very vulnerable to predation. When crabs mature they will move into deeper water and moult and mate for the first time (March to June). Most crabs are mature by June. Females will spawn between July and September. Crab stocks in Cockburn Sound are genetically distinct. The crab fishery has been declining since 1997 and 1999. There are three possible factors causing low recruitment: low spawning stock, poor environmental conditions, and/or pollution/habitat degradation. There is a need to maximise egg production in 2006–7 and 2007–8 following low recruitment in 2006.	CSMC

5. Oral Information – Interview Summary

The following provides a summary of the interviews conducted as part of the Multiple-use and Resource Assessment Project. Full transcripts of the interviews are retained by the Council in electronic form if readers wish to view them.

1. Interview with Dr Nic Dunlop, Biodiversity Promotions Officer, Conservation Council of Western Australia, conducted 17 April 2007. Interviewee is included in a group providing advice to the Government on future regional marine planning. Interviewee also discussed the artificially maintained marine system and his belief there has been a regime shift in biological values and that any change in anthropogenic influence will eventuate in either a negative or positive regime shift.

2. Interview with Mr Peter Crisp, boater and fisher in Cockburn Sound, conducted 13 July 2007. Interviewee told of his long association and memory of Cockburn Sound including his disappointment at the changes that have taken place in Cockburn Sound over time. Interviewee told of his visit activity and his observations of Cockburn Sound over a period exceeding 50 years.

3. Interview with Mr Caine Moyle, Policy Officer Recfishwest and Mr Keith Tocas, Board member Recfishwest and member of Cockburn Sound Management Council, conducted 25 July 2007. Interviewees indicated the importance of seagrass areas in Owen Anchorage and Cockburn Sound for recreational fishing and identified the four main-stay fishes that are being targeted in both locations.

4. Interview with Mr Andrew Stachewicz, General Manager Royal Freshwater Bay Yacht Club, conducted 25 July 2007. Interviewee told of the club's interest in the Owen Anchorage and Cockburn Sound for national and international sailing competitions and the belief that further sail-training development may occur in these areas in the future.

5. Interview with Mr Rod Sergeant, resident of Rockingham and lessee at the Aviation, Interior and Works Camp at Cape Peron for over 50 years, conducted 3 August 2007. Interviewee provided insight about his knowledge and the history of the area over the past 50 years including advice that he believed fishing is much better now than it had been some 30 years ago.

6. Interview with Mr Terry Howson, Owner Rockingham Wild Encounters conducted 10 May 2007. Mr Howson told of his concern about his business and that dolphin welfare was not being given due consideration during decision making for planning, management and development of Cockburn Sound. Mr Howson also provided significant information on dolphin observations and the interactions occurring currently within Cockburn Sound.

7. Interview with Mr Karl Van Kruyssen, Manager, The Cruising Yacht Club of Rockingham, conducted 3 August 2007. Interviewee provided information on the activities of the club within Cockburn Sound, including sail training and ownership of moorings adjacent to the clubrooms. Interviewee stressed the importance of the jetty infrastructure and active support for the extension and upgrade to the jetties proposed for the area.

8. Interview with Ms Bec Donaldson, Independent Researcher Murdoch University, conducted 9 July 2007. Interviewee discussed her research into dolphins in Cockburn Sound, including research on the behaviour of females and their calving activities. Interviewee also stressed the importance of education on the feeding of dolphins and provided advice on research which has been undertaken elsewhere in the world that shows that increased noise makes dolphin echolocation less effective, and therefore can affect their feeding ability.

9. Interview with Belinda Heath, Acting Project Manager Resource Condition Monitoring, Department of Agriculture and Food, conducted 20 April 2007. Interviewee said that she works closely with all sectors of the NRM community, lives in Coogee and makes use of the Cockburn coast regularly to walk the beach, swim and exercise her dogs. Interviewee also advised she is unaware of any current or proposed projects involving Cockburn Sound and Owen Anchorage.

10. Interview with Mick Platts, Colin McKinley, members Cockburn Power Boat Association and Darryl Caddy and Bob Kennington members of Cockburn Power Boat Club conducted 28 July 2007. All interviewees told of their long association with the Power Boat Club and of their history of use of Cockburn Sound and Owen Anchorage. Information on fishing activity and species targeted whilst fishing was provided. All raised concerns regarding the decline in fishing in Cockburn Sound over the last 10 years.

11. Interview with Mr David Bliss, first and largest mussel farmer in Cockburn Sound during the 1980s, conducted 17 July 2007. Mr Bliss told of his experience and difficulty in attempting to establish commercial mussel farming within Cockburn Sound during the 1980s including his difficulty in dealing with the Government of the day and problems establishing leases for suitable sites within Cockburn Sound.

12. Interview with Mr Glen Dibbin, owner and operator of Blue Lagoon Mussels, member Cockburn Sound Management Council and board member Aquaculture Council of WA, conducted 17 July 2007. Interviewee provided a summary of his involvement in the setting up and operation of his mussel business within Cockburn Sound as well as concerns about development within Cockburn Sound that may potentially have an impact on the business in the future.

13. Interview with Mr Jeff Cox, VFLO Department of Fisheries and member Mangles Bay Fishing Club, conducted 1 August 2007. Interviewee provided information on fishing activity and distribution of fishers in Cockburn Sound including target species and locations for this activity within Cockburn Sound.

14. Interview with Mr Jim Brewer, member Cockburn Sound Power Boat Association, conducted 16 July 2007. Interviewee told of his history of fishing in both Cockburn Sound and Owen Anchorage, including trips undertaken weekly. Interviewee provided extensive information on preferred locations for fishing for himself and the locations of other fishers that he sees on the water on a regular basis.

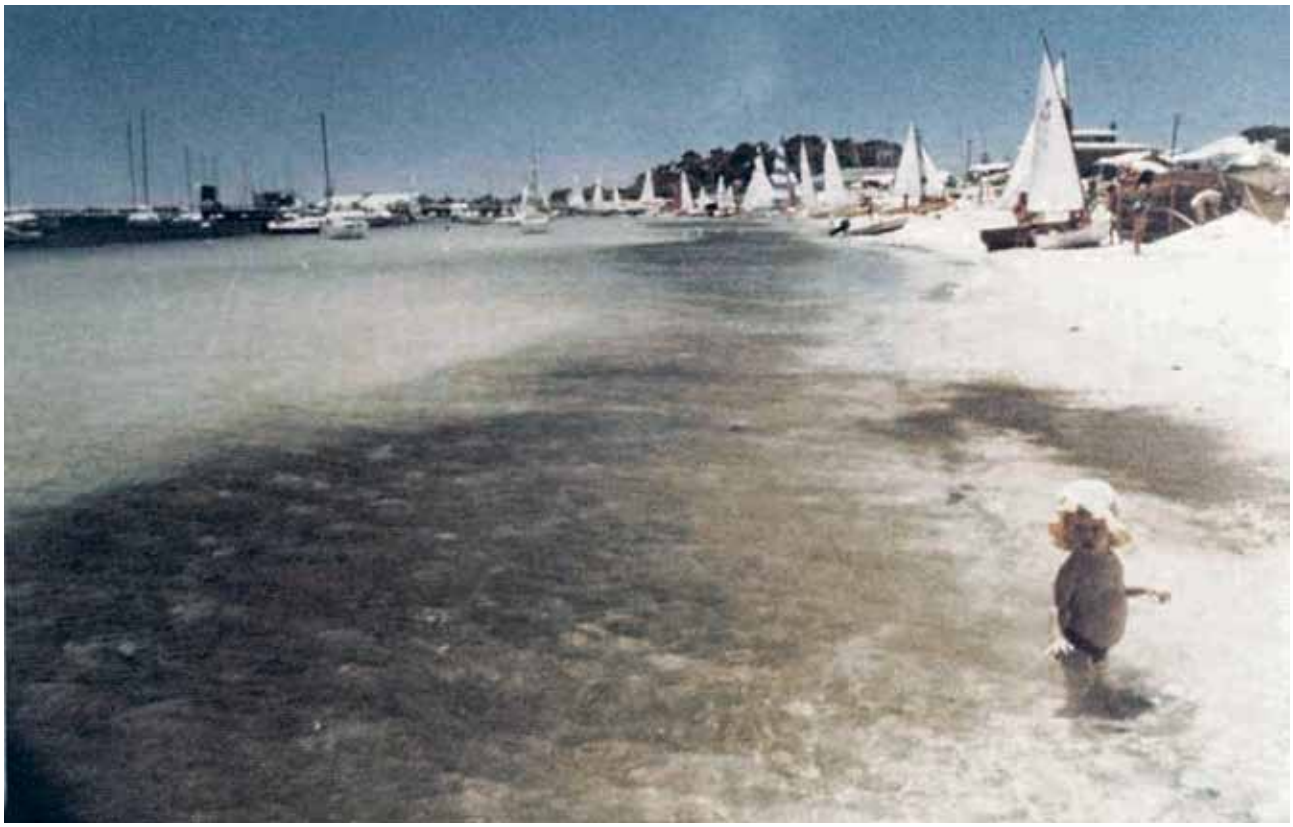
15. Interview with Mr John Smedley, Cockburn Sound Management Council Recreational Boating Representative and member Cockburn Power Boat Association, Jervoise Bay, conducted 11 July 2007. Interviewee provided an outline of his interest in Cockburn Sound, history of the Power Boat Club and his recollections of a number of activities that used to occur and still occur in both Cockburn Sound and Owen Anchorage. Interviewee told of his concern that not enough was done to preserve seagrass during the construction of the Northern Harbour breakwater and the lack of consideration of these types of issues when marine structures are proposed and constructed.

6. Photographic Collection

(Photographs 1 to 9 show aspects of early history associated with Cockburn Sound and Owen Anchorage)

Photograph 1: RAN vessels moored at Palm Beach jetty during WWII

Photograph 2: Prior to military establishment, Garden Island during the 1930s
(Source caption: Careening Bay, Garden Island 1930)



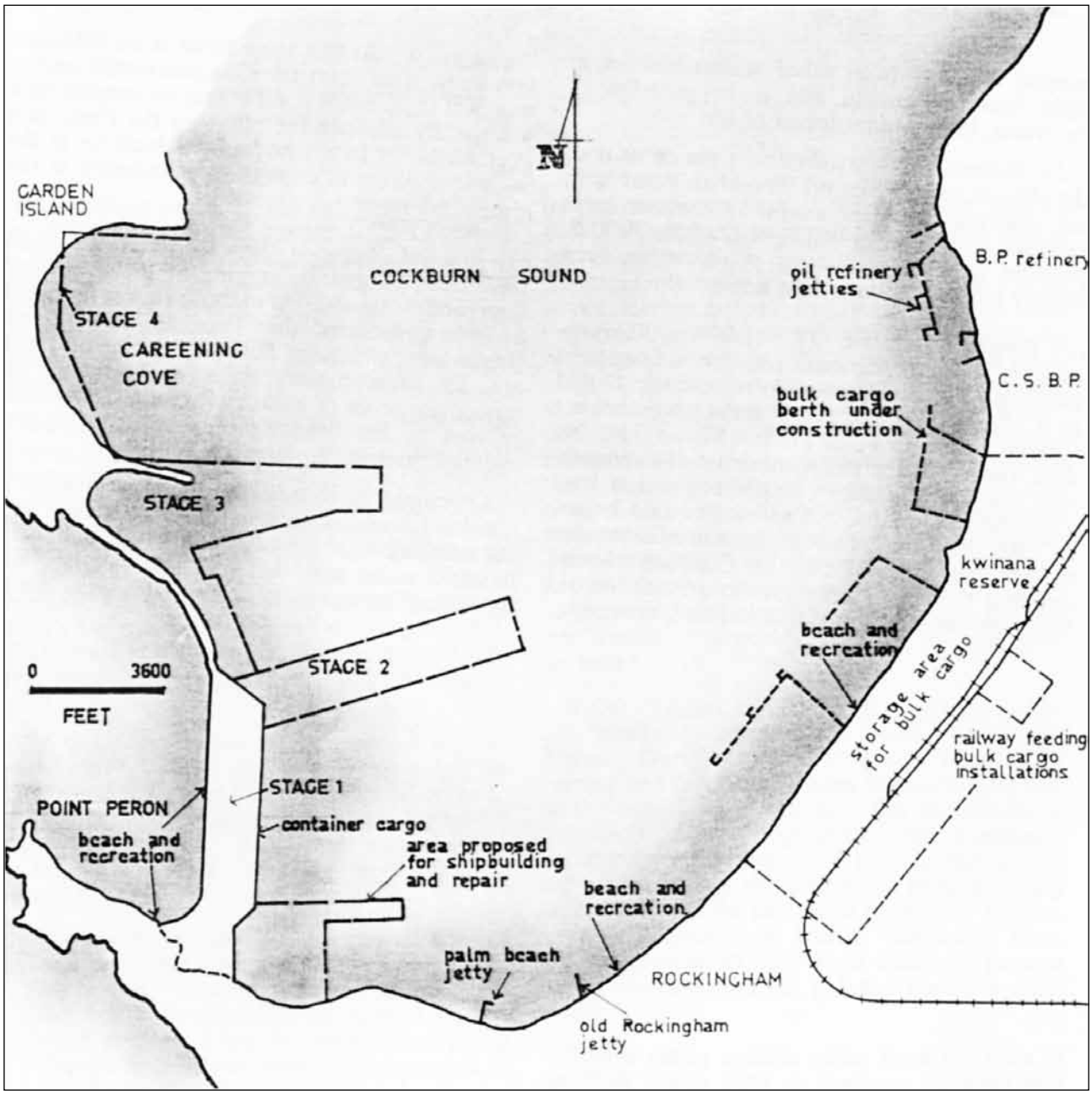
Photograph 3: Rockingham foreshore during the 1970s
(Source caption: PLATE 2: Foreshore area at Rockingham showing growth of phytobenthos on sand substrate between the beach and seagrass area. As the plate shows the water is clear, thus phytobenthos and phytoplankton blooms are not necessarily synchronous in occurrence. Taken December 1974.)

Photograph 4: Rockingham foreshore 1970s
(Source caption: PLATE 3: Foreshore area at Rockingham. This photograph was taken mid morning on a Saturday in February when the temperature was in excess of 37°C. It shows excessive phytoplankton and phytobenthos bloom in the nearshore area. The northeast wind was beginning to stir up phytobenthos making the water unpleasant. It is important to note the absence of people using the beach during a period in which one would expect high usage for both sunbaking and swimming. Taken february 15, 1975.)

Photograph 5: Cockburn Sound fishing activity 1970s
(Source caption: PLATE 19: Boats fishing for herring on the sewage outfall plume, Cockburn Sound, August 1970.)

Photograph 6: Rockingham jetty in the early years

Photograph 7: Captain James Stirling C.1840



Photograph 8: 'What could have been' 1966
(Source caption: Fig. 7 , Progressive stages in the development of a causeway to Garden Island as proposed by the Fremantle Port Authority. (From "The West Australian", April 29, 1966), showing existing and proposed future industrialization around the southern end of Cockburn Sound.)

Photograph 9: 'the developers were busy back then too!'

(Photographs 9 to 28 show Cockburn Sound and Owen Anchorage today)

Photograph 10

Photograph 11

Photograph 12

Photograph 13

Photograph 14

Photograph 15

Photograph 16

Photograph 17

Photograph 18

Photograph 19

Photograph 20

Photograph 21

Photograph 22

Photograph 23

Photograph 24

Photograph 25

Photograph 26

Photograph 27

Photograph 28

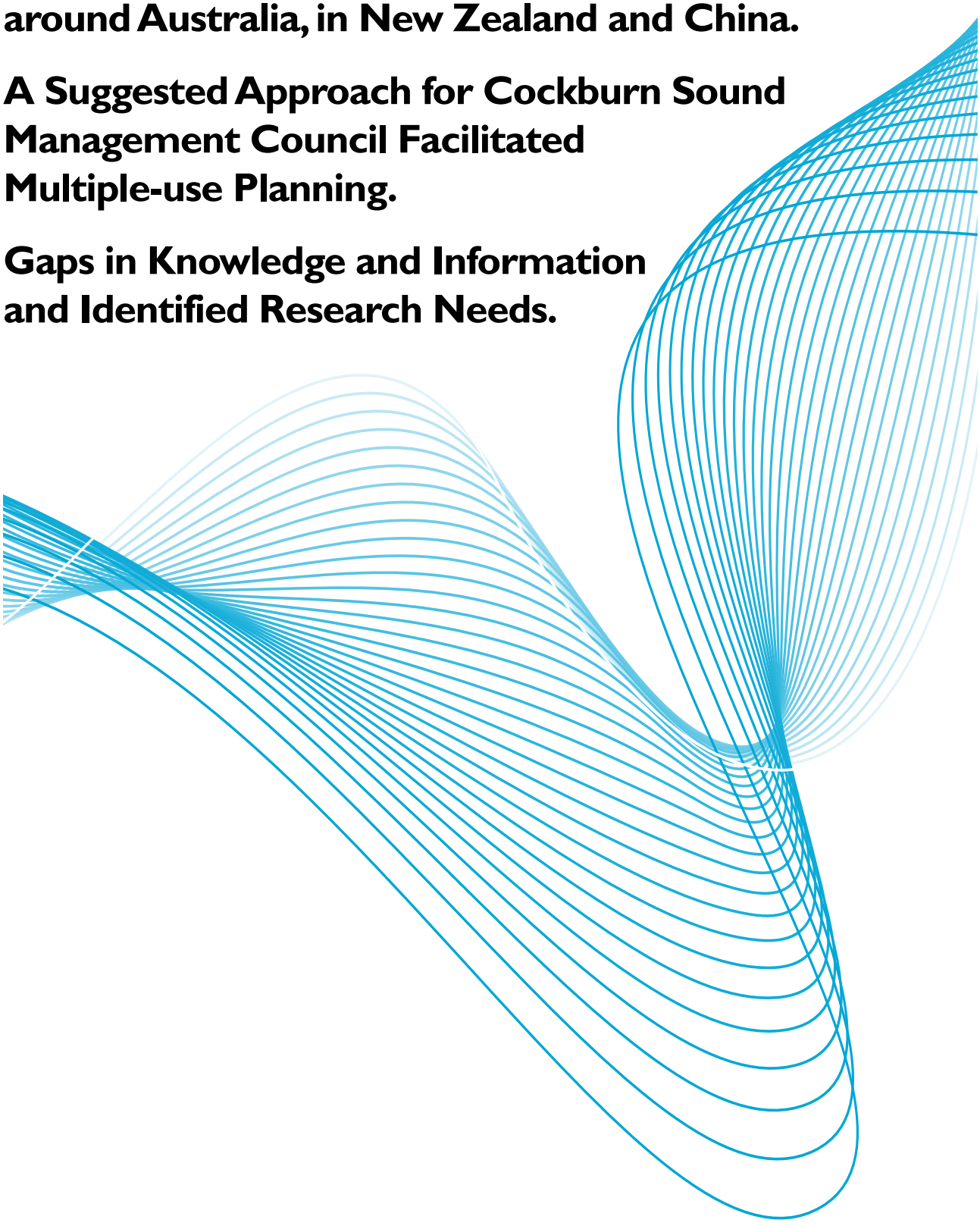
Photograph 29

PART III.

Examples of Multiple-use Marine Planning Approaches around Australia, in New Zealand and China.

A Suggested Approach for Cockburn Sound Management Council Facilitated Multiple-use Planning.

Gaps in Knowledge and Information and Identified Research Needs.



1. Multiple-use Marine Planning Approaches in Use

Multiple-use planning has developed strongly in the area of land use, with planning schemes and land-use strategies providing overarching guidance to planners and managers within defined management areas. Land-use planning is most often provided with a strong statutory basis to allow the setting of 'rules' and the creation of boundaries across the landscape. Land ownership, both public and private, has facilitated a divvying up of land ensuring that cross boundary conflict can generally be avoided. However, land use boundaries almost never coincide with ecological boundaries, a legacy of administrative boundaries being established in isolation of ecological knowledge (David Pitts Environment Science and Services 1997) – and thus conflict may occur through impacts on the natural environment.

In the marine environment there is almost never any private ownership and it essentially remains the last great common on earth. Administrative boundaries can and do exist but they are generally not exclusive unless there are safety risks or proprietary issues such as ownership of gear.

At the oceanic or bioregional scale multiple-use planning in the marine environment can be less spatially complex than that proposed at a local scale for Cockburn Sound and Owen Anchorage. Complexities arise due to proximity to the metropolitan area and the intense use and highly valued shared resources these water bodies provide socially, economically and environmentally to the whole community.

It is important to gain an overview of different types of approaches to multiple-use marine planning around the world and Australia to ensure the Cockburn Sound Management Council can draw on others' experience in pursuing its Section 2 EMP objective: 'To recognise and facilitate multiple-use management of Cockburn Sound and its foreshore'.

1.1 Multiple-use Marine Planning at the Commonwealth Level

Australians are responsible for a greater area of ocean than the people of any other nation on earth. With the world's greatest area of ocean territory, Australia is a leader in oceans planning and management (Australian Government 2004).

Australia is a signatory or party to several international agreements on the sharing and protection of the marine environment, within the Economic Exclusion Zone (from 3–200 nautical miles from shore) (Environment Australia 1997): United Nations (UN) Convention on the Law of the Sea; the Convention on Biodiversity; the Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks; and the UN Food and Agricultural Organisation Code of Conduct for Responsible Fishing. These agreements influence national policy development and have resulted in the production of: the National Strategy for Ecologically Sustainable Development (Government of Australia 1992); the Intergovernmental Agreement on the Environment (Government of Australia 1992a); the Commonwealth Coastal Policy (Government of Australia 1995); the National Strategy for Conservation of Australia's Biological Diversity (Government of Australia 1996) and the National Oceans Policy (Government of Australia 1998).

According to the Commonwealth Government there are four necessary and fundamental principles for successful multiple-use marine management:

1. Maintenance of Ecosystem Integrity
   - ★ *Maintenance of biodiversity*
   - ★ *Maintenance of ecological processes*
   - ★ *Maintenance of not only the existence of ecosystems and biodiversity but also their functional role*
   - ★ *Application of precautionary and anticipatory decision-making.*
2. Wealth Generation and Resource Use
   - ★ *Management and use which is sustainable, efficient and effective in delivery of food, economic wealth, human enjoyment and human well-being.*
3. Equity
   - ★ *The delivery of inter-generational, intra-generational, cross-sectoral, cross-boundary and cross-cultural equity and options, including national security.*
   - ★ *Avoidance of actions that are not potentially reversible on a time scale of a human generation.*
4. Participatory Framework for Decision-making.
   - ★ *Decision-making framework that meaningfully includes and considers all sectoral and community interests, and ensures processes are not dominated or determined by particular sectors or interest groups.*

It is suggested that the elements required for an effective multiple-use management framework are:

- ★ An appropriate legislative framework
- ★ An appropriate operational framework, consisting of:
  - i. A consultative mechanism encompassing inter and intra-sectoral interests and comprising cooperative management arrangements across sectors, facilitation arrangements, mechanisms for conflict resolution and for potential compensation and/or for transfer of rights.
  - ii. Explicit management strategies and plans that meet a minimum set of cross-sectoral objectives based on consistent interpretation of multiple-use management and ecologically sustainable development.

iii. Evaluation and assessment of the management plan, including demonstration that it can reasonably be expected to achieve defined management objectives despite lack of knowledge and uncertainties.

iv. Implementation capability and process, including the financial, legal and human resources to allow effective implementation of management plans.

(Adapted from Environment Australia 1997).

In developing the above principles and elements the authors identify that the Commonwealth legislative framework 'is overly complex and cumbersome, does not adequately address multiple-use management and will make integrated management difficult' (Environment Australia 1997). This issue could be considered common to multiple-use planning and management at all levels of government and community, considering marine planning and management is still a new frontier in regard to managed resource sharing. However, since the preparation of the 1997 report, the Australian Government has brought its program of regional marine planning directly under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 176 of the EPBC Act provides a general description of the provisions a Marine Bioregional Plan may include (Australian Government 2007).

1.1.1 Department of Environment and Heritage – Bioregional Marine Planning in Australian Territorial Waters

The Commonwealth Government has only recently completed the development of the first bioregional marine plan for Australian waters in the south-east of the country (Australian Government 2004a). The network of Commonwealth Marine Protected Areas in south-eastern Australia (Figure 5) will provide for some areas to be strictly protected with no extractive use and limited disturbance whilst others are managed resource use areas. This will include scientific study, recreational enjoyment and income generation through tourism and other sustainable uses such as mining and commercial fishing.

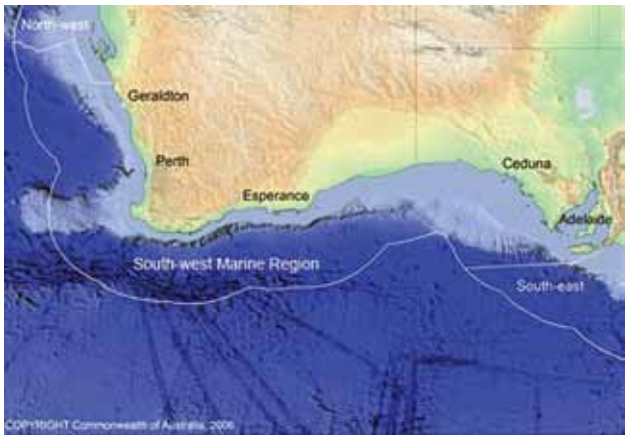


Figure 5: The South-west Marine Bioregion covers more than 1.3 million square kilometres of ocean waters from the eastern-most tip of Kangaroo Island off the South Australian coast to a point level with Cape Inscription on the outer coast of Shark Bay off Western Australia.

In the last two years the Commonwealth has now begun a second planning process in south-western Australia which is expected to be completed by 2009 (Department of Environment and Heritage 2006). The south-west region includes one of the world's marine biodiversity hotspots because of its high level of endemism (Department of Environment and Heritage 2006).

This planning is on a grand scale and involves the allocation of considerable resources and the development of new scientific approaches to assessment of the deep sea marine environment. Information on the marine environments of Australia is necessary if the EPBC Act is to be implemented, particularly in the area of assessment of potential development and uses of these areas of marine water and benthos. It is envisaged that bioregional planning will deliver certainty for industry, protection for the remarkable marine environment and conservation of its biodiversity <www.environment.gov.au/publications/mbp>.

The Commonwealth has a staged approach to the development of bioregional marine plans:

Stage 1: Preparation of a Regional Profile. The Department of Environment and Heritage works with the major scientific institutions in the region and with those that hold key data to bring together and evaluate information about the geology, oceanography and ecology of the region.

Stage 2: Preparation of the Draft Plan. The plan will be developed in consultation with stakeholders and will consider economic and social impacts of proposed conservation measures.

Stage 3: Preparation of the Final Plan. The planning process will have resolved issues and conflicts prior to finalisation and any action necessary to give effect to the Plan is started.

Stage 4: Implementation of the Final Plan. An implementation Strategy will be developed.

(Department of Environment and Heritage 2006).

The Commonwealth Government, through the Department of Environment and Heritage, has responsibility for the implementation of the plan when complete, in consultation with relevant State governments where interests overlap. For example in Western Australia, the State also has

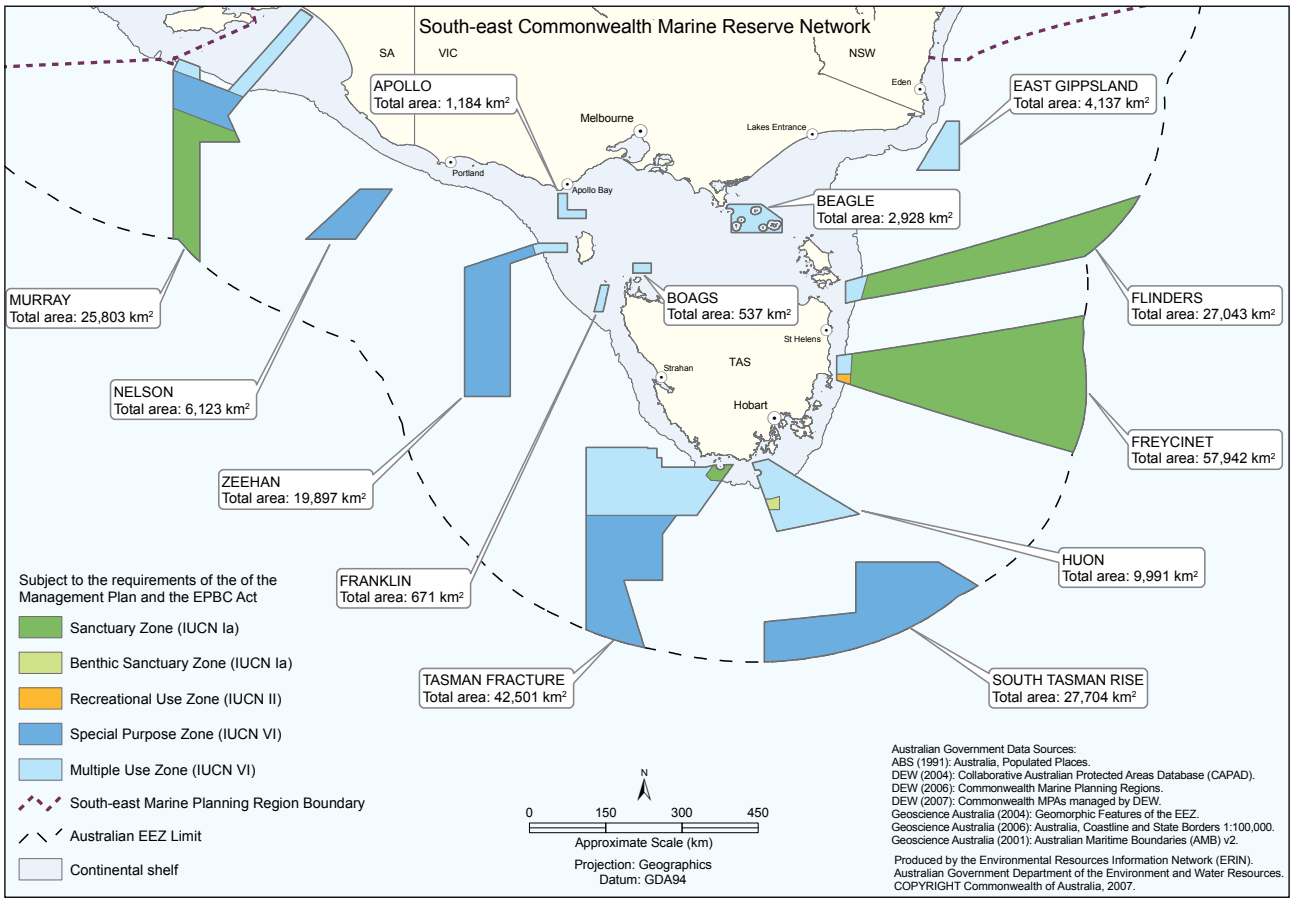


Figure 6: South-east Commonwealth Marine Reserve Network

responsibility under the Offshore Constitutional Settlement[1] for the management of most fish stocks out to the 200 nautical mile limit of the Australian Fishing Zone (Department of Environment and Heritage 2006).

1.1.2 Great Barrier Reef Marine Park Authority – Great Barrier Reef Marine Park Zoning Plan 2003

The Commonwealth *Great Barrier Reef Marine Park Act 1975* provides for the establishment, control, care and development of the Great Barrier Reef Marine Park. The Great Barrier Reef Marine Park Authority (GBRMPA) is responsible for the management of the Marine Park. The Great Barrier Reef Marine Park Zoning Plan 2003 is the primary statutory planning instrument for the conservation and management of the Marine Park (GBRMPA 2003).

The following information is extracted from the Zoning Plan. The Marine Park is managed as a multiple-use area and zoning provides for a range of recreational, commercial and research opportunities, and for the continuation of traditional activities. The Marine Park is divided into eight zone types:

- ★ General Use Zone
- ★ Habitat Protection Zone
- ★ Conservation Park Zone
- ★ Buffer Zone
- ★ Scientific Research Zone
- ★ Marine National Park Zone
- ★ Preservation Zone
- ★ Commonwealth Island Zone.

The zoning plan sets out the purposes for which each zone may be used. The General Use Zone provides for the widest range of activities, with few activities excluded. The objective for the General Use Zone is to provide for the conservation of areas of the Marine Park, while providing opportunities for reasonable use such as low impact-no take recreational activities, licensed fisheries, recreational fishing, traditional uses, photography/filming, limited impact research, education, and navigation of a vessel or aircraft (GBRMPA 2003). The General Use Zone is essentially a multiple-use area that is managed through regulatory processes coordinated by the GBRMPA.

The functions of the GBRMPA are supported by legislation, providing the organisation with the ability to proactively, and in some cases flexibly, manage the marine environment of a very large area of water and habitat. The main focus of the GBRMPA is conservation, with all uses allowed in the Marine Park being assessed for their impact on the environment and the zone in which they are proposed, or do occur.

[1] At the Premiers Conference on 29 June 1979, the Commonwealth and the States completed an agreement of great importance for the settlement of contentious and complex offshore constitutional issues. This agreement was published in 1980 by the Australian Government Publishing Service.

GENERAL USE (LIGHT BLUE) ZONE (GUZ)

The objective of the **General Use Zone** is to provide opportunities for reasonable use of the Great Barrier Reef Marine Park, while still allowing for the conservation of these areas.

ACTIVITY	General Use Zone
Aquaculture	Permit
Bait Netting	✓
Boating, diving, photography	✓
Crabbing (trapping)	✓
Harvest fishing for aquarium fish, coral and beachworm	Permit
Harvest fishing for sea cucumber, trochus, tropical rock lobster	Permit
Limited collecting	✓
Limited impact research	✓
Limited spearfishing (snorkel only)	✓
Line fishing	✓
Netting (other than bait netting)	✓
Research (other than limited impact)	Permit
Shipping (other than a designated shipping area)	✓
Tourism program	Permit
Traditional use of marine resources	Permit or an accredited TUMRA
Trawling	✓
Trolling	✓

COMMONWEALTH ISLAND ZONE (CIZ)

The Commonwealth Island Zone is comprised of those areas of the Great Barrier Reef Marine Park that are above the low water mark; namely, Commonwealth islands or parts of Commonwealth islands.

The areas forming part of the Commonwealth Island Zone include North Barnard Island, the Pipon Islands, Russell Island, North Reef Island, Low Isles, Pine Islet, Lady Elliot Island, Albany Rock, Coppersmith Island, Hannah Island, Bailey Islet, Clerke Island, Coquet Island, Eshelby Island, Hannibal Island, High Peak Island, Rocky Island and South Brook Island, together with parts of Dent and Penrith Islands.

The Commonwealth Island Zone can be used or entered without permission for low impact (non-extractive) activities, photography, filming, sound recording and limited educational programs. Traditional use of marine resources is allowed with written permission or in accordance with an accredited Traditional Use of Marine Resources Agreement.

Figure 7: An example of zoning information for the Great Barrier Reef Marine Park, Queensland
<Sourced: www.gbrmpa.gov.au>

1.2 Australian State Approaches to Multiple-use Marine Planning

Three State-based Australian examples of multiple-use marine planning are presented, in addition to approaches currently utilised in Western Australia. Each example provides a different approach that may stimulate ideas for progressing multiple-use planning in Cockburn Sound and Owen Anchorage.

1.2.1 Western Australia

Marine planning and management in Western Australia is undertaken under the *Conservation and Land Management Act 1984* (CALM Act) and the *Fish Resources Management Act 1995* (FRM Act) and has a marine conservation focus. The Department of Environment and Conservation implement the requirements of the CALM Act and the Department of Fisheries implement the requirements of the FRM Act.

Marine planning does not appear to occur through any other legislative mechanisms in Western Australia, except in the case of the Rottnest Island Authority (RIA) where the marine environment is included in the tenure allocation with the land area. The RIA, through the development of a marine management strategy (Rottnest Island Authority 2007) linked to its statutory management plan (Rottnest Island Authority 2003), has declared sanctuary zones over parts of the marine portion of the reserve with the remainder being for general use. The RIA has no authority or management responsibility beyond the boundary of its reserve which extends an average distance of 800 m from the island's shores.

***Department of Environment and Conservation and the Marine Parks and Reserves Authority* –**
Marine Conservation Reserves

Under the CALM Act, an area of the marine environment can be set aside as a marine nature reserve, marine park or marine management area. Marine nature reserves allow for the conservation and restoration of the natural environment;

the protection, care and study of indigenous flora and fauna; and the preservation of any feature of archaeological, historic or scientific interest. Marine parks allow only that level of recreational and commercial activity which is consistent with the proper conservation and restoration of the natural environment, the protection of indigenous flora and fauna and the preservation of any feature of archaeological, historic or scientific interest and can consist of general use areas, sanctuary areas, recreation areas, or special purpose areas. Marine management areas allow for the management and protection of the marine environment so that it may be used for conservation, recreation, scientific and commercial purposes including aquaculture, mining, seismic survey, drilling and petroleum production. The Marine Parks and Reserves Authority (MPRA) is the vesting body for marine conservation reserves and oversees the implementation of management plans through the Department of Environment and Conservation.

The CALM Act requires the Department of Environment and Conservation to maintain a consistent process for stakeholder involvement during planning for marine conservation reserves. This process is rigorous and may take a number of years and has resulted in a best fit implementation approach to marine conservation reservation around the State since the early 1980s.

The Department of Environment and Conservation is currently exploring a bioregional approach to marine conservation planning on the south coast of Western Australia and are working towards the production of a bioregional marine strategy. This strategy will aim to identify areas on the south coast that are priorities for marine conservation attention. This work is being undertaken in close consultation with a marine reference group consisting of nominated stakeholders with a strong interest in the south coast marine environment.

At the same time the State Government is working with key stakeholder groups to review the State's marine conservation policy – New Horizons (Government of Western Australia 1998) to update the State's approach to marine planning for conservation reserves.

Department of Fisheries – **Fish Habitat Protection Areas Program**

The FRM Act allows for marine management in so much as it regulates the taking of fish through the development of fishery management plans, or through the regulation of gear and take. Section 115 of the FRM Act provides for the declaration of Fish Habitat Protection Areas (FHPA) for: (a) the conservation and protection of fish, fish breeding areas, fish fossils or the aquatic eco-system; (b) the culture and propagation of fish and experimental purposes related to that culture and propagation; or (c) the management of fish and activities relating to the appreciation or observation of fish. A FHPA cannot be created in a marine nature reserve or marine park; however fishery management plans can be implemented within those reserves.

The first FHPA gazetted in the State was the Abrolhos Islands, an important fishing and tourism resource off the coast of Geraldton. This area includes all islands in the Abrolhos group and allows the Department of Fisheries to manage land and sea. Smaller FHPAs exist around the State, having been initiated by community groups in discussion with Department of Fisheries to protect favoured areas for marine appreciation. These smaller areas generally relate to (a) and (c) purposes of section 115 of the FRM Act.

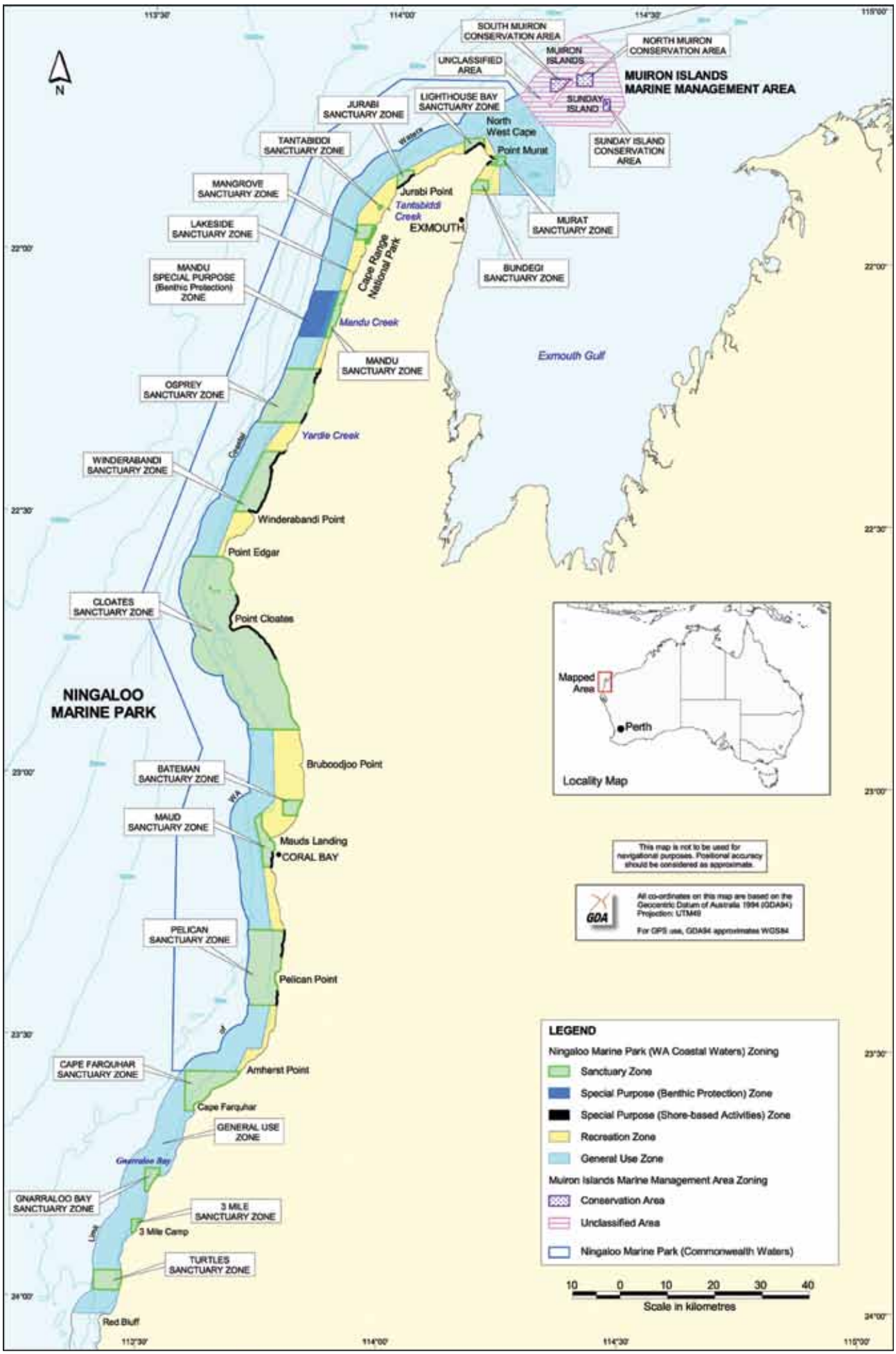


Figure 8: Zoning scheme for the Ningaloo Marine Park and Muiron Islands Marine Management Area

***Albany Harbours Planning Group* –**
Albany Harbours Planning Strategy

On the south coast of Western Australia, the Albany Harbours Planning Group (the Planning Group) was formed in 1995 to facilitate integrated management of the Albany harbours (King George Sound, Princess Royal Harbour and Oyster Harbour) and the marine/estuarine water bodies close to the City of Albany.

The Planning Group consists of representatives from the organisations with some management responsibility relating to the harbours or their shores (presently DEC, DoW, Albany Port Authority, City of Albany, DPI and Fisheries. The Planning Group was initially formed on a voluntary good-will basis with the catalyst for formation being concern over uncoordinated development processes, particularly related to aquaculture. Assessment for

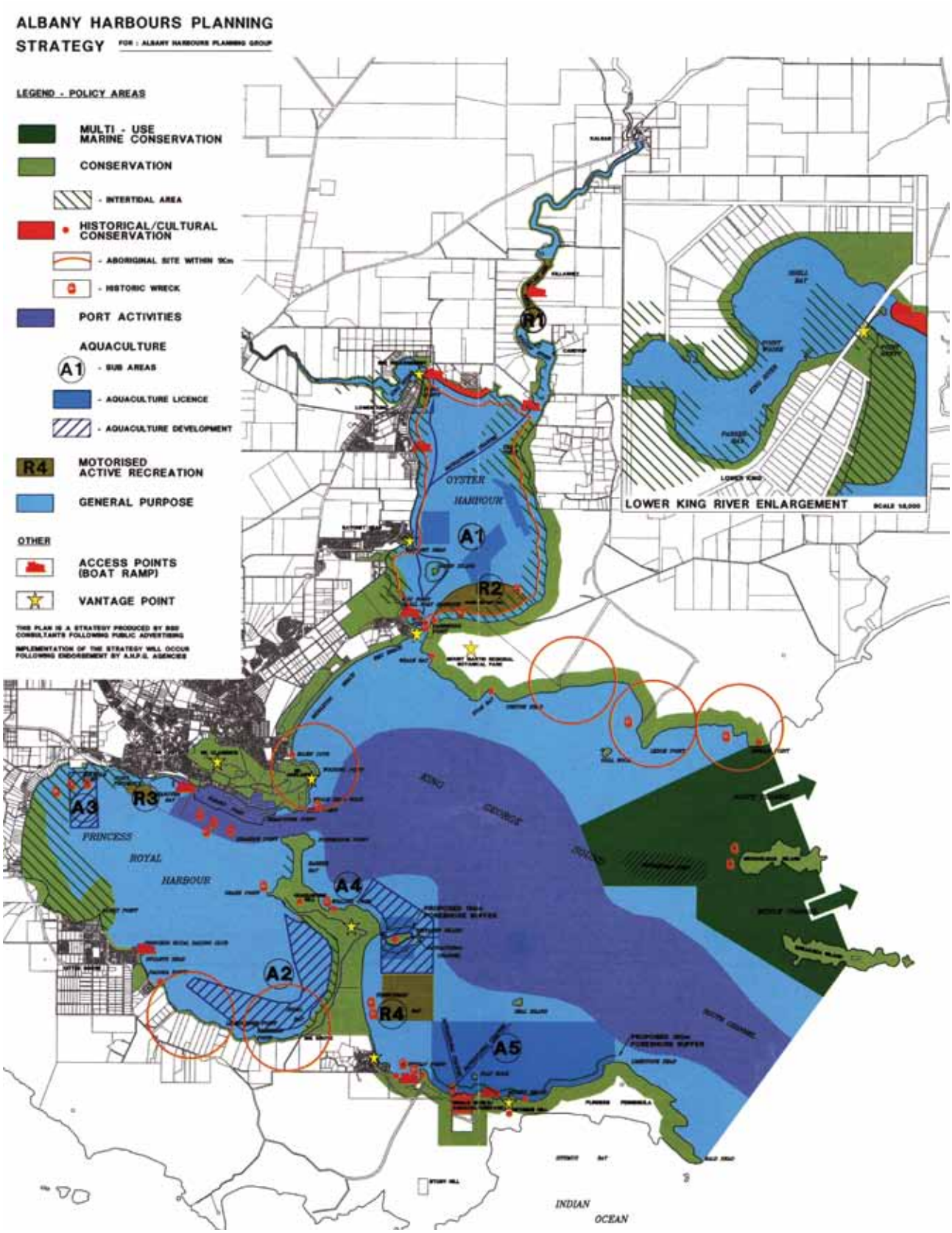


Figure 9: Albany Harbours Policy Areas (Sourced Albany Harbours Planning Strategy 1997)

proposed developments in Albany's harbours had previously been complicated due to the number of agencies involved in management of the harbours. This made the preparation of proposal applications difficult and time consuming, and often advice provided to proponents was not consistent across agencies.

To mitigate this confusion the Planning Group produced the Albany Harbours Planning Strategy (BSD Consultants Pty Ltd 1997). Extensive community consultation was undertaken as part of this planning exercise. The Strategy's aim is to manage the harbours' multiple uses and facilitate an integrated and transparent approval process for development on, in, under, over and/or adjoining the harbour areas. The Strategy is also a statement of what the community, stakeholders and authorities want for the future of the Albany Harbours, and how this can be achieved. It provides direction and guidance for harbour users and agencies whose decisions and actions will determine whether the shared vision is reached. It also promotes the maintenance of the harbours' ecological and aesthetic values while allowing reasonable use of the area's resources through the identification of policy areas (zones).

Table 4: Policy Area Objectives for the Albany Harbours (BSD Consulting Pty Ltd 1997)

Policy Area	Objective
Port Activities	To develop, maintain and operate a viable Port within an ecologically sustainable framework.
Historical/ Cultural Conservation	To ensure sites of scientific, heritage and cultural importance in or around the harbours are identified, conserved and protected.
Aquaculture	To provide for the ecologically sustainable development of an aquaculture industry within the harbours.
Motorised Recreation	To provide for near shore active motorised water-based recreational activities including water skiing, jet skiing and power boat racing operation; and To ensure the safety and amenity of others, and the physical environment, is not unduly impacted upon.
Multi-use Marine Conservation	To provide for the conservation of marine flora and fauna within representative areas of Albany's harbours and to manage multiple-use within these areas.
Conservation	To provide for the conservation of flora and fauna and the management of multiple-uses along the harbour foreshores; To protect the amenity of the harbours; and To provide for public access with controls (e.g. cycleways).
General Purpose	To provide for multiple-use of the harbour areas not included in other Policy Areas, whilst minimising conflict and negative impacts within an ecologically sustainable framework.

The declaration of seven agreed policy areas[1] (see Table 4) acknowledged the differential nature of the resource base by identifying activities which would be most compatible with the resource characteristics while allowing for the combination of activities that are compatible and the separation of activities that are not.

Each Policy Area is supported by general provisions, a list of compatible uses and guidelines for development. The Albany Harbours Planning Strategy Guidelines (Albany Harbours Planning Committee 1999) provides the detailed implementation plan for the Planning Strategy and each Policy Area.

After nearly twelve years the group is still functioning on a bi-monthly basis with executive support provided by the Department of Water. The provision of advice and comment on development proposals is still discussed at a collective level prior to a formal submission to decision-making bodies, including the Environmental Protection Authority and the Minister for the Environment.

1.2.2 Queensland

The Queensland Parks and Wildlife Service undertakes multiple-use planning in its waters through application of the *Marine Parks Act 2004* and the *Nature Conservation Act 1992*. Outside marine parks, there is no formal approach to multiple-use marine planning and management, with individual uses being managed by separate legislative processes (for example, specific Fisheries management across State waters).

Environmental Protection Agency, National Parks and Wildlife Service – Queensland Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004

The Queensland Government has developed a zoning plan for the Great Barrier Reef Coast (Government of Queensland 2007) through the *Marine Parks Act 2004*[2]. This plan has a conservation focus and allows for multiple-use in General Use Zones within the marine park in State managed waters. This zoning plan is implemented and regulated by the Queensland Parks and Wildlife Service, in liaison with GBRMPA. The plan is complementary to the Great Barrier Reef Marine Park Zoning Plan (GBRMPA 2003).

The plan is based on extensive zoning, with each zone having regulations supporting its use (generally in keeping with the GBRMP regulations). While the plan has a conservation focus, the designation of large areas for General Use allows for a range of activities to occur quite freely, although some such as aquaculture, dredging, mooring, research and tourism are required to have written permission, with a permit issued by GBRMPA and the Government of Queensland together (D. Savage Pers. Comm.).

[1] The term 'policy area' was used in place of 'zone' to avoid confusion with a Town Planning Scheme zone.

[2] The main purpose of this Act is to provide for conservation of the marine environment. The purpose is to be achieved by a comprehensive and integrated strategy that involves, among other things….recognition of the cultural, economic, environmental and social relationships between marine parks and other areas, whether land or water and the provision of opportunities for public appreciation, understanding and enjoyment of the marine environment (extracted from *Marine Parks Act 2004* Qld).

1.2.3 Tasmania

The Department of Primary Industries and Water undertakes planning for multiple-use of the marine environment under the 'Living Marine Resources Management Act 1995', the 'National Parks and Wildlife Act 1970' and the 'Marine Farming Planning Act 1995'. The 'National Parks and Wildlife Act 1970' cannot be used to protect fish, or control fishing activities, even if a part of the marine environment is reserved under this Act, hence the 'Living Marine Resources Management Act' and 'National Parks and Wildlife Act' are utilised together, both delivering conservation outcomes within marine nature reserves (Department of Primary Industries and Water 2001). In addition to planning for marine conservation reserves and fisheries management, the Department of Primary Industries and Water also coordinates the development of *Marine Farming Development Plans* which are prepared under the '*Marine Farming Planning Act 1995'* and in accordance with the Tasmanian State Coastal Policy (Government of Tasmania 1996).

The purpose of the Marine *Farming Planning Act* is to achieve well-planned sustainable development of marine farming activities having regard to: the need to integrate marine farming activities with other marine uses; minimise any adverse impact of marine farming activities; set aside areas for activities other than for marine farming activities; take account of land uses; and take account of the community's right to have an interest in those activities. Under the *Marine Farming Planning Act,* the Government is required to appoint a Marine Farming Planning Review Panel consisting of eight persons, two being State Government senior officers and the remainder being drawn from the community in different areas of expertise: marine farming, boating, marine management, local government and general interest. The Panel is required to review draft marine farming plans and provide advice to the Minister on matters relating to the plans. A marine farming plan can make any provision which relates to the use, development, protection or conservation of any thing in the area under scrutiny.

An example of a Marine Farming Development Plan is discussed here, as it has application to multiple-use marine planning outside legislation that has a direct conservation focus.

***Department of Primary Industries and Water* – Marine Farming Development Plan: Georges Bay**

Georges Bay is situated on the east coast of Tasmania. The Georges Bay Marine Farming Development Plan covers approximately 1788 ha of marine and estuarine waters. There is a range of uses within the Plan area including navigation, commercial fishing (second largest fishing port in Tasmania), marine farming, recreational fishing and boating, diving, sailing/windsurfing, waterskiing, power boat racing, swimming and stormwater and sewage disposal. The area is under the control of Marine and Safety Tasmania (*Marine and Safety Authority Act 1997).*

The Marine Farming Development Plan designates agreed zones in which marine farming can take place in Georges Bay, reviews environmental impacts on each zone and presents management controls to manage negative effects (Department of Primary Industries and Water 1998). The Plan takes into account the requirements of other users but makes no designation of space for those other uses, nor does it look at their impacts.

In effect, the plan has the single focus of designating zones for marine farming that have limited impact on other users. As such the plan does not present a holistic, integrated approach to multiple-use planning in Georges Bay.

1.2.4 Victoria

Western Australia and Victoria were developing a similar approach to the protection of Cockburn Sound and Port Phillip Bay in the late 1990s. It appears that the ideology may have been the same but the outcomes have been quite different.

***Department of Natural Resources and Environment* – Port Phillip Bay Environmental Management Plan**

Port Phillip Bay is one of the world's largest marine embayments. The Bay is of significant social, economic and environmental value to Victoria. The shipping and manufacturing infrastructure along its shores gives it national economic significance (Department of Natural Resources and Environment 2002a). Management of the Bay is undertaken under the Port Phillip Bay Environmental

Management Plan: plan and critical programs to 2003 (Department of Natural Resources and Environment 2002).

The management approach to issues affecting Port Phillip Bay is very similar to that the Western Australian Government has taken in regard to Cockburn Sound with the following exceptions. In Victoria no 'independent body' was established as a coordinating agent as was the case with the Cockburn Sound Management Council and there is no reporting requirement against the implementation of the SEPP or EMP. In addition, the Victorian Department of Natural Resources and Environment has established a non-statutory management framework, based on an ISO 14001 Environmental Management System,[1] which allows for the integration of the many management efforts being affected in Port Phillip Bay into one document that has relationship to the State Environmental Protection Policy (Waters of Victoria) (SEPP) (State Government of Victoria 1997). Apart from the application of the intent of this policy at no point does the Department attempt to develop a multiple-use approach to the management of the Bay. Essentially, the Port Phillip Bay EMP was intended to provide guidance on the remediation of water quality issues and marine species introduction. These two issues were targeted because they were considered the highest environmental management priorities at the time the EMP was developed. Time has shown, however, that the management of introduced marine species was beyond the scope of the SEPP and the EMP has had little effect on this issue (J. Klemke Pers. Comm.).

It appears to be understood that several organisations have various responsibilities in the effective management of the Bay and that their efforts are a necessary part of the use and protection of Port Phillip Bay's social, economic and environmental values.

To explain how Victoria is implementing this management approach would require a great deal of detail. In summary, however, it can be said that the organisations peripherally involved in the implementation of the SEPP and Port Phillip Bay EMP and other relevant environmental plans have a statutory basis and have jurisdictional responsibilities for environmental and water management. It should also be noted that the SEPP has limited scope in regard to the protection of environmental values beyond water quality. In addition, there appears to be little commitment from those responsible for water quality management to pursue the implementation of the EMP as a lead document.

1.3 Multiple-use Marine Planning Example from New Zealand

As Australia's nearest neighbour of similar culture and legislative structure it could be expected that New Zealand may have approaches to multiple-use marine planning and management that could be used as examples upon which to draw experience. The following presents a non-statutory approach developed in New Zealand for multiple-use marine planning that has some organisational similarities to the Cockburn Sound Management Council.

1.3.1 Guardians of Fiordland's Fisheries & Marine Environment Inc. – *Fiordland Marine Conservation Strategy*

[*Te Kaupapa Atawhai o Te Moana o Ata (Maori) – Fiordland Marine Area Strategy*]

This example shows a process where a bottom-up community-based approach has been empowered by government to drive multiple-use marine planning.

The Guardians of the Fiordland's Fisheries (the Guardians), formed in 1995, include representatives of commercial and recreational fishers, charter operators, Ngai Tahu Whanui (customary), community, environment and marine science interests. Members all live within or near to the Fiordland region. The Guardians were self formed from a voluntary base of people who care deeply about what happens to Fiordland's fisheries and marine environment. In 2003, the Guardians developed the Fiordland Marine Conservation Strategy (Teirney 2003) with support and advice from Environment Southland[2], Ministry for Fisheries, Department of Conservation[3], and the Ministry for the Environment[4] – the principal funding agency.

What is most interesting about the Guardians is that they began a marine planning process outside of any policy or guidelines and pursued a community-based bottom-up approach. As part of their approach they reviewed legislation affecting the natural environment, both administrative and resource related, and found that it could adequately deal with their concerns and the implementation of an independently

[1] ISO 14001 is one of a family of environmental management standards, known as the ISO 14000 Series, prepared by the International Organisation of Standards. Central to the standards application is an 'environmental management system' that allows a structured approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved (Department of Natural Resources and Environment 2002a).

[2] Environment Southland is the statutory body responsible for managing the natural and physical resources of air, land, water and coast in the South Island of New Zealand – equivalent to an Australian State government agency.

[3] The Department of Conservation is the central government organisation charged with conserving the natural and historic heritage of New Zealand.

[4] The Ministry is the New Zealand Government's principal adviser on environmental sustainability and international matters that affect the environment – equivalent to an Australian Commonwealth government agency.

developed marine conservation strategy. Interestingly, the Guardians were provided financial and advisory support for strategy development from the New Zealand government.

In developing the strategy the Guardians set clear objectives and worked to the following process:

1. Identified existing knowledge and gaps in knowledge
2. Facilitated the closure of knowledge gaps through discussion with regular users of the Fiordland, and through advocating research.

These two stages were undertaken over a six to eight year period, with information being collected and stored by the Guardians. The methods used were:

- ★ Compiled records of Maori and early European association with Fiordland;
- ★ Recorded recent history (1900 onward) from interviews with knowledgeable locals;
- ★ Recorded and mapped knowledge about the distribution of harvested species and fishing pressure;
- ★ Gathered available information about the Fiordland marine habitats and biology of each species;
- ★ Recorded details of the commercial fishery for each species;
- ★ Surveyed recreational fishing patterns and catch;
- ★ Surveyed charter boat fishing patterns;
- ★ Described customary fishing management provisions;
- ★ Successfully advocated research into recreational fishing patterns and harvest, and into charter boat fishing patterns and harvest;
- ★ Successfully advocated research on the blue cod[1];
- ★ Gathered knowledge about special values and areas;
- ★ Supported the development of a Geographic Information System (GIS);
- ★ Compiled an annotated bibliography of references relating to Fiordland fisheries and marine environment; and
- ★ Produced three publications containing information collected (Guardians of the Fiordland's Fisheries 1996, 1999, 2001).

(Extracted and interpreted from Tierney 2003).

The Guardians also developed an overall vision and key objectives for problem areas to help them maintain a consistent approach through debate and decision-making. They undertook long and careful negotiation and consultation with the wide range of interested groups and stakeholders resulting in each sector giving up some of their interests in the marine environment to ensure its overall protection: this was referred to as the 'gifts and gains'. The Guardians strongly recommended that all management measures be implemented to ensure that the carefully negotiated balance of gifts and gains was not compromised (Ministry for the Environment 2004).

When the Fiordland's Marine Conservation Strategy finalised in June 2003 was recognised by the Ministers of Fisheries and Environment (Tierney 2003). The Guardians asked the government to take the necessary policy and legislative steps to implement their strategy (Ministry for the Environment 2004). In September 2003 the Ministers committed the Government to implementing the Strategy by September 2005.

In November 2003, less than a year after the release of the Strategy and nine years after the formation of the Guardians, the New Zealand Ministry for the Environment formed an Investigative Group to provide advice to the Minister on options for implementing the Strategy. The Investigative Group recommended a preferred option which involved the development of special legislation incorporating specific provisions to recognise Fiordland's special marine environment and to improve integration of planning and management. It also recommended some consequential amendments to current legislation (Ministry for the Environment 2004). It was believed that special legislation was desirable to provide a suitable single, recognisable 'home' for management measures that didn't fit well with existing legislation and statutory processes and that one set of legislative provisions in a specific, locally focussed Act that stipulated the requirements for the Fiordland Marine Guardians, recognised the purposes and roles of other management regimes, and recognised the need for integration, would require fewer changes to existing legislation and allow for the commitment made by government to be met. It was recognised that the process for developing improved marine resource management for Fiordland was unique and without precedent in New Zealand (Ministry for the Environment 2004). As a result of this process the *Fiordland (Te Moana o Atawhenua) Marine Management Act 2005* (the Act) was introduced with the purpose of recognising the Fiordland Marine Area's local, national and international importance, unique marine environment, distinctive biological diversity, and outstanding landscape and cultural heritage (Government of New Zealand 2005).

Part 3 of the Act provides for statutory recognition of an eight member group of the Fiordland Marine Guardians as

[1] A highly valued recreationally and commercially targeted bottom dwelling fish.

a committee under the New Zealand *Conservation Act 1987* and describes their function in relation to the management of the Fiordland Marine Area. The Act essentially provides for the specialised management of the Fiordland Marine Area in accordance with the recommendations of the Fiordland Marine Conservation Strategy and recognises the Fiordland Marine Guardians to be best placed to promote and facilitate that management in liaison with relevant management agencies.

1.4 Multiple-use Marine Planning Example from China

1.4.1 Republic of China – Sea-Area Use Management Law

In China the increase in disorderly, excessive and free use of the sea has resulted in China developing a legislative approach to multiple-use management. The major maritime activities occurring in the seas of China are salt production, aquaculture, fishing and ship building. While these activities may in some areas of the world be managed sustainably, the density and dramatic rise in activity in China is an issue of major concern. Unmanaged activity has resulted in serious coastal damage, loss of about 70% of mangroves and destruction of 80% of coastal coral reefs, a seriously abused marine resource base, abuse of property rights of the State and no protection for legitimate investors.

The situation in China is not totally analogous with Cockburn Sound and Owen Anchorage at present. Nevertheless, with time and population increase, similar problems could arise if appropriate management is not in place.

The Chinese government has deemed it necessary to develop Sea-Area Use Management legislation. This law requires any entity or individual who intends to use the sea to apply in advance and obtain the right to the sea use according to the law. The law allows for the development of a Marine Functional Zoning System and all activities must comply with the requirements of this zoning and are required to pay a use-fee. Essentially, China's multiple-use management is user based on a user-pays system resulting in 70% of return going to the local area in which the activity occurs, and 30% to the central government.

Marine functional zoning involves dividing a sea area into dominantly functional sub-areas with independent geographic units in natural conditions in accordance with the natural environmental condition and geographic locations, and considering marine development and use status and the needs for social and economic development. It gives guidelines on what is suitable and what is unsuitable for a specific sea area. For this reason, marine functional zoning serves as one of the important systems for sea area use and management in a developing China. (Extracted and interpreted from <www.ioc3.unesco.org/marinesp/files/Chinas_Sea_Use_Management_Legislation>)

2. Relevance of Multiple-use Marine Planning Examples to Cockburn Sound Management Council

At present the Council's first stage approach, the Multiple-use and Resource Assessment Project, is consistent with the methodology used for most marine planning processes. It is the foundation layer of information required for the development of informed discussions and decisions within and outside the Council.

The closest example that may have relevance to the Council's aspiration for the facilitation of multiple-use planning is the approach taken by the Albany Harbours Planning Group. This group has successfully worked together to facilitate a collection process to promote integrated multiple-use for the past twelve years through the implementation of a strong localised policy approach. The policy approach has no statutory basis and its only power lies in the cooperative manner in which it is acknowledged and implemented. The Council is potentially in a strong position to pursue a similar approach. Because the Council is government appointed, the outcomes will also require government support if they are to be successfully and cooperatively implemented.

Another interesting example which may provide inspiration, if not guidance, to the Council is the work of the Guardians of the Fiordlands Fisheries in New Zealand. This community-based group successfully coordinated the development of a marine conservation strategy outside a statutory framework and then gained government support because of the detailed, disciplined and responsible approach the group took in regard to the formulation of the strategy.

The Port Phillip Bay example may show the strength of the Council's role in maintaining whole-of-community interest in the monitoring and management of the environmental values of Cockburn Sound and Owen Anchorage over the last seven years. The presence and structure of the Council and the application of the SEP provide a stronger foundation for working towards a cooperative approach than is provided for in Victoria where the SEPP has limited application, and is not supported by an independent, multi-faceted, and government supported coordinating body.

It is evident however, that the Council is unique in its aspiration to facilitate multiple-use outside a statutory process while also working within the requirements of a State policy and State government departmental agendas. Most multiple-use approaches presented in this section have a statutory basis and also a marine conservation focus. The Council will need to determine the best method to meet the needs of all members and organisations. This will be the first step in determining a firm direction for facilitating multiple-use.

Zoning has been strongly pursued by all examples of marine planning and management presented in this section. Zoning is a place-based ecosystem management system that reduces conflict, uncertainty and cost by separating incompatible uses and specifying how particular areas are to be used. Zoning can occur by happenstance or by design. Zoning by design allows zoning decisions to be made with all of society's goals in mind, not just single goals. And zoning by design increases the chance that adjacent zones are compatible (Norse 2006). China provides the extreme example where zoning is supported by a user-pays system and where significant environmental decline has occurred through unmanaged use of the marine environment.

The Council's aim of developing a facilitated multiple-use framework for Cockburn Sound and Owen Anchorage will require a new approach to marine planning and management in Western Australia and may provide an important example to marine managers in Australia and around the world who are looking to facilitate a multiple-use approach to busy and developing waterways. It could be expected that the creation and implementation of a new design for marine planning and management will be challenging, and will need to be supported by government and the wider community.

Accelerating population growth and the increase in significantly large proposals for the development of maritime structures in Cockburn Sound and Owen Anchorage is putting these water bodies under ongoing pressure. This pressure is, in the most part, not pollution related any longer, instead being associated with impacts on the remaining ecological values. The facilitation of multiple-use in Cockburn Sound and Owen Anchorage will no doubt rely on some complex choices and a considerable amount of responsible foresight by managers as there is a strong whole of community expectation that all care will be taken to protect the remaining marine and coastal environmental attributes and values, all of which have been changed significantly since the first settlers arrived on these shores in 1829, a mere 178 years ago.

Cockburn Sound and Owen Anchorage can be considered the most consistently used, and probably the most economically diverse and valuable coastal waters in Western Australia. All care is required during decision-making as we move forward as a community to fully and equitably utilise the marine environment of the southern Perth metropolitan area for the benefit of all.

3. Suggested Approach for Council Facilitated Multiple-use Planning

The recognition and facilitation of multiple-use management in Cockburn Sound and Owen Anchorage by the Cockburn Sound Management Council is an ambitious undertaking by the Council because of the diversity and responsibilities of its membership. However, this diversity, and the strength of membership of the Council, will play a positive part in ensuring it is able to work through a range of future challenges.

It is acknowledged by the Council that there are some areas where there is a general lack of information about current natural resources, ecological processes, biodiversity and the cumulative impact of uses. It will be an issue to work through in facilitating a multiple-use framework.

The following provides a suggested formula to enable the Council to play a stronger lead role in facilitating multiple-use management of Cockburn Sound and Owen Anchorage.

3.1 Constraints and Strength

Because the Council is governed by the requirements and contents of the SEP and EMP many issues relating to multiple-use may fall outside its direct sphere of responsibility. Nevertheless, the application of the SEP and EMP constitutes strength, such that the Council can provide firm advice and direction to proponents and users for the protection of three dominant ecosystem components: seagrass health and extent; sediment quality; and water quality.

The approach taken needs to recognise the jurisdictional boundaries of the organisations that have legislative responsibilities, so that the Council can work with those organisations specifically in the development of a multiple-use approach.

3.2 Gaps in Knowledge Identified during Multiple-use and Resource Assessment Project

The main knowledge gaps identified during this project include information on;

- Management associated with habitats and their contribution to sustaining the Sound's food-chains including habitat dynamics and factors affecting invertebrate and fish species recruitment, survival and management
- Management of fisheries
- Adaptive management associated with high value species (crabs, pink snapper, herring, whiting, octopus and prawns)

3.3 Recommendations to Assist the Council in Revising its Environmental Management Plan

In order to incorporate a multiple-use framework into the CSMC's future revised EMP, the following recommendations will need to be addressed properly to achieve a new multiple-use framework:

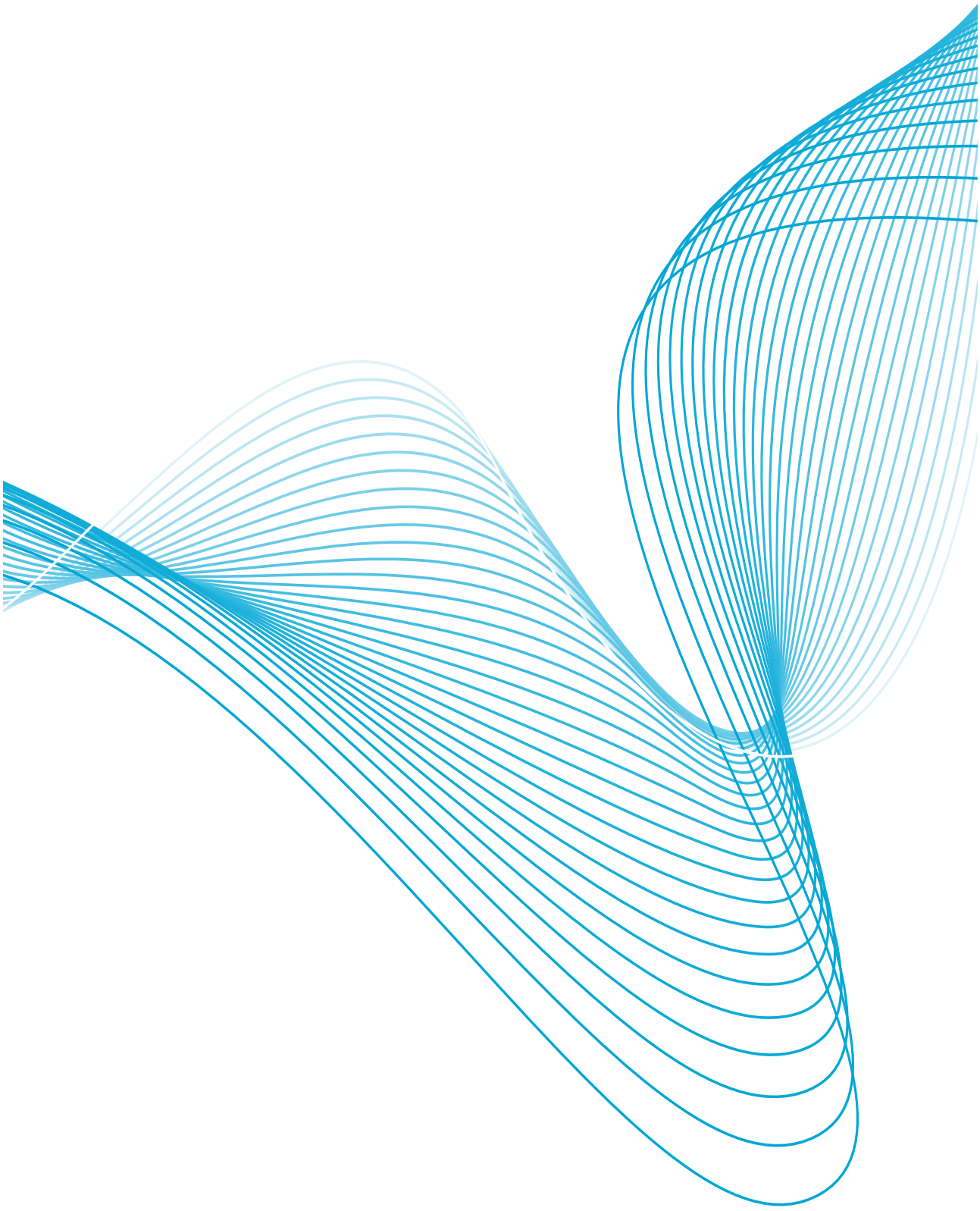
- EMP needs to consider Council structure and resourcing.
- EMP needs to include consideration for appropriate decision support tools to assist the Council in its advisory role, for example Marxan or Marzone as well as Management Strategy Evalution (MSE).
- EMP needs to be fully costed.

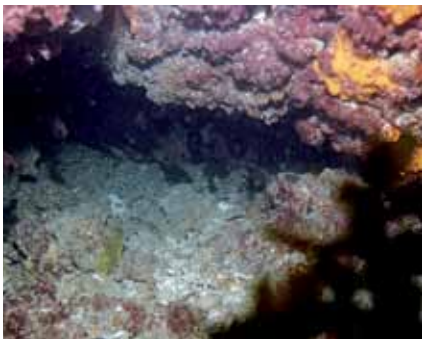
3.4 Framework for Future Action

1. **All activities need to be in accordance with the SEP.**
2. **A vision needs to be developed for multiple-use management of Cockburn Sound and Owen Anchorage based on agreed principles, and the objectives of the SEP.**
3. **The EMP needs to be reviewed with appropriate stakeholder consultation.**
4. **The revised EMP will specify actions and measurable targets relevant for facilitating multiple-use.**
5. **There is a need to expand the scope of CSMC work to include issues related to the environmental health of Cockburn Sound and Owen Anchorage, but not necessarily defined within the SEP.**

End of Part III

Appendices






APPENDIX 1.
Representation List of CSMC Membership

1–4. Four Community Members (including the Chair)
5. Conservation Council of Western Australia
6. Recfishwest
7. Cockburn Powerboat Association
8. Kwinana Industries Council
9. WA Fishing Industry Council
10. City of Cockburn
11. Town of Kwinana
12. City of Rockingham
13. Royal Australian Navy
14. CSIRO Marine
15. Department of Environment and Conservation
16. Department of Industry and Resources
17. Department of Fisheries
18. Department for Planning and Infrastructure
19. Fremantle Ports
20. Department of Water
21. Water Corporation
22. WA Vegetable Growers Association

APPENDIX 2.
Cockburn Sound Management Council Terms of Reference

The objects of the Council are to:

1. Facilitate and coordinate ongoing environmental management between Government, industry and the community to achieve a set of environmental goals covering the waters of Cockburn Sound and its catchments.
2. Under delegated authority from the Environmental Protection Authority, develop an Environmental Management Plan (EMP) consistent with an Environmental Protection Policy initiated and developed by the Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986*, for endorsement by the Ministerial Council (on advice of the Minister for the Environment) for the waters of Cockburn Sound and its catchments which would:
   (a) recognise and facilitate multiple use-management of Cockburn Sound;
   (b) incorporate environmental quality objectives and criteria of the Environmental Protection Policy;
   (c) foster integration between environmental planning and management for the land and marine environment.
3. Administer and coordinate implementation of the Environmental Management Plan, and publicly report on its performance in achieving its stated objectives.
4. Coordinate the management of pollution impacts on Cockburn Sound and its catchments.
5. Investigate, monitor, review and report on environmental objectives, criteria and targets where appropriate, in accordance with the Environmental Management Plan and the Environmental Protection Policy.
6. Coordinate and/or undertake research and investigations as a basis for development and implementation of environmental and management objectives.
7. Report annually to the Ministerial Council and the Board of the Water and Rivers Commission [now Department of Environment and Conservation] on progress.

APPENDIX 3.
Examples of Council Advice and Comment Offered on Proposals

The following are two examples where the Council, through its Department of Environment and Conservation officers, has provided advice and comment on large-scale, potentially high impact development proposals.

Perth Seawater Desalination Plant

In May 2003 the Water Corporation of Western Australia received environmental approval for the construction and operation of a seawater desalination plant at a site in the Kwinana or East Rockingham area.

In February 2004 the Water Corporation released an Environmental Review document which proposed to upgrade the capacity of the plant, from the originally approved 30 GL/annum capacity to 45 GL/annum. This revised proposal was only relevant to the Kwinana site location and received environmental approval in July 2004.

Construction of the desalination plant was completed in late 2006 with operation commencing in November 2006. The plant is built on the shores of Cockburn Sound in Kwinana and draws seawater from the Sound for desalinating. The plant supplies water to the Water Corporation's Integrated Water Supply Scheme, which accounts for approximately 17% of Perth's water supply. The saline brine, a waste product of desalination, is discharged back to Cockburn Sound via a sub-sea diffuser pipeline located approximately 300 m offshore.

Throughout the environmental approvals process and the construction of the plant the Council provided strategic advice to the Environmental Protection Authority (EPA), the Minister for the Environment and the Department of Environment and Conservation (formally Department of Environment). The Council also liaised closely with the Water Corporation throughout the entire environmental approvals process and the construction period, and continues a close relationship during its operational phase.

The Council's advice has been guided by the principles and policies of the SEP and the EMP. The overarching focus of this advice relates to ensuring established environmental values and objectives are maintained. In the case of an effluent discharge this is achieved by meeting measurable environmental quality criteria.

More specifically, the advice provided by the Council during the environmental assessment of the desalination plant proposal related to the following:

- Discharge of saline brine to the marine environment and the expectation that it must comply with Environmental Quality Criteria established for Cockburn Sound and that there be sufficient monitoring to ensure this;
- The potential for the discharge of highly saline water to cause prolonged periods of vertical stratification in the deep basin of Cockburn Sound;
- Discussion on increased nitrogen levels entering Cockburn Sound as a result of the plant's discharge and advice that such an increase is undesirable;
- The effect of anti-scalants and anti-foulants on marine organisms;
- Overall cumulative impacts caused by the interaction of the plant's saline discharge with other nearby industrial discharges;
- Planning issues associated with the intake and outlet pipeline locations in respect of future large-scale port proposals.

In addition to the provision of advice during the environmental impact assessment process, the Council provided advice on the various environmental management plans prepared for the plant. It was a requirement of the Ministerial Conditions for the plant that the Council be consulted on the production of these plans. Of particular interest to the Council was the *Consultative Environmental Management Plan* (Water Corporation & ProAlliance 2005) which included management components for water quality, flora and fauna and hazardous materials.

There was also concern from the Council as to whether the Ministerial Conditions were the best mechanism to ensure strict management of potential and actual issues. The Council raised this issue with the Minister for the Environment and the Department of Environment and Conservation. As a result, the Minister announced that the plant was to be licensed under Part IV of the *Environmental Protection Act* and there would be a requirement for the Water Corporation to implement a real-time water quality monitoring program. This monitoring program would monitor salinity and dissolved oxygen levels in the deep basin of Cockburn Sound and trigger contingency actions if dissolved oxygen levels became a concern. Licensing the plant meant specific conditions and stringent criteria in relation to possible stratification could be placed on it.

This example shows the influence of the Council in ensuring environmental values are maintained through the most appropriate regulatory processes and that advice and comment provided to the EPA and Minister for the Environment related chiefly to the maintenance of environmental quality objectives within Cockburn Sound as required by the SEP.

Cape Peron Tourist Precinct Project

The Cape Peron Tourist Precinct Project is a conceptual proposal to develop an inland marina facility at Mangles Bay, in the south-west corner of Cockburn Sound. In 2006 the Minister for the Environment requested the EPA to review the proposal and provide strategic environmental advice. The EPA then approached the Council to provide them with comment on the marina concept.

Table A summarises the Council's comments provided to the EPA. The comments recognise that the SER was prepared in such a way as to allow the EPA an opportunity to examine the key environmental issues associated with the marina concept, including identifying any potential 'fatal flaws'. The Council acknowledged that any decision to proceed with the marina concept as an actual proposal would most likely result in formal environmental assessment by the EPA.

Table A. Council comment on the Strategic Environmental Review for the Cape Peron Tourist Precinct Project

Issues	Comment/Advice Provided
Relevant Policies and Approvals	★ Developments are expected to comply with the principles and recommendations of the SEP and the Council's EMP. ★ Dredging proposals undertaken within Cockburn Sound may require a sea dumping permit by the Department of Environment and Heritage under the *Environmental Protection (Sea Dumping) Act 1981*. ★ There needs to be recognition of the importance of underwater cultural heritage within Cockburn Sound. Proponents should become aware that there are over thirty shipwreck sites in Cockburn Sound that still haven't been found. All wreck sites are protected under the Commonwealth *Historic Shipwrecks Act 1976* and the State *Maritime Archaeology Act 1973*.
Shoreline and Seabed Change	★ *Guidelines for Developments Affecting the Shoreline and Seabed.* These guidelines, contained in the EMP, are used when providing advice on future developments and should be used by proponents as guidance when developing a proposal and considering offsets. ★ Prior to considering potential offsets, the proponent should make all reasonable efforts to limit (minimise) the environmental impacts resulting from the proposed development. ★ This project could potentially face considerable challenges in terms of ensuring adequate environmental protection, given the location and nature of the environment in which it is proposed. It may be beneficial to consider further the requirements of such a project in light of alternative site locations and potential environmental benefits which may be achieved from such alternative sites. ★ The Council supports the principles of the EPA's *Position Statement No 9 Environmental Offsets* (EPA 2006), which should be given consideration in respect of this project.
Seagrass Impacts	★ There are concerns regarding current health of seagrass, noting that Mangles Bay has been identified as 'highly stressed' in annual seagrass health surveys. ★ The sensitivity of seagrass within Mangles Bay is a critical issue and should be fully considered in respect of both direct and indirect effects from this proposal. Key issues for consideration include the loss of seagrass due to 'scouring' effects from extending causeway openings, impacts from turbidity plumes caused by dredging operations (both construction and maintenance dredging), release of nutrients and contaminants from sediments due to dredging operations and the effects associated with potential reductions in water quality. ★ Noting the estimated loss of seagrass from this proposal, it would be expected that all reasonable effort be made by the proponent to minimise impacts upon other areas of seagrass. Noting the historical loss of seagrass from Cockburn Sound, the acceptability of any future loss of seagrass due to development proposals would require careful consideration by the Council. ★ The Council believes it fair to say that the success of seagrass rehabilitation is highly variable, and it may therefore be difficult to make an informed decision relating to the enduring nature of such offsets in the absence of sufficient scientific data on the success of rehabilitation programs within Mangles Bay. Significant investigations, such as long-term site specific trials, would be critical to allowing an informed decision to be made on loss of seagrass and to the possibility of achieving the EPA's no-net loss requirement.

Issues	Comment/Advice Provided
Seagrass Impacts (continued)	★ The Council believes it fair to say that the success of seagrass rehabilitation is highly variable, and it may therefore be difficult to make an informed decision relating to the enduring nature of such offsets in the absence of sufficient scientific data on the success of rehabilitation programs within Mangles Bay. Significant investigations, such as long-term site specific trials, would be critical to allowing an informed decision to be made on loss of seagrass and to the possibility of achieving the EPA's no-net loss requirement. ★ Concern at the proposed location of a seagrass rehabilitation site in an area where increased water flow rates exist. This concern is based on the fact that seagrass loss has occurred in this area due to increased flow rates through the causeway opening. ★ The Council has long held concerns regarding uncontrolled moorings in Mangles Bay and resultant loss of seagrass. ★ The Council intends to see an improvement in mooring management and that in principle support is given by the Department for Planning and Infrastructure (DPI) to declare the waters a Mooring Control Area. ★ The current mooring situation is a critical issue that requires immediate attention. In light of this project, there may be opportunities to improve mooring facilities and minimise impacts; however, this should be in addition to the management response committed to by the DPI, and this project should not in any way inhibit the progress or implementation of a required management response.
Water Quality Impacts	★ Mangles Bay has long been highlighted as an area of concern for water quality. Elevated levels of chlorophyll a have been recorded for Mangles Bay. ★ The implications of the proposed project on water quality in Cockburn Sound will need detailed consideration of the potential for this project to further degrade water quality within Mangles Bay, and the associated effects this may cause (such as impacts upon seagrass). ★ The Council will give careful consideration to this project and its ability to ensure that the water quality related environmental values and objectives established for Cockburn Sound under the SEP are achieved. ★ There are issues regarding the lack of available data for the Mangles Bay area, and in particular the known gap in specific (local) wind speed data. The CSMC became aware of this issue following completion of the Mangles Bay 'Causeway' Study. In the absence of this information during any formal environmental assessment it would be difficult for an adequate evaluation of critical water quality issues associated with this project to be made. ★ The fate of the 'Mangles Bay drain' would need careful consideration given that its route conflicts with this project. Opportunities to improve the quality of water discharged to Mangles Bay via this drain may exist and should be given consideration. ★ There may be limited opportunities for the disposal of water from the Mangles Bay drain. The Council prefers that all water be recharged back on-site. Disposal of water into Cockburn Sound will be considered only after all other options have been fully investigated. Any proposal to dispose of water from dewatering activities into Cockburn Sound will be required to comply with the SEP and its associated criteria.
Marine Fauna	★ Mangles Bay is an exceptionally important nursery area for juvenile King George Whiting. The importance of this area for this species and other potentially important species (such as Blue Swimmer Crabs), should be given a high priority in any future assessment.
Lake Richmond	★ Lake Richmond is a unique ecosystem which has significant ecological and cultural importance. The proximity of this project to Lake Richmond raises significant concerns for the Council and should be a key issue which warrants serious consideration during the SER process. ★ The threatened ecological communities supported by Lake Richmond, including the Thrombolites (listed as endangered under the *Environmental Protection and Biodiversity Conservation Act 1999*), should be high priorities when considering potential for impacts from this project.

Issues	Comment/Advice Provided
Lake Richmond (continued)	★ The proximity of Lake Richmond to the project area would require detailed assessment of interactions between the project, Mangles Bay and Lake Richmond. Detailed hydrological studies will be required before any informed decision can be made on the potential for detrimental impacts to occur as a result of this project. ★ A key concern is the potential for saltwater to move inland via groundwater and affect both the levels and water quality of Lake Richmond and local groundwater. Impacts on water quality and levels have the potential to impact significantly upon the threatened ecological communities within the area.
Sepia Depression Ocean Outlet Line (SDOOL)	★ From the concept options presented it appears that the project may require the SDOOL to be relocated. If this relocation is to occur it is likely that this operation in itself will require significant planning and management. If no changes to the SDOOL's location are required, the proximity of the pipe to the project area may still require careful consideration.
Geological Heritage	★ The Cape Peron area contains important geological heritage values which should be given consideration. ★ "The cuspate foreland of Cape Peron is the largest sedimentary coastal deposit on the south-western Australian coast which, by nature of its formation, contains a 7,000 year Holocene history of seagrass dominated sedimentation, sea level changes, shoreline and beach ridge plain origin and development, calcrete development, rocky shore development, and climate history. It is the largest seagrass-sediment-derived seagrass bank, developed on a cuspate foreland, in the world" (Wetlands Research Association Inc. 2006).
Vehicle Traffic	★ Traffic congestion and security risks need to be considered given the proximity of the project area to the Department of Defence access point to Garden Island via the Causeway. ★ Consideration needs to be given to potential environmental and security risks associated with vehicles that may be carrying dangerous or hazardous goods travelling in close proximity to a marina facility.

This example shows the range of Council's interest in the protection of the environmental values of Cockburn Sound which in most cases link directly and indirectly back to the principles and objectives of the SEP and EMP.

APPENDIX 4.
Council related publications

The State Environmental Policy

The Council coordinates and facilitates the implementation of the *State Environmental (Cockburn Sound) Policy 2005* (Government of Western Australia 2005) (see Appendix 3). The purpose of the policy is as follows:

(a) to declare, protect and maintain the environmental values of Cockburn Sound;

(b) to abate pollutants and restrict activities that diminish the environmental values of Cockburn Sound;

(c) to establish a program to protect and enhance the environmental quality to support the environmental values of Cockburn Sound;

(d) to give effect to the environmental quality objectives and the environmental quality criteria for Cockburn Sound; and

(e) to give effect to the Environmental Management Plan for Cockburn Sound.

The policy provides strength to the efforts and actions of the Council in pursuing a coordinated approach to planning and management of Cockburn Sound and Owen Anchorage and provides for the preparation of an Environmental Management Plan.

The policy also guides the Environmental Protection Authority in its decision making when considering development proposals which may have an impact on Cockburn Sound or Owen Anchorage.

The Environmental Management Plan

In 2002 the Council prepared an Interim Environmental Management Plan for Cockburn Sound (Cockburn Management Council 2002). This plan required the release of the State Environmental (Cockburn Sound) Policy before it could be finalised. After the release of the Policy in 2005, the Council endorsed the *Environmental Management Plan for Cockburn Sound and its Catchment 2005* (Cockburn Sound Management Council 2005). Since this time the Council has worked to implement both the requirements of the policy and the recommended actions of the management plan.

The management plan follows a five point plan of action based around:

1. Protecting the environmental values of Cockburn Sound;
2. Facilitating multiple-use of Cockburn Sound and its foreshore;
3. Integrating management of the land and marine environments;
4. Coordinating research and investigations;
5. Monitoring and reporting on performance.

Council Publications to Date

The Council has undertaken considerable work towards understanding the complexities of management for Cockburn Sound. The following publications have been released by the Council since its formation:

The State of Cockburn Sound – A Pressure-State-Response Report (DAL 2001)

This report provided the Council with up-to-date information on the environmental *state* of the Sound, the *pressure*s on it, and the management *response*s in place to manage those pressures.

Interim Environmental Management Plan for Cockburn Sound and its Catchment (CSMC[1] 2002)

The Interim Environmental Management Plan was developed to guide the Cockburn Sound Management Council's effort in working to protect environmental values within Cockburn Sound prior to the release of the State Environmental (Cockburn Sound) Policy in 2005. After the release of the Policy the Plan was finalised to include necessary actions required by the Policy.

Memorandum of Understanding between City of Cockburn, Town of Kwinana, City of Rockingham and the Cockburn Sound Management Council (CSMC 2003)

Local government and the Cockburn Sound Management Council developed and signed an MOU to ensure a mutual and coordinated effort in the management and protection of Cockburn Sound.

Influence of the Garden Island Causeway on the Environmental Values of the Southern End of Cockburn Sound (DAL Science and Engineering 2003) and Community Summary Paper

This report provides necessary information to the ongoing discussion about the degree to which the Garden Island causeway's restriction of exchange between the waters of the southern end of Cockburn Sound and the open ocean has influenced, and is still influencing, the marine environment. The report provides scenarios should the causeway be removed and looks at the advantages and disadvantages of these scenarios.

Sampling and Analysis Plan – Zinc, Nitrogen and Phosphorus measurements in the water and sediments of the Lake Richmond drains and Mangles Bay, and in the waters of Lake Richmond (CSMC 2003)

This sampling analysis plan was formulated in partnership with the Department of Environment's Aquatic Sciences Branch and the Naragebup Regional Environment Centre.

[1] CSMC=Cockburn Sound Management Council

The aim of the plan was to describe the procedures for sampling and analysis of representative samples of water and sediment at selected points of Lake Richmond, Mangles Bay and the drain between the two water bodies.

Local Planning Policy for the Cockburn Sound Catchment (CSMC 2004)

At a local level, three local governments are within the Cockburn Sound catchment: the City of Cockburn, the Town of Kwinana and the City of Rockingham. In 2003–2004 the Council worked with these organisations to develop a local planning policy to provide for a cooperative response for the protection of Cockburn Sound through the management of land use impacts within the Cockburn Sound catchment. The policy links the objectives of the Council's management plan with State and local government, to provide a consistent and unified approach to ensure planning and management decisions by local government within the catchment do not result in unsustainable additional nutrient loading or contamination of surface or ground-water resources (CSMC 2004).

Benthic Habitat Mapping of the Eastern Shelf of Cockburn Sound 2004 (DAL Engineering et al (2004) *(and Community Summary Paper)*

This report presents the findings of detailed surveys which were undertaken to accurately map the benthic coverage and assemblages of the Eastern Shelf, Cockburn Sound, for summer 2004, using sidescan sonar and extensive groundtruthing. The results provide a level of detailed habitat information not previously available for this area. In addition, it provides an accurate baseline against which future habitat extent can be accurately compared (DAL Science & Engineering et al 2004).

Summary Paper: Fish Habitat in the nearshore regions of Cockburn Sound (Hyndes 2004)

This report provides a summary of the significance of sandy nearshore areas in Cockburn Sound as fish habitat, and places them in context of such habitats in the broader region of the south-west of Western Australia.

Assessment of Zinc, Nitrogen and Phosphorus in the Water and Sediments of the Lake Richmond Drains and Mangles Bay, and in the waters of Lake Richmond, November 2003- DRAFT (CSMC 2004)

This assessment of the water and sediments of the Lake Richmond drains and Mangles Bay, and the waters of Lake Richmond, was in response to the identification of zinc levels above water quality guideline trigger values, in the outlet drain from Lake Richmond which drains into Mangles Bay. Due to the identification of contributions of nitrogen and phosphorus into Mangles Bay via the drains, assessments of nitrogen and phosphorous in sediments were also carried out. This assessment was based on a one-off sampling regime and may have limitations in interpretation.

Environmental Management Plan for Cockburn Sound and its Catchment (Cockburn Sound Management Council 2005)

This plan details a five point plan of action towards implementing the *State Environmental (Cockburn Sound) Policy 2005* and coordinating environmental planning and management of Cockburn Sound and its catchment. The five point plan involves:

1. Protecting the environmental values of Cockburn Sound;
2. Facilitating multiple-use of Cockburn Sound and its foreshore;
3. Integrating management of the land and marine environments;.
4. Coordinating research and investigations;
5. Monitoring and reporting on performances.

This plan brings together all issues affecting Cockburn Sound which had community and scientific focus at the time of its development. The plan has a life of 5–7 years and will require review in about 2010.

Status of Groundwater Quality in the Cockburn Sound Catchment (CSIRO Land and Water 2006) *(and Community Summary Paper)*

This report informs the Council on the current state of groundwater contamination in the Cockburn Sound catchment and on opportunities for improving the environmental management practices for the Sound. It highlights the difficulties involved in gaining a thorough understanding of aquifer and groundwater characteristics given the level of development that has already occurred throughout the catchment. Much of the data sourced for this study was volunteered by industry along the shores of Cockburn Sound.

Investigation into Tributyltin (TBT) Contamination in Cockburn Sound (Oceanica Consulting Pty Ltd 2006) *(and Community Summary Paper)*

The Council commissioned a study of TBT levels in sediment and imposex in marine snails in 2005, when its annual monitoring and reporting system found high TBT levels in sediments in Jervoise Bay. TBT contamination of sediments and imposex levels in the marine snail *Thais orbita* were examined at five sites in Cockburn Sound in the winter of 2005. This study found that only sediments within Jervoise Bay Southern Harbour exhibited TBT contamination above acceptable levels. The occurrence of imposex in *Thais orbita* was exhibited widely throughout Cockburn Sound although limitations to this study were identified and included the limited sample size and the relatively long life of *Thais orbita*.

Toxicants in Sediment Survey Report 2006, Cockburn Sound and Owen Anchorage (Department of Water, 2006)

The Cockburn Sound Management Council commissions monitoring of toxicants in sediment at a frequency of 3–5 years. The data from this survey is compared with the

Environmental Quality Criteria in the *State Environmental (Cockburn Sound) Policy 2005*.

The levels of contaminates in the sediments analysed in this survey were generally low with very few environmental quality guidelines exceeded. Exceedance of guidelines for mercury in the sediment of Kwinana Bulk Jetty was likely to be in non-bioavailable forms and therefore of little environmental concern. TBT exceeded the guidelines and environmental quality standards at Careening Bay signifying an unacceptable risk to the environmental values of this region of Cockburn Sound.

State of Cockburn Sound (CSMC 2005, 2006, 2007 & 2008)

Each year, since the release of the 'State Environmental (Cockburn Sound) Policy 2005', the Council has been required to prepare an annual report providing information about their activities and the results of monitoring undertaken throughout the year. The *State of Cockburn Sound* (CSMC 2005, 2006, 2007 & 2008) report is submitted to Parliament through the Minister for the Environment.

Cockburn Sound Coral Survey (Underwater Explorers Club, 2006)

This survey was a joint initiative of the Cockburn Sound Management Council and the Swan Catchment Council. The aim of the survey was to assess the presence and diversity of corals in Cockburn Sound and increase community awareness of marine ecology. Two sites were found to support over fifty separate coral colonies. The report recommends that other sites be investigated in future surveys.

The State of Owen Anchorage – A Pressure-State-Response Report (Oceanica Consulting Pty Ltd 2007) *(and Community Summary Paper)*

In August 2004 the Minister for the Environment announced the expansion of the Council's roles and responsibilities to include the waters of Owen Anchorage. The Owen Anchorage Sub-committee (OASC) was formed to oversee Council's interests and independent consultants were engaged to work with them. The OASC believed that prior to the development of an Environmental Management Plan for Owen Anchorage, an up-to-date understanding of the study environment was needed. The consolidation of available information was best achieved using the 'Pressure-State-Response' model. This model identifies all 'pressures' (including current and potential), describes the current 'state' or condition of the environment and documents knowledge and management 'responses' to the pressures identified.

The report provides an important starting point for future planning for the protection of the environmental values of Owen Anchorage and its catchment.

Study of the Contaminants in the Waters of Cockburn Sound 2008 (Parsons Brinckerhoff Pty Limited 2009)

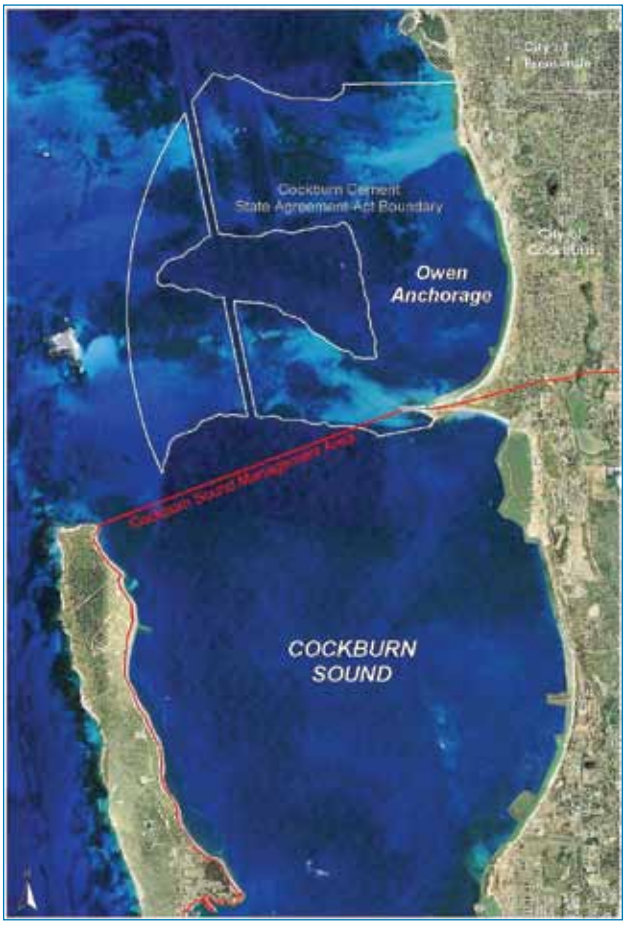
Sea water was collected at 21 locations in Cockburn Sound, Owen Anchorage and Warnbro Sound over a four day period in late April, 2008. Samples were analysed for a selected suite of metals, metalloids, biocides, organics, phenols, detergents and other miscellaneous potentially polluting compounds. The purpose of the 2008 "Contaminants in Water" sampling program was to contribute to "Ecosystem Health" report cards by providing data from a "snapshot" of contaminant concentrations within Cockburn Sound. Further to previous surveys, it was hoped the results could indicate spatial and temporal trends after comparison with historical data. Results from the 2008 Contaminants in Water study demonstrated that concentrations of all potential contaminants that have an Environmental Quality Criteria (EQC) were below the EQC guideline values for both Moderate and High ecological protection areas. EQC guideline values were only available for 17 of the 87 parameters analysed. Parameters without EQC's were found to be so low that most contaminants were below detection limits or Limits of Reporting (LOR). The extremely low contaminant concentrations found in this study suggested that Cockburn Sound water quality meets the highest standards required for ecological protection (i.e. high) and was therefore of a sufficiently high standard that a healthy aquatic ecosystem can be expected. This study was compared to the results from the 2006 Sediment Study which indicated that two sites, Kwinana Bulk Jetty (KBJ) and Careening Bay (C430), had concentrations of mercury and tributyl tin respectively higher than the EQC. However, these metals were not detected in the water column at any sites in 2008.

APPENDIX 5.
Information Collection Strategy for the Multiple-use and Resource Assessment Project

INFORMATION COLLECTION STRATEGY

FOR MULTIPLE-USE AND RESOURCE ASSESSMENT PROJECT

Stage 1 of the Journey Towards a Multiple-use Framework for Cockburn Sound and Owen Anchorage



COCKBURN SOUND MANAGEMENT COUNCIL

Prepared by
Cockburn Sound Management Council
July 2007

Prepared by

Barb Green
Department of Environment and Conservation

in consultation with the
Multiple-Use Support Team
(a sub-group of Cockburn Sound Management Council)
inclusive of:

Professor Kateryna Longley	Chair, Cockburn Sound Management Council
Mr Gino Valenti	Environment Manager, Fremantle Port Authority
Mr Ian Briggs	General Manager Strategic Policy, Department of Industry and Resources
Mr Keith Tocas	Board Member, Recfishwest
Mr John Smedley	Member, Cockburn Power Boat Association
Dr John Keesing	Head of Marine Research, CSIRO
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1.0 BACKGROUND

The Cockburn Sound Management Council (CSMC) is guided by the Environmental Management Plan for Cockburn Sound and its Catchments (EMP) (2005). The CSMC has committed itself to facilitating multiple-use within Cockburn Sound and Owen Anchorage based on recommendations within the EMP.

Extensive discussion has occurred within CSMC on development of a Multiple-use Framework over the last three years. In April 2007 the CSMC Executive endorsed Stage 1 of a journey towards the development of a Multiple-Use Framework (see Appendix 1 for development stages). Stage 1 involves a comprehensive compilation of information relating to economic, social and environmental use and resources within Cockburn Sound and Owen Anchorage. The Multiple-use and Resource Assessment Project will be undertaken over a six to twelve month period. The Multiple-use Support Team (MuST), a sub-group of CSMC, will oversee the project during that time.

This strategy outlines the pathways for information collection.

1.1 SPATIAL INFORMATION COLLECTION

At present CSMC has access to the Department of Water GIS Viewer software and shapefiles but has limited capacity to undertake spatial analysis or presentation of information. The CSMC has formulated an agreement with Department of Environment and Conservation (DEC) GIS Branch[1] to obtain the necessary support for this project. However, the extent of this assistance is limited to some degree by available financial resources, but it is expected that the agreement will enhance CSMC's access to spatial data and allow a greater opportunity for information presentation. In addition CSMC will introduce ArcGIS 9.0 software to its office so that new spatial data can be created, and existing data viewed.

Data already in existence will be sourced from DEC's database and the following government agencies wherever possible:

- Department of Water
- Department of Land Information
- Department of Food and Agriculture
- Department for Planning and Infrastructure
- Department of Industry and Resource Development
- Department of Fisheries
- Peel Development Commission
- Rockingham Development Office
- Fremantle Ports
- Landcorp
- Department of Defence (HMAS Stirling, Garden Island)
- CSIRO

Local government may also be an important source of information:

- City of Rockingham
- Town of Kwinana and
- City of Cockburn.

It is expected that spatial information may also be sourced from private organisations such as:

- Oceanica Pty Ltd
- Kwinana Industries Council
- Universities

All spatial data will be collated into a central project area for quick access by CSMC and organisations with an interest in Cockburn Sound and Owen Anchorage.

1.2 VERBAL INFORMATION COLLECTION

There is a large amount of information on Cockburn Sound and Owen Anchorage which may not exist as spatial or written data. Many private users of Cockburn Sound and Owen Anchorage may be able to provide important information on their use patterns and location of resources. It will be important to talk to as many people as possible, particularly those who have a long history of use.

It is acknowledged that this may be the most difficult information to collect, and that it may be time consuming. It is proposed that one-on-one, or interest group, meetings should be pursued to allow this collection of information to be undertaken.

Shopping centre displays will be useful for creating an opportunity for information collection from people not normally accessed by CSMC officers or members. In addition, conversations held with the public during events, such as MusselFest, will be noted for inclusion.

Suggested interest groups that can be contacted in the first instance include:

- Cockburn Power Boat Association
- Jervois Bay Sailing Club
- Coogee Surf Life Saving Club
- Kitesurfing Association of Western Australia

[1] CSMC is an advisory body to the Minister for Environment under the 'Environmental Protection Act 1986' section 25 and will be working within the DEC framework, not DoW.

- Coogee Jet Ski
- Rockingham Sea Adventures
- Coogee Progress Association
- Coogee Caravan Park Residents Association
- Naragebup Environment Centre
- WA Naturalist's Club

The discovery of new information through discussions may result in new spatial data being created.

1.3 WRITTEN INFORMATION COLLECTION

Cockburn Sound is one of the most studied water bodies in Australia. A review will be undertaken of major sources of written information. This review will result in a reference bibliography of publications being produced, including a brief overview of contents relevant to Cockburn Sound and Owen Anchorage. This reference bibliography will be maintained into the future by CSMC and will have a life beyond this current project. In addition to being a useful tool for the CSMC the bibliography will also assist future researchers and reporters to access information expediently.

It is expected that some information gained from this review will assist in the development of new spatial data displaying information only found in text.

1.4 PHOTOGRAPHIC COLLECTION

A collection of photographs will be displayed in the final report and will provide a pictorial display of changes that have occurred in use and perception of Cockburn Sound and Owen Anchorage over time. Photographs will be accessed from private and public collections.

2.0 MEDIA STATEMENTS

A media statement highlighting the project will be released to relevant local papers just prior to shopping centre displays being set up. A media statement will also be issued to the 'West Australian' highlighting the work of the CSMC in undertaking the project. Media statements should be issued when the project is nearing completion so to enable a better display of gathered information if necessary.

3.0 DISPLAY MATERIAL

Display material based around the topic '***What can YOU tell us about Cockburn Sound and Owen Anchorage'?*** The display will be left in place for a one to two week period at high profile shopping centres in Rockingham, Kwinana and Cockburn. The displays will be unmanned as it is usual for people to avoid displays that are manned. Display material will be designed in-house by CSMC officers and produced by DEC GIS Branch at a nominal charge.

4.0 INFORMATION COLLECTION STRATEGY OUTCOMES

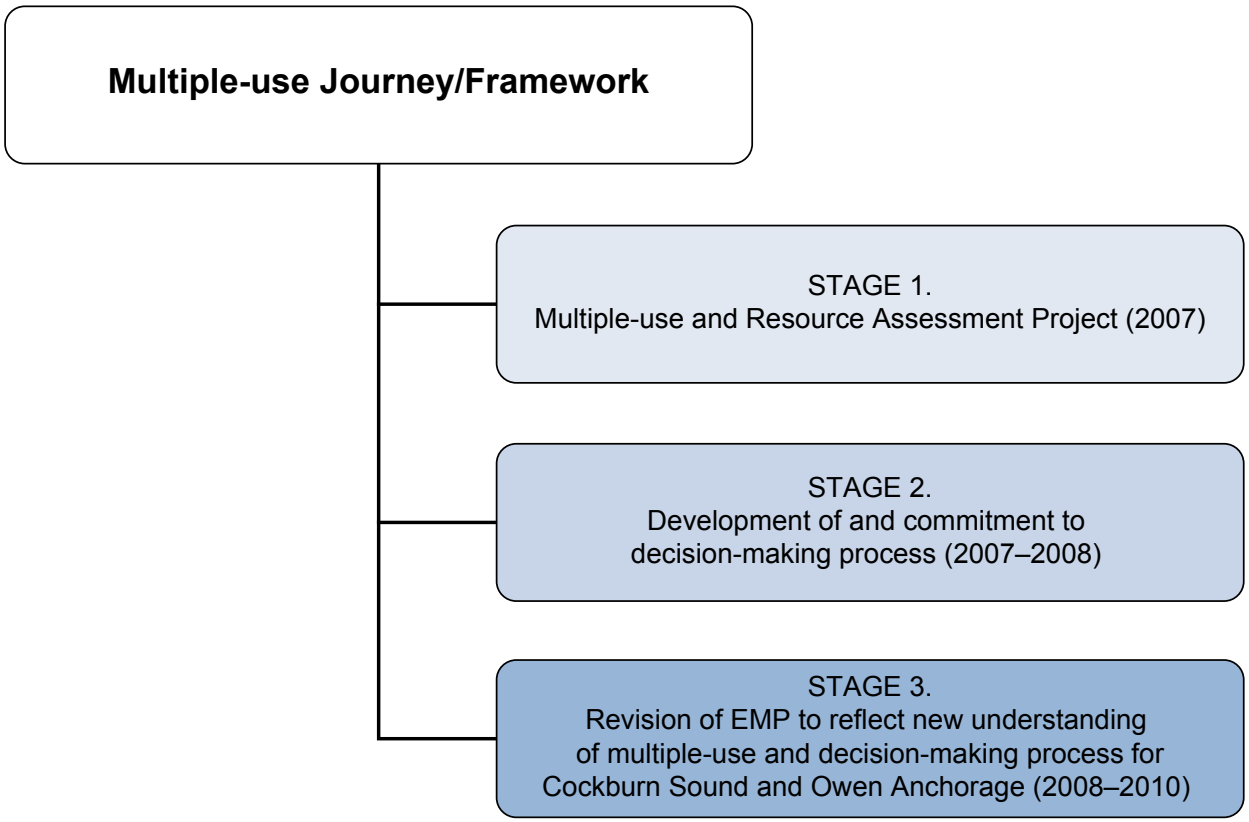
Upon completion of information collection a report presenting:

- reference bibliography;
- summary of verbal accounts;
- spatial mapping and metadata; and
- photographs

will be prepared. This report will allow CSMC and the public to have an up-to-date catalogue of information from which to pursue the development of the Multiple-use Framework. The final report will be titled 'Multiple-use and Resource Assessment Report for Cockburn Sound and Owen Anchorage'.

APPENDIX 1. Information Collection Strategy

Staged Journey to a Multiple-use Framework for Cockburn Sound and Owen Anchorage



Staged Journey to a Multiple-use Framework for Cockburn Sound and Owen Anchorage

APPENDIX 2. Information Collection Strategy

Required Outcomes of the Multiple-use and Resource Assessment Project – Stage 1

1. **Preparation of a GIS Shapefile Catalogue containing**
   - ★ existing uses
   - ★ existing conflict areas
   - ★ existing resources (natural and built)
   - ★ proposed uses
   - ★ potential conflict areas
2. **Preparation of a report describing and displaying information collected during the project, inclusive of interviews and meetings.**
3. **Preparation of a Discussion Paper on multiple-use planning and management models in use interstate and around the world and suggested options for a way forward.**

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'When he left the beach, the sea was still going on'

Derek Walcott[1]

1 Walcott D (2005) *The Sea, The Sea*,(ed. Clare Hubbard), New Holland Publishers (UK) Ltd

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