



Government of South Australia
Primary Industries and Resources SA

POLICY REPORT

EASTERN SPENCER GULF AQUACULTURE MANAGEMENT POLICY REPORT

Supporting the Aquaculture (Zones - Eastern Spencer Gulf) Policy 2005

Hardwicke Bay (Inner) Subtidal Aquaculture Zone
Hardwicke Bay (Middle) Subtidal Aquaculture Zone
Hardwicke Bay (Outer) Subtidal Aquaculture Zone
Point Pearce Prospective Aquaculture Zone
Point Riley Aquaculture Exclusion Zone
Port Broughton Intertidal Aquaculture Zone
Port Broughton Aquaculture Exclusion Zone
Port Hughes Aquaculture Exclusion Zone
Tickera (Inner) Intertidal Aquaculture Zone
Tickera (Outer) Subtidal Aquaculture Zone
Wallaroo Subtidal Aquaculture Zone
Wallaroo Aquaculture Exclusion Zone
Woods Point Prospective Aquaculture Zone

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1. Executive Summary

This Policy Report supports the Aquaculture (Zones – Eastern Spencer Gulf) Policy 2005, ‘the Policy’. The Policy has been developed to ensure the ecologically sustainable development of aquaculture and associated activities in the Eastern Spencer Gulf region. The Policy aims to provide certainty for industry stakeholders, improve community confidence and facilitate the consolidation of existing industry and opportunities for moderate aquaculture development.

The Policy allows for the culture of molluscs in waters adjacent the west side of Yorke Peninsula, from Woods Point in the North, to Hardwicke Bay in the South (Figure 1). This area currently has 72 hectares of intertidal development and 55 hectares of subtidal mollusc aquaculture development.

Table 1: Area descriptions for aquaculture zones in the Zone Policy (ha)

Aquaculture Zone	Zone area	Current leased	Additional lease area to be made available	Total Area
Hardwicke Bay (Inner)	420	0	60	60
Hardwicke Bay (Middle)	1,053	0	60	60
Hardwicke Bay (Outer)	1,402	0	60	60
Point Pearce (P)	23,849	22	0	22
Point Riley Exclusion	9,639			
Port Broughton Exclusion	4,384			
Port Broughton Intertidal	355	65	0	65
Port Hughes Exclusion	3,422			
Tickera (Inner) Intertidal	512	0	40	40
Tickera (Outer) Subtidal	2,397	0	60	60
Wallaroo Exclusion	5,941			
Wallaroo Subtidal	2,000	320	0	320
Woods Point (P)	13,196	0	10	10
Total (P) Prospective	37,045	22	0	22
Total Aquaculture Zones	8,139	407	280	687
<i>Of which:-</i>				
<i>Commercial farming</i>		407	275	682
<i>R&D farming allocation</i>		0	5	5
Total Exclusion Zones	22,936	0	0	0

* P = Prospective Aquaculture Zones.

The Policy allows a maximum area of 682 hectares to be developed for the purpose of commercial aquaculture and an additional 5 hectares for farming for

research and development purposes, making a total of 687 hectares available for farming. The Zone Policy covers an area of approximately 197,000 hectares. The Policy establishes Aquaculture Zones covering an area of 8,139 hectares. Aquaculture Prospective Zones cover an area of 37,045 hectares and permit additional aquaculture development to be considered on merit only until the zone can be further reviewed. Aquaculture Prospective Zones may exist for a maximum of three years during which time further information must be gathered regarding potential for current or novel aquaculture. Following the three year period some or all of the zone may, following consultation, be declared an Aquaculture Zone or Aquaculture Exclusion Zone. Alternatively, the zone may lapse without specific zoning if there is no pressing case for allocating the area as suitable for aquaculture or of high conservation significance. Aquaculture Exclusion Zones cover 22,936 hectares and no aquaculture development is permitted in these Zones.

1.1 Proposed Zones

The Policy establishes the following zones (Figure 1);

- Hardwicke Bay (Inner) Subtidal Aquaculture Zone
- Hardwicke Bay (Middle) Subtidal Aquaculture Zone
- Hardwicke Bay (Outer) Subtidal Aquaculture Zone
- Point Pearce Prospective Aquaculture Zone
- Point Riley Aquaculture Exclusion Zone
- Port Broughton Intertidal Aquaculture Zone
- Port Broughton Aquaculture Exclusion Zone
- Port Hughes Aquaculture Exclusion Zone
- Tickera (Inner) Intertidal Aquaculture Zone
- Tickera (Outer) Aquaculture Zone
- Wallaroo Subtidal Aquaculture Zone
- Wallaroo Aquaculture Exclusion Zone, and
- Woods Point Prospective Aquaculture Zone.

Approval of leases and licences in these zones will be subject to requirements under the *Aquaculture Act 2001*; assessment of individual site suitability, criteria outlined in the Aquaculture Tenure Allocation Policy, ongoing environmental monitoring and other relevant plans and policies.

1.1.1 Hardwicke Bay (Inner) Subtidal Aquaculture Zone

The Hardwicke Bay (Inner) Subtidal Aquaculture Zone provides for the establishment of 60 hectares of subtidal mollusc aquaculture development. This Zone covers an area of 420 hectares.

1.1.2 Hardwicke Bay (Middle) Subtidal Aquaculture Zone

The Hardwicke Bay (Middle) Subtidal Aquaculture Zone provides for the establishment of 60 hectares of subtidal mollusc aquaculture development. This Zone covers an area of 1,053 hectares.

1.1.3 Hardwicke Bay (Outer) Subtidal Aquaculture Zone

The Hardwicke Bay (Outer) Subtidal Aquaculture Zone provides for the establishment of 60 hectares of subtidal mollusc aquaculture development. This Zone covers an area of 1,402 hectares.

1.1.4 Point Pearce Prospective Aquaculture Zone

The Point Pearce Prospective Aquaculture Zone limits aquaculture development in the region pending further investigation of suitability for aquaculture development and consultation and negotiation with stakeholders. The Point Pearce Prospective Aquaculture Zone provides for the development of 22 hectares of intertidal mollusc. At the time of this report, the area had all been allocated. This Zone covers an area of 23,849 hectares.

1.1.5 Point Riley Aquaculture Exclusion Zone

The Point Riley Aquaculture Exclusion Zone provides a one kilometre buffer for seafloor cables between Point Riley and Shoalwater Point on the Eyre Peninsula near Cowell. This Zone covers an area of 9,639 hectares.

1.1.6 Port Broughton Intertidal Aquaculture Zone

The Port Broughton Intertidal Aquaculture Zone provides for a total of 65 hectares of intertidal mollusc aquaculture development. At the time this report

was prepared, 65 hectares was allocated. This Zone covers an area of 355 hectares.

1.1.7 Port Broughton Aquaculture Exclusion Zone

The Port Broughton Aquaculture Exclusion Zone incorporates area in the Port Broughton channel that is utilised by other marine resource users. Particularly, ensuring the channel into Port Broughton does not contain aquaculture development in order to maintain clear passage for commercial and recreational fishing vessels travelling into the Port Broughton boat ramp and jetty. This Zone covers an area of 4,384 hectares.

1.1.8 Port Hughes Aquaculture Exclusion Zone

The Port Hughes Aquaculture Exclusion Zone provides buffers between aquaculture development, conflicting marine resource uses and areas of high conservation significance. This Aquaculture Exclusion Zone provides a buffer from Bird Island Conservation Park and other areas of high visual amenity. This Zone covers an area of 3,422 hectares.

1.1.9 Tickera (Inner) Intertidal Aquaculture Zone

The Tickera (Inner) Intertidal Aquaculture Zone provides for the establishment of 40 hectares of intertidal mollusc aquaculture development. At the time of this report being prepared there was no aquaculture development in the zone. This Zone covers an area of 512 hectares.

1.1.10 Tickera (Outer) Subtidal Aquaculture Zone

The Tickera (Outer) Subtidal Aquaculture Zone provides for the establishment of 60 hectares of subtidal mollusc aquaculture development. Development in this Zone must be linked to established intertidal mollusc aquaculture development in the Tickera (Inner) or Port Broughton Intertidal Aquaculture Zones. The Tickera (Outer) Subtidal Aquaculture Zone had no development when this report was prepared. This Zone covers an area of 2,397 hectares.

1.1.11 Wallaroo Subtidal Aquaculture Zone

The Wallaroo Subtidal Aquaculture Zone provides for the establishment of 320 hectares of subtidal mollusc aquaculture development. At the time this report was prepared 300 hectares of subtidal mollusc leases had been approved. An application for the remaining twenty hectares had been received. The Policy provides for the existing sites and applicants. The Wallaroo Subtidal Aquaculture Zone covers 2,000 hectares.

1.1.12 Wallaroo Aquaculture Exclusion Zone

The Wallaroo Aquaculture Exclusion Zone is established to provide clear passage for vessels into Wallaroo Port and provides a buffer around the ships mooring site and along the Wallaroo township foreshore including the North Beach area. The Zone covers an area of 5,941 hectares.

1.1.13 Woods Point Prospective Aquaculture Zone

Previous intertidal mollusc aquaculture in this area has performed poorly. For this reason, the Policy establishes a Prospective Aquaculture Zone to limit the scale and type of aquaculture development pending further investigation of the area's suitability for aquaculture. This Zone covers an area of 13,196 hectares.

2. Introduction

This policy report supporting the Zone Policy has been developed to inform and involve all stakeholders in the decision making process for aquaculture allocation in the Eastern Spencer Gulf region. The Policy will promote the orderly and efficient development of the aquaculture industry and recognises the industry as a legitimate user of the State's marine resources, providing guidance and increased assurances for access to the marine resources for the aquaculture industry.

The aquaculture industry has developed rapidly in recent years. Through its relatively large requirement for labour and material inputs, the industry has shown the potential to increase the complexity and diversity of local economies. In total, the value of aquaculture industry economic output in South Australia was estimated at over \$355 million in 2002/03. In terms of employment, 2,969 jobs were generated through the aquaculture industry including direct, downstream and flow-on employment.

Aquaculture in the Eastern Spencer Gulf region was previously managed under the Spencer Gulf Aquaculture Management Plan (PISA 1996) prepared under the *Fisheries Act 1982*. With the introduction of the *Aquaculture Act 2001*, there is a need to review these plans. This ensures many community and industry issues are dealt with during the zone planning phase rather than during the individual application process.

This policy report introduces objectives for the development and management of aquaculture resources in coastal waters adjacent to Eastern Spencer Gulf within the framework of ecologically sustainable development.

Objectives

- Objective 1: To provide for the development of a sustainable aquaculture industry in the region.
- Objective 2: To protect proclaimed conservation areas in the region.
- Objective 3: To protect historic shipwrecks and sites of Aboriginal heritage value in the region.
- Objective 4: To minimise the impact of aquaculture development on the tourism and residential qualities of the region.
- Objective 5: To minimise the impact of aquaculture development on fishing in the region.
- Objective 6: To minimise the impact of aquaculture on sensitive species and habitat in the region.

3. Benefits of aquaculture

South Australia's natural geography positions the State well to maximise the opportunities aquaculture presents. One attraction is the excellent water quality that stems from low levels of runoff as a result of low rainfalls and sparse regional population. The State's aquaculture products have a good reputation in the export markets, where a consistent supply and good quality product is able to attract premium prices.

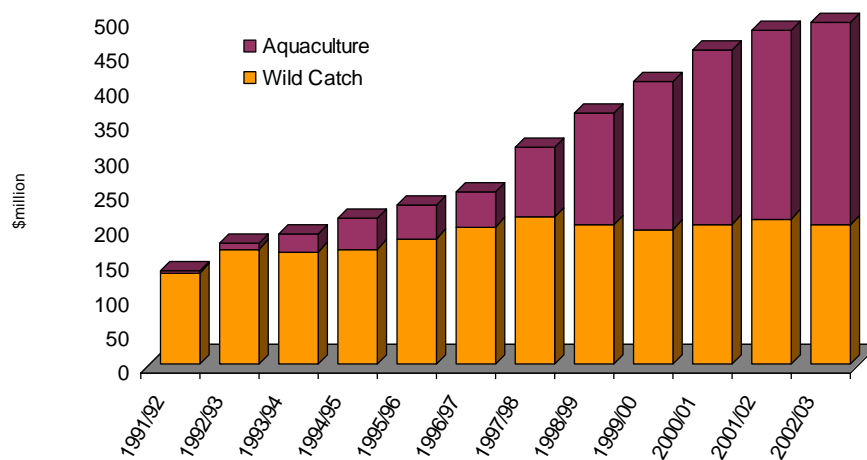
Aquaculture allows producers to plan their harvest to utilise the variability in market demand and to manage processing capacity, storage and transport

availability. To improve, maintain and protect this reputation, aquaculture must be appropriately managed to prevent potential negative interactions with the environment and to minimise conflict with other users of the waters and adjacent coast.

3.1 Economic impacts of aquaculture

The aquaculture industry plays an important role in creating wealth and prosperity for the State, particularly in regional communities (Herrera *et. al* 2004). The South Australian Seafood Food Plan estimates the seafood industry (including wild fisheries) will produce \$2 billion by 2015 (SISDC 2005). However, because the contribution of fisheries is likely to remain static, much of the growth will be met by aquaculture (Figure 2). The Policy will assist the National Aquaculture Industry Action Agenda in meeting targets of \$2.5 billion production from the aquaculture sector by 2010. South Australia produces 38% of Australia's aquaculture production and 14% of the national seafood production. This trend is reflected worldwide with expectations that, by 2030, aquaculture will produce 50% of the global seafood demand (FAO 2004). The State aquaculture industry body, the SA Aquaculture Council has produced industry targets. They estimate that by 2013, aquaculture production in South Australia will generate a farm gate value of \$650 million.

Figure 2: South Australia's seafood production trends

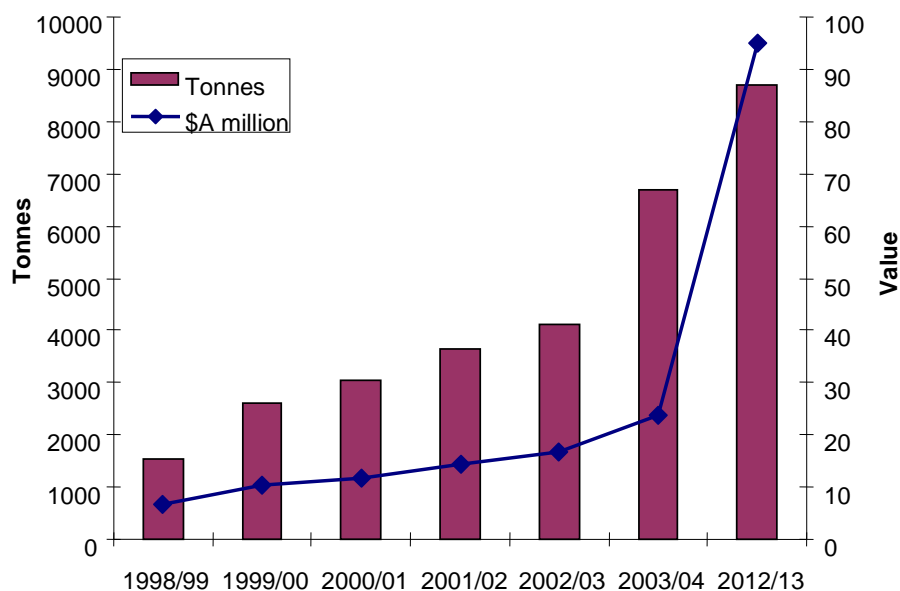


Source: PIRSA Scorecard

The value of the South Australian aquaculture industry output was estimated at over \$355 million in 2002/03, a farm gate value of \$302 million and associated direct business turnover impacts in the processing, transport, retail and food sectors of \$53 million. This activity generated further business turnover (output) of \$286 million in other South Australian industries. The value of the State's aquaculture harvest now represents over 60.5% of the State's total seafood production.

The intertidal and subtidal mollusc aquaculture sectors in South Australia currently consist of abalone, mussel and oyster production. Mussels and oysters produced a farm gate value of \$15.7 million in 2002/03, and industry targets predict a farm gate value of \$39.3 million by 2013 (Figure 3). Subtidal abalone; a relatively new sector are yet to contribute production however it is expected there will be significant revenue generated by this sector.

Figure 3: Subtidal and intertidal mollusc production trends in SA



3.2 Social impacts of aquaculture

In terms of employment 1,361 jobs were generated directly in aquaculture, 253 jobs in downstream activities and approximately 1,355 flow on jobs generated in other sectors of the State's economy in 2002/03.

The aquaculture sector can be seen to provide social benefits through jobs and additional income, which leads to improved social cohesion, increased training opportunities, additional business opportunities and improved social stability, particularly in rural and regional South Australia.

State government predictions are that, by 2016, the population on Yorke Peninsula will decline by between 7 and 11% if changes to the economic structure are not implemented (DTUPA 2000). The area is experiencing an increase in the average age and fewer young people.

The positive social impacts of aquaculture employment have been advantageous to towns such as Port Lincoln, Ceduna, Cowell and Arno Bay.

3.3 Regional impacts of aquaculture

In 2002/03 oyster farming was responsible for the direct employment of 65 people in the Yorke Peninsula region. Associated downstream activities and flow-on business activity was estimated to created employment for a further 152 jobs (EconSearch 2004).

The aquaculture industry in South Australia has developed rapidly in recent years. Through its relatively large requirement for labour and material inputs, the industry has shown the potential to increase the complexity and diversity of local economies. The demand for local labour, goods and services can help offset the contraction of other local industry and may assist in alleviating the range of economic and social pressures associated with declining regional economies.

Aquaculture development in many regions has been seen to have a positive impact through diversified training and employment opportunities and an injection of income and jobs, including new youth job opportunities, into regional areas (many of which are socially and economically disadvantaged).

The jobs on aquaculture farms require locally based, permanent and skilled staff. There is constant employment in fish husbandry, environmental management, processing, boat and net maintenance. This consistent workload balances out the peaks and troughs of the tasks and provides ongoing employment including labouring, professional, scientific or managerial positions. Workers tend to live close to their work site, providing significant social cohesion, more business opportunities and greater economic stability to the local area.

The regional impact of the aquaculture industry has, to date, been largely concentrated in the Eyre Peninsula region, reflecting the dominance of tuna and oyster farming. However, other sectors such as yellowtail kingfish, mussels and abalone have increased significantly in recent years in terms of production volume and value of production and this has resulted in the spread of benefits to other regional areas.

In addition to the regional impacts generated by recurrent expenditures in the aquaculture sector, further economic impacts are generated by the investment of profits, by aquaculture operators, in local ventures. As an example, the current profitability in the tuna farming sector near Port Lincoln underpins substantial local investment by tuna farmers in the local cannery, shipyard, marinas, property (eg hotels) and other industries (eg viticulture).

3.4 Infrastructure factors

Much of South Australia that is best suited to aquaculture development is comparatively remote from major regional centres. Hence adequate power, water, road and other transport systems are needed to support marine based industry development in the regions. Coupled with this is the need for harbour and breakwater facilities to support marine activities. As the demand for aquaculture increases, so will the need for appropriate infrastructure, which can cater for current demand and for future expansion.

The Yorke Peninsula is only a few hours drive from Adelaide and hence has ready access to airports and other transport. Marine infrastructure in the region includes commercial jetties and boat ramps at Port Broughton and

Wallaroo. The holiday settlements in the region variously have jetties and boat ramps for recreational use. The infrastructure at Hardwicke Bay is small scale and will need upgrading should significant volumes of aquaculture production occur in these zones.

Wallaroo is well serviced by wharves, boat slips and other support services. Land based hatcheries, processing sheds and boat ramps need to be as close to the Aquaculture Zones as possible, thus local planning should seek to classify an industrial zone close to the boat ramps if possible.

Access to coastal areas is deemed essential for aquaculture operators to minimise the distance between marine sites and processing or maintenance sheds. This reduces the operating costs and reduces the movement of boats and trucks through towns. Large sheds are needed for processing and require fresh water and three phase power. Subtidal farming requires infrastructure for large barges with cranes on board, wharves for loading / unloading and boat moorings.

Lack of housing has been a hindrance to the aquaculture industry and has been indentified by a number of Councils as a key blockage to the future development of the aquaculture industry (Planning SA 2003, 2005).

4. Management obligations

Management obligations are those requirements an aquaculture operator must undertake according to the *Aquaculture Act 2001* and other relevant legislation. Penalties for failures of compliance include expiation fees, fines and suspension or cancellation of licence.

4.1 Environmental monitoring and management

Environmental regulation is supported through the *Aquaculture Regulations 2005*, which prescribe details for managing waste management, chemical use and environmental monitoring and reporting.

All aquaculture developments are managed with regard to the principles of ecologically sustainable development (ESD). Accordingly, applications to undertake aquaculture are subject to a risk assessment that considers the potential environmental, social and economic risks that may arise should the operation be licensed. This risk assessment process is consistent with the PIRSA Aquaculture Environmental Management Framework and the nationally agreed ESD framework (Fletcher *et al.* 2004). The environmental risk assessment component considers the nature of the specific activity relative to the environment in which it will be undertaken at different spatial scales, namely; at the level of the individual site, at the bay or catchment level and at the regional or whole-of-industry level. Risks are ranked and adaptively managed according to their priority and complexity. Risks ranked unacceptably high require immediate modification of the application or development whereas those ranked as negligible or low may only require monitoring and reporting with a management response only necessary if levels deviate from the expected range. Developments that entail moderately ranked risks may be allowed to proceed with more frequent monitoring and reporting requirements and appropriate management responses. Each operation is required to provide an annual Environmental Monitoring Program

(EMP) report that provides information relating to those risks which require ongoing adaptive management.

For intertidal mollusc developments, the potential environmental risks tend to be limited to changes to the seafloor, 'escaped' mollusc forming feral populations and the incidence of diseases. A representative oyster farm within each growing region or bay is chosen to monitor changes to the seafloor and all licensees are required to provide information on the remaining issues via an annual EMP report. The subtidal mollusc environmental monitoring program documents any incidence of mollusc disease, chemical and medicinal usage, and interactions with large marine vertebrates. In addition, an underwater video of the seafloor is taken. The video is examined for evidence of significant biodeposition including accumulated faeces and pseudofaeces, detached mussel shells and anoxic sediments. Based on the information received annually from the farmers there is no evidence of significant environmental changes from subtidal mollusc farming.

The South Australian Shellfish Quality Assurance Program (SASQAP) provides human health protection to consumers of molluscs. Mollusc and water samples are analysed for microbiological, phytoplankton and biotoxin, heavy metal and agricultural pesticide contaminants. Bivalve mollusc produced outside the SASQAP program must not be sold for human consumption. Bivalve shellfish production must comply with the SASQAP Policy forming part of this series of aquaculture policies.

4.2 Marine mammal and other animal interactions

In this State there have been no reported incidences of negative interactions (such as entrapments or entanglements) between mollusc aquaculture operations and marine animals. The requirement to report interactions form part of licence conditions and Regulations under the *Aquaculture Act 2001*. If interactions occur then modifications to farming practices may be required.

Licensees are required to submit a Seabird and Large Marine Vertebrate Interaction Reduction Strategy, which satisfies the Minister, at the commencement of operations, as outlined in the Regulations under the *Aquaculture Act 2001*. The strategy will detail what procedures the licensee will implement to minimise the risk and manage incidences of entanglement or entrapment of seabirds, dolphins, seals, sharks and whales. Operators may be audited against the operating practices detailed in their strategy at any time. Failure to comply with the strategy may result in an expiation fee or fine.

4.3 Disease

A range of health controls are included in the management of licensed aquaculture activities. All applications for new aquaculture licences are assessed for health risks as part of the ESD assessment. Regulations under the *Aquaculture Act 2001* require that operators report to PIRSA any increases in background mortality and must not move any animals showing signs of clinical disease without Ministerial approval. Requirements designed to manage other on-farm activities are included in a variety of legislation and policy. Diseases of particular concern and those that are regarded as posing particular threats to environmental, economic or social processes are listed as notifiable under the *Livestock Act 1997* and it is an offence under that Act to fail

to report the occurrence, or suspected occurrence, of a notifiable condition. Translocation of organisms is managed through a process of Import Risk Analysis and the outcomes of these analyses, which include factors to reduce risk of disease or pest introduction and consideration of genetic integrity, are included in Orders under the *Livestock Act*, including the *Livestock (Restrictions on Entry of Aquaculture Organisms) Notice 2005*. Use of any therapeutants or treatments can be conducted only under a Ministerial approval (for off-label use as defined by the *Veterinary Practice Act 2003*) or under conditions specified by the Australian Pesticides and Veterinary Medicines Authority either on the label of registered products or included in Minor Use Permits.

Disease issues are seriously considered during the licence application stage by conducting a risk assessment that takes into consideration the culture technique, technology and specific environment of the application.

Activities that may pose a risk have risk mitigation procedures imposed and are carefully monitored, including the reporting of mortalities and translocation activities.

4.4 Exotic species and preservation of biodiversity

The most efficient and therefore economic species for aquaculture production are those that are fast growing. These may not necessarily be native species.

There are potential risks associated with the introduction of exotic species into an environment. For the protection of the aquaculture industry, and of the natural environment, controls must be maintained on the introduction and movement of aquatic organisms, bearing in mind the potential risks involved with aspects of disease and genetic manipulation. The primary concerns associated with the introduction of exotics are that they may form feral populations, which may compete for habitat and reduce the availability of nutrients to local species.

Genetically modified organisms proposed for use in South Australia would require approval by the Commonwealth Office of the Gene Technology Regulator. Other potential genetic issues are addressed as part of the risk assessment and licence application process.

4.5 Stock escapes

The escape of aquaculture stock from a site is considered during the ESD risk assessment of the application. This is the best stage to consider the level of risk presented by the species under consideration and the technology used. Consideration will be given to the source of the cultured stock and whether the species is present in the area of the farm. Regulations under the *Aquaculture Act 2001*, require operators be proactive, undertake the development of escape prevention strategies and immediately report escaped stock.

The Pacific oyster is not endemic to the South Australian marine environment but is being cultivated in many oyster leases. A native species to Japan, it was first introduced to Tasmania in the 1940's for aquaculture purposes and subsequently introduced to South Australia in 1969. Annual surveys of each oyster site monitors feral Pacific oyster numbers in South Australia. Surveys have not found established populations of Pacific oysters in the wild (Hone 1996, Madigan 1998). The establishment of Pacific oyster populations in

South Australia are likely to be limited by the low success rates of oyster larval settlement in the comparatively high water temperatures and salinity.

The Blue Mussel is now widespread across South Australia. It is believed to have been introduced to Australian waters as fouling attached to the hulls of ships and has subsequently established populations along the southern coast of Australia. Genetic evidence indicates that the most likely explanation for the southern hemisphere distribution of the species is trans-equatorial migration from the northern hemisphere to the southern hemisphere via the Atlantic during the Pleistocene (between 1.64 million and 10,000 years before present). This is supported by the presence of the species in Australian Pleistocene deposits (including examples from Kangaroo Island in South Australia).

4.6 Doing it better - research and adaptive management

Evidence based policies require robust research to inform the decision making process. As such PIRSA Aquaculture has initiated several projects with the Fisheries Research and Development Corporation (FRDC) to improve our knowledge and inform our policies, in particular, the PIRSA /FRDC Innovative Solutions for Aquaculture Planning and Management Program. This suite of projects aims to develop tools to ensure a sustainable and competitive aquaculture industry for South Australia. These tools will;

- (a) identify more effective ways to manage aquaculture
- (b) minimise the regulatory burden on industry
- (c) ensure that environmental considerations for South Australian aquaculture remain a clear priority.

Research is currently underway in the areas of;

- (a) Environmental audits of marine aquaculture – this project aims to quantify the real and perceived environmental risks surrounding aquaculture and further develop and refine environmental monitoring.
- (b) Addressing seal interactions – this project is designed to provide a better understanding of how seals behave in the marine environment and has already produced results of significant conservation value. The data gathered will allow zones to be located taking into consideration knowledge of seal habitat use around Port Lincoln and the West Coast. This project represents a considerable increase in pinniped research nationally.
- (c) Spatial impacts and carrying capacity – this project aims to further refine the mathematical modelling of carbon and nutrient deposition from aquaculture farms.
- (d) Parasite interactions between wild and farmed yellowtail kingfish – this project aims to proactively assess the risks to both wild and farmed stocks from parasite transmission.

Further projects are planned to develop environmental indicators (allowing the development of more efficient environmental monitoring programs) and also incentive instruments (to encourage participation in proactive environmental management programs).

4.7 R&D area allocation

Research into commercially related new species or technologies and improved environmental management can be hindered by delays in getting approvals

and subsequent access to suitable sites. It is frequently inconvenient or unsuitable for researchers to use industry sites for research purposes. This proposal sets aside a small area (size will be industry dependant) that is not for commercial use but will be made available solely for research purposes. A total of five hectares will be made available in any of the Aquaculture Zones, but not in the Aquaculture Exclusion Zones.

4.8 Disaster resilience

Marine based aquaculture is particularly exposed to the uncontrollable elements of the weather. Being prepared to deal with the vagaries of the weather or other disasters, natural or man made, requires foresight and planning to minimise loss of aquaculture stock from such events, and to reduce social and economic disruptions that may arise from them.

Industry must have foresight and be prepared. Foresight is the key to reducing potential costs from disasters. The government planning process must also be flexible. Planning for emergency response is included in the Aquatic Animals Chapter of the PIRSA Emergency Management Documents and various Aquavetplan Manuals.

4.9 Site decommissioning

There will be times when an aquaculture site in the zone is no longer being used. In this case the lease contract requires that the site be rehabilitated and reinstated by the lessee at the expiry of the lease. The lease also requires the operator to be party to an approved indemnity scheme or bank guarantee.

5. Policy status

This Policy Report supports the Aquaculture (Zones – Eastern Spencer Gulf) Policy 2005. The Policy has been finalised following the release and public consultation of the draft Policy in March 2005. The final Policy has been developed under the Aquaculture Act 2001 and it is intended that the Policy will be reviewed after five years. The format of the final Policy has changed slightly from that available as the draft policy due to a review of the requirements of the Act. The Zone Policy will also be recognised under the Development Act 1993.

The Policy has been designed to guide the development of an ecologically sustainable aquaculture industry within the sustainable limits of available marine resources and their existing use. The Policy is not designed as a comprehensive management framework for the protection of the whole marine environment. The Policy cannot consider all issues for individual aquaculture applications to the detail required for a complete assessment of the environmental risks of an application. Each application within a zone will be subject to an Ecologically Sustainable Development Assessment as part of the licence application process in accordance with the PIRSA Aquaculture Environmental Management Framework Policy. However, the Policy does provide certainty for developers and those concerned with broader environmental and stakeholder impacts.

5.1 Consistency

The Policy seeks to further the objectives of the State Government goals and strategies contained in the South Australia Strategic Plan and is consistent with the objectives of that Strategy. The policy was developed within the framework

of key objectives established in the South Australian Government's Food Plan and Directions for Regional South Australia. Additionally, the policy is consistent with the provisions of the *Environment Protection Act 1993*, *Native Vegetation Act 1991*, *Harbours and Navigation Act 1993* and *Coast Protection Act 1972*.

The *Development Act 1993* recognises the policies in Aquaculture Zone Policies prepared under the *Aquaculture Act 2001*. Aquaculture Management Policies will be reflected in the relevant Development Plan. This will provide for aquaculture development to be identified as an appropriate use within the relevant zone.

The Planning Strategy for Regional South Australia, January 2003, contains a number of strategies relevant to the development of the policy. In particular, the Policy is consistent with strategies relating to diversifying primary production into new areas to replace or complement existing activities and the integrated and sustainable management of natural resources in a manner that maintains ecological processes.

Australia's Oceans Policy sets in place a framework for integrated and ecosystem-based planning and management for Australia's marine jurisdictions. It promotes ecologically sustainable development of the ocean resources and encourages internationally competitive marine industries, whilst ensuring the protection of marine biological diversity. The key tool is Regional Marine Planning i.e. planning based on large areas that are ecologically similar, and seeks to integrate the use, management and conservation of marine resources at the ecosystem level.

Marine Plans establish an overarching strategic planning framework to guide State and local government planners and natural resource managers in the development and use of the marine environment. Fundamental to these Marine Plans is an ecologically-based zoning model. Each of these zones are supported by goals and objectives.

Marine Parks (or Marine Protected Areas) protect an area by managing some or all of the human activities that take place within it. Marine Park Zoning plans are designed to achieve long-term conservation of the biodiversity within a marine park, whilst providing opportunities for ecologically sustainable use. The zoning plans for each Marine Park (of which 19 are proposed for South Australia) will feature a combination of zones and special purpose areas to manage activities and uses within marine parks. Aquaculture policies will be prepared having regard to Marine Plan and Marine Park objectives and boundaries. However, consultation between the Department of Environment and Heritage and PIRSA Aquaculture continues to ensure aquaculture, and the management arrangements in place to ensure ecologically sustainable development, are appropriately recognised within Marine Parks and Marine Plans. Agreement has been reached with the Department for Environment and Heritage regarding the size, intent and position of zones in the Policy.

The Policy has been prepared having regard to the *Natural Resource Management Act (NRM) 2004*. The intent of this Act is to establish an integrated system of natural resource management that will assist in achieving sustainable natural resource management in South Australia. Both the

Aquaculture Act 2001 (and Policies prepared under it) and the NRM legislation are underpinned by ecologically sustainable development principles and are intended to complement each other. Natural Resource Management Regional Plans are required to recognise best practice by an industry sector. The *Aquaculture Act 2001* and management policies established under it provide a very good basis for managing the industry against best practice.

Relevant provisions of the Land Not Within A Council Area (Coastal Waters) Development Plan provide that aquaculture development should be undertaken in an 'ecologically sustainable way', in 'a manner which recognises the social and economic benefits to the community' and so as 'to conserve environmental quality, in particular water quality, and other aspects of the coastal environment including sea floor health, visual qualities, wilderness, ecosystems, and biodiversity'. Additionally, aquaculture should be undertaken 'in a manner which recognises other users of marine and coastal areas and ensures a fair and equitable sharing of marine and coastal resources' and minimises 'conflict between water and land based users', 'adverse impact on the visual amenity of the coastal environment and unspoilt views adjacent to the coast' and 'adverse impacts on sites of ecological, economic, cultural, heritage or scientific significance.' The Policy is consistent with these provisions in that it seeks to ensure the ecologically sustainable development of the aquaculture industry and recognise and respect other users of the marine resource.

The Policy was developed within the context of the Environment Protection Act and the Environment Protection (Water Quality) Policy 2003 (the "Water Quality Policy").

The Water Quality Policy established under the Environment Protection Act came into operation on 1 October 2003. The principal object of this Policy is to achieve the sustainable management of waters by protecting or enhancing water quality while allowing economic and social development. In particular, the Water Quality Policy requires all reasonable and practicable measures to be taken to avoid the discharge or deposit of waste into any waters or onto a place from which it is reasonably likely waste will enter any waters. The Water Quality Policy prescribes water quality criteria that must not be contravened and prohibits the discharge or deposition of pollutants into any waters that results in:

- Loss of seagrass or other native aquatic vegetation; or
- Reduction in numbers of any native species of aquatic animal or insect; or
- Increase in numbers of any non-native species of aquatic animal or insect; or
- Reduction in numbers of aquatic organisms necessary to a healthy aquatic ecosystem; or
- Increase in algal or aquatic plant growth; or
- Water becoming toxic to vegetation on land; or

- Water becoming harmful or offensive to humans, livestock or native animals; or
- Increased turbidity or sediment levels.

The Objects of the Environment Protection Act include the promotion of the principles of ecologically sustainable development and, in particular, to prevent, reduce, minimise and, where practicable, eliminate harm to the environment. Section 25 of the Environment Protection Act imposes a “general environmental duty not [to] undertake an activity that pollutes, or might pollute, the environment unless...all reasonable and practicable measures to prevent or minimise any resulting environmental harm [are taken]”. This duty is enforceable through environment protection orders. The Environment Protection Act also provides that communities must be able to provide for their economic, social and physical well-being.

The Environment Protection Act defines general offences relating to environmental harm and environmental nuisance. Environmental harm is “material environmental harm if...it consists of an environmental nuisance of a high impact or on a wide scale, it involves actual or potential harm to the health or safety of human beings that is not trivial, or other actual or potential environmental harm (not being merely an environmental nuisance) that is not trivial or it results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding \$5,000”. Serious environmental harm is defined as “environmental harm which involves actual or potential harm to the health or safety of human beings that is of a high impact or on a wide scale or other actual or potential environmental harm (not being merely an environmental nuisance) that is of a high impact or on a wide scale, results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding \$50,000.”

This Policy is consistent with the provisions of the Water Quality Policy and Environment Protection Act in that it seeks to minimise or prevent harm to the environment associated with aquaculture.

South Australia's Food Plan was developed with the objective of increasing the food industry's contribution to the South Australian economy to \$15 billion by 2010. The Food Plan identifies eight strategies to accelerate the food industry's growth. The Policy is aligned with strategies relating to market driven food exports, sustainable production and a committed government. Aquaculture Policies support the growth of the food industry – specifically the seafood industry – by allocating and managing marine tenure in which the industry can grow sustainably. In addition; the policy is consistent with the objectives of the South Australia Seafood Plan in that it seeks to consolidate existing industry and allow appropriate expansion in aquaculture production.

The South Australian Government's regional development policy 'Directions for Regional South Australia' identifies a number of objectives for regional development. The Policy is aligned with objectives relating to planning and infrastructure building, responsive government and economic generation.

The *Harbors and Navigation Act 1993* vests the seabed in the fee simple with the Minister responsible for administration of that Act. That is, section 15 (1) of the Harbors and Navigation Act vests all adjacent and subjacent land in the Minister for Transport.

Adjacent land is land extending from the low water mark on the seashore or the edge of any navigable waterway or body of water to the nearest road or section boundary, or to a distance of fifty metres from high water mark (whichever is the lesser distance). Subjacent land is land underlying navigable waters within the jurisdiction.

Under the *Aquaculture Act 2001*, plans such as aquaculture policies can be prescribed in State waters. State waters being those waters adjacent the State and territorial sea, and other navigable waters declared as such by regulation.

Matters of title and jurisdiction related to the territorial sea adjacent to the State are further addressed in the *Coastal Waters (State Powers) Act 1980*, *Seas and Submerged Lands Act 1973* and *Coastal Waters (State Title) Act 1980* of the Commonwealth.

Section 15 (4) of the *Harbors and Navigation Act* provides that “the *Crown Lands Act 1929* does not apply to land vested in the Minister under this Act but the Crown may, with the concurrence of the Minister, exercise any other power that it has to grant a lease or licence over its land in relation to land vested in the Minister under this Act.”

Part 6 of the *Aquaculture Act* provides for the grant of aquaculture leases in “State waters or State waters and adjacent land within the meaning of the *Harbors and Navigation Act*”. Section 20 of the *Aquaculture Act* provides that the grant of aquaculture leases is subject to the concurrence of the Minister responsible for administration of the *Harbors and Navigation Act*. The Policy is consistent with these provisions as they relate to the jurisdiction of the *Aquaculture Act* and the requirement for concurrence.

The *Coast Protection Act 1972* establishes the Coast Protection Board. The Coast Protection Board has a number of functions including...’to protect the coast from erosion, damage, deterioration, pollution and misuse’. The Policy is consistent with the provisions of the Coast Protection Act in that it seeks to protect the coast by minimising any risk of erosion, damage, deterioration, pollution and misuse of the resource, through appropriate siting of Aquaculture Zones and Aquaculture Exclusion Zones, the specification of appropriate types and levels of aquaculture development and the encouragement for the development of suitably located and designed infrastructure.

The *Native Vegetation Act 1991* sets out objectives relating to native vegetation in South Australia. Objectives relevant to this policy include ‘the conservation of the native vegetation of the State in order to prevent further reduction of biological diversity and further degradation of the land and its soil and the limitation of the clearance of native vegetation to clearance in particular circumstances including circumstances in which the clearance will facilitate the management of other native vegetation or will facilitate the efficient use of land for primary production.’ This Policy is consistent with these objectives in that it seeks to minimise impacts on native vegetation through

appropriate siting of Aquaculture Zones and Aquaculture Exclusion Zones around sensitive habitats.

5.2 Consultation

The Policy Report and Zone Policy has been developed with input from other government agencies, regional stakeholders, local governments and industry. Draft aquaculture policies and the related reports were referred to prescribed bodies and relevant public authorities. Following the release of the draft policy for consultation in March 2005, further public meetings were held in the local community and interested persons invited to make written submissions in relation to the draft policy. The public meeting was attended by two persons from the aquaculture industry.

Following consultation, the Minister must consult with and consider the advice of the Aquaculture Advisory Committee on all matters raised as a result of public consultation. Following approval of the draft policy by the Minister the draft policy must be referred to the Environment, Resources and Development Committee (ERDC) of Parliament. The ERDC may approve the policy, seek amendments to the policy or object to the policy. In the event that the ERDC objects to the draft policy the policy must be laid before both Houses of Parliament where it may be disallowed by either House.

6. Marine resources in the area

Detailed and independent investigations of many aspects of the area were carried out by consultants (PPK & SARDI 2002, PB & SARDI 2003) prior to the development of the Policy. The scientific reports indicated areas suitable for the various forms and classes of aquaculture.

6.1 Physical characteristics

The eastern Spencer Gulf region has a variety of coastal types including wide dune belts, limestone cliffs, rocky outcrops, tidal swamps and samphire flats. The coastline south of Cape Elizabeth consists of a wide dune belt and a small section of limestone cliffs. From Port Hughes to Cape Elizabeth a wide dune belt is present followed by eroding clay cliffs. Cape Elizabeth has rocky outcrops and ledges that extend offshore. The Bays around Wallaroo are dominated by wide dune belts followed by aelonite and limestone cliffs. Tidal swamps with mangroves and samphire flats are located in the vicinity of Warburto Point.

West and East Bird Islands are located near Warburto Point. Extensive areas of mangrove are located on the mudflats surrounding the islands. Hardwicke Bay opens to the northwest and is sheltered from westerly and southwesterly winds. The southern coastline of Hardwicke Bay consists largely of rocky coastline and cliffs extending into the sea to form rocky reefs.

The region has a Mediterranean climate with hot, dry summers and cool, wet winters. Daily maximum temperatures range between 17 and 27°C in summer and between 8 and 15°C in winter. The annual average daily temperature ranges from 11 to 21°C. Average annual rainfall is 448 millimetres (PB & SARDI, 2003).

South-easterly winds prevail in the region for most of the year with the exception of July when north-westerly winds occur (PB & SARDI, 2003).

The northern areas of the region experience low to moderate wave energy with most frequently occurring wave heights of 1.0 metre with a period of 3.0 seconds. During high wind conditions, wave heights reach approximately 2.5-3.0 metres with a wave period of 6.5-7.0 seconds. Further south some areas experience moderate or moderate to high wave energies (Petrusevics *et al.*, 1998).

The tidal range at Wallaroo is approximately 2.8 metres. The highest tides tend to occur in winter and the lowest in summer. Low tides occur on very hot days more frequently in this region than other locations in Spencer Gulf. On average one tide below 0.1 metres coincides with temperatures above 40°C and 28 tides below 0.5 metres coincide with days above 35°C annually.

The tidal pattern is semi-diurnal with a marked inequality between the two daily tides. Whilst timing of the tides is largely predictable, the tidal range is very variable due to local winds, barometric pressure and general weather patterns. A fortnightly pattern of dodge tides (days in which there is little or no tidal variation) occurs in the region.

The region has moderate to strong currents with tidal flows adjacent to Cape Elizabeth, Tiparra Reef and Warburto Point strong and irregular reaching speeds of two knots. In the vicinity of Balgowan, the western coast of Wardang Island and southern parts of Hardwicke Bay currents reach approximately 1.25 knots (Petrusevics *et al.*, 1998).

Average water temperature in the region ranges from 23.8°C in summer to 13.3°C in winter (Petrusevics *et al.*, 1998).

Salinity in the region ranges from 38.7 ppt in summer to 37.7 ppt in winter (Petrusevics *et al.*, 1998).

A mixed, intertidal red algal community grading into a mixed, subtidal *Cystophora* and *Sargassum* community dominates rocky shores in the region. Extensive subtidal seagrass meadows consisting of *Posidonia sinuosa*, *Amphibolis antarctica* and *Heterozostera tasmanica* are present at Wallaroo, Moonta Bay, Hardwicke Bay and shallow waters around Goose and Wardang Islands. Tidal swamps with mangroves and samphire flats occur at Warburto Point. Tidal mud flats occur at Bird Island and Warburto Point. Mud flats and mangroves provide an abundant food source and shelter for fish and crustacean larvae. This area is an important breeding and feeding ground for pied cormorants, crested terns, Caspian terns, Pacific gulls and silver gulls.

It is an objective of this policy to site aquaculture such that, where possible, it avoids fishing sites, high amenity areas, navigation channels and moorings and minimises disturbance to sensitive species and habitats.

Aquaculture sites require an appropriate depth of water and good water flow to maintain conditions for healthy stock. The wave height data indicates that the region is suitable for intertidal and subtidal mollusc aquaculture structures.

The water depth, tidal range, temperature and salinity are suitable for oyster growth in the intertidal development zones. Pacific oysters grow best in salinities between 30 to 35 ppt and water temperatures of 15° to 18°Celsius. Whilst the natural environment ranges indicated previously may extend beyond

these ideal parameters it has been shown that oysters can be grown successfully intertidally, especially for the on-growing industry.

The subtidal areas of the region are suitable for mussel culture. Blue mussels exhibit maximum growth within a temperature range 16° to 22°C. The offshore areas allocated to subtidal aquaculture are suited to mussel culture as they will not tolerate high water temperatures or low salinities that can be experienced in inshore waters.

Two types of aquaculture zoning are proposed in the Policy, intertidal and subtidal culture. Environmental monitoring reports indicate that changes to the benthic habitats directly under such structures are minimal. Both culture types require sites with benthic sand substrate to allow the insertion of posts that hold the longlines or racks in place. Subtidal aquaculture is regulated to ensure several metres separation between the benthic habitat and the floating structures which greatly limits any opportunity for environmental interaction with the benthos.

6.2 Current aquaculture in the area

Eastern Spencer Gulf supports an aquaculture industry consisting of 65 hectares of intertidal oyster farm leases at Port Broughton, 300 hectares of licensed subtidal mussel farms (with twenty hectares yet to be approved) at Wallaroo and twenty two hectares of approved intertidal oyster farms at Wardang Island (Figure 1). The approved leases are at various stages of development.

6.3 Oysters

Pacific oysters (*Crassostrea gigas*) are grown intertidally in South Australia using several methods; traditional rack and rail systems, the unique South Australian BST longline system or hybrid systems that suit particular growing areas. The oyster racks hold bags of oysters and are subject to the tides, spending only part of the time under water, hence the term 'intertidal'. Culturing systems differ between bays and have been developed to allow oysters the greatest access to food to ensure that the optimum meat to shell ratio is obtained.

Oysters are graded several times to minimise parasite and fouling settlement and maximise growth. South Australian oysters are sold in a range of sizes to meet customer demands. The growout time varies with size, but usually takes between 18 to 30 months.

6.4 Mussels

The mussel aquaculture industry in Australia has increased since the early 1990's. Viable businesses have been operating in South Australia, Western Australia, Victoria and New South Wales, all reliant on relatively strong market demand in Australian capital cities.

The principal species grown in South Australia is the black or blue mussel, *Mytilus galloprovincialis*. This is the same species found throughout European and American waters.

The basic mussel farming techniques that have been applied successfully in Australia do not differ greatly from those that have been used for many years in Europe and America. Although site specificities have necessitated some minor

adaptations, the techniques and practises are generally the same around the world. Typically these techniques employ a series of long-lines and 'droppers' with mussel spat being collected at sea and on-grown to market size. In South Australia, it takes approximately 12 – 18 months for mussels to reach market size (depending on site productivity).

6.5 Abalone

The main species being considered for abalone culture in South Australia are greenlip abalone (*Haliotis laevis*) and blacklip abalone (*H. rubra*). The novel nature of the industry means a variety of different technologies are expected to be used in perfecting the farming techniques. Technologies currently being trialled include the use of longlines, similar to subtidal mussel culture structures, from which cages are suspended, or utilising fish farm cages with abalone cages inside them.

Many farms are not proposing to utilise additional feed, other than the naturally growing algae on the cages. This will result in reduced potential for environmental change from excess feed. However, to support conservative planning practices, allocation of hectares has been carried out assuming the abalone farms are going to be provided with supplementary feed.

6.6 Carrying capacity and filter feeder allocation

Oysters feed on microscopic organic particles including phytoplankton (Van den Enden 1994), detritus (Quayle 1988) and protozoa (Le Gall *et al.* 1997) and rely on natural production of these nutrients. Consequently, the maximum sustainable shellfish stocking density or carrying capacity of a region is determined by the natural productivity of adjacent waters. Natural production may be derived internally or imported from surrounding waters depending on the hydrodynamics of the water body.

A number of attempts have been made in Australia and internationally to determine the carrying capacity of waterways for shellfish production. These studies have been hampered by lack of knowledge of seasonal and size related changes in energy requirements of the shellfish, seasonal changes in the productivity and feeding habits of the shellfish and the hydrodynamics of many areas (Incze *et al.* 1981). Methodological, measurement and analytical problems have been encountered with the models used to determine carrying capacity (Raillard and Menesquen 1994) and research has been hampered by the lack of long term environmental data (Crawford *et al.* 1996).

In the absence of more refined carrying capacity data, marine resources are allocated conservatively for the culture of filter feeding molluscs in South Australia and subject to continuing reviews of productivity. Declining productivity in oyster farming areas has historically been addressed by reducing total oyster density through partial relocation to new areas.

In allocating new area for filter feeders, the carrying capacity for an area is determined by modelling the nutrient availability to filter feeders (plankton and organic material) after measuring the background phytoplankton levels, water currents and depth. To minimise the potential impact on surrounding native filter feeders, only 20% of the available nutrients are allocated to cultured filter feeders, managed through prescribing a limited area for development. Of the phytoplankton allocated to cultured filter feeders, only 20% are physically able

to be consumed by the filter feeders, further limiting their ability to impact on background phytoplankton levels. In the Eastern Spencer Gulf Policy area, models were developed to predict the available carrying capacity of aquaculture areas. Based on the procedure described, it was calculated that the Tickera (Inner) Intertidal Zone could support 2.8 million molluscs and the Hardwicke Bay Zones could support 78 million molluscs. However, with a further view to conservative allocation and to encourage the progressive allocation of new areas, the zone policy allocation only provides for 400,000 molluscs in Tickera (Inner) Intertidal Zone and 2 million in the Hardwicke Bay Zones.

As discussed previously, some areas covered by the Policy have historically experienced poor oyster farming performance despite technical investigations indicating their potential for oyster farming. Applicants for lease areas should be aware of this when selecting sites.

7. Considerations for aquaculture development

Aquaculture development in Eastern Spencer Gulf region is limited by the physical characteristics of the region and other marine resource users. The Zones are located to avoid navigational channels, recreational fishing sites, conservation areas and are at least one kilometre from known commercial fishing sites.

7.1 Infrastructure

The major hindrances to aquaculture development are often the lack of supporting land based infrastructure. During early stages of industry development this may be a lack of hatcheries or some other link in the production process. As the industry matures more employment is created and pressure is then created for the provision of suitable housing for workers. Land based planning needs to address waste management issues, the movement of large boats and trucks through town sites and plan for consolidation of aquaculture ancillary activities.

7.2 Environmental quality

The ability to culture high quality, healthy aquaculture products, which are safe for human consumption and suitable for market requirements requires the best marine environmental conditions available. Substandard environmental conditions will impact the economics of a business through higher mortality rates, slower growth rates and more disease prone stock.

Substandard water quality may result from poor site selection either in terms of the species and technology requirements or the selection of areas where outside factors may have an impact.

Suitable aquaculture sites may be impacted by terrestrial pollution and nutrient input through poor land management practices leading to urban or agricultural runoff into the marine environment. With increasing levels of coastal development this is a significant risk to the aquaculture industry.

The *Natural Resource Management Act 2004* will play an overarching role in coordinating regional natural resource management (NRM) issues. These will be coordinated through the State NRM Council, and will be implemented by the regional NRM Groups. The *Natural Resource Management Act 2004* applies

to coastal waters of the State, and will address potential interactions of terrestrial resource management impacting on marine resources.

7.3 Commercial and recreational fishing

The Policy has been developed utilising the available data on commercial and recreational fishing. The central Spencer Gulf region is of moderate overall importance for the marine scalefish fishery. Approximately 15% of the States marine scalefish catch comes from this area with snapper and calamari dominating catches. Other significant commercial fisheries in the area include abalone and prawn trawling.

Rock Lobster

Southern rock lobster catch in this area is minimal. In 1994/5 and 1995/96 three and two licensed rock lobster fishers operated in this region. The Southern rock lobster fishing occurs south of Corny Point. The take data is not available due to confidentiality constraints, but it is likely to be under 1% of the total state catch. It is unlikely that farms will be located over hard substrates, so interactions between the potential farms and rock lobster fishing will be minimal.

Prawn Trawling

The areas in question occupy sections of prawn fishing blocks 37 (Tickera Zones), 45 and 48 (Wallaroo Zone), 69, 71 and 85 (Point Pearce Zone) and 86 and 95 (Hardwicke Bay Zones). The areas that are subject to development that overlap fishing areas (i.e. those areas deeper than 10m) are in the Tickera (Outer), Wallaroo, Point Pearce and the Hardwicke Bay (Inner), (Middle) and (Outer) Zones. Prawn fishers do not fish in the Tickera (Outer), Point Pearce or Hardwicke Bay Zones due to concerns about high levels of by-catch of juvenile finfish.

Area-specific impact

The Wallaroo Zone overlaps a small section of the available fishing ground. The Wallaroo Aquaculture Zone was reduced by 700 hectares from the proposed Wallaroo Shellfish Zone in the Draft Eastern Spencer Gulf Aquaculture Management Policy, to reduce the potential for overlap with current prawn trawling sites. This zone includes six approved sites totalling 300 hectares and a further 20 hectares has development approval but is currently under appeal. This additional aquaculture area represents 0.007% of the Wallaroo Prawning Region and is too small to impact the overall sustainability of the Spencer Gulf Prawn Fishery. The Hardwicke Bay (Outer) Aquaculture Zone has also been moved away from the potential prawn trawling ground, by moving the Zone South. Eastern Spencer Gulf is not a major prawn recruitment or nursery area (Carrick, 1996; Carrick, 2003) and aquaculture is managed and environmental monitoring is conducted to ensure that impacts on important juvenile prawn habitats such as seagrass are negligible. Current aquaculture practices do not have impacts on mangrove or samphire habitats that have been shown to be important for prawn recruitment (Skilleter *et al.*, 2005).

Abalone

Licensed fishers operating in a limited entry fishery with a limited Total Allowable Commercial Catch (TACC) harvest abalone in South Australia. The

statewide yearly commercial catch is around 1,000 tonnes (Mayfield and Ward, 2002). The industry is divided into three sectors, the Western, Central and Southern Zones. The Central Zone includes most of Spencer Gulf proper and is the fishery that is considered in the Policy. Median catch per unit effort (CPUE) is around 80 kg/h.

The abalone fisheries in this area form a major part of the Central Zone abalone fishery. Tippara Reef (abalone fishing blocks 21A-H) produced 31.5% of the total greenlip catch in South Australia in the 1995/6 season (Edyvane, 1999). Limited amounts of blacklip abalone are harvested in this region (under 2 tonne per year). Lesser amounts of abalone are harvested from blocks 22A (under one tonne per year, combined greenlip and blacklip catch) and 24A (under one tonne per year, combined greenlip and blacklip catch) (Mayfield and Ward, 2002). These blocks produced 9.22% and 1.89% of the South Australian greenlip abalone catch during the 1994/5 and 1995/6 seasons, respectively (Edyvane, 1999).

Area-specific impact

The Wallaroo Zone overlaps block 21H but the Policy does allow for only 20 hectares additional development in this zone. An application has been received for this 20 hectares and was granted a lease, license and development approval, but is currently under appeal. Other areas proposed in the Policy overlap with zones 22A and 24A, but it is unlikely that farms will be located over the hard substrates that are required for abalone fishing. Any abalone farms located within 1 kilometre of a wild population of abalone must source their broodstock from that population to limit the risk of farmed stock having any genetic effects on wild abalone.

Marine scale fishery

Six hundred and sixty-five licence holders had access to the marine scalefish fishery at August 2005. The sector has access to twenty nine species or groups of related teleosts, four types of crustaceans, seven types of mollusc, polychaete annelids and all species of elasmobranchs except great white sharks. Scalefish are taken predominantly by nets, longlines and lines. The total annual commercial catch of fish in the marine scalefish fishery is approximately 5,000 tonnes. Access to the commercial marine scalefish fishery is limited to holders of a Marine Scalefish Fishery Licence. Other management restrictions include closed seasons and size limits. In addition, rock lobster licence holders also have access to harvest marine scalefish stocks.

Fishing activity in Eastern Spencer Gulf includes longline fishing for snapper and whaler sharks and line and net fishing for King George whiting, snapper and squid. Marine scalefishers may also take five gummy or school sharks per trip from some areas in Eastern Spencer Gulf. The aquaculture zone areas in question occupy sections of marine scalefish blocks 23 (Woods Point, Tickera and Wallaroo Zones), block 32 (Point Pearce Zone) and block 33 (Hardwicke Bay Zones). Additional farming area is only available in the Tickera and Hardwicke Bay zones. Due to the size of the Marine Scalefish Blocks, data on the specific use of the proposed zone area is not available.

Area-specific impact

Eastern Spencer Gulf provides relatively small proportion of the marine scalefish catch. Approximately 1.43% of South Australia's total scalefish catch came from the Northern area covered by the Policy region during 1996/97. The Southern region provided 2.16% of the state's scalefish catch during 1996/97. King George whiting, tommy ruff, Australian salmon, calamari and snapper dominate catches in this area.

Most fishing for marine scalefish will be largely unaffected by the proposed changes in aquaculture activities. Commercial and recreational snapper fishers, however, actively fish the areas around the edges of aquaculture leases in other parts of South Australia (fishSA.com, 2004). It is possible that the structures associated with aquaculture provide artificial habitat for fish that are targeted commercially and by recreational anglers, although Williams (2004) showed that aquaculture pens at Fitzgerald Bay did not cause demersal species to aggregate. The Tickera (Inner) Zone was split to protect a known fishing area. The Tickera (Outer) Zone includes another such fishing area and this will be taken into account when individual licences are placed within that zone. Similar consideration will be taken into account when determining the location of sites to be licensed in the Hardwicke Bay zones.

Blue swimmer crab fishery

Fishing for blue crabs (*Portunus pelagicus*) in Spencer Gulf is managed through an Individual Transferable Quota (ITQ) management system. The take in South Australia during 2003 was approximately 380 tonnes. Blue crabs are taken in Eastern Spencer Gulf in relatively shallow waters (under 10m depth).

Area-specific impact

Blue crab and sand crab fishers may experience some decrease in area available for fishing due to the 240 hectares total increase in available area for subtidal mollusc farming and 40 hectares increase in area for intertidal mollusc farming. This area represents less than 0.5% of the total zone area and is regarded as negligible. The location of individual farming areas in these zones will take into account the activities of commercial fishers

Recreational fisheries

Participation in recreational fisheries in South Australia is not controlled and approximately 24% of South Australia's population over 5 years of age and around 29% of households participated in recreational fishing at least once a year (Henry and Lyle 2003). Take by recreational fishers in South Australia is managed through controls on devices used, size limits, bag and boat limits, closed seasons and closed areas, including aquatic reserves. Recreational fishing in Eastern Spencer Gulf centres on line fishing for King George whiting, sand flathead, yelloweye mullet, Australian salmon, snapper, garfish, tommy rough, and southern calamari. Trap fishing for blue swimmer crabs also occurs in this area.

Area-specific impact

Recreational fishing is important for the local community and tourism value of Yorke Peninsula. Recreational fishing in Eastern Spencer Gulf includes shore fishing and boat fishing for a variety of species. Subtidal mollusc farming

developments may affect recreational fishers. This impact can be assessed only on a case-by-case basis, depending on the location of individual farms.

The location of farms within the wider Eastern Spencer Gulf Zone will take into consideration the activities of commercial and recreational fishers. The limited amount of intertidal mollusc aquaculture development permitted in the Tickera Inner Zone is unlikely to affect recreational fishing. The zone has been placed to avoid areas of significance for fishing. The location of individual farming areas in these zones will take into account the activities of recreational fishers.

7.4 Navigation

The waters of Eastern Spencer Gulf are used heavily for recreational and commercial navigation. A major port is located at Wallaroo and jetties are located at Port Broughton and Moonta. Marked navigation channels are located at Port Broughton. Designated mooring sites are located at Wallaroo outside the Port boundary, and are included in the Wallaroo Aquaculture Exclusion Zone. Aquaculture should be located to minimise impacts on navigational safety. Aquaculture sites must be marked for marine safety and navigation in accordance with the requirements of the Department of Transport, Energy and Infrastructure.

There are a number of shipwrecks in the region. Four shipwrecks are located at Port Broughton, nine around Wardang Island, one at Port Victoria, two at Balgowan and two in Moonta Bay. There may be further shipwrecks that have not yet been located at Corny Point, Wardang Island and Port Victoria and around Wallaroo and Moonta Bay. Developers should consult with the Maritime Heritage Unit of Heritage SA to identify possible shipwreck locations before submitting an aquaculture application.

The aquaculture developer needs to be aware that there is legislation that protects shipwrecks and that it is an offence to interfere with, disturb, damage, or dispose of an historic shipwreck or relic, punishable on conviction of a fine of up to \$50 000 or 5 years imprisonment.

Aquaculture developers are advised that a 550 metre radius buffer zone applies around the historic shipwreck, and that no aquaculture development should take place within this area.

7.5 Tourism

The tourism industry is a significant component of the economy of Yorke Peninsula and the eastern coast of Spencer Gulf is an area of high visual amenity as well as recreational and commercial use. The Policy seeks to ensure the aquaculture industry in the region is progressed in a responsible manner that will benefit the local community with minimal impact on the other users.

There are opportunities for positive synergies between aquaculture and tourism. Tourism activities associated with the aquaculture sector, such as recreational fishing and farm tours, provide an additional source of income and employment for regional economies with a well developed aquaculture sector.

Good planning will reduce the negative conflicts between aquaculture and tourism. The Port Hughes and Wallaroo Aquaculture Exclusion Zones are

located partly to protect areas of high visual importance to coastal tourist drives, as identified by SA Tourism Commission during the consultation phase.

7.6 Indigenous heritage

There are extensive indigenous interests along the western Yorke Peninsula coast. The policy sites aquaculture development to avoid potential impacts on sensitive indigenous sites. Indigenous heritage sites in the region are located in a number of clusters along the coast. There is a cluster of twelve sites stretching from Warburto Point southwards about five kilometres along Moonta Bay. The next main cluster of sites stretches from Cape Elizabeth to Point Turton with ninety-two sites. The current high density of recorded archaeological features along this coastline suggests this area was widely used pre-European contact and it is highly likely that further archaeological investigation will identify additional sites.

PIRSA Aquaculture recognises the Narrunga people as the traditional owners of the land in the area. The Narrunga Indigenous Land Use Agreement was signed in December 2004 and deals with local government and future acts. Currently fishing and aquaculture are not being considered however, commercial fishing and potentially aquaculture may be addressed in the future. For this reason, the Point Pearce Prospective Aquaculture Zone allows a few years for the investigation of the suitability of these areas for development of Aquaculture Zones, or Aquaculture Exclusion Zones, and clarification of indigenous issues.

Applicants may wish to seek a Section 12 Determination under the *Aboriginal Heritage Act* to ensure their development does not damage or disturb an Aboriginal site that has restricted information access. Applicants are advised to contact the State Department of Aboriginal Affairs and Reconciliation, before submitting an aquaculture application.

7.7 Reserves and conservation areas

There are no marine reserves or marine parks in this area. Three Conservation Parks and one Aquatic Reserve are located in the region. There are no nationally significant wetlands within ten kilometres of the region (Morelli, 1996).

Leven Beach Conservation Park is adjacent to this region. The Park was proclaimed in 1988 to conserve remnant drooping she-ok (*Allocasuarine verticillata*). The Hardwicke Bay Aquaculture Zones are over ten kilometres away from this Conservation Park.

Bird Island Conservation Park consists of two small islands that provide an important breeding and feeding ground for bird life including pied cormorants, crested terns, Caspian terns, Pacific gulls and silver gulls. This Park is enclosed in the Port Hughes Aquaculture Exclusion Zone and is some three kilometres from the Wallaroo Subtidal Aquaculture Zone.

Wardang Island Conservation Park protects subtidal areas with diverse communities of algae, seagrasses, benthic communities and fish. A number of shipwrecks occur in the region. This park is on the register of the National Estate. This area is enclosed in the Point Pearce Prospective Aquaculture Zone.

Goose Island Aquatic Reserve was proclaimed in 1971 for scientific research and education purposes. The Reserve is connected to the northern end of Wardang Island by a submerged reef. Fishing is not permitted in the reserve, but boating, diving and swimming are permitted. This area is enclosed in the Point Pearce Prospective Aquaculture Zone.

7.8 Sensitive habitats

There are several areas along the western border of the Yorke Peninsula, that contain important biological values for the region. These sites have been identified through technical investigations, and areas for aquaculture development have been broadly zoned away from these areas.

Both Woods Point and Tickera have broad intertidal flats and salt marsh around the zones. Properly managed intertidal mollusc farms should not adversely impact on these.

Near Wallaroo, there are a number of mangroves, salt marshes and seagrass meadows of high ecological value. These habitats provide important nursery areas for a number of species.

Tiparra Reef is an extensive, seagrass-reef shoal system between Warburto Point and Cape Elizabeth. This provides excellent habitat for a diversity of marine life. No aquaculture has been planned around here and there is an exclusion zone along the coastline between Point Warburto and Cape Elizabeth.

Hardwicke Bay has some inshore rocky reefs, and the relatively rare nature of this habitat in sheltered areas in South Australia. For this reason intertidal farming has not been considered, and the area for the Inner and Middle Zones has been reduced from the Draft Eastern Spencer Gulf Aquaculture Management Policy. Fish farming has not been considered because of the presence of seagrasses and shallow water.

7.9 Protected species

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* addresses the protection of matters of national environmental significance. A search was conducted of the web site to obtain a list of the protected and threatened species that are considered to potentially occur in the region. This data is derived primarily from general distribution maps, and thus it is likely that at least some of the species listed will not occur.

Listed species fall into the following five groups:

- Seabirds, which may be adversely affected by activity around any feeding, roosting or nesting sites in the area.
- Great white shark, which some fear may become entangled in mooring lines from subtidal mollusc culture units, although this has never occurred.
- Marine mammals, including Australian Sea Lions, Blue Whale, Southern Right Whale and the Humpback Whale, which would have the potential to become entangled in nets or mooring lines. There have not been any reported entanglements of these species in shellfish culture systems in this State.
- Syngnathid fishes, many of which are likely to be present, especially in the seagrass, algal and reef assemblages. It is known that at least some seahorses are abundant around finfish cages, using them as an alternative habitat to

seagrass beds and algal assemblages. Thus it is likely that these species will not be adversely affected.

- A number of terrestrial species that may be affected by land based access to aquaculture sites, however, it should be noted that any coastal development or user of the coastal environment could have this same potential for impact. Aquaculture, by definition, is no more or less likely to have these impacts, and applications for land based activities facilities undergo a complex ESD assessment that includes consideration of coastal protection.

Data was obtained from the *Environment Conservation and Biodiversity Conservation Act 1999*, online database (www.ea.gov.au/epbc) on the 6th October 2005 using an area search with a 1 km buffer along a line from Woods Point to Hardwicke Bay.

The management of aquaculture in South Australia is designed to minimise any potential for impact on the above listed protected species. Aquaculture operators are bound by all environmental legislation including the *Coastal Protection Act*, *Environment Protection Act*, the Water Quality Policy and other environmental plans and policies. The outcomes from the Aquaculture Advisory Committee subcommittee, the Marine Mammal-Marine Protected Area's Aquaculture Working Group, found that Australian Sea Lions face a very low risk of entanglement or entrapment with mollusc aquaculture structures.

Reporting of adverse interactions with wildlife is covered by *Aquaculture Regulations 2005*, which also requires that licence holders must submit a interaction Seabirds and Large Marine Vertebrates Avoidance Strategy for approval by the Minister.

7.10 Fisheries nursery and juvenile habitats

Concern has been expressed that aquaculture could affect commercially important fisheries (such as marine scalefish or prawns) either through direct impacts on the fishing grounds or indirect impacts on the fish population. It is argued that impacts on the fish population could result from effects on the habitat or food source of any life stage of the fish. The common species of commercial concern in this area are prawns and King George Whiting. Research on adult fish assemblages in Fitzgerald Bay by Williams (2004) has suggested that fish farm structures had no detectable impact on the demersal fish assemblages.

The early life stages of fish and prawns involve larval stages where the prawns and fish live in the water column feeding on plankton. Larval prawns are filter feeders, feeding on organic detritus and plankton, for up to a month (Carrick *et al.* 2005). The food resources are naturally renewed and cultured filter feeding organisms such as oysters might be seen to compete for the limited food supply.

For prawns, these early life stages have a very low survival rate, with less than 1% surviving to two years (Tanner 2001). For aquaculture to have an effect on prawns populations there would have to be an effect over and above the greater than 99% natural mortality. This is extremely unlikely due to the distance separation and segregation of trophic competition such that the

nutrient sources for the juvenile fisheries tend to be geographically distinct from aquaculture areas.

Juvenile fish and prawns often spend part of their life cycle in inshore habitats including seagrasses and mangroves (Bryars 2004). Prawns for example may spend a year or more in the vicinity of seagrass habitat in their juvenile phase. However, they are generally found closer to mangroves (Skilleter 2005). Aquaculture sites in the area are sited to avoid these sensitive areas.

Impacts of aquaculture are further limited by the limited scale of aquaculture compared to the available feeding habitat for these species. The Policy has a maximum aquaculture allocation of 687 hectares across an area of 197,000 hectares. Additionally, the aquaculture areas and the nursery fish or prawn life stages are separated by hundreds of kilometres. In the Eastern Spencer Gulf region, larval prawns are found in the northern Spencer Gulf and can be up to hundreds of kilometres from the aquaculture zones.

In addition, to prevent the potential for adverse impacts, allocation of aquaculture for filter feeding organisms is done conservatively with respect to calculated primary nutrient productivity.

8. Aquaculture Zones

Technical investigations suggest that this region has extensive potential for aquaculture production. However, the Policy adopts a cautious approach and only limited further development will be permitted in the first instance.

While the technical investigations concluded that Hardwicke Bay could support a finfish aquaculture industry in addition to molluscs, the Policy only permits mollusc production. This decision is based largely on water depth and the moderately low current speeds in the vicinity that may not provide an efficient assimilative capacity for sustainable finfish production. These current speeds are a function of the sheltered location of Hardwicke Bay and currents will be greater in more exposed locations.

There is more area in the region physically suited to aquaculture than is being considered for Aquaculture Zones at this stage. Aquaculture development in the region has been limited by the maintenance of appropriate buffers from commercial fishing areas, sensitive habitats, conservation parks and potential indigenous interest areas.

The Policy affects waters from Woods Point in the north to Hardwicke Bay at the base of Yorke Peninsula. Current aquaculture activity in the area consists of intertidal and Subtidal mollusc development. The Policy will only allow mollusc farming in the area, and allows for an additional forty hectares of intertidal development and an additional two hundred and forty hectares of subtidal development. Aquaculture Exclusion Zones cover 22,936 hectares. Prospective Aquaculture Zones cover 37,045 hectares. These are areas where the development of aquaculture zones will be considered over the next few years with more input from additional research and investigations.

8.1 Eastern Spencer Gulf Aquaculture Zones

During consultation on the draft Eastern Spencer Gulf Aquaculture Management Policy, the area occupied by the three Hardwicke Bay Zones has been reduced in area to minimise the impact on sensitive reefs and potential

Marine Parks as identified by the Department of Environment and Heritage, and also to reduce potential impacts with the prawn trawling industry.

There are three Aquaculture Zones in Hardwicke Bay. In order to maintain orderly development, it is intended that development will occur in the Inner zone, then the Middle and finally the Outer Zone.

Hardwicke Bay is protected from southerly and south-westerly swells by the foot of Yorke Peninsula. Extensive seagrass meadows occur in inshore areas grading into bare sand with patches of platform reef in offshore areas. The area has high visual amenity and has experienced rapid growth in tourism and housing.

Technical investigations in this area indicate that it is suited to subtidal aquaculture of molluscs such as abalone, mussels and scallops. The Zones have been located away from the inshore seagrass beds, and far enough offshore to not be readily visible from the houses and shacks along the shore. At the time the Policy was prepared no aquaculture had been developed in the area.

8.1.1 Hardwicke Bay (Inner) Subtidal Aquaculture Zone

The Hardwicke Bay (Inner) Subtidal Aquaculture Zone provides for the establishment of 60 hectares of subtidal mollusc aquaculture development. This Zone covers an area of 420 hectares.

8.1.2 Hardwicke Bay (Middle) Subtidal Aquaculture Zone

The Hardwicke Bay (Middle) Subtidal Aquaculture Zone provides for the establishment of sixty hectares (60 ha) of subtidal mollusc aquaculture development. This Zone covers an area of 1,053 hectares.

8.1.3 Hardwicke Bay (Outer) Subtidal Aquaculture Zone

The Hardwicke Bay (Outer) Subtidal Aquaculture Zone provides for the establishment of 60 hectares of subtidal mollusc aquaculture development. This Zone covers an area of 1,402 hectares.

8.1.4 Point Pearce Prospective Aquaculture Zone

The Point Pearce Prospective Aquaculture Zone limits aquaculture development in the region pending further investigation. The Point Pearce Prospective Aquaculture Zone accommodates the existing 22 hectares of intertidal mollusc development in the Wardang Island and Point Pearce areas. The physical characteristics (high chlorophyll, high nutrients and high currents) of the Point Pearce Prospective Aquaculture Zone indicate that the area appears suitable for mollusc aquaculture development. However, the area has a significant concentration of sites of Aboriginal cultural significance. The primary purpose of this zone is to allow further consultation and negotiation with stakeholders including indigenous representatives. The maximum allocation for aquaculture development in this zone is 22 hectares pending further review and consultation. The Policy has effect for three years during which time further review and investigation will occur to determine if the area is suitable for development of an Aquaculture Zone or Aquaculture Exclusion Zone and to further clarify indigenous interests. The Zone covers an area of 23,849 hectares.

8.1.5 Point Riley Aquaculture Exclusion Zone

Aquaculture Exclusion Zones are developed to provide buffers between aquaculture and other marine resource uses. The Point Riley Aquaculture Exclusion Zone provides a one kilometre buffer to protect seafloor cables between Point Riley and Shoalwater Point on the Eyre Peninsula near Cowell. The Zone covers an area of 9,639 hectares.

8.1.6 Port Broughton Intertidal Aquaculture Zone

The Port Broughton Intertidal Aquaculture Zone provides for a total of 65 hectares of intertidal filter feeding mollusc aquaculture development. The licence holders for fifteen hectares have relinquished their licences, but current development approval remains on the sites.

The benthic communities of the Port Broughton Intertidal Aquaculture Zone are characterised by bare sand in the inshore areas, intermediate areas are characterised by mixed seagrass species including *Posidonia* and *Heterozostera* and offshore areas are characterised by extensive *Posidonia* meadows. The seagrass *Amphibolis antarctica* was prominent in this area until a significant die-off in 1992. Recolonisation by other seagrass species including *Zostera* and *Heterozostera* is currently occurring. The area is relatively shallow and experiences very high salinity and temperature.

The Port Broughton Aquaculture Zone provides for 65 hectares of intertidal mollusc aquaculture development. At the time this Policy was prepared, all sixty five hectares have development approval. The Zone covers an area of 355 hectares.

8.1.7 Port Broughton Aquaculture Exclusion Zone

The Port Broughton Aquaculture Exclusion Zone incorporates area in the Port Broughton region that is utilised by other marine resource users. The channel into Port Broughton has been included in the Exclusion Zone in order to maintain clear passage for commercial and recreational fishing vessels travelling into the Port Broughton boat ramp and jetty.

8.1.8 Port Hughes Aquaculture Exclusion Zone

The Port Hughes Aquaculture Exclusion Zone provides buffers between aquaculture development, conflicting marine resource uses and areas of high conservation significance. This Aquaculture Exclusion Zone provides a buffer from Bird Island Conservation Park and other areas of high visual amenity. This Zone covers an area of 3,422 hectares.

8.1.9 Tickera (Inner) Intertidal Aquaculture Zone

The Tickera (Inner) Intertidal Aquaculture Zone has broad intertidal flats approximately one to five kilometres wide. Inshore areas are characterised by bare sand, intermediate areas are characterised by mixed seagrass species including *Posidonia* and *Heterozostera* and offshore areas are characterised by extensive *Posidonia* meadows. The zone is divided to avoid fishing sites.

At the time of this report being prepared there was no development in this zone. The Tickera (Inner) Intertidal Aquaculture Zone provides for the establishment of 40 hectares of intertidal mollusc aquaculture development in the region. The Zone covers an area of 512 hectares.

8.1.10 Tickera (Outer) Subtidal Aquaculture Zone

The Tickera (Outer) Subtidal Aquaculture Zone is characterised by extensive *Posidonia* beds interspersed with large sandy patches. Water depth in the area is approximately five metres. The Tickera (Outer) Subtidal Aquaculture Zone provides for 60 hectares of subtidal mollusc aquaculture development linked to established intertidal mollusc aquaculture development in the Tickera (Inner) or Port Broughton Intertidal Aquaculture Zones. At the time of this report, there was no development in the Tickera (Outer) Subtidal Aquaculture.

Oyster farmers in the Port Broughton and Woods Point areas have historically experienced problems growing and conditioning oysters. Integrated subtidal and intertidal mollusc farming systems show considerable potential to address this problem. The primary purpose of this zone is to provide opportunities for intertidal oyster farmers in the Port Broughton, Tickera (Inner) and any potential Woods Point Intertidal Aquaculture Zones to develop integrated subtidal and intertidal oyster farming systems. Allocation of sites in this zone will be subject to applicants demonstrating satisfactory performance and development of intertidal sites in accordance with the Aquaculture Tenure Allocation Policy. The Tickera (Outer) Subtidal Aquaculture Zone provides for 60 hectares of subtidal development. At the time of this report being prepared there was no development in the zone. The Zone covers an area of 2,397 hectares.

8.1.11 Wallaroo Aquaculture Exclusion Zone

The Wallaroo Aquaculture Exclusion Zone is established to provide clear passage for vessels into Wallaroo Port and provides a buffer around the ships mooring site and along the Wallaroo township foreshore including the North Beach area. The Zone covers an area of 5,941 hectares.

8.1.12 Wallaroo Subtidal Aquaculture Zone

The Wallaroo Subtidal Aquaculture Zone is characterised by water depths of between fifteen and twenty metres. The benthic environment consists of largely bare sand and rubble grading to medium density *Posidonia* seagrass beds.

At the time this report was prepared 300 hectares of subtidal mollusc leases had been approved, and another twenty hectares had been applied for. The Policy provides for the existing leases and applicants. The Wallaroo Subtidal Aquaculture Zone therefore allows only for 320 hectares of development for the commercial expansion of the existing sites and applicants. The Wallaroo Subtidal Aquaculture Zone covers 2,000 hectares. This Zone has been reduced in area since the Draft Eastern Spencer Gulf Aquaculture Management Policy in order to reduce potential interactions with prawn trawlers in the area.

8.1.13 Woods Point Prospective Aquaculture Zone

The Woods Point Prospective Aquaculture Zone is characterised by broad intertidal flats approximately five kilometres wide. Inshore areas are characterised by bare sand, intermediate areas are characterised by mixed seagrass species including *Posidonia* and *Heterozostera* and offshore areas are characterised by extensive *Posidonia* meadows. The area is relatively shallow and experiences very high salinity and temperature.

The physical characteristics (high chlorophyll, high nutrients and high currents) of the Woods Point area indicate that the area may be suitable for intertidal mollusc aquaculture development. However, previous oyster aquaculture in this area has performed poorly. For this reason, the policy establishes a Prospective Aquaculture Zone to limit aquaculture development pending further investigation of the area's suitability for mollusc aquaculture. The Zone covers an area of 13,196 hectares.

9. Triple bottom line impact analysis

Sustainability, or triple bottom line, reporting enables a measure to be made of the economic, social and environmental performance of the aquaculture industry in the region and the effects of the zone Policy. This is important, as the aquaculture industry is a growing component of the State's economy, particularly in the area of regional development. The Policy is designed to promote balanced ecologically sustainable development (ESD).

Sustainability reporting requires all components of ESD to be understood. In the first instance this requires having some indicators to represent the three components of ESD – economic, social and environmental factors.

There is an array of indicators in the literature (GRI 2002, DPC 2005) and over time more indicators will be developed. The State Strategic Plan has some 79 indicators and the Policy will support the achievement of a number of these strategies (DPC 2004). However, not all the indicators in the literature are readily measurable. Over time our ability to report at the finer scales will improve. In the meantime, for the purpose of considering the impact of the Policy on the community of western Yorke Peninsula, simple indicators have been developed.

9.1 Economic indicators

The aquaculture industry can have significant impact through direct economic effects. For the purposes of this report, the indicator being used is the farm gate value of the aquaculture industry in Eastern Spencer Gulf. In the future reporting under economic impacts could identify the value chain impacts and include the flow-on and value-added economic impacts.

The current allocation for aquaculture sites in Eastern Spencer Gulf allows for a potential farm gate production of \$19.5 million.

9.2 Social indicators

Social indicators are the least researched factors of ESD. For this analysis direct full time equivalent jobs, household income and aquaculture resource dependency have been used. Development of future indicators may involve education levels, population impacts and other measures of social and community capital.

The current allocation in Eastern Spencer Gulf creates jobs for 54 people. The main towns affected by this policy are Port Broughton, Wallaroo and Hardwicke Bay. These towns have populations of 1473, 2720 and 1917 residents (ABS 2002) and unemployment levels of 8.7%, 13.8% and 9.8% respectively. These towns have a resource dependency on the aquaculture industry of 5.8 (Port Broughton), 3.7 (Wallaroo) and zero (Hardwicke Bay) where there is no aquaculture yet, with an average value of 3.2%. Aquaculture resource

dependency is defined as the percentage of people who are employed in the aquaculture industry (including those employed in flow-on and value added sectors).

9.3 Environmental indicators

There has been considerable research into the environmental changes associated with aquaculture and several years of results derived from the annual environmental monitoring program required as part of the operators licence conditions. Based on this information it is evident there is negligible environmental changes from mollusc farming. If this level of change was used as an indicator, reporting would remain consistently negligible. Future indicators may utilise environmental monitoring program indicators developed as the environmental monitoring programs are refined

Given an already favourable environmental performance it was decided to utilise potential conservation indices, assuming that there is a general conservation benefit from non-development of an area. The first indicator examines the area of bay under development. The second examines the area precluded from development in Aquaculture Exclusion Zones.

9.4 Presenting the balanced ESD analysis

Balanced presentation of the indicators is difficult as the value of, or the relative impact on, an indicator is not necessarily equal for all indicators. However, understanding the direction the indicator moves and the reasons why is more important to developing smart policy. The indicators have been grouped and graphed in a spider graph (modified from R. Esvelt of PIRSA Scorecard Group). This allows visualisation of the relative impacts from a number of ESD components.

The spider graph (Figure 4) demonstrates which indicators are affected by this proposed policy. By measuring along the axes, the difference between the current and the future situation can be estimated. By presenting both the current and future situation concomitantly, it is possible to identify how this proposed policy will affect the community. In this case there is little change proposed in the development, and so the current and future spiders largely overlap. The axes bear a logarithmic scale due to the degree of positive impact from the environmental indicators, and are graphed as a percent change. One hundred percent represents no change to an indicator, less than 100% represents a negative impact on the indicator and more than 100% is a positive impact on the indicator.

9.5 Economic impact

The graph demonstrates how an increase in production value as a result of the Policy translates into a positive economic gain for the region. The Policy has been designed to expand the current level of intertidal and subtidal development in the region. The current farm gate value from aquaculture production in Eastern Spencer Gulf is \$19.5 million. The Policy is estimated to increase the farm gate value by \$14.0 million, to a total of \$33.5 million.

9.6 Social impact

It is estimated there will be an increase in the number of jobs and in the household income from the Policy (Table 4). Full time direct jobs will increase from 54 to 87. Household income will experience a rise from \$2.0 million to

\$3.2 million. Resource dependency on aquaculture will also increase slightly from 3.17% to 5.73%. Port Broughton has a significant increase in resource dependency on aquaculture jobs, rising to over 14%. Wallaroo has no impact as there is no increase in aquaculture development in that Zone, and Hardwicke Bay has an increase to 2.4%.

9.7 Environmental impact

The Policy outlines a significant gain (from zero to 22,936 hectares) in the area covered by Exclusion Zones and a small increase in the area available for development of aquaculture. From a conservation perspective any minor increases in aquaculture development is balanced by the introduction of large Aquaculture Exclusion Zones.

It is important to appreciate the increase in production is commensurate with the number of jobs created and the proposed economic impact and that environmental monitoring indicates negligible environmental impact. This suggests that the proposed Policy will balance the three ESD components and that with the introduction of the large Exclusion Zone, there are significant environmental positives in the Policy.

9.8 Triple Bottom Line Summary

The spider graph shows that three indicators (economic, jobs and household income) increase under the Policy. These indicators all increase by about 60 to 70% above the current level for the region. This demonstrates that the industry is developing in a balanced manner, with most indicators progressing equally. The largest increase is an environmental gain in the area classified as Aquaculture Exclusion Zones. This area increases from zero to 22,936 ha, resulting in a marked benefit on the environmental side of the graph.

Table 4: Eastern Spencer Gulf Policy Triple Bottom Line Analysis

Economic impact	Current	New	Total
Farm gate value (\$m)	19.5	14.0	33.5
Social			
Jobs (Direct)	54	33	87
Household Income (\$m)	2.0	1.2	3.2
Resource dependency Avg	3.17		6.97
Port Broughton	5.8	9	14.8
Wallaroo	3.7	0	3.7
Hardwicke Bay	0.0	2.4	2.4
Environmental			
Exclusion Area (ha)	0	23,386	22,936
Aquaculture Area (ha)	407	280	687

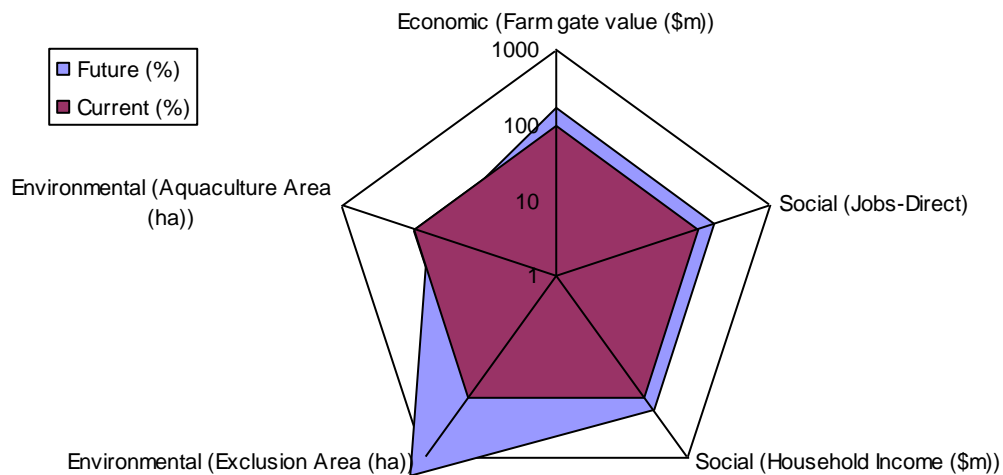


Figure 4: Triple Bottom Line Sustainability Reporting

10. References

- ABS (1997). 1996 Census of population and housing.
- ABS (2002). 2001 Census of population and housing. ABS Catalogue No. 2901.0
- Anon (2005). A guide to regional consultation for South Australian government agencies. April 2005.
- Bond, T. (1991). Murat Bay Aquaculture Management Plan. Department of Lands, Adelaide, South Australia.
- Bond, T. (1992). Murat Bay Aquaculture Management Plan – Smoky Bay Amendment. Department of Environment and Land Management, Adelaide, South Australia.
- Bond, T. (1994). Streaky Bay Aquaculture Management Plan. Department of Environment and Natural Resources, Adelaide, South Australia.
- Bryars, S. (2004). An inventory of important coastal fisheries habitats in South Australia. Report by PIRSA fish Habitat Program.
- Carrick, N (1996) Key factors which affect prawn recruitment and implications to harvesting prawn stocks. Final report to FRDC 91/3.
- Carrick, N. (2003). Spencer Gulf Prawn (*Melicertus latisulcatus*) Fishery. Fishery assessment report to the PIRSA Prawn Fishery Management Committee.
- Crawford, C., Mitchell, I. & Brown, A. (1996). Predictive modelling of carrying capacities of oyster (*Crassostrea gigas*) farming areas of Tasmania. Fisheries Research and Development Corporation (FRDC) 92/54.
- DTUPA (2000). Department for Transport, Urban Planning and the Arts Population Projections for South Australia (1996-2026) and Statistical Divisions (1996-2016) ISBN 1 8767 0234 6
- DPC (2005). Overview of the Social Inclusion Agenda. Social Inclusion Unit, Department of Premier and Cabinet, South Australia.
- DPC (2004). South Australia Strategic Plan. Department of Premier and Cabinet
- EconSearch. (2004). The Economic Impact of Aquaculture on the South Australian State and Regional Economies, 2002/03. A report prepared for PIRSA Aquaculture.
- Edyvane, K.S. (1999). Conserving Marine Biodiversity in South Australia. Part 2 – Identification of areas of high conservation value in South Australia. South Australian Research and Development Institute. ISBN 0730852490.
- FAO (2000) State of World Fisheries and Aquaculture, FAO Fisheries Department, Rome.
- fishSA.com 2004 World wide web electronic resource. www.fishSA.com July 25, 2004.

- Fletcher, W.J., Chesson, J., Fisher M., Sainsbury, K.J., and Hundloe, T.J. (2004) *National ESD Reporting Framework: The 'How To' Guide for Aquaculture*. Version 1.1 FRDC, Canberra, Australia 88 pp.
- GRI (2002). Sustainability Guidelines, Global Reporting Initiative 2002.
- Henry, G.W. & Lyle, J.M. (2003) The National Recreational and Indigenous Fishing Survey. FRDC Project No. 99/158. 188 pp.
- Herrería, E. , Woodhead, A, Tottenham, R, Magpantay, C. (2004). Social profile of people employed in the Agriculture, Forestry and Fishing industries Rural Industries Research and Development Corporation Publication No 04/122.
- Hone, P. (1996). Summary of existing data collected for the Shellfish Environmental Monitoring Program 1992 to 1994.
- Incze, L.S., Lutz, R.A. & True, E. (1981). *Modelling Carrying Capacities for Bivalve Molluscs in open, suspended-culture systems*. Journal of the World Mariculture Society, 12: 143-155.
- Le Gall, S., Hassen, M.B. & Le Gall, P. (1997). Ingestion of a bacterivorous ciliate by the oyster *Crassostrea gigas*: protozoa as a trophic link between picoplankton and benthic suspension feeders. Marine Ecology Progress Series 152: 301-306. Western Zone Abalone (*Haliotis laevis* & *H. rubra*) Fishery 2. Region B. Fishery Assessment Report to PIRSA Fisheries.
- Madigan, S and Clarke, S. (1998). Oyster Environmental Monitoring Program. Water quality and feral oyster monitoring field trips June to August 1998.
- Mayfield, S & Ward, T.M. 2002 Abalone (central zone). Fishery Assessment Report to PIRSA Fisheries Policy Group 2002/02b. SARDI Aquatic Sciences, Adelaide.
- Morelli, J. & de Jong, M.C. (1996). *A Directory of Important Wetlands in Australia – South Australia*. Australian Nature Conservation Agency, Canberra.
- Oceanique Perspectives. (1995). Simulation of water movement in Smoky Bay south Australia. Report to PIRSA.
- Parsons Brinckerhoff and South Australian Research and Development Institute. (2003). *Technical Review for Aquaculture Phase 2. Volume A - Upper Spencer Gulf*. Report prepared for PIRSA Aquaculture.
- PPK & SARDI (2002). *Technical Review for Aquaculture Phase 1*. Report prepared for Primary Industries and Resources South Australia Aquaculture. By Pak Poy Kneebone & South Australian Research and Development Institute.
- Petrusevics, P. (1995). *Simulation of Water Movement in Murat Bay, South Australia*. Oceanic Perspectives, Adelaide, South Australia.
- Petrusevics, P., Noye, J., Harbison, P. & Petrusivics, A. (1998). *Key sites for off-shore Aquaculture development in South Australia*. Primary Industries and Resources South Australia Aquaculture Group, Adelaide.
- Planning SA (2003). Planning Amendment Report for Arno Bay Explanatory Statement. By District Council of Cleve.

- Planning SA (2005). Draft Planning Amendment Report for Smoky Bay Explanatory Statement. By District Council of Ceduna.
- PISA (1996). *Spencer Gulf Aquaculture Management Plan*. Primary Industries South Australia.
- PISA and DENR (1996). *Streaky Bay Aquaculture Management Plan*. Primary Industries South Australia and the Department for Environment and Natural Resources.
- Primary Industries and Resources South Australia Scorecard Team. (2005). Performance of South Australian Seafood Industry.
- Quayle, D.B. (1988). *Pacific oyster culture in British Columbia*. Canadian Bulletin of Fisheries and Aquatic Sciences 218.
- Raillard, O. & Menesguen, A. (1994). An ecosystem box model for estimating the carrying capacity of a macrotidal shellfish system. *Marine Ecology Progress Series* 115: 117-130.
- SARDI (2004). Fishing production statistics. South Australian Research and Development Institute By South Australian Research and Development Institute. Accessed at www.sardi.sa.gov.au 12 September 2004.
- SATC (2003). Eyre Peninsula – Regional Profile. By South Australian Tourism Commission.
- SIDSC. (2005). *SA Seafood Food Plan 2005-2015*. Seafood Industry Development Steering Committee
- Skilleter, GA, Olds, A, Loneragan, ND, Zharikov, Y. (2005). The value of patches of seagrass to prawns depends on their proximity to mangroves. *Marine Biology* 147(2): 353-366.
- Van den Enden, R. (1994). The role of phytoplankton in the diet of juvenile and adult Pacific oysters (*Crassostrea gigas*) cultured in Little Swanport Lagoon. Honours Thesis, University of Tasmania.
- Williams, K. (2004) An investigation into the effect of finfish aquaculture on the demersal macrofauna in Fitzgerald Bay (Spencer Gulf, South Australia) using remote underwater video. Honours thesis, Flinders University of South Australia.
- Wilson, J. (1989). Coffin Bay Waterways Land Tenure Management Plan. Department of Lands, South Australia.