



State of Cockburn Sound



2012 Report



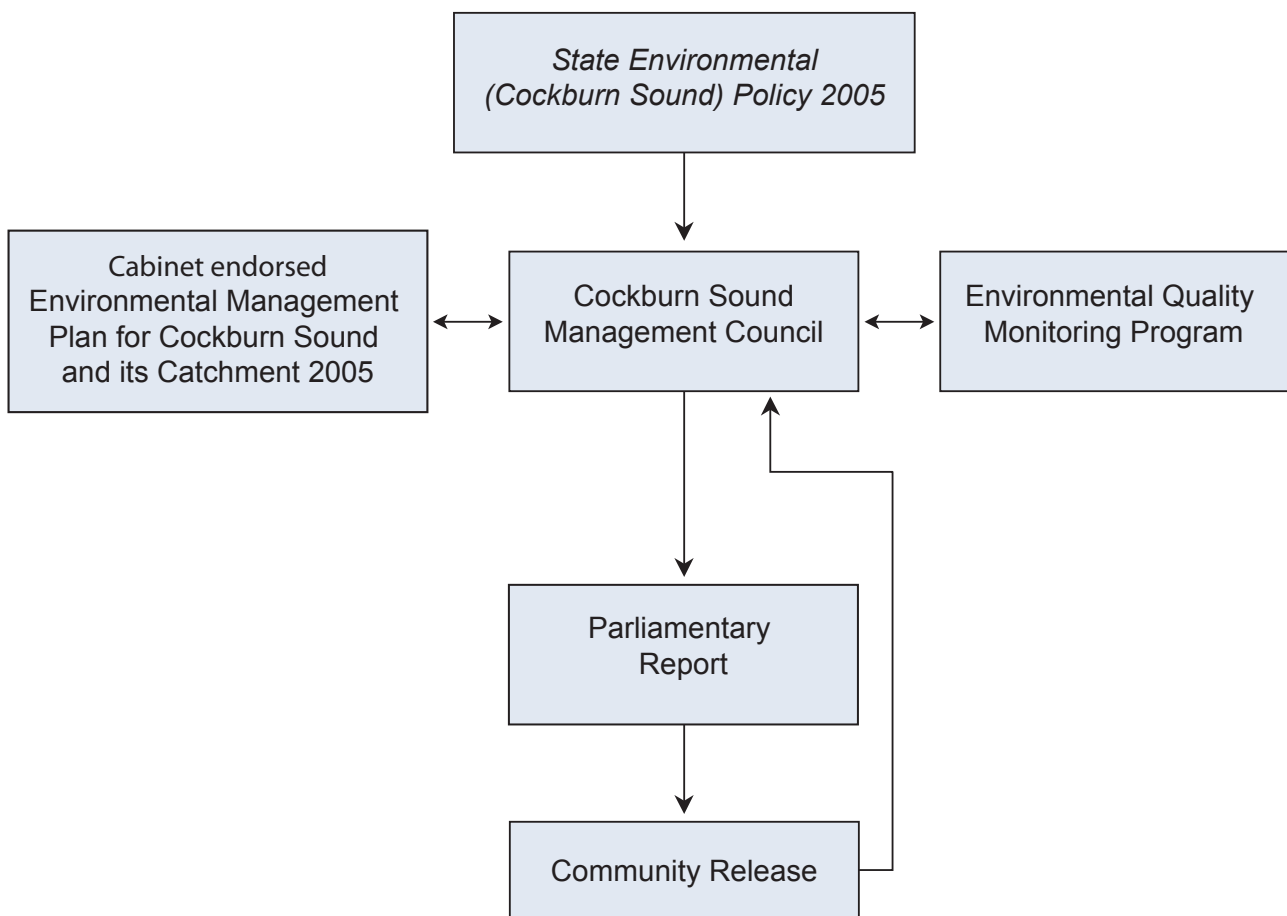
COCKBURN SOUND
MANAGEMENT COUNCIL

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Fremantle Port Authority Infrastructure in Cockburn Sound

The role of the Cockburn Sound Management Council in implementing the *State Environmental (Cockburn Sound) Policy 2005*



This report was endorsed by the Cockburn Sound Management Council
on 22 February 2013

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The causeway to Garden Island

Foreword

Cockburn Sound is a strikingly beautiful and productive marine environment south of Perth, stretching from the beaches of Cockburn, Kwinana and Rockingham westwards to the shores of Garden Island and northwards towards Fremantle. It is a waterway that is remarkable not only for its physical beauty, but also because it represents an outstanding example of the successful co-existence of an extraordinary diversity of uses, habitats and pressures, including some that may appear to be conflicting.

Home to at least 75 resident dolphins and approximately 400 little penguins, the relatively calm waters of Cockburn Sound provide a supportive habitat and breeding ground for a variety of fish and crustaceans including the recreationally popular snapper fishery. During migration periods, whales are frequently seen. A tourism industry is built around the Sound's prolific natural attractions.

At the same time Cockburn Sound is an industrial powerhouse for Western Australia and beyond, with dozens of major industries operating on its shoreline, including those represented by the Kwinana Industries Council and the Australian Marine Complex. Ever increasing shipping movements from industry and also from the Department of Defence's naval base on Garden Island are strategically important activities in terms of the economy and national security. Alongside these, recreational swimming, boating and fishing bring a range of enjoyment but also pressures that are increasing as the local population grows.

The Cockburn Sound Management Council (CSMC) was formed in 2000 to safeguard the health of the waters of the Sound while also supporting the multiple

uses that had been established historically. Within the strong framework of the State Environmental (Cockburn Sound) Policy 2005 the CSMC coordinates an annual program of monitoring and reporting. This policy, the only one of its kind in Western Australia, with its supporting scientific documents, has provided the guiding principles for all monitoring, and for the results that are displayed in user-friendly pictorial form on the Report Cards and maps in this Report.

I am pleased to report that the health of the Sound continues to be stable, although some longstanding localised problems continue. While there are specific results that fluctuate from year to year, and while there appear to be some systemic shifts, the overall picture is one of a generally healthy marine environment. The enclosed maps, charts and summaries, tell the story.

I want to thank the staff of the CSMC office for the intensive work they have done to produce the results published in the Report, the dedicated members of the Council who oversee and contribute to the process, and also the staff of the Office of the Environmental Protection Authority and of the Marine Science Branch of the Department of Environment and Conservation for their collaboration and support.

It is with pleasure that I present the 2012 State of the Sound report.



Professor Kateryna Longley
Chair, Cockburn Sound Management Council
22 February 2013

Executive Summary

The Cockburn Sound Management Council (CSMC) is responsible for coordinating and undertaking a range of environmental monitoring programs to assess the environmental health of Cockburn Sound. The CSMC reports annually to the Minister for Environment, Parliament, the Environmental Protection Authority (EPA) and the wider public on the state of the Sound and on whether the environmental values and objectives established for the Sound are being met. These objectives are defined in the *State Environmental (Cockburn Sound) Policy 2005* (SEP). The activities, kinds of advice and progress of CSMC projects and programs are also reported to Parliament and the community.

The SEP and the CSMC's Environmental Management Plan 2005 (EMP) are endorsed Cabinet and government documents. This report is the seventh *State of the Sound Report* submitted to the Minister for Environment and Parliament. During 2012 nine scientific monitoring programs were accessed and analysed to assess ecosystem health in Cockburn Sound.

The 2012 Report Cards indicate that the health of the marine environment of Cockburn Sound, based on the criteria established by the SEP, is generally stable. The areas or zones of High and Moderate ecological protection, which currently make up 95% of the Sound, broadly conformed to the SEP Guidelines and Standards. Monitoring carried out at all sites in the Sound has shown that in the majority, key environmental variables relating to dissolved oxygen, temperature, salinity and pH levels have met established Guidelines. These are all key indicators of a healthy ecosystem. However, a number of individual monitoring sites raise some concerns in relation to other environmental criteria, as the Report Cards indicate.

Some environmental variables assessed for whole zones failed to meet Guidelines or Standards. These included light attenuation, chlorophyll 'a' – phytoplankton biomass and seagrass shoot density. With respect to seagrass shoot density, three of the eight sites located in the High Ecological Protection Area exceeded Standards and two sites exceeded

the Guidelines. Accordingly, the CSMC considered it prudent to grade the whole zone as red or as exceeding environmental Standards based upon the precautionary principle.

The seagrass picture is incomplete this year, primarily because the Department of Defence (DoD) did not monitor seagrass near Garden Island during 2012. Two of the three sites exceeded the Standards in 2011 and under the rules of the SEP; these sites remain in exceedance until they meet Guidelines, based upon future monitoring results.

The CSMC has written to the Department of Defence to seek an appropriate management response for addressing these exceedances. These sites have not had any obvious recent impacts or influences that could be directly responsible for their decline and it may be that the changes have natural causes or are the result of a combination of historical draw-down of nutrients from contaminated ground water leaving Garden Island and some other, unknown nutrient loading or natural environmental factor in Cockburn Sound.

The main activities of the CSMC during 2012 fell into three broad categories: annual; strategic; and community-investigative. The CSMC now has eleven years of SEP defined continuous environmental data. This information provides a robust foundation for understanding this highly complex marine embayment and helps to quickly identify areas of concern. Utilising its extensive knowledge and experience, the CSMC provided expert advice on development proposals throughout 2012 to various stakeholders, including the Commonwealth and State Governments and the EPA, and to the three local governments bordering Cockburn Sound and Owen Anchorage, on a wide variety of issues.

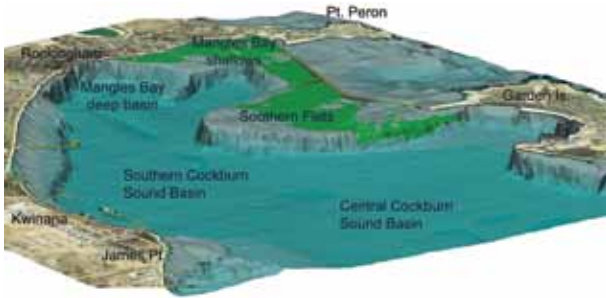
The CSMC office near Rockingham Beach, and its community contact phone number, remained popular, attracting more than 500 telephone enquiries, approximately 280 office visitors and approximately 3000 window front display visitors. Table 2 provides a summary of the many issues and queries the CSMC office has received throughout 2012.



Setting the Scene

The coastal waters and beaches of Cockburn Sound are a major community asset to the people of Western Australia and offer significant attractions for overseas visitors.

The location provides a wide variety of coastal features ranging from protected embayments to exposed beaches and offshore reefs and islands and is home to an interesting mix of temperate marine species with some tropical species.



Southern Cockburn Sound bathymetry

These features combined with high water clarity and a Mediterranean climate make these waters attractive for recreational activities such as fishing, crabbing, swimming, yachting, parasailing, wind and kite surfing and diving. They also support commercial activities such as fishing, aquaculture, shipping, and industry.

Cockburn Sound has, unfortunately, had a chequered history. Since first settlement, at Garden Island in 1829, a range of uses and activities, primarily along foreshore areas, has resulted in detrimental impacts on the waters and foreshore of this marine embayment.

Historic industrial activity, beginning in the 1950s, resulted in the destruction of approximately 80% of the Sound's seagrass meadows, a key ecological asset and one that drives many of the primary ecosystem's functions.

Improved industrial practices and tighter regulation saw a dramatic improvement in water quality by the mid 1990s. This resulted in seagrass loss being halted and the occurrence of algal blooms declining significantly.

The creation of the Garden Island causeway in the early 1970s reduced the level of flushing in Cockburn Sound by approximately 40%, particularly at the southern end, resulting in poorer water circulation, flushing and clarity compared to the central and northern Sound, and a high level of epiphytic seagrass growth (a smaller plant that grows on another plant upon which it depends for mechanical support).

In 2000 the CSMC was established to oversee the environmental planning and management of Cockburn Sound, resulting in a holistic approach to protecting this important marine ecosystem and the catchment surrounding the Sound. The CSMC's primary goal is to ensure that activities are controlled in a manner that reduces impacts on water quality and protects the remaining seagrass meadows in Cockburn Sound.

The CSMC is guided in its activities by the *Environmental Management Plan for Cockburn Sound and its Catchment 2005* and the *State Environmental (Cockburn Sound) Policy 2005* (SEP). This policy, currently being reviewed by the OEPA, provides the framework for monitoring and for managing the Environmental Quality, Values and Objectives of Cockburn Sound. Benchmarks, known as Environmental Quality Criteria (EQC), are used to determine whether the Environmental Values for Cockburn Sound are being protected and maintained. These Criteria are outlined in a companion document titled *Environmental Quality Criteria Reference Document for Cockburn Sound (2003–2004)*, Environmental Protection Authority 2005.

The CSMC produces annual Report Cards on the health of Cockburn Sound and presents them in a simple 'traffic-light' format that can easily be understood by the general community. The results are derived by comparing monitoring data with relevant environmental quality criteria.

The 2012 Report Cards are included within this report. Under the SEP, the Cockburn Sound Management Council is required to report on the State of Cockburn Sound to the Minister for the Environment and Environmental Protection Authority and this report is tabled in Parliament annually.

In August 2004 the CSMC's role and responsibilities were expanded to include the waters and catchment of Owen Anchorage.

Since 2004 the CSMC has coordinated the Owen Anchorage Water Quality Monitoring Program which was reviewed and modified in 2007 to include a total of 10 sites being monitored, with site locations rationalised for a better overall spatial distribution for the future of the program. Of the ten original sites, five remain basically unchanged, with a number of new monitoring sites established and a range of additional monitoring parameters added to increase the effectiveness of the monitoring program. Resource constraints have led to monitoring being reduced to one month in late summer.

Environmental Quality Monitoring Program (EQMP)

What did we do?

In 2012, the CSMC coordinated an EQMP to assess the health of Cockburn Sound. Data was collected for physical and chemical measures, direct and indirect biological measures, contaminants in sediments and water and biological contaminants. Seven monitoring programs were accessed for reporting (two by the CSMC, the rest by industry and local and state government agencies). However, while not used for reporting the CSMC also accessed another six monitoring programs to gain a better understanding of the entire ecosystem.

A detailed report outlining the monitoring programs undertaken in Cockburn Sound is available at <<http://csmc.environment.wa.gov.au>>.

Previous reports are also available on this web site.

Summary of Overall Health

Water Quality – The Marine and Freshwater Research Laboratory (MAFRL) monitored the water quality of Cockburn and Warnbro Sound during the summer of 2011–12 for the Cockburn Sound Management Council (CSMC).

Water quality indicators measured during summer 2012 were compared with those of previous years to determine if there were any regions of consistently high phytoplankton and nutrient concentrations. They were also compared with reference sites, located in Warnbro Sound, which were chosen to highlight any regional effects and to allow comparisons to be made for zones and sites against criteria outlined in the EQC document.

Water quality was monitored weekly from the 5th December 2011 until the 26th March 2012 at 20 sites (18 located within Cockburn Sound and two in Warnbro Sound). The Mangles Bay site situated in the high protection zone in the shallows of Mangles Bay was first added during the 2009–2010 monitoring program and has been included every year since.

In addition, sampling at sites CS13 and WS4 (see maps at the end of this section) included discrete surface and bottom samples for nutrient analysis. This was to test for any differences in the surface and bottom waters at these sites, as compared to integrated samples, in order to highlight any changes

occurring near the water/sediment interface (i.e. sediment release) and in the surface water.

Physical and chemical parameters – depth, temperature, salinity, dissolved oxygen, pH, turbidity, chlorophyll fluorescence and secchi depth – were measured *in situ* and water samples were collected for the analysis of ammonium, nitrate-nitrite, total nitrogen, phosphate, total phosphorus and chlorophyll ‘a’. Samples for total suspended solids (TSS) were also collected from selected sites over a four-week period during February 2012.

Light attenuation was measured utilising two underwater light sensors recording simultaneously against two depths to correct for changes in ambient conditions. Attenuation coefficients were calculated from the logarithm10 of irradiance values. All methods followed those specified in the Manual of Standard Operating Procedures for Environmental Monitoring against the Cockburn Sound EQCs and recent international peer reviewed water quality testing methods.

Non-parametric statistics were used to determine changes between the various chemical and physical parameters between sites and over the years, based on samples collected over a four-month period during summer and early autumn. These have highlighted a general trend of decreasing nutrient concentrations over time and a decrease in the within-year variations over time.

Concentrations of the dissolved inorganic nutrients – filterable reactive phosphorus, ammonium and nitrate-nitrite – during the last six survey periods (2007 to the present) were significantly lower than in the majority of other years sampled. Concentrations of inorganic nutrients measured in Cockburn Sound were similar to those of reference sites located in Warnbro Sound.

There has also been a significant improvement in chlorophyll ‘a’ concentrations in the years from 2005 to 2010, compared with the 1990s and early 2000s. However, during the last two survey periods, in 2011 and 2012, statistically significant increases have been measured in Cockburn Sound.

The median chlorophyll ‘a’ concentrations were again higher in Cockburn Sound than in Warnbro Sound and, more significantly, they were above the

EPA (2005) criteria both at sites in the high protection zone and sites in the moderate protection zone for the first time in the last seven years of monitoring. In particular, the south and south-eastern shoreline areas of the Sound had consistently higher levels of chlorophyll 'a'.

Light attenuation appears to have remained relatively stable over the last few years, after some improvements from earlier years. However, along with the higher recorded chlorophyll 'a' concentrations during the last two survey periods there has been a slight increase in light attenuation. The median light attenuation in both the moderate protection zone and high protection zone was equal to the EPA (2005) criteria over the last two surveys in 2011 and 2012.

Comparison of the phytoplankton biomass EQC values with the percentage of occasions that the value was exceeded over the last eight years shows that there were two sites in the high protection zone that were above the Guideline and that a higher proportion of sites exceeded the value than ever before.

In the moderate protection zone (harbours) the EQC criteria were exceeded again, as they were in each of the past six years.

Dissolved inorganic nutrient distribution was uneven across Cockburn Sound during the 2012 monitoring period. At sites along the eastern shore and southern sites (CS9, CS9A, CS10, CS11, CS13 and MB) higher ammonium, nitrate-nitrite and filterable reactive phosphorus concentrations were recorded than at the central basin (CS4, CS5 and CS8), the two Garden Island sites (G2 and G3) and the Warnbro Sound sites (WS4 and WSSB).

Phytoplankton populations, as measured by chlorophyll 'a' concentrations, were higher across the southern and south-eastern shoreline sites (MB, CS9, CS9A, CS10, CS11 and CS13) than in the north and central basin of Cockburn Sound and the reference sites in Warnbro Sound.

Similarly, total phosphorus and total nitrogen concentrations were higher at the southern sites, corresponding to the elevated chlorophyll 'a' concentrations, than in other areas. The water quality of the Northern Harbour of Jervoise Bay was significantly poorer than at most other locations in Cockburn Sound.

The Mangles Bay water quality site was marginally lower in chlorophyll 'a' when compared to the other sites in the south of Cockburn Sound this year but it was still relatively elevated in total phosphorus and total nitrogen.

The water quality of the northern Garden Island sites, and in the centre and north-western parts of Cockburn Sound, was less affected by elevated chlorophyll 'a' and nutrient concentrations and was more comparable to that of the reference sites in Warnbro Sound.

MAFRL made recommendations and comments to the CSMC in their report, which can be summarised as follows:

- ★ The more recent observed increases in chlorophyll 'a' concentrations and light attenuations over the last two survey periods may be an indication of potential changes occurring in the water quality of Cockburn Sound. It reinforces the importance of a continued integrated sampling program which is paramount in detecting annual patterns of change.
- ★ The addition of site MB to the monitoring program has highlighted the state of water quality in the shallow near shore area of Mangles Bay and should be continued in future programs as a high protection monitoring point relating to future developments in the sampling area. The additional measurement of TSS at this site would also provide useful baseline data for comparison against future development.
- ★ The recent addition of turbidity profile data to the physical measurement dataset is complementary to the other water clarity related measurements such as total suspended solids and light attenuation and aids in the interpretation of the water quality data and should be continued.
- ★ The use of reference sites in Warnbro Sound to provide a basis for water quality comparisons should be continued as Warnbro Sound is a similarly deep basin and is not subject to the same level of nutrient inputs and external pressures as Cockburn Sound.
- ★ The measurement of *in situ* chlorophyll 'a' by fluorescence detection shows a good correlation with the traditional laboratory extraction method for measuring chlorophyll 'a' and provides valuable additional water column information for a marginal increase in cost.
- ★ The measurement of total suspended solids at selected sites over four occasions in the month of February should be continued and in addition it is recommended that a loss on ignition (LOI) be performed on the TSS samples to enable an estimate of the percentage organic matter contained in the suspended solids. This can provide additional information as to the nature of the suspended material and helps indicate organic phytoplankton and inorganic percentages.

- ★ The water sampling method utilising integrated water samples appears to have a small but important effect on the nutrient concentration results within Cockburn Sound and Warnbro Sound. It would be beneficial, in addition to the normal integrated sampling, to continue to monitor discrete surface and bottom water samples at site CS13 which is both deep and has comparatively lower dissolved oxygen concentrations. However, it would also be helpful to continue this at the deeper reference site WS4 which is not subject to the same sources and degree of nutrients as Cockburn Sound.

Seagrass Health – The annual Seagrass Monitoring Program was conducted for the CSMC by Wave Solutions. It included the measurement of a number of seagrass meadows in Cockburn Sound, Owen Anchorage and Warnbro Sound.

Undertaken over five days in February 2012 this work continued the annual program that has occurred since 1994. It was previously undertaken by the Centre for Marine Futures at UWA (CMF) and Edith Cowan University (ECU). The Dept of Defence (DoD) did not undertake their normal seagrass monitoring program in 2012.

Seagrass shoot densities, shoot heights and epiphyte loads were estimated for 25 sites comprising 11 seagrass ‘health’ sites, five seagrass ‘reference’ sites and four ‘depth transect’ sites. Sampling measured *Posidonia sinuosa*, the dominant species at these health sites, at all Cockburn Sound sites. Five reference sites are notionally called ‘test reference’ sites by CSMC officers. Five test reference sites were established at northern Garden Island.



Garden Island 2 m seagrass monitoring site

Shoots of *Posidonia sinuosa*, *Posidonia australis* and *Posidonia coriacea* were counted by SCUBA divers in 24 permanent 20 × 20 cm quadrats at each of the seagrass ‘health’ and ‘reference’ sites according to the methods described by Lavery & Gartner (2008) and in the SEP.

A general description of the health of the seagrass meadows indicates heavy epiphytic growth at the northern Garden Island transect sites, particularly Garden Island 2 m, 5.5 m, and 7 m sites. These sites are on the western side of Cockburn Sound.

This contrasted with the lower levels of epiphytic growth at Southern Flats which is also on the western side of Cockburn Sound. However, overall it appeared that there were healthy seagrass meadows at all sites on the western side of Cockburn Sound. It was also noted that although Southern Flats had quite dense coverage of seagrass shoots, the shoots were noticeably shorter than those at other sites. This may be due to the strong surge and currents that occur in this region.



Southern Flats seagrass monitoring site

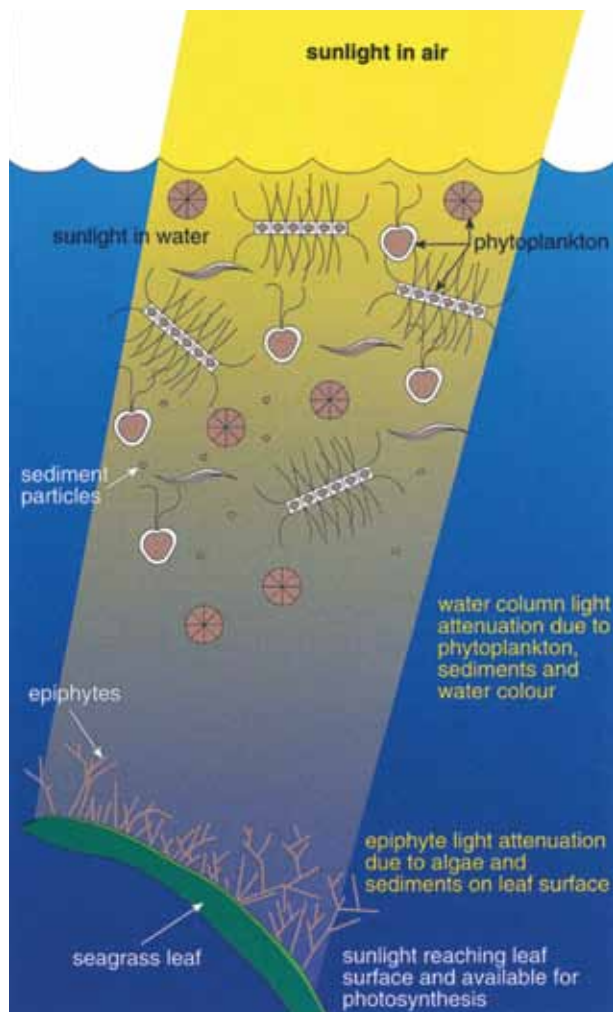
Heavy epiphyte growth also occurred at sites on the eastern side of Cockburn Sound and at the Southern site, Mangles Bay, which had high epiphytic coverage, with fragile seagrass shoots. This site also had very low visibility and there was a high level of sediment deposited around the shoots.

Jervoise Bay was characterised by healthy seagrass meadows and a high number of sponges and razor clams living amongst the seagrass patches. With the exception of Mangles Bay, the seagrass at the other sites generally appeared healthy, with some degree of sediment build up around the shoots.



Mangles Bay seagrass monitoring site

The seagrass meadows at the southern end of the survey area were covered by the Warnbro Sound reference and Mersey Point sites. Overall, the seagrass appeared healthy. However, a number of transects and sites (Warnbro Sound 2.0 m, 2.5 m and 3.2 m reference sites) are located at the edges of migrating seagrass meadows. The shoot density at the edge of a meadow may not be representative of seagrass density in the main meadow. The edge of the meadow is also observed to be patchier and may result in a greater number of zero counts being recorded during a survey.



A diagram showing the effects of excessive epiphyte and phytoplankton growth on seagrasses

While zero counts are excluded from the analysis in accordance with SEP and EQC guidelines and will not affect calculation of seagrass shoot density directly, any reduction in shoot density associated with 'edge effects' will lead to an underestimation of the health of these sites. This may provide an explanation for the general decline in shoot density at the Warnbro Sound reference sites.

At the Warnbro Sound 2.0 m reference site, the seagrass meadow has either eroded or migrated such that sampling now occurs on the edge of the seagrass

meadow with results unlikely to be representative of the health of the seagrass meadow.

With the exception of the Garden Island 2.5 m test reference site, there has been a decline in seagrass shoot density observed at all required reference sites. The Warnbro Sound 2.5 m reference site, the Garden Island 5.5 m and Garden Island 7 m test reference sites all have the lowest shoot densities recorded in the last five years (since 2008). At the Warnbro Sound 3.2 m reference site, the significant decline in seagrass shoot density that was observed during the 2011 survey has levelled out, although a slight decline was observed between 2011 and 2012. In contrast to the other sites, shoot density levels at the Garden Island 2.5 m test reference site are increasing and are almost back to those recorded by the 2008 and 2009 surveys.



Transect three at Warnbro Sound 2.0 m reference site. The seagrass bed has migrated or been eroded such that in 2012, sampling occurred on the edge of the meadow.

Wave Solutions recommended that as part of the ongoing review of the seagrass monitoring program in Cockburn Sound and Western Australia, the CSMC:

- ★ Investigate the reason for an observed decline in seagrass shoot density at the reference sites, particularly in Warnbro Sound. As seagrass health sites are compared to Warnbro Sound reference sites in a pair-wise fashion, if declines in shoot density are occurring that are related to sampling design it may have significant implications for the assessment of seagrass health at the seagrass health sites.

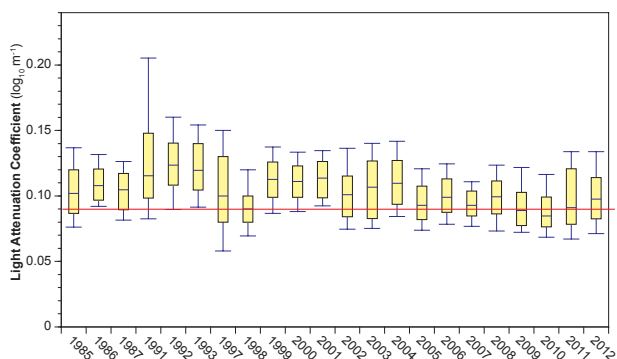
What did we find?

High Ecological Protection Area (HEPA) (Report Card 1, Maps 1a, 1b and 1c)

The High Ecological Protection Area did not meet the Environmental Quality Guidelines (the Guidelines)

for chlorophyll 'a' concentrations. It exceeded the Environmental Quality Criteria (EQC) at eight of the 10 sites in this Area.

Median light attenuation also did not meet the Guidelines at four of the eight sites.



Median summer light attenuation coefficients in Cockburn Sound. The red line represents the high protection EQG of 0.09 m^{-1} for Cockburn Sound.

All sites met the Guidelines for temperature, salinity, pH and dissolved oxygen in the southern Sound although site CS11 recorded one monitoring occasion when dissolved oxygen exceeded the Guidelines, falling to a saturation level of 86.84%. However, values overall did not result in the area being graded as exceeding the Guidelines.

Chlorophyll 'a' as an indicator of phytoplankton biomass concentrations for the HEPA, when assessed against the EQG Part A, met the Guideline (EQG A: Overall median did not exceed three times the median chlorophyll 'a' concentration for updated historical data at site WS4). However, two sites exceeded the Standard (EQG B: The values on > 25% of the sampling occasions at two sites, CS11 and CS13 exceeded the EQG B – i.e. EQGs were exceeded in two consecutive years). Phytoplankton Biomass Standards were not met because the EQG (A and/or B) was exceeded in two consecutive years (i.e. Report Card 2011 was also coded Red).

This year a number of key seagrass health sites failed to meet the Standards for seagrass shoot density or significant declines in seagrass shoot density were observed.

The monitoring site at Mangles Bay failed to meet the Standards and both Southern Flats and Kwinana showed significant declines in seagrass shoot density, with the result that these sites were coded as Amber. It should be noted that the Garden Island Settlement and Luscombe Bay sites were not monitored by the DoD this year. When last monitored in 2011, both of these sites exceeded the Environmental Quality Standards and therefore remain in exceedance of the Standards.

The CSMC has written to the Department of Defence, in accordance with the SEP, as the agency most suitable to undertake an investigation and to provide the CSMC with an acceptable management response and timeframe for these exceedances to be rectified.



Seagrass at Luscombe Bay, Garden Island

The CSMC, in consultation with the Office of the Environmental Protection Authority will consider, on what, if any, management response can be undertaken to overcome the seagrass shoot density Standard exceedance at Mangles Bay and the marked declines at Southern Flats and Kwinana.

The CSMC will continue to monitor seagrass health in 2013 to determine whether the declines in seagrass shoot density and overall seagrass health are continuing. While it is possible that declines in shoot density may be the result of natural variation, until further investigations are completed, the CSMC will continue to work with responsible agencies to ensure that any non-natural impacts are managed and mitigated to allow seagrass shoot density to improve at these sites.

All relevant seagrass monitoring sites met the Guidelines for seagrass depth limits. No observed reductions in the seagrass depth limit were detected. Stability at the lower depth limit suggests that there has not been a regional decline in water clarity and light availability sufficient to cause a loss of seagrass meadows. A Seagrass review was completed in 2011: Review of Cockburn Sound SEP Seagrass monitoring program, 2011 available at <http://portal.environment.wa.gov.au/pls/portal/docs/PAGE/ADMIN_CSMC/CSMC_PUBLICATIONS/TECHNICAL_REPORT/SEP%20REVIEW%20FINAL.PDF>.

No formal Contaminants in Water sampling occurred in the High Ecological Protection Area during 2012. The last formal sampling occurred in 2008. Results in that year indicated that all sites met the Guidelines or were below normal laboratory reporting limits.

No TBT sediment sampling was done this year. Samples taken in 2007 were all well below the Guidelines and graded green.

All sediment samples monitored to date (collected at 86 sites in March 2006) met the Guidelines.

In summary, the High Ecological Protection Area appears to be generally healthy. However, there have been declines in Seagrass Shoot Density, coupled with increasing Chlorophyll 'a', Light Attenuation (LAC) and higher levels of Phytoplankton Biomass (as Chlorophyll 'a') at some southern Sound sites.

The CSMC is considering what kind of management response is appropriate to mitigate the identified Environmental Quality exceedances and whether there is any specific action that can be taken and will report on this in the 2013 State of the Sound report.

Moderate Ecological Protection Area (MEPA) (Report Card 2, Map 2)

Chlorophyll 'a' did not meet the Guidelines. Concentrations were above Guideline levels at five of the seven sites in this Area. Light attenuation did not meet the Guidelines at three of the seven sites. All sites met the Guidelines for dissolved oxygen, temperature, salinity and pH. All sites met the Guidelines for Phytoplankton Biomass (activity).

Seagrass shoot density at the only site for the Moderate Protection Area met the Guidelines. Concentrations of contaminants in water met the Guidelines or were below laboratory reporting limits.

Limited sampling of contaminants in sediments (mainly around industrial and commercial jetties and terminals) met the Guidelines although one site (KBT3) had total TBT concentrations which exceeded Part B of the Environmental Quality Guidelines and this site was coded Amber.

No formal sampling for imposex in snails has been done by the CSMC since 2005–06. Data are considered to be too old to report on. However, university surveys since then have indicated substantial reductions in the incidence of imposex compared to the 2005–06 survey results.

The Area met Guidelines for metals and metalloids. Two sites had elevated cadmium and copper sediment concentrations but were below Guidelines and no sites exceeded the Guidelines for poly-aromatic hydrocarbons.

In general, the Moderate Ecological Protection Area appears to be relatively healthy. However, Chlorophyll 'a' results exceeded the Guidelines at

a majority of sites and two sites in the southern area of the MEPA had Light Attenuation levels which exceeded Guidelines.

The CSMC is considering what kind of management response is appropriate to mitigate the identified Environmental Quality exceedances and whether there is any specific action that can be taken.

Moderate Ecological Protection Area – Harbours (MEPAH) (Report Card 3, Map 3)

The median chlorophyll 'a' concentration for Jervis Bay Northern Harbour exceeded the Guidelines at the single site monitored. Light attenuation at the single site in Northern Harbour exceeded the Guidelines. No sampling occurred in the Southern Harbour in 2012.

Dissolved Oxygen, temperature, salinity and pH concentrations in Northern Harbour met the Guidelines. There was no sampling for chlorophyll 'a' in the Southern Harbour in 2012.

Phytoplankton biomass exceeded the Standards in Jervis Bay Northern Harbour as it has every year since 2003. The median chlorophyll 'a' concentration exceeded the Standards. There was no sampling in the Southern Harbour in 2012.

TBT monitoring results for both Northern and Southern harbours indicated that TBT exceeded the Guidelines at two of the four sampling sites in each harbour.

While no sampling for imposex in snails has been undertaken by the CSMC in the harbours since 2005–06, university studies suggest that there have been significant declines since 2005–06.

In summary, no monitoring (other than for TBT) was undertaken in Southern Harbour in 2012. Limited sampling for water quality (from only one monitoring site) was undertaken in Northern Harbour, except for TBT in the sediments which was monitored at four sites.

Results have again shown that phytoplankton biomass (as chlorophyll 'a') exceeded the Standards as it has since monitoring began in 2003. In response, the CSMC has developed a Management Action Plan (MAP), which has been submitted to the major stakeholders, Minister for Environment and the Environmental Protection Authority.

This MAP is the result of four years' work by the CSMC and the Jervis Bay Northern Harbour Working Group. This group was tasked to make recommendations to the Minister and EPA on

strategies to address continuing poor water and sediment quality in this harbour.

Safe Seafood for Eating (Report Card 4, Map 4)

All sites met the Guidelines for thermo-tolerant faecal coliform levels in water and thermo-tolerant faecal coliforms in seafood flesh. Levels of potentially toxic phytoplankton algae density exceeded the Guidelines at both Kwinana Grain Terminal and Southern Flats and exceeded EQCs and Western Australian Shellfish Quality Assurance Plan (WASQAP) Guidelines. However, no formal DoH or WASQAP testing for algal bio-toxins was undertaken. No sampling was undertaken this year in Jervoise Bay Northern or Southern Harbours.

Seafood tested in commercial growing areas did not exceed WASQAP Guidelines and was considered safe for eating. Whilst these potentially toxic species were present they have previously been found not to produce toxins.

Under WASQAP, commercially farmed mussels in Cockburn Sound are subject to strict quality assurance processes, including routine water quality and mussel sampling, to protect public health.

A watch-list of species known to be toxic to human health is maintained by WASQAP. These species, when tested in Cockburn Sound, have not been found to be toxic.

All sites met the Guidelines for contaminant organic compounds. No problems were identified for aquaculture in the monitoring data. All contaminant organic chemicals were below laboratory reporting limits or were well below food and safety Guidelines.

In summary, waters monitored near aquaculture sites were found to be generally acceptable for the consumption of seafood. On a small number of occasions elevated levels of potentially toxic species of algae were observed, but when tested no samples proved to be toxic. This has been an on-going pattern since monitoring began over nine years ago.

Clean Waters for Swimming and Boating (Report Card 5, Map 5)

All sites met the Guidelines for bacterial *Enterococci* (Swimming). Beach sites have greatly improved in terms of bacterial contamination over the last few years. In 2010 three out of seven sites exceeded Guidelines. In 2011 and again this year no sites exceeded the Guidelines. This is a very positive result.

All sites met the Guidelines for bacterial *Enterococci* for boating.

All sites met the Guidelines for toxic algae, based on WASQAP sampling further off-shore. There were no reports of skin or eye irritation caused by toxic algae, or of algal poisoning, by recreational users in 2012

All sites met the pH Guidelines. All sites except Mangles Bay met the Guidelines for water clarity; this site exceeded the Guidelines on two of the 16 occasions that water clarity was measured. All sites met the Guidelines for Contaminants in Water. The CSMC's Contaminants in Water survey conducted in 2008 indicated that a large majority of sites had very low or non-detectable levels of contaminants, including pesticides. They were often well below laboratory reporting limits.

In summary, a majority of waters monitored near recreational beaches and boating areas were found to be 'clean'. An improvement in near-shore drainage and waste water treatment has resulted in much cleaner waters in both Cockburn Sound and Owen Anchorage and this is a very good result again this year.

Protecting the Health of Aquaculture Species (Report Card 6, Map 6)

All sites met the Guidelines for dissolved oxygen and pH. All sites met the Guidelines for Contaminants in Water. All sites were either below laboratory reporting limits or registered very low levels for all parameters, well below any Guidelines or trigger values. In summary, all sites met the Guidelines this year and this is a very good result.

Report Card Comparisons 2003–2012, Boundaries between the High and Moderate Ecological Protection Areas and location, size and cumulative area of authorised Low Ecological Protection Areas (Pages 30, 31 and 32)

The CSMC will be considering, in consultation with the DEC and EPA, whether there are any practical management steps that can be taken to improve system wide sub-regional results within the Sound.

The Council has recently released its Management Action Plan (MAP) to the Minister for Environment to assist in addressing poor water and sediment quality problems in Jervoise Bay Northern Harbour. This plan has also been provided to management agencies that have responsibilities relating to this busy harbour precinct.

Action from 2012 Report Cards

The CSMC has provided the 2012 Report Cards to the Minister for Environment and advised the Environmental Protection Authority of all exceedances of Guidelines and Standards.

The CSMC has written to the Dept of Defence in relation to microbial and general water quality issues along the eastern shore of Garden Island and the 2012 gap in the seagrass monitoring that is normally undertaken by the Dept of Defence.

The CSMC is discussing management options with the EPA, the DEC and Dept of Defence on how best to address the declines of seagrass shoot densities at the sites which exceeded Standards this year and at Defence monitored sites which exceeded Standards last year at both Garden Island Settlement and Luscombe Bay. A report will be provided in the 2013 State of the Sound report.

In addition, the CSMC will continue to monitor and investigate parameters of concern to attempt to

better determine whether natural variation or possible anthropogenic activities are the main reasons for poor or declining monitoring results. A primary area of focus will be declines in seagrass shoot density at specific sites where water quality parameters exceed Environmental Quality Guidelines or Standards.

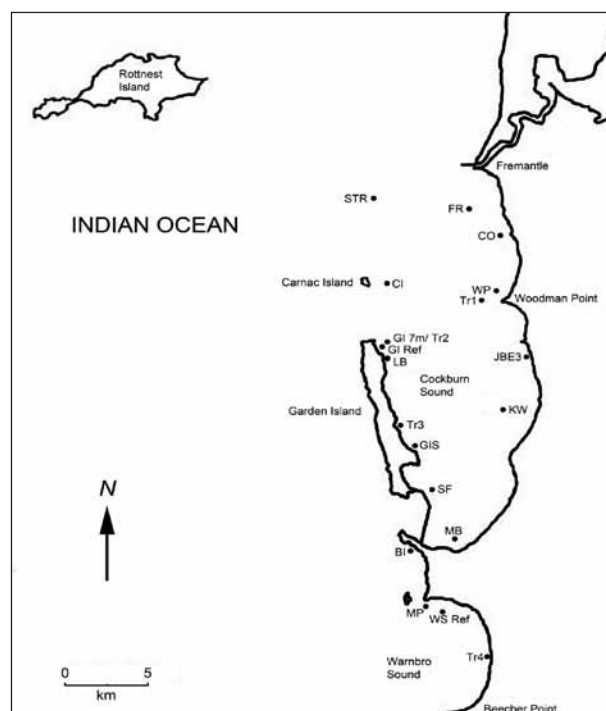
The CSMC will also, where possible, incorporate relevant recommendations, made by the seagrass and water quality monitoring program contractors as outlined earlier in this section of the report, into future monitoring activities.

The CSMC will collaborate with the OEPA and DEC to ensure that data presented in the annual Report Cards and the State of the Sound report undergo rigorous scientific analysis and peer review in accordance with the recommendations of the Office of the Auditor General in 2010.

The current review of the SEP by the EPA will further strengthen the framework for the environmental management of Cockburn Sound, Owen Anchorage and their catchments.



Water quality sampling sites. Sites 4, 5, 8, G2, G3, SF, CB, 11, 13 and MB in Cockburn Sound are designated sites in the High Protection Zone. Sites G1, 6A, 7, 9, 9A, 10, 12 and NH in Cockburn Sound are designated sites in the Moderate Protection Zone and WSSB and WS4 in Warnbro Sound are reference sites.



Location of sampling sites and depth transects in Cockburn Sound, Owen Anchorage and Warnbro Sound. FR – Fish Rocks, STR – Stragglers Rocks, WP – Woodman Point, CI – Carnac Island, GI7m – Garden Island 7m, LB – Luscombe Bay, GIS – Garden Island Settlement, JBE3 – Jervoise Bay E3, CO – Coogee, KW – Kwinana, SF – Southern Flats, MB – Mangles Bay, BI – Bird Island, MP – Mersey Point, GI Ref – Garden Island Reference sites, WS Ref – Warnbro Sound Reference sites, Tr1 – Woodman Point Transect, Tr2 – Garden Island North Transect, Tr3 – Garden Island South Transect, Tr4 – Warnbro Sound Transect.

Cockburn Sound Management Council Environmental Report Cards 2012

Legend for Report Cards

M **Monitor:** below Guidelines, continue monitoring.

I **Investigate:** above Guidelines; investigate and where necessary take precautionary action.

A **Action Required:** Above standards; initiate management response.

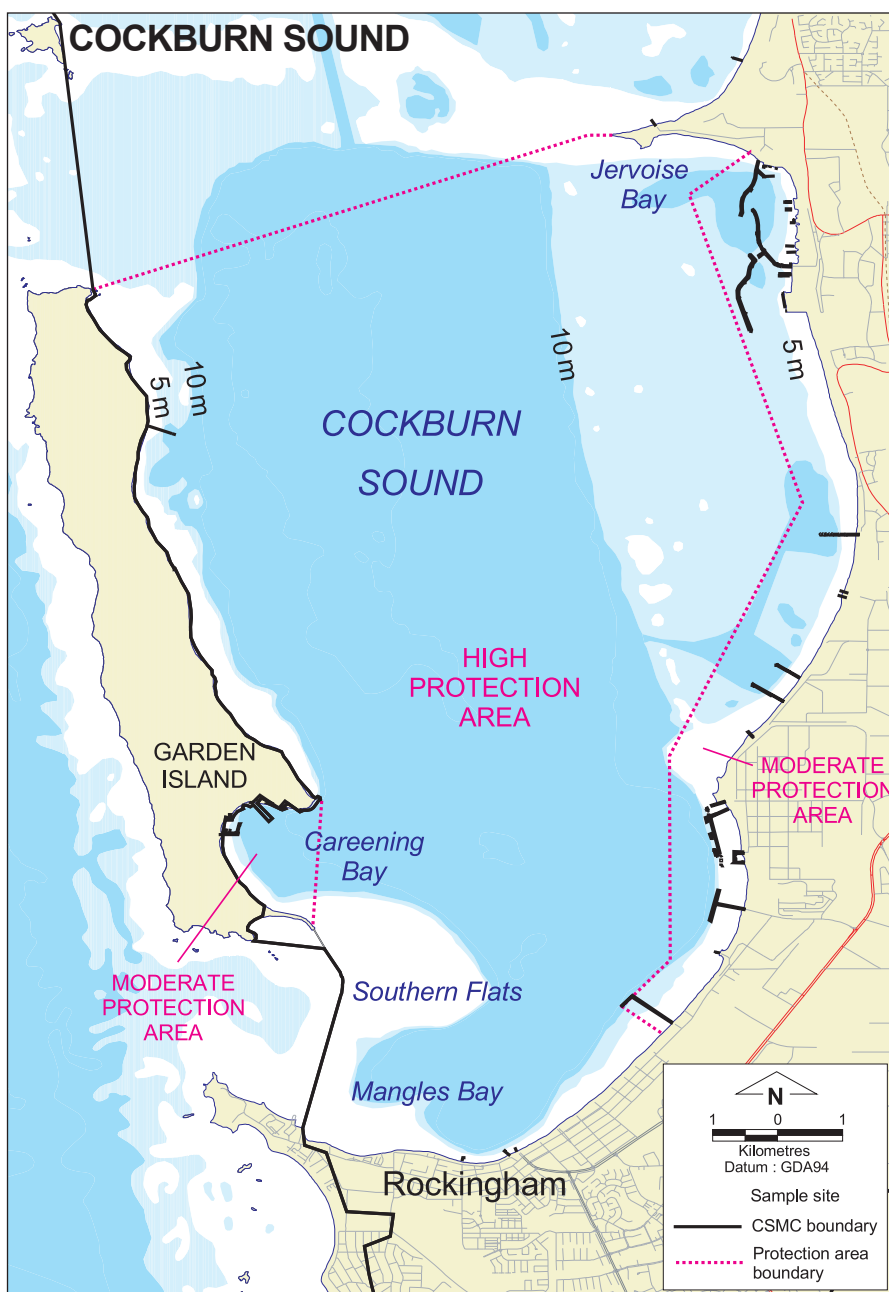
N/A No official rating can be supplied.

Green hatched: data greater than one year old but met Guidelines when last measured.

Orange hatched: data greater than one year old but exceeded Guidelines when last measured.

Red hatched: data greater than one year old but exceeded Standards when last measured.

Unable to Report: Monitoring did not occur, data results were not available or data is too old to report on.



Protection Areas

Cockburn Sound Management Council Environmental Monitoring Results – Evaluation Rules

The State Environmental (Cockburn Sound) Policy 2005 (SEP) requires the Cockburn Sound Management Council (CSMC) to report on two Ecological Protection Areas – High and Moderate Ecological Protection Areas. The CSMC have also created a third Ecological Protection Area – *Moderate Protection Area Harbours* – based on the SEP that advises the performance of harbours and marinas should be assessed individually and not be part of overall Moderate Ecological Protection Areas if the area is displaying different environmental conditions. Because of poor environmental conditions in Jervoise Bay harbours, the CSMC created this third Area. Each Area is monitored at a number of sites. Measurements at each site are collectively analysed to report on the environmental performance for each Ecological Protection Area. Environmental data is analysed according to the rules and criteria outlined in the SEP and associated Environmental Quality Criteria (EQC) and Standard Operating Procedure (SOP) documents. While the CSMC reports mainly on the *Areas* of Ecological Protection, a number of parameters are reported on a *site* basis. This is either because that is the specified procedure for reporting on that set of Environmental Quality Objectives (EQO) e.g. Clean Waters for Swimming and Boating – or because the CSMC believes that regardless of the overall Area meeting Environmental Quality Standards or Guidelines (EQS-EQG), exceedances at sites are deemed important enough to grade the whole Area as exceeding the Guideline or Standard. In some cases this year, even though the Area met the EQC, if $\geq 50\%$ of sites did not, then the Area was reported to have exceeded the EQC. When reporting, the CSMC also provides maps to show how the Areas

and individual sites have performed against the EQC for a given parameter. The word ‘Guidelines’ is used to indicate Environmental Quality Guidelines while the word ‘Standards’ is used when referring to Environmental Quality Standards.





















Seagrass health is a key indicator of the environmental performance of the Cockburn Sound marine ecosystem. The CSMC will grade seagrass as either amber or red if too few sites are meeting the Guidelines or Standards based on the 50% rule outlined above. For example, if three of the seven seagrass sites within the High Protection Area exceed either the Guideline or Standard, the Council, at its discretion, will grade this reporting parameter as either amber or red. The decision will depend on the individual monitoring results at each site. Because poor seagrass health may demonstrate a potentially broader water quality problem within the ecosystem, the Council generally adopts a conservative approach in borderline cases, triggering investigation for amber and intervention for red.

The CSMC Report Cards are issued with the intent of communicating annual results as simply as possible but readers should be aware that monitoring and reporting on natural ecosystems requires an appreciation for the wide variation in results that can occur for natural non-human influences. However, monitoring to meet the SEP is based on the premise that a human caused signal can be detected despite natural variation and the CSMC draws their conclusions based on their experience, statistics and common sense.

High and Moderate Ecological Protection Area boundaries, Low Protection Area location, size and cumulative areas are shown in Appendix 1. The CSMC does not monitor water or sediment quality in the Low Ecological Protection Areas.

Report Card 2012

High Ecological Protection Area

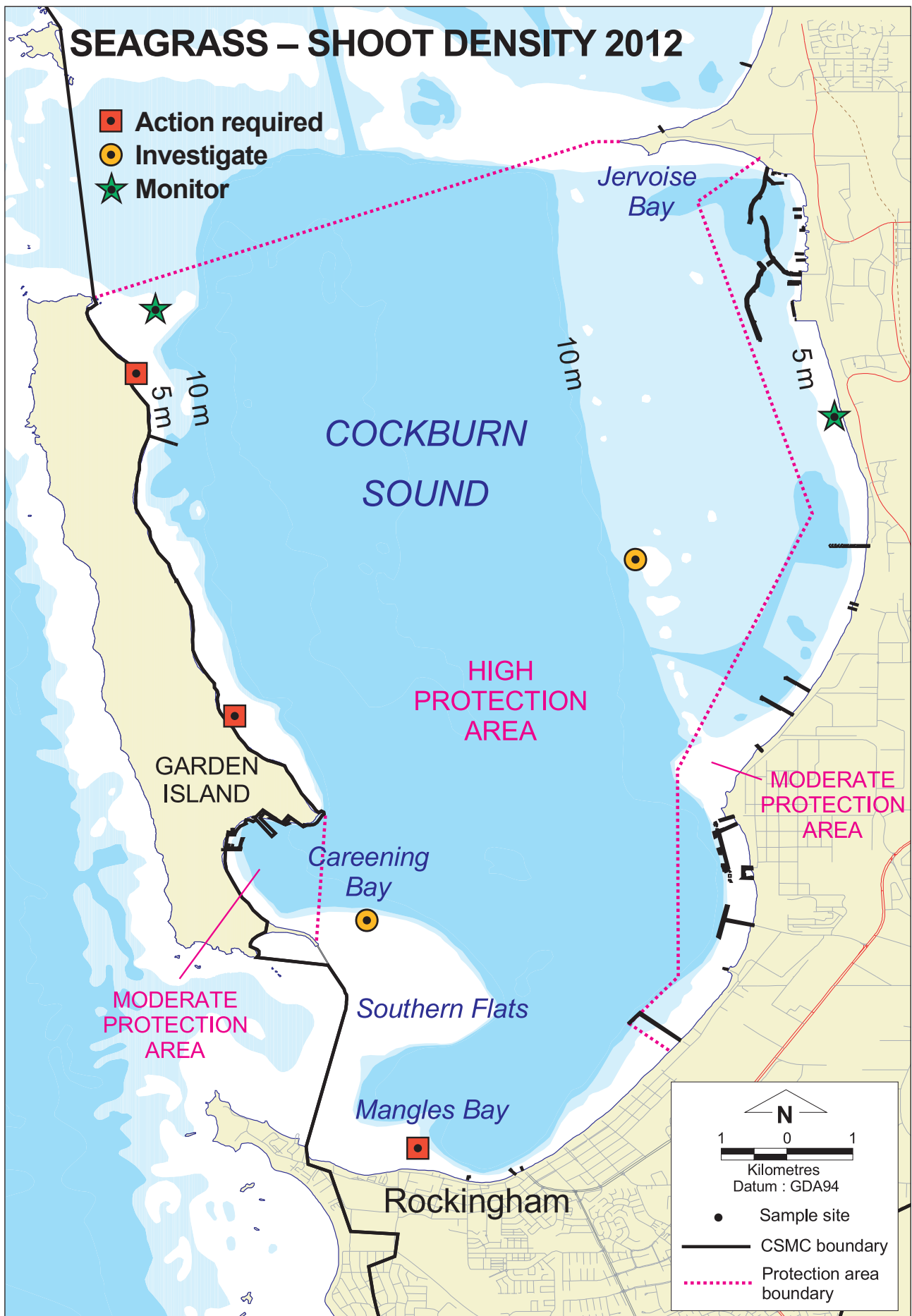
Environmental Quality Indicators		Management Response	Comments	
Physical and Chemical Measures				
<ul style="list-style-type: none">Chlorophyll ‘a’	I		The High Ecological Protection did not meet the Guidelines; Chlorophyll concentrations exceeded the Environmental Quality Criteria (EQC) at eight of the ten sites in this Area.	
<ul style="list-style-type: none">Light Attenuation	I			
<ul style="list-style-type: none">Dissolved Oxygen	M		All sites met the Guidelines for Temperature, Salinity, and pH. All sites met the Guidelines for Dissolved Oxygen except site CS11, in the deeper southern Sound; this site exceeded the Guideline on one monitoring occasion.	
<ul style="list-style-type: none">Temperature	M			
<ul style="list-style-type: none">Salinity	M			
<ul style="list-style-type: none">pH	M			
Direct Biological Measures				
<i>Phytoplankton Biomass (Activity)</i> <ul style="list-style-type: none">Chlorophyll ‘a’	A		Chlorophyll ‘a’ as an indicator of Phytoplankton Biomass did not meet the Standards. Concentrations at two sites in the deeper Southern Sound (CS11 and CS13) exceeded the Standards and were labelled red.	
<i>Seagrass</i> <ul style="list-style-type: none">Shoot density	A		Mangles Bay exceeded the Standards this year. Luscombe Bay and Garden Island Settlement sites were not monitored this year. However, both these sites exceeded the Standards last year and as such these sites remain in exceedance of the Standards. In addition, the Southern Flats and Kwinana sites were labelled Amber as both sites showed substantial declines in shoot density combined with reduced light attenuation and increased chlorophyll ‘a’ over the last two years.	
<ul style="list-style-type: none">Depth limits	M		All sites met the Guidelines. No observed reductions in the Seagrass Depth Limit were detected. Stability at the Lower Depth Limit suggests that there has not been a regional decline in water clarity and light availability sufficient to cause a loss of seagrass meadows at depth (Seagrass monitoring results were reviewed in Aug–Sept 2011).	
Contaminants in Water				
<i>Metals and Metalloids</i>	M		No formal Contaminants in Water sampling occurred in 2012. 2008 sampling indicated that all sites met the Guidelines or were below normal laboratory reporting limits.	
<i>Non-metallic Inorganics</i>				
<ul style="list-style-type: none">Organics	M			
<ul style="list-style-type: none">Pesticides	M			
<ul style="list-style-type: none">Herbicides and Fungicides	M			
<ul style="list-style-type: none">Surfactants	M			
<ul style="list-style-type: none">Hydrocarbons	M			
<ul style="list-style-type: none">Miscellaneous/Others	M			
Contaminants in Sediments				
<i>Organometallics (e.g. TBT)</i>	<i>Sediment</i>	M		No TBT sediment sampling was done this year. Samples taken in 2007 were all well below the Guidelines and graded green ¹ .
	<i>Imposex in Marine Snails</i>	A		No formal sampling for imposex in Snails has been done by CSMC since 2005–06 ² , but university studies (not published) have shown substantial reduction in imposex. CSMC data is considered too old to report on.
<i>Metals and Metalloids</i>		M		All sediment samples monitored to date (collected at 86 sites in March 2006) met the Guidelines ¹ .
<i>Organics</i>		M		

High Ecological Protection Area Summary

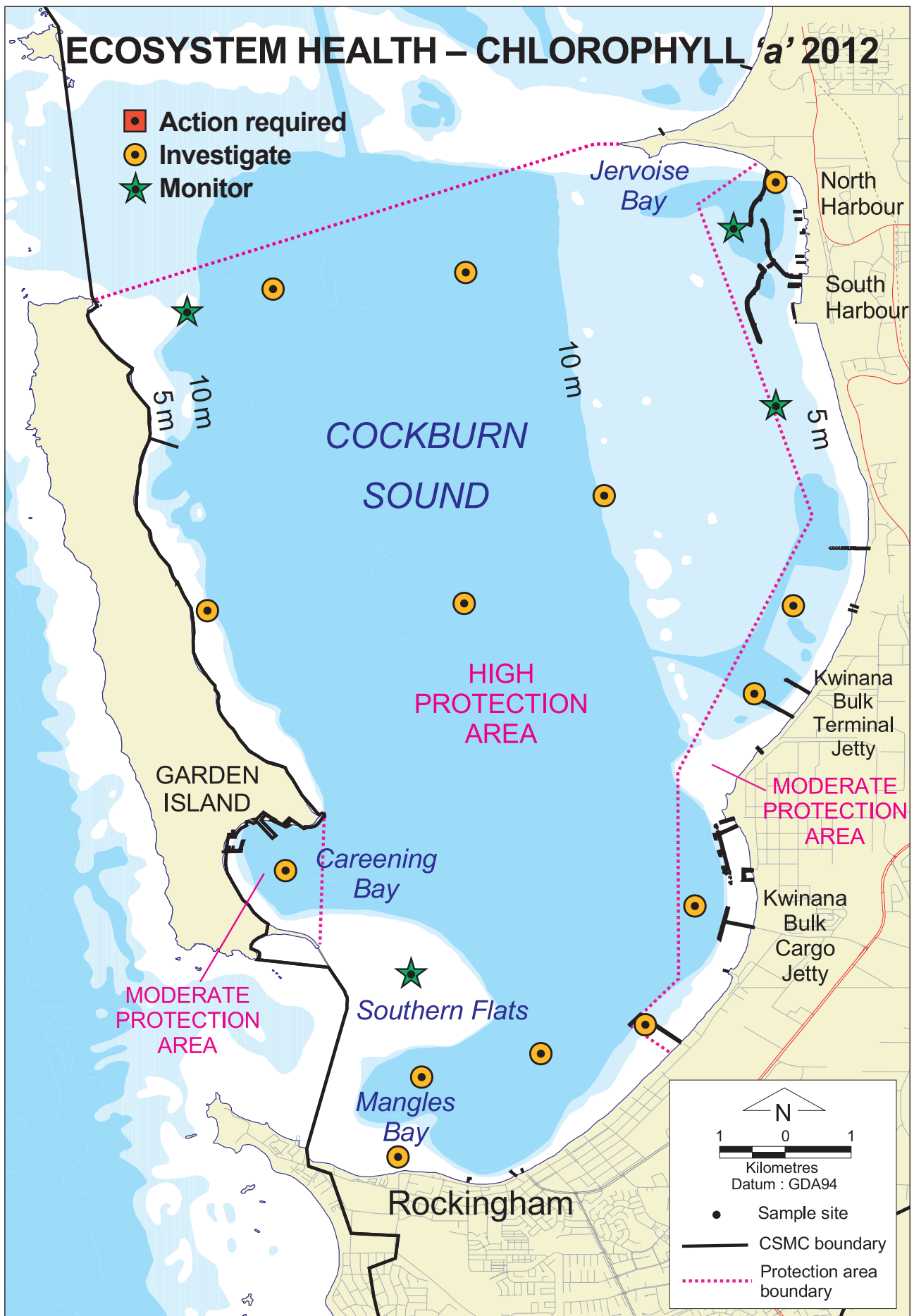
In general the High Ecological Protection Area appears to be healthy. Declines in Seagrass Shoot Density, coupled with increasing Chlorophyll 'a' and Light Attenuation (LAC) results and higher levels of Phytoplankton Biomass (as Chlorophyll 'a') at a couple of southern Sound sites are areas of concern for the Council. The CSMC will be seeking advice from the Environmental Protection Authority (EPA) and the Department of Defence on the best management response and avenues to investigate declining Seagrass Shoot Density at the sites identified and also to seek advice on whether a management response is appropriate and what, if any action, can be taken to mitigate these Environmental Quality exceedances.

¹ Toxicants in Sediment Survey Report Cockburn Sound and Owen Anchorage prepared for Cockburn Sound Management Council by Aquatic Science Branch Department of Water October 2006

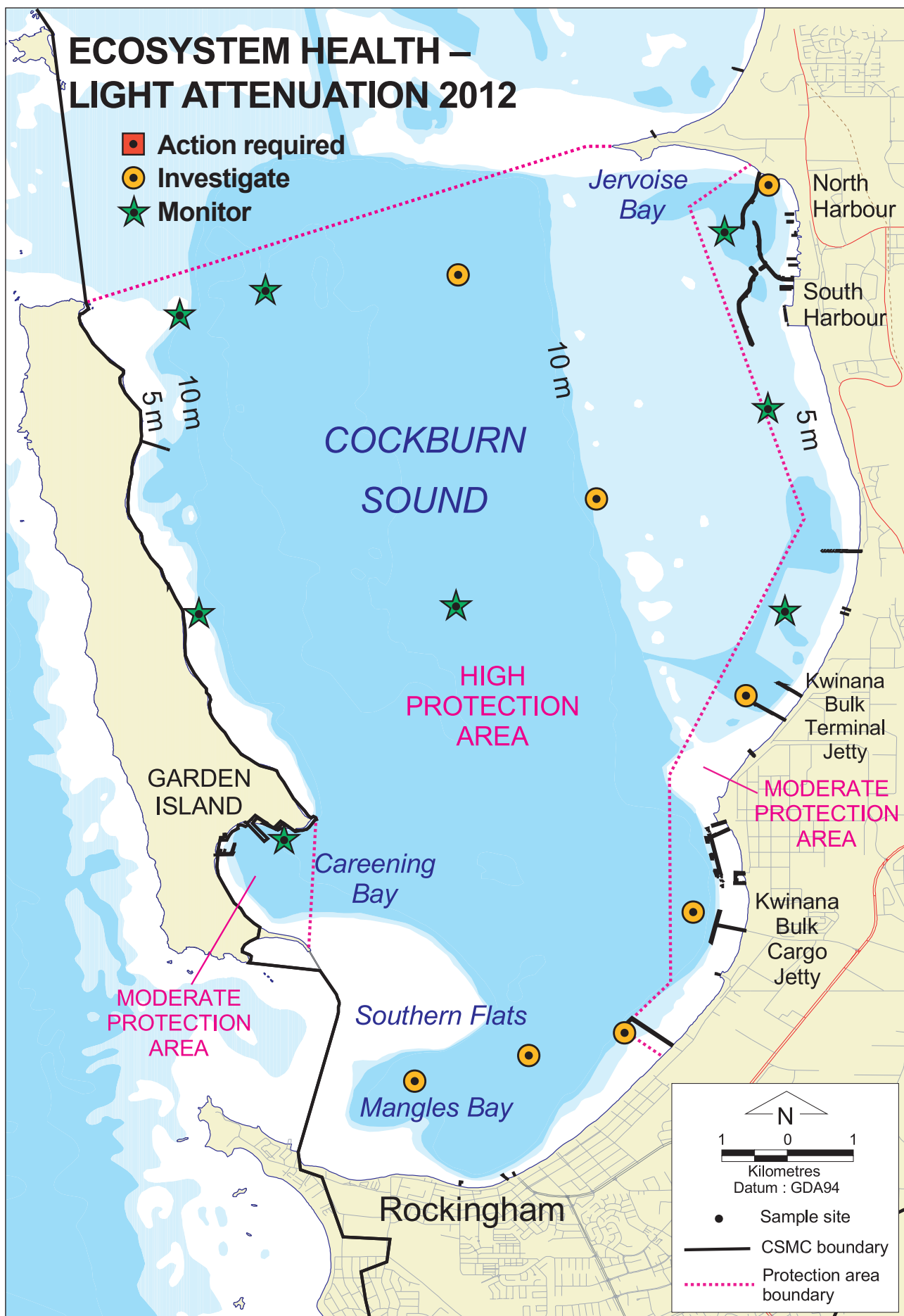
² Limited sampling for imposex in 2011 (out of season Curtin University studies 2007, 2009 & 2011) indicated a continued decline in TBT contamination in Perth coastal waters as measured through the degree of imposex. However Colpoys Point, Garden Island, Woodman Point and Jervoise Bay harbours still have levels of imposex, indicating the effects of TBT contamination are still present around industrial and naval harbours in the Sound. The 2011 university study showed a significant reduction in imposex frequency was observed at Woodman Point and Colpoys Point which have shown significant improvement since the 2005 and 2007 university studies.



Map 1a























Map 1b



Map 1c

Report Card 2012

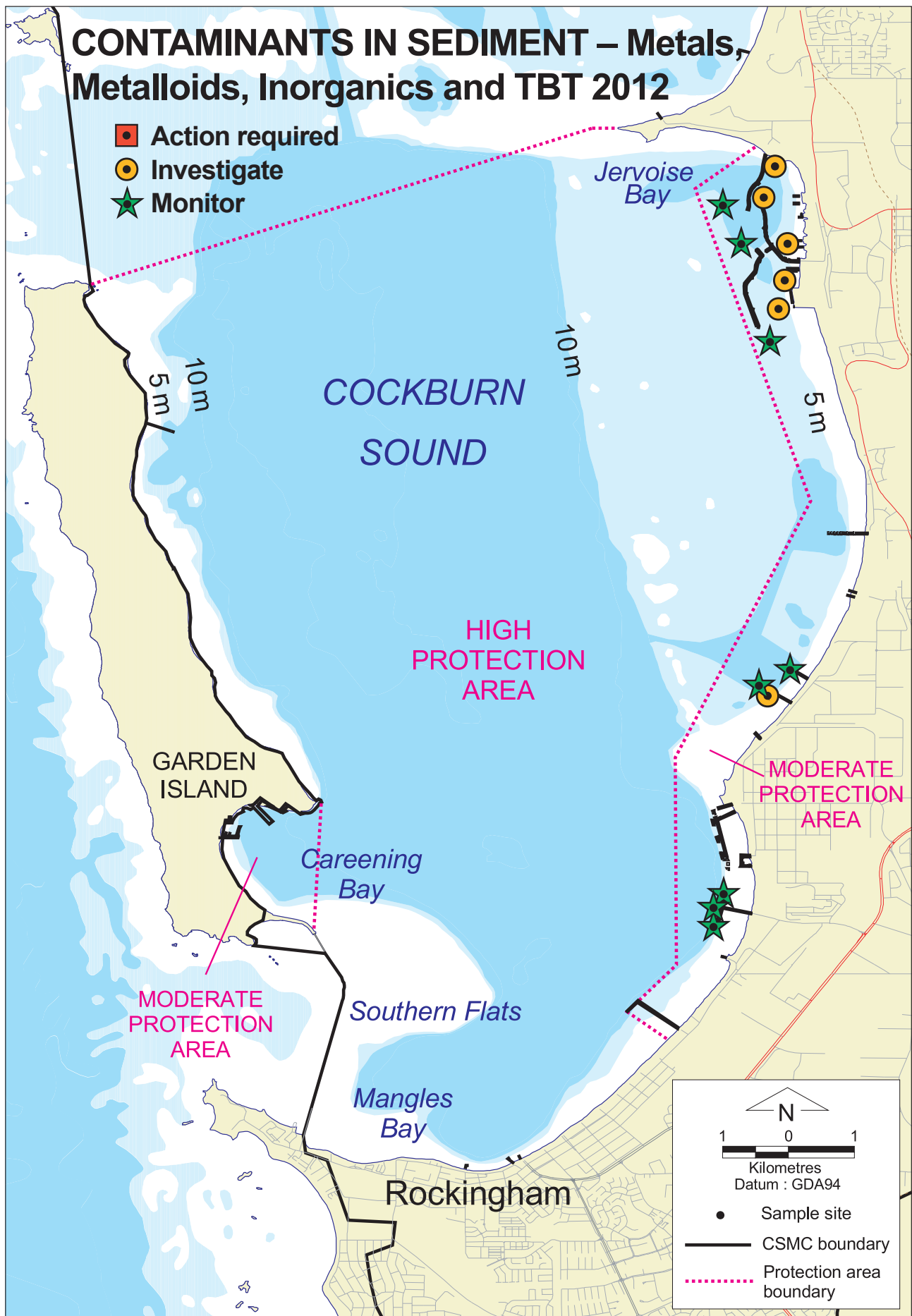
Moderate Ecological Protection Area

Environmental Quality Indicators	Management Response	Comments
Physical and Chemical Measures		
<ul style="list-style-type: none"> Chlorophyll 'a' Light attenuation Dissolved Oxygen Temperature Salinity pH 	I  I  M  M  M  M 	Chlorophyll 'a' did not meet the Guidelines; concentrations were above Guideline levels at five of the seven sites in this Area. Light Attenuation Coefficient did not meet the Guidelines at three of the seven sites in this Area. All sites met the Guidelines for Dissolved Oxygen, Temperature, Salinity and pH.
Direct Biological Measures		
<i>Phytoplankton Biomass (Activity)</i> <ul style="list-style-type: none"> Chlorophyll 'a' <i>Seagrass</i> <ul style="list-style-type: none"> Shoot density Depth limits 	M  M  M 	All sites met the Guidelines for Phytoplankton Biomass (activity). Seagrass Shoot Density met the Guidelines. All sites met the Guidelines. No reduction in Seagrass Depth Limits was observed.
Contaminants in Water		
<i>Metals and Metalloids</i> <i>Non-metallic Inorganics</i> <ul style="list-style-type: none"> Organics Pesticides Herbicides and Fungicides Surfactants Hydrocarbons Miscellaneous/Others 	M  M  M  M  M  M  M 	Concentrations met the Guidelines or were below laboratory reporting limits.
Contaminants in Sediments		
<i>Organometallics (e.g. TBT)</i>	<i>Sediment</i>	M  Limited sampling of Contaminants in Sediments (mainly around industrial and commercial jetties and terminals) met the Guidelines although one sample exceeded the Guidelines for TBT.
	<i>Imposex in Marine Snails (2006)</i>	A  No formal sampling for imposex in snails has been done by CSMC since 2005–06 ² . Data is considered to be too old to report on.
<i>Metals and Metalloids Organics</i>		M  M  The Moderate Ecological Protection Area met the Guidelines. Three sites had elevated Cadmium concentrations and two sites had elevated Copper sediment concentrations but all samples were below the Guidelines and no sites exceeded the Guidelines for Poly-Aromatic Hydrocarbons.

Moderate Ecological Protection Area Summary

In general the Moderate Ecological Protection Area appears to be healthy. Chlorophyll 'a' results exceeded the Guidelines at a majority of sites and two sites in the southern Sound had levels of Light Attenuation Coefficient which exceeded Guidelines. The CSMC will be seeking advice from the Environmental Protection Authority (EPA) on the best management response if it is appropriate and what, if any action, can be taken to mitigate these Environmental Quality exceedances.

² Limited sampling for imposex in 2011 (out of season Curtin University studies 2007, 2009 & 2011) indicated a continued decline in TBT contamination in Perth coastal waters as measured through the degree of imposex. However Colpoys Point, Garden Island, Woodman Point and Jervoise Bay harbours still have levels of imposex, indicating the effects of TBT contamination are still present around industrial and naval harbours in the Sound. The 2011 university study showed a significant reduction in imposex frequency was observed at Woodman Point and Colpoys Point which have shown significant improvement since the 2005 and 2007 university studies.



Map 2

Report Card 2012

Moderate Ecological Protection Area Harbours

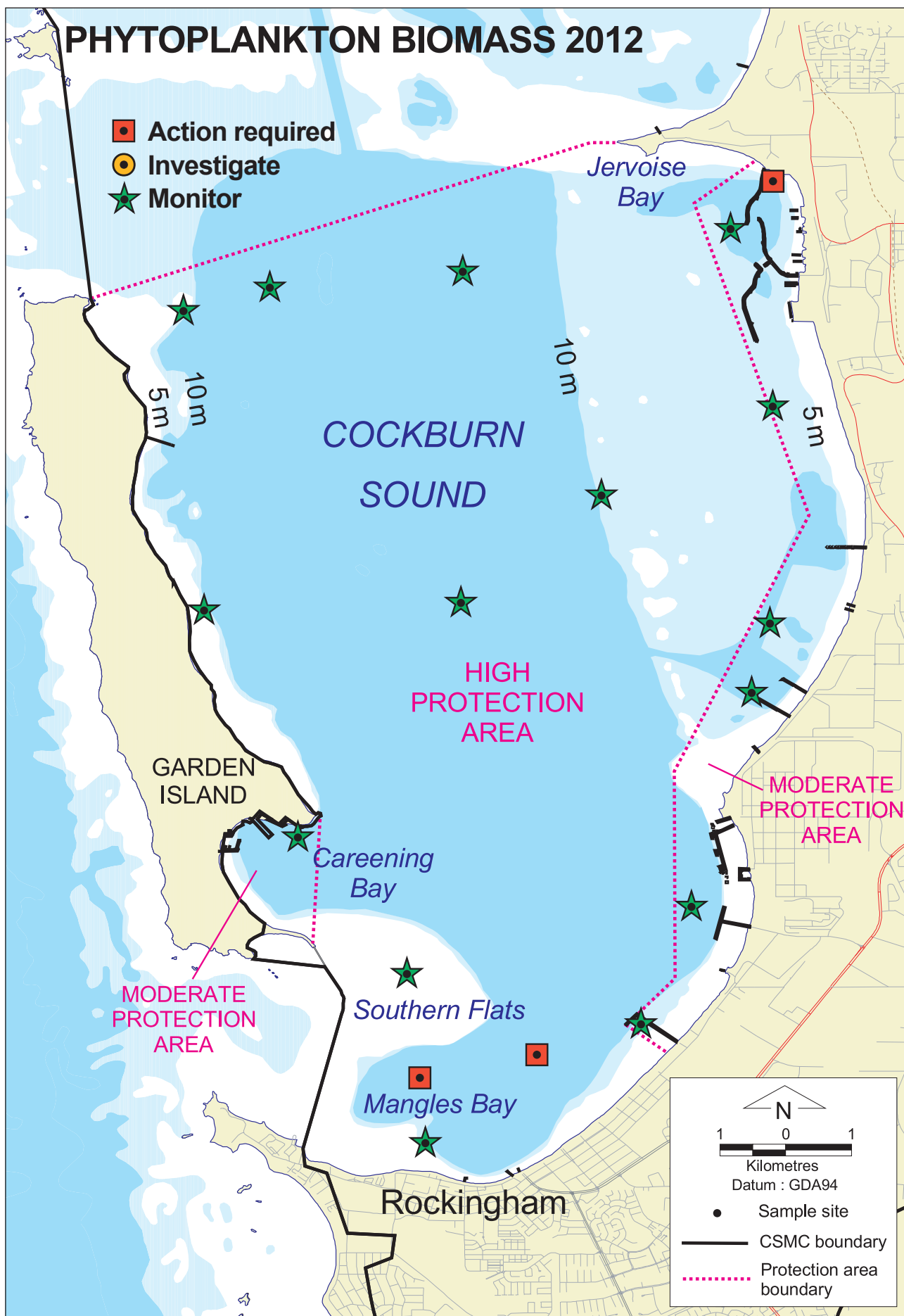
Environmental Quality Indicators		Management Response		Comments	
		Northern Harbour	Southern Harbour [▲]		
Physical and Chemical Measures					
• Chlorophyll 'a'	I	<div></div>	<div></div>	The median Chlorophyll 'a' concentration for Jervoise Bay Northern Harbour exceeded the Guidelines at the single sampling site in this Area. No sampling occurred in the Southern Harbour in 2012.	
• Light Attenuation	I	<div></div>	<div></div>	Light Attenuation in Northern Harbour exceeded the Guidelines at the single sampling site in this Area. No sampling occurred in the Southern Harbour in 2012.	
• Dissolved Oxygen	M	<div></div>	<div></div>	Dissolved Oxygen, Temperature, Salinity and pH concentrations in Northern Harbour met the Guidelines. No sampling occurred in the Southern Harbour in 2012.	
• Temperature	M	<div></div>	<div></div>		
• Salinity	M	<div></div>	<div></div>		
• pH	M	<div></div>	<div></div>		
Direct Biological Measures					
Phytoplankton Biomass (Activity) • Chlorophyll 'a'	A	<div></div>	<div></div>	Exceedance of a Standard (high Phytoplankton Biomass) was registered in Jervoise Bay Northern Harbour as it has every year since 2003. The median Chlorophyll 'a' concentration at the only site measured this year exceeded the Standards on every monitoring occasion. No sampling occurred in the Southern Harbour in 2012.	
Contaminants in Water					
Metals and Metalloids	M	<div></div>	<div></div>	No sampling for Contaminants in Water was undertaken in these Areas this year. When last tested in 2008 contaminant levels met the Guidelines.	
Non-metallic Inorganics	M	<div></div>	<div></div>		
• Organics	M	<div></div>	<div></div>		
• Pesticides	M	<div></div>	<div></div>		
• Herbicides and Fungicides	M	<div></div>	<div></div>		
• Surfactants	M	<div></div>	<div></div>		
• Hydrocarbons	M	<div></div>	<div></div>		
• Miscellaneous/Others	M	<div></div>	<div></div>		
Contaminants in Sediments					
Organometallics (e.g. TBT)	TBT in Sediment	I	<div></div>	Two of the four sampling sites in each harbour exceeded the Guidelines for TBT in Sediments.	
	Imposex in Marine Snails	A	<div></div>	No formal sampling for Imposex in Snails has been done by CSMC since 2005–06 ² . Data is considered to be too old to report on.	
Metals and Metalloids	M	<div></div>	M	<div></div>	No sampling for Organic Contaminants in the Northern and Southern Harbours was undertaken this year. The last sampling occurred in 2003. Data is considered to be too old to report on.
Organics	M	<div></div>	M	<div></div>	

Moderate Ecological Protection Area Harbours Summary

Limited monitoring (from one monitoring site) was undertaken in Northern Harbour in 2012. Results have again shown that Phytoplankton Biomass (as Chlorophyll 'a') exceeded the Standards as it has done since monitoring commenced in 2003. In response the CSMC has developed a Management Action Plan (MAP), which was submitted to the Minister for Environment and the Environmental Protection Authority in late 2012. This MAP is the result of four years work by the CSMC and the Jervoise Bay Northern Harbour Working Group to identify and make recommendations to the Minister and EPA on avenues and strategies to address continuing poor water and sediment quality results in this harbour. TBT in Sediments was monitored in both Northern and Southern Harbours (at four sites each) in 2012.

[▲]The CSMC did not receive any external stakeholder Physical/Chemical, Direct biological or Contaminants in Water monitoring data for the Northern and Southern Harbours in 2013 and older data is considered too unreliable to report upon. The last time monitoring for this data occurred was in 2008.







²Limited sampling for imposex in 2011 (out of season Curtin University studies 2007, 2009 & 2011) indicated a continued decline in TBT contamination in Perth coastal waters as measured through the degree of imposex. However Colpoys Point, Garden Island, Woodman Point and Jervoise Bay harbours still have levels of imposex, indicating the effects of TBT contamination are still present around industrial and naval harbours in the Sound. The 2011 university study showed a significant reduction in imposex frequency was observed at Woodman Point and Colpoys Point which have shown significant improvement since the 2005 and 2007 university studies.



Map 3

Report Card 2012

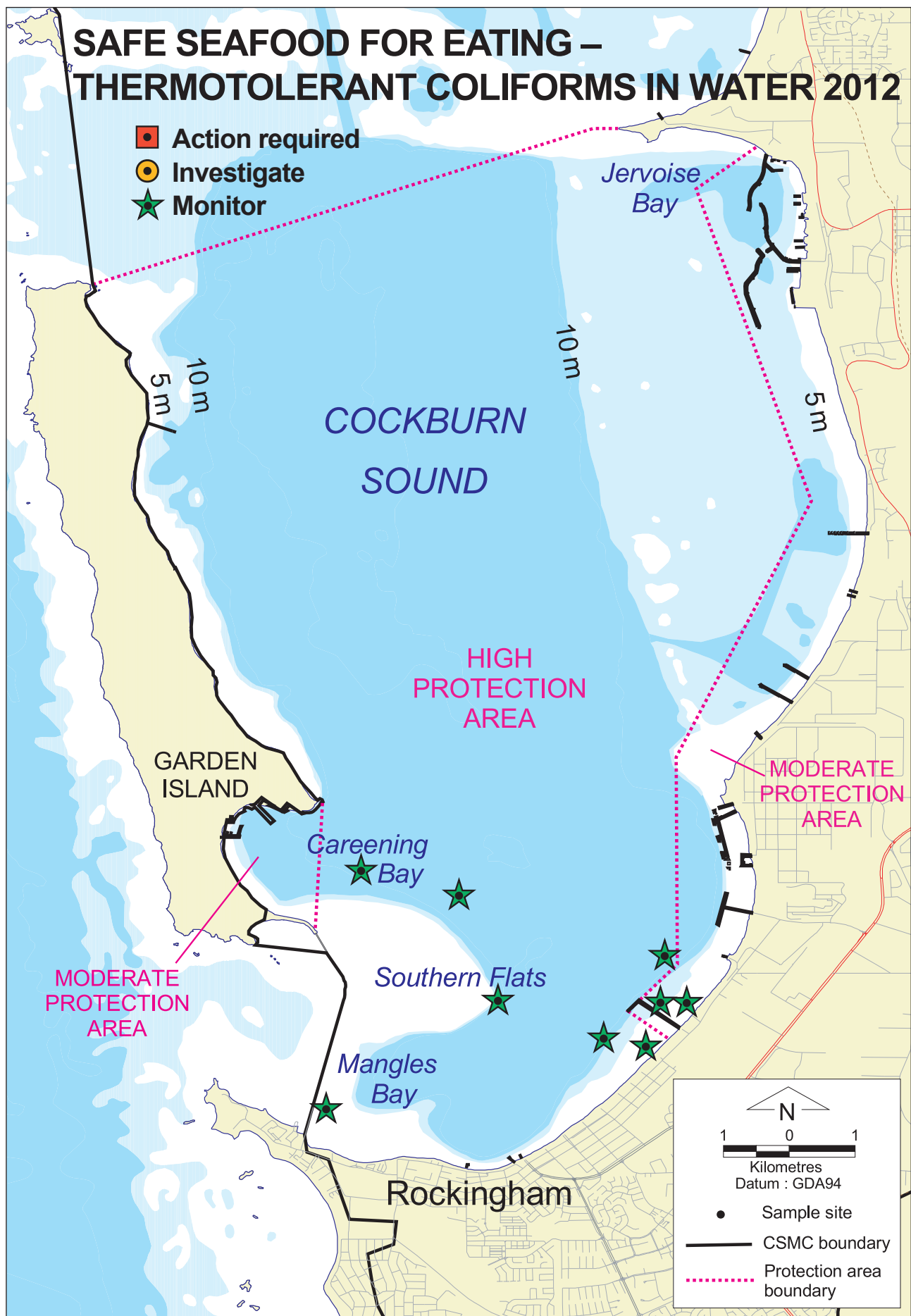
Safe Seafood for Eating

Environmental Quality Indicators	Management Response	Comments
Biological Contaminants in Waters		
<ul style="list-style-type: none"> Thermo-tolerant faecal coliform levels in water 	M 	All sites met the Guidelines.
<ul style="list-style-type: none"> Algal Bio-toxins <ul style="list-style-type: none"> Presence of potentially toxic algae above Guideline levels (e.g. > 15 000 cells/mL) Presence of algal bio-toxins in mussel flesh due to elevated levels of toxic algae 	I 	<p>The concentrations of several toxic Phytoplankton species, i.e. <i>Gymnodinium</i> sp. 005, <i>Gymnodinium</i> sp. 011, <i>Prorocentrum</i> sp. 001, and <i>Pseudo-nitzschia</i> spp. exceeded the Guidelines for these species in samples collected at Kwinana Grain Terminal and Southern Flats.</p> <p>No testing by the Mussel Growers or Health Department for Algal Bio-toxins was undertaken. Seafood tested in commercial growing areas did not exceed WASQAP Guidelines and was considered safe for eating. Although these species were present they did not produce toxins.</p> <p>Under WASQAP, commercially farmed mussels in Cockburn Sound are subject to strict quality assurance processes to protect public health, including routine water quality and mussel sampling*.</p> <p>A watch-list of species known to be toxic to human health is maintained by WASQAP. These species, when tested in Cockburn Sound, have not been found to be toxic.</p> <p><i>*The public needs to be aware of the risk associated with the consumption of potentially contaminated seafood collected recreationally outside of areas monitored by WASQAP, particularly in Jervoise Bay or around any jetties, piers and port related facilities. These shellfish are unmonitored and their quality cannot be assured.</i></p>
Biological Contaminants in Seafood flesh		
<ul style="list-style-type: none"> Presence of algal bio-toxins in mussel flesh due to elevated levels of toxic algae 	M 	No sampling was undertaken this year, last year all sites met the Guidelines.
<ul style="list-style-type: none"> Thermo-tolerant faecal coliforms in seafood flesh 	M 	No sampling was undertaken this year, last year all sites met the Guidelines.
<ul style="list-style-type: none"> Metals 	M 	No sampling was undertaken this year, last year all sites met the Guidelines for Metal levels in mussel flesh. Some natural heavy metals were detected but well below food and safety Guidelines.
<ul style="list-style-type: none"> Organic Chemicals 	M 	No sampling was undertaken this year, last year all sites met the Guidelines. No problems were identified for aquaculture in the monitoring data. Previous monitoring identified all Organic Chemicals were below laboratory reporting limits or were well below food and safety Guidelines.

Safe Seafood for Eating Summary

Waters monitored near aquaculture sites were found to be generally acceptable for the consumption of seafood. On a small number of occasions elevated levels of potentially toxic species of Algae were observed, but when tested no samples proved to be toxic.









Report Card 4



Map 4

Report Card 2012

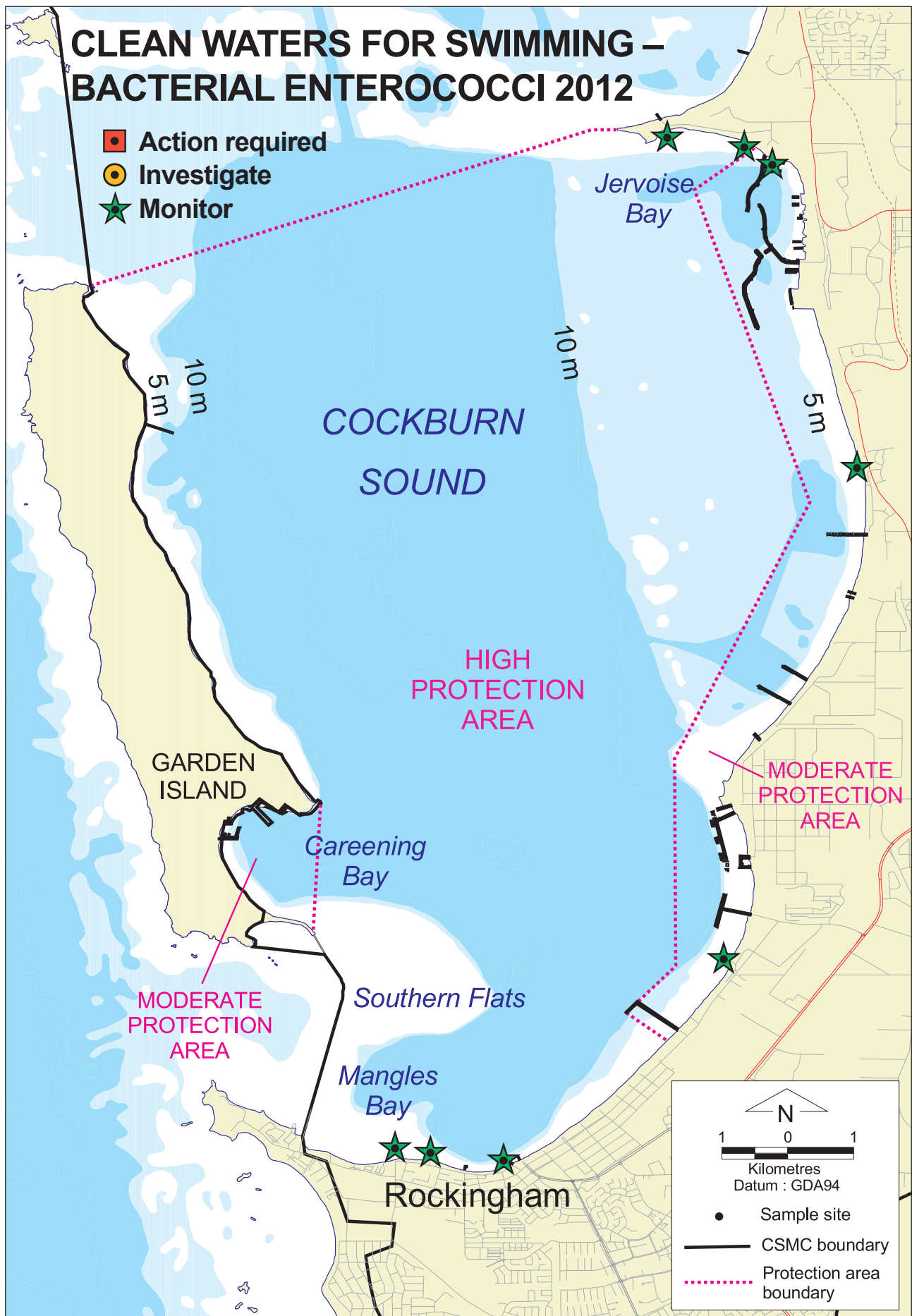
Clean Waters for Swimming and Boating

Environmental Quality Indicators	Management Response	Comments
Physical Measures		
• Bacterial <i>Enterococci</i> (swimming)	M 	All sites met the Guidelines. Beach sites have greatly improved for Bacteria Contamination over the last few years. In 2009 all sites exceeded the Guidelines and Standards; In 2010 year 3 out of 7 sites exceeded the Guidelines. In 2011 and again this year no sites exceeded the Guidelines. This is a very positive result.
• pH	M 	All sites met the Guidelines.
• Water Clarity	M 	All sites met the Guidelines except Mangles Bay. This site exceeded the Guidelines on two of the 16 occasions monitored.
• Inorganic Chemicals	M 	All sites met the Guidelines.
• Organic Chemicals	M 	All sites met the Guidelines.
• Pesticides	M 	All sites met the Guidelines.
Biological Measures		
• Bacterial <i>Enterococci</i> (boating)	M 	All sites met the Guidelines.
• Toxic algae	M 	All sites met the Guidelines based on WASQAP sampling further off-shore. There were no reports of skin or eye irritation caused by Toxic Algae or Algal poisoning by recreational users in 2012.

Clean Waters for Swimming and Boating Summary

Waters monitored near recreational beaches and boating areas were found to be clean. An improvement in near-shore drainage and waste water treatment has resulted in much cleaner waters in both Cockburn Sound and Owen Anchorage and this is a very good result again this year.





Report Card 5



Map 5

Report Card 2012

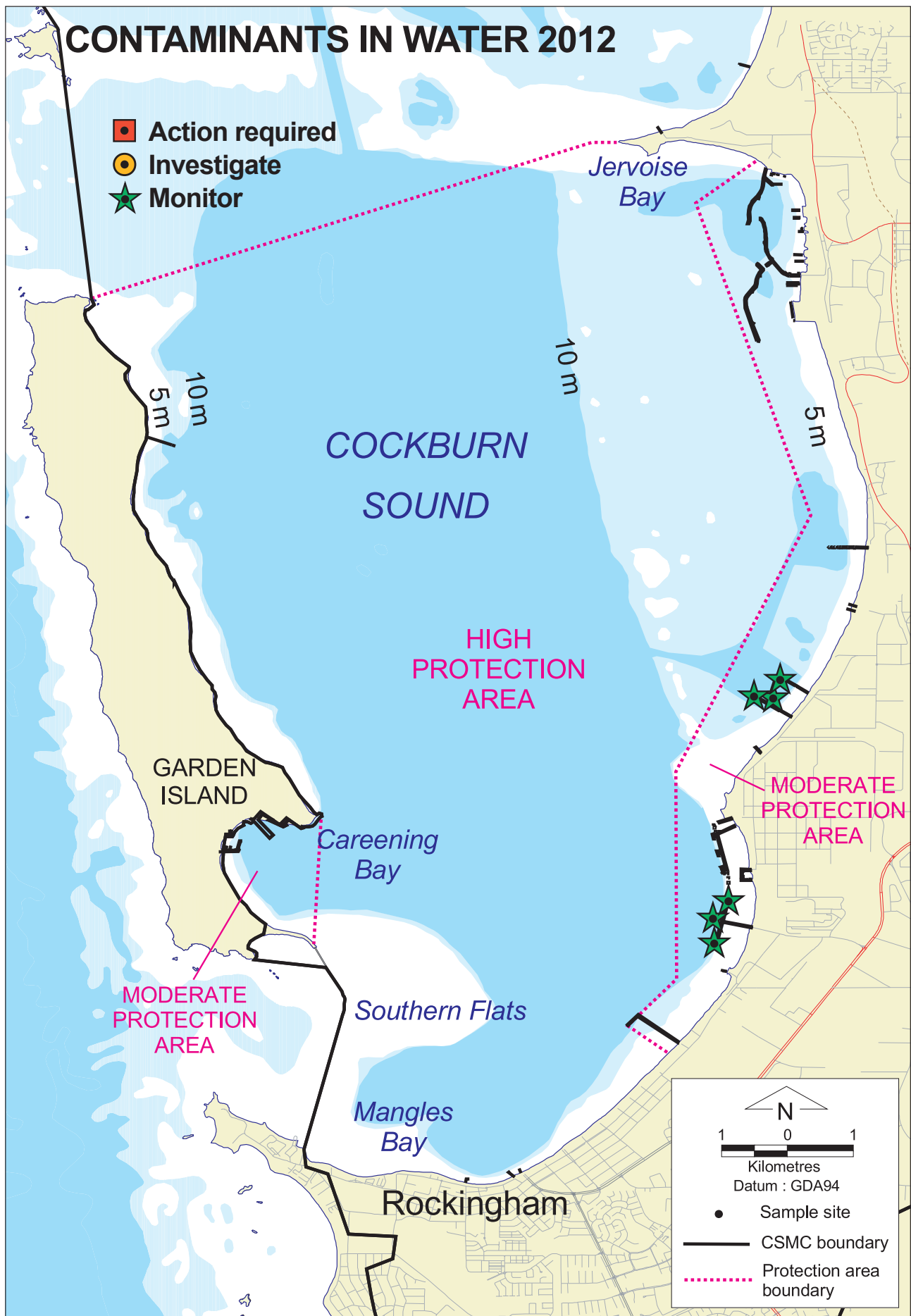
Protecting the Health of Aquaculture Species

Environmental Quality Indicators	Management Response	Comments
Physico-Chemical Stressors		
<ul style="list-style-type: none"> Dissolved Oxygen pH 	M  M 	All sites met the Guidelines for DO and pH.
Contaminants in Water		
<i>Metals and Metalloids</i>	M 	All sites met the Guidelines. Contaminants in Water at all sites were either below laboratory reporting limits or measured at very low levels, well below any Guideline or trigger values.
<i>Non-metallic inorganic chemicals</i> <ul style="list-style-type: none"> Organic Chemicals Pesticides 	M 	

Protecting the Health of Aquaculture Species Summary

All sites met the Guidelines this year which is a very good result.

Report Card 6



Map 6

Report Card Comparisons – 2003–2012

Parameter	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Change
High Area											
Light Attenuation	I	I	M	I	N/A	I	M	M	I	I	↔
Chlorophyll 'a'	M	M	M	M	M	M	M	M	I	I	↔
Dissolved Oxygen	M	M	M	M	M	M	I	M	M	M	↔
Seagrass Shoot Density	I	I	I	M	M	M	I	I	I	A	↓
Safe Seafood for Eating (Presence of potentially toxic algae)	M	M	I	I	I	M	I	M	M	I	↓
Clean Waters for Swimming – Potentially toxic algae Primary Contact	M	M	M	M	I	I	I	M	M	M	↔
Clean Waters for Swimming – <i>Enterococci</i> Primary Contact	M	M	A	A	I	I	I	M	M	M	↔
Imposex – TBT (All areas)	N/A	N/A	N/A	A	A	A	A	A	A	A	↔
Moderate Area											
TBT Sediment	A	I	M	A	I	M	M	M	M	M	↔
Moderate Harbour Area (North)											
Light Attenuation	N/A	N/A	I	I	N/A	I	I	I	I	I	↔
Chlorophyll 'a'	I	I	I	I	I	I	I	I	I	I	↔
Phytoplankton Biomass	A	A	A	A	A	A	A	A	A	A	↔
TBT Sediment	A	I	I	A	I	I	I	I	I	I	↔
Moderate Harbour Area (South)											
TBT Sediment	A	I	I	A	I	M	M	M	M	I	↓

M = Continue monitoring, I = Investigate (Investigation*), A = Action Required (Intervention*)

* In the case of an Investigation or Intervention the CSMC will report these exceedances to the EPA and Minister for Environment. Where a responsible Public Authority can be identified, the CSMC will refer the exceedance to this authority to investigate and implement an appropriate management response that takes into account reasonable and practicable measures, within a timeframe agreed with the CSMC. If the CSMC identifies that there is no relevant public authority, it will investigate the exceedance and advise the Environmental Protection Authority and the Minister for Environment on the best means of meeting the environmental quality objectives for Cockburn Sound.

CSMC Activities 2012

In 2012 the CSMC undertook a range of activities that fell broadly under the headings: annual; strategic; and community-investigative. All were undertaken within the framework of the *State Environmental (Cockburn Sound) Policy 2005* and the CSMC's *Environmental Management Plan 2005*. A selection of examples is provided here:

Annual

The CSMC's Seagrass Monitoring and Water Quality Monitoring programs (January to March 2012) provided a large portion of the information on the ecosystem health of the Sound. Monitoring programs undertaken by Fremantle Ports, DoH, Aquaculture Industries and Local Government contributed to contaminant and bacterial information which the CSMC assessed and reported on. The DoD did not provide water and sediment data in 2012. The Department of Commerce and LandCorp have ceased monitoring for seagrass and water microbial data in both northern and southern Jervoise Bay harbours as their ministerial commitments have been satisfied. In 2013 the CSMC will be working to address monitoring shortfalls.

The annual State of the Sound Report integrates all the monitoring, investigations and advisory work undertaken by the Council over the course of the year. The environmental results are now peer reviewed by in-house experts and by the OEPA and the Marine Science Branch of the DEC. The report is endorsed by the Council before being submitted to the Minister for Environment and Parliament.

The CSMC also develops an **annual Environmental Quality Management Program (EQMP)** as required by the SEP. CSMC officers publish annual EQMPs on the CSMC website <<http://csmc.environment.wa.gov.au>>. The CSMC relies on between eight to eleven annual environmental monitoring programs. The CSMC oversees these to ensure that monitoring conforms with the SEP SOPs. Non-conforming data that is rigorously collected may be used as supporting information in the interpretation of results.

CSMC staff responded to or assisted with over 700 direct queries, phone calls and letters on a wide range of issues from concerned and interested community members, students, local government and other parties. They related to matters as diverse as: injured, stranded and dead fauna (e.g. penguins, turtles, seals, seal pups, crabs and birds), aquaculture and fish feeding (particularly snapper), smoke and burn-offs, jetty works, contaminated sites, pollution incidents

vessel discharges, litter on beaches, boating speeds and shark sightings.

The CSMC is proud of its reputation for dealing effectively with the concerns and queries of the public. In this way the CSMC serves a vital community service in that the officers are often able to defuse anxiety, improve awareness and correct misinformation at an early stage. The 2012 CSMC Community Forum contributed to this process.

Advice was provided to proponents and the OEPA in relation to the formal Public Environmental Review for the Mangles Bay Marina proposal. Advice was also provided on the James Point Private Port proposal and the sand by-passing undertaken at the Port Coogee Marina. The CSMC contributed to three Environmental Improvement Plans for industry, including Cockburn Cement, particularly in relation to reducing the plume that emanates from their shell sand wash plant. CSMC officers also contributed to Stakeholder Reference Groups for James Point Private Port Stage 1 and as technical liaison for the Mangles Bay Marina Project.

CSMC advice was provided on other issues including: the Sepia Depression Ocean Outfall Line (SDOOL) duplication works near Lake Richmond and Palm Beach Rockingham; the proposed East Rockingham Sewage Treatment Plant; licence renewals for local Kwinana Industry; potential impacts of industrial accidents, including the large Verve Energy spill which released approximately 520,000 litres of diesel into the environment.

Officers participated in professional conferences, workshops and seminars on diverse topics including marine natural disasters, urban ecology and forest and catchment diseases and pathologies.

Strategic

The activities of the CSMC are guided by its Strategic Plan – 2010–2015.

The Office of the Auditor General, in its 2010 report on the environmental management of Cockburn Sound, made recommendations on contaminant load assessments and environmental risk, in addition to seagrass issues. A Senior Officers Group (SOG) representing the CSMC, DEC, and OEPA commissioned a Contaminant Loads Assessment. The CSMC, DEC, OEPA, EPA, industry stakeholders and local government officers worked collaboratively to identify and assess historic and contemporary contaminant loads entering the Sound. A significant

number of data gaps have been identified. The report provides information that can contribute to future risk assessment.

Data-base development. The CSMC has more than 12 years of SEP related environmental monitoring data as well as more than 20 years of other water quality and environmental data. The establishment of a Database Management System to help the Council address the growing external demand for environmental information, as well as supporting its own analytical and reporting responsibilities, is a high priority.

Community-Investigative

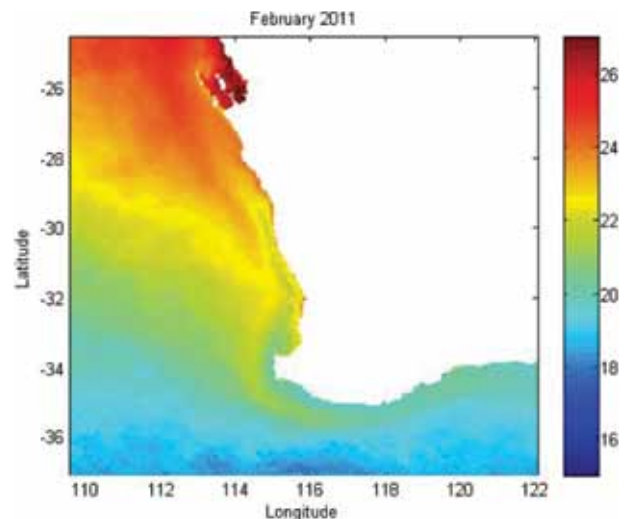
Grey Sands Investigation. The investigation looked at sediment along the beaches, submerged banks and Garden-Carnac islands. The 2011 report concluded that the greyness of the sands washed ashore along Owen Anchorage was primarily a natural phenomenon. The full report and the “Grey Sands Community Summary Report” were put on the CSMC website in 2012.



Grey Sands of Owen Anchorage Report

Heat Wave Plume (Leeuwin Current) Feb-April 2011 – Published technical paper. CSMC officers in collaboration with scientists from the School of Plant Biology at the University of Western Australia (now Ocean Institute) published a scientific paper in the international journal *Ocean Science*. This

paper, “*The 2011 marine heat wave in Cockburn Sound, southwest Australia*” in *Ocean Science*, 2012, Volume 8: 545–550 by T. Rose, D.A. Smale & G. Botting was based on a CSMC report that had been published by the Department of Fisheries. It is available online at <<http://www.ocean-sci.net/8/545/2012/os-8-545-2012.pdf>>.



Mean Sea Surface Temperature for Feb 2011 along the southwest Australian coastline. Temperatures are in degrees Celsius.

Australian Research Council Industry Linkage Grant Submission. The CSMC, with the University of Western Australia’s Oceans Institute, attracted a group of contributing industry partners to develop an Australian Research Council (ARC) grant submission. The project’s objective is to investigate the influence of warming marine waters on the settlement of organisms on hard surfaces in Cockburn Sound.

The CSMC, in collaboration with the Kwinana Industries Council, extended its research and scholarship plan to support research related to little penguins and dolphin population dynamics within Cockburn Sound and Owen Anchorage.

The CSMC has also participated in a multi-stakeholder partnership (Cockburn Sound Coastal Alliance) headed by the City of Cockburn that studies coastal vulnerability and adaptation in anticipation of expected warmer climate and sea level rising.

Community Liaison and Involvement – Natural Resource Management. The CSMC maintained active involvement with the Perth Natural Resource Management Council and with programs supported by this Council. It also worked with the Rockingham Bay Seagrass Monitoring Group (RBSMG) and the South West Reference Group which is developing an integrated NRM plan for the southern metropolitan area of Perth (i.e. catchments of Owen Anchorage and Cockburn Sound).

Introduced Marine Pests

To protect our marine environment and industries, the Australian and state/territory governments along with marine industries and marine scientists are implementing the National System for the Prevention and Management of Marine Pest Incursions <http://www.marinepests.gov.au/national_system>.

Two Introduced Marine Pests have, amongst others, already been identified within Cockburn Sound and Owen Anchorage. They include:

Sabella – The Fan Worm

Sabella spallanzanii (the Mediterranean fan worm) became established a number of years ago and is a filter-feeding tube worm that has the potential to alter native marine ecosystems and compete with native organisms for food and space. It may also inflict economic damage by competing with mussels and oysters in aquaculture farms.



Sabella
Photograph courtesy: John Polglaze

Asian Green Mussel

As an invasive species, the Asian Green Mussel is viewed as a significant threat within Australia and also has the potential to displace native mussels by introducing harmful parasites and diseases and outcompeting them. There have been recent incursions in Careening Bay at Garden Island, Henderson Common User Facility and in Jervoise Bay; however ongoing monitoring has shown that the species hasn't established itself at any of these locations.



Asian Green Mussel
Photograph courtesy: Graham Wharton

Western Australian Biosecurity

In Western Australia, the Department of Fisheries Biosecurity Unit carries out research into the distribution, identification, management and control of invasive aquatic pests.

Defence Biosecurity Management

In 2012 the Department of Defence completed the first stage of its Biosecurity and Overabundant Native Species (BONS) Management Plan for Garden Island and HMAS Stirling. At a cost of \$100,000 the comprehensive project addressed the biosecurity and overabundant native species risks which relate to Defence activities on Garden Island. In undertaking this work Defence is demonstrating its commitment to maintaining the unique environmental, economic and recreational values of Garden Island and Cockburn Sound. The main objectives of the plan are to:

- ★ Reduce the potential health and safety risks that might be associated with uncontrolled BONS on the Defence Estate and surrounding Cockburn Sound;
- ★ Minimise the potential negative impacts of BONS on Defence capability;
- ★ Ensure that management of BONS is in accordance with relevant legislation, policy codes of practice and industry lead practice;
- ★ Minimise the potential impacts of BONS on environmental values contained on the Defence Estate and other locations where Defence operates; and
- ★ Ensure that BONS management considers potential impacts on Defence neighbours such as users of Cockburn Sound.



Defence biosecurity management
Photograph courtesy Dept of Defence

In addition Defence has engaged the WA Department of Fisheries to undertake annual potential marine pest monitoring within Naval Waters around the Island and port infrastructure. The program aims to provide early detection and response to marine pests that could arrive in Cockburn Sound.

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Table I

CSMC Membership

Member	Designation	Representation	Occupation
Professor Kateryna Longley	Chair	Independent	Emeritus Professor Murdoch University
Bob Goodale	Member	Community	Past Convenor Naragebup Rockingham Regional Environment Centre
John Polglaze	Member	Community	Environmental Consultant
Bart Houwen	Member	Community-Com Net Inc	Business Manager Bendigo Bank
Professor Philip Jennings	Member	Conservation Council	Emeritus Professor of Energy Studies Murdoch University and Past President, Conservation Council of WA
Matt Gillett	Member	Reefishwest	Committee member
Glenn Dibbin	Member	WA Mussel Producers Assoc	Chair, WA Mussel Producers Association
Chris Oughton	Member	Kwinana Industries Council	Director, Kwinana Industries Council
Cr Carol Reeve-Fowkes	Member	City of Cockburn	Councillor, City of Cockburn
Cr Ruth Alexander	Member	Town of Kwinana	Councillor, City of Kwinana
Cr Richard Smith	Member	City of Rockingham	Councillor, City of Rockingham
Jarrad Scott	Member	Department of Defence	Senior Environmental Manager, Defence Support Group WA
Dr John Keesing	Member	Commonwealth Scientific & Industrial Research Organisation	Head of Marine Research CSIRO
Ian Briggs	Member	Department of Mines and Petroleum	General Manager Strategic Policy
Stefan De Haan	Member	Department of Environment and Conservation	Regional Manager Swan Region
Gino Valenti	Member	Fremantle Ports	General Manager Strategy and Planning
Laurie Caporn	Member	Department of Fisheries	Principal Management Officer
Vivienne Panizza	Member	Department of Planning	Planning Manager, Policy Coordination
Jim Dodds	Member	Department of Health	Director of the Environmental Health Directorate
Gordon Groth	Member	Water Corporation	Environmental Operations Manager
Vacant	Member	Department of Water	Vacant – to be determined

Cockburn Sound Management Council Members



Professor
Kateryna Longley,
Chair



Bart Houwen



Ruth Alexander



Ian Briggs



Laurie Caporn



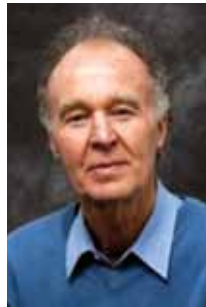
Stefan DeHaan



Glenn Dibbin



Bob Goodale



Professor
Phil Jennings



Dr John Keesing



Chris Oughton



Vivienne Panizza



John Polglaze



Carol
Reeve-Fowkes



Jarrad Scott



Richard Smith



Gino Valenti

Cockburn Sound Management Council Staff



Dr Tom Rose



Geoff Botting



Sue Stephen



Sarah Macey

Absent: Matt Gillett, Jim Dodds, Gordon Groth

Table 2 – 2012 CSMC Shopfront Customer Inquiries

Summary of CSMC related public issues

- ★ Mangles Bay Marina Public Environmental Review
- ★ Blue Swimmer Crab fishing
- ★ Blue Swimmer Crab mortality Verve Energy outlet
- ★ Port Rockingham Marina - inquires
- ★ Mooring control and gazettal
- ★ Mangles Bay swimming safety
- ★ Starfish washed up on beach
- ★ Brittle Stars
- ★ Palm Beach Jetty
- ★ Data Query – Seagrass monitoring
- ★ Data Query – Water Quality monitoring
- ★ Broken moorings Mangles Bay
- ★ ‘Lissa Solkint’ mooring Palm Beach
- ★ ‘Lissa Solkint’ sewage release
- ★ Lake Richmond Main Drain management
- ★ Port Coogee sand by-passing
- ★ Algal blooms
- ★ Seagrass at dog beach
- ★ Sub-Antarctic Fur Seals
- ★ Pink Snapper
- ★ Fishing
- ★ Bag limits
- ★ Cockburn Sound - general
- ★ Garden Island
- ★ TBT information request
- ★ Silver Gulls
- ★ CBH grain loading
- ★ Boats adrift after storms
- ★ Oil/fuel spills from moored and anchored boats

- ★ Dolphin mortalities
- ★ Dolphin entanglement
- ★ Seagrass anchor damage
- ★ Little penguin boat strikes
- ★ Foreshore car parking and storm damage
- ★ City of Cockburn query Cockburn Cement Study
- ★ Cockburn Cement dredging trial
- ★ Aquaculture contacts
- ★ Rubbish at Val Street jetty
- ★ Hazard from Sunken yacht
- ★ Yachts washed ashore Palm and Rockingham beaches
- ★ Latitude 32 native vegetation clearing
- ★ Turtle observations Cockburn Sound
- ★ Verve Energy diesel spill
- ★ Garden Island causeway works
- ★ James Point Harbour development
- ★ Palm Beach Jetty
- ★ Regional boat ramps
- ★ Aerobic/Alternative treatment units in Kwinana
- ★ Foreshore rehabilitation and weed control

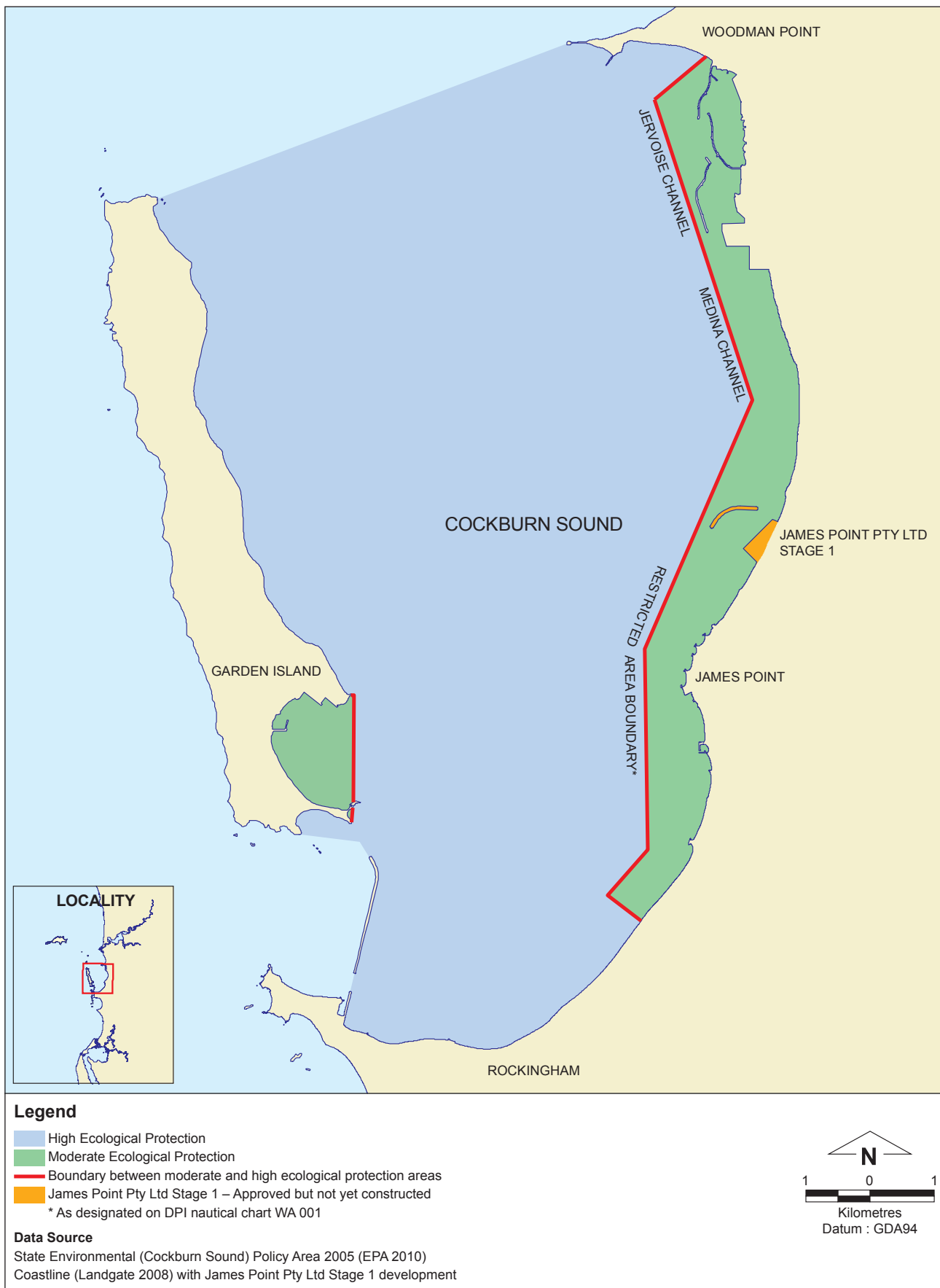
Summary of other Issues

- ★ Shoalwater Islands Marine Park/brochures
- ★ Penguin Island/brochures
- ★ Shoalwater Island Marine Park information
- ★ Magpies
- ★ Wasps in Foreshore Park
- ★ Snakes/removal
- ★ Exotic spiders at Secret Harbour
- ★ Turtle mortality Shoalwater beach

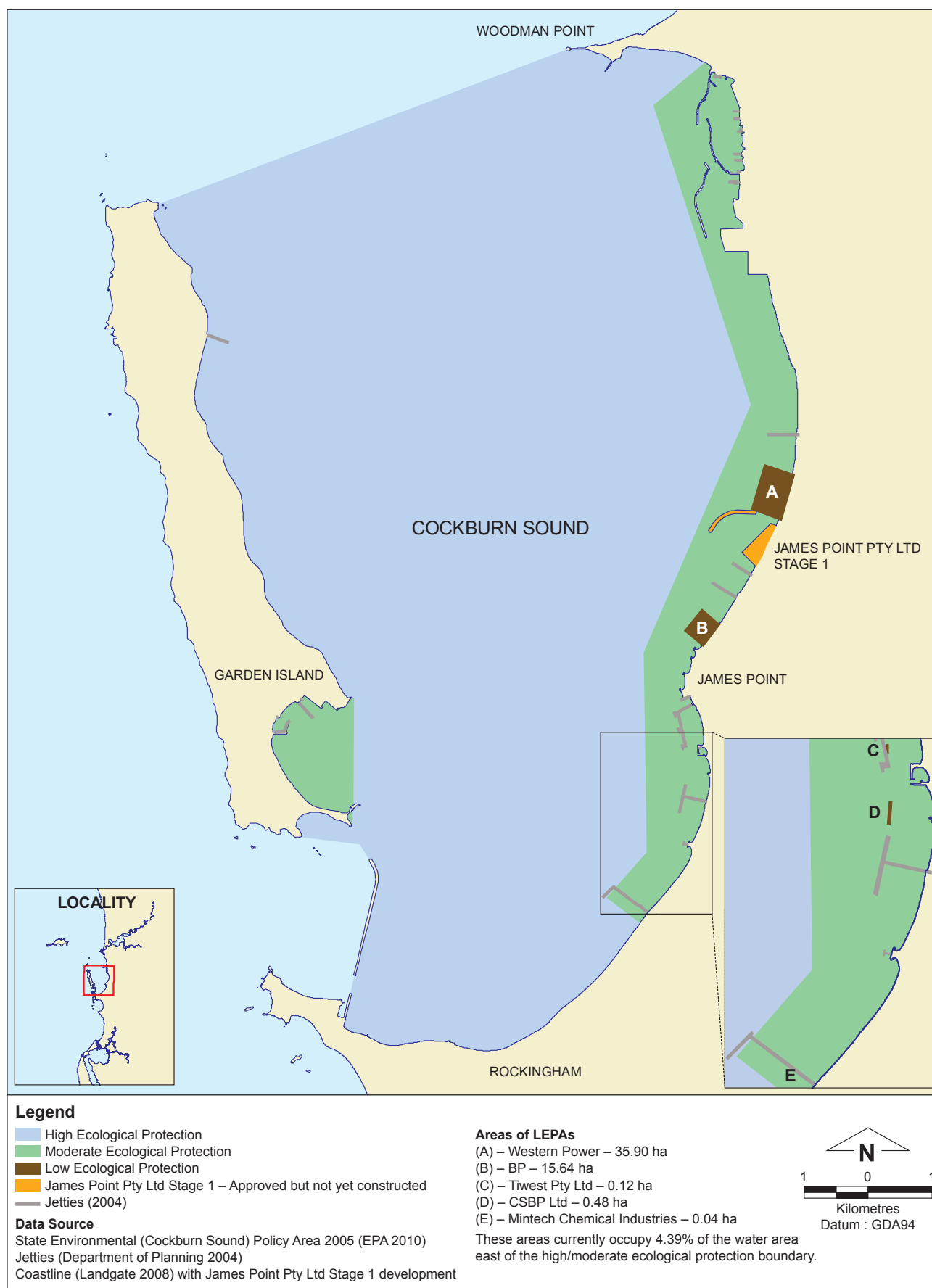
Glossary

AMC	Australian Marine Complex (Henderson)
BONS	Biosecurity and Overabundant Native Species
CoC	City of Cockburn
CoK	City of Kwinana
CoR	City of Rockingham
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSMC	Cockburn Sound Management Council
DEC	Department of Environment and Conservation
DoD	Department of Defence
DoF	Department of Fisheries
DoH	Department of Health
DoP	Department of Planning
DMP	Department of Mines and Petroleum
DoW	Department of Water
EMP	<i>Environmental Management Plan for Cockburn Sound and its Catchment 2005</i>
EPA	Environmental Protection Authority
EQC	Environmental Quality Criteria
EQG	Environmental Quality Guideline
EQMP	Environmental Quality Monitoring Program
EQO	Environmental Quality Objectives
EQS	Environmental Quality Standard
EV	Environmental Values
KIC	Kwinana Industries Council
MARZONE	Maritime Zone boundaries software based marine multiple use planning software
MCA	Mooring Control Area
MSE	Management Strategy Evaluation
OAG	Office of the Auditor General
OEPA	Office of the Environmental Protection Authority
SEP	<i>State Environmental (Cockburn Sound) Policy 2005</i>
SRT	Swan River Trust
TBT	Tributyltin (ingredient in anti-fouling paint pre 1992 for recreational vessels and 2003 for commercial vessels)
WAMPA	Western Australian Mussel Producers Association
WASQAP	Western Australian Shellfish Quality Assurance Program

Appendix I



State Environmental (Cockburn Sound) Policy 2005 Schedule 2 – Boundaries between the High and Moderate Ecological Protection Areas



State Environmental (Cockburn Sound) Policy 2005

Schedule 3 – Location, size and cumulative area of authorised Low Ecological Protection Areas



COCKBURN SOUND MANAGEMENT COUNCIL

Shop 1, 15 Railway Terrace
Rockingham Beach WA 6168

PO Box 5161
Rockingham Beach WA 6969

Telephone: (08) 9591 3837
Facsimile: (08) 9528 5387

Email: csmc@environment.wa.gov.au
Website: csmc.environment.wa.gov.au



Department of
**Environment and
Conservation**



Our environment, our future