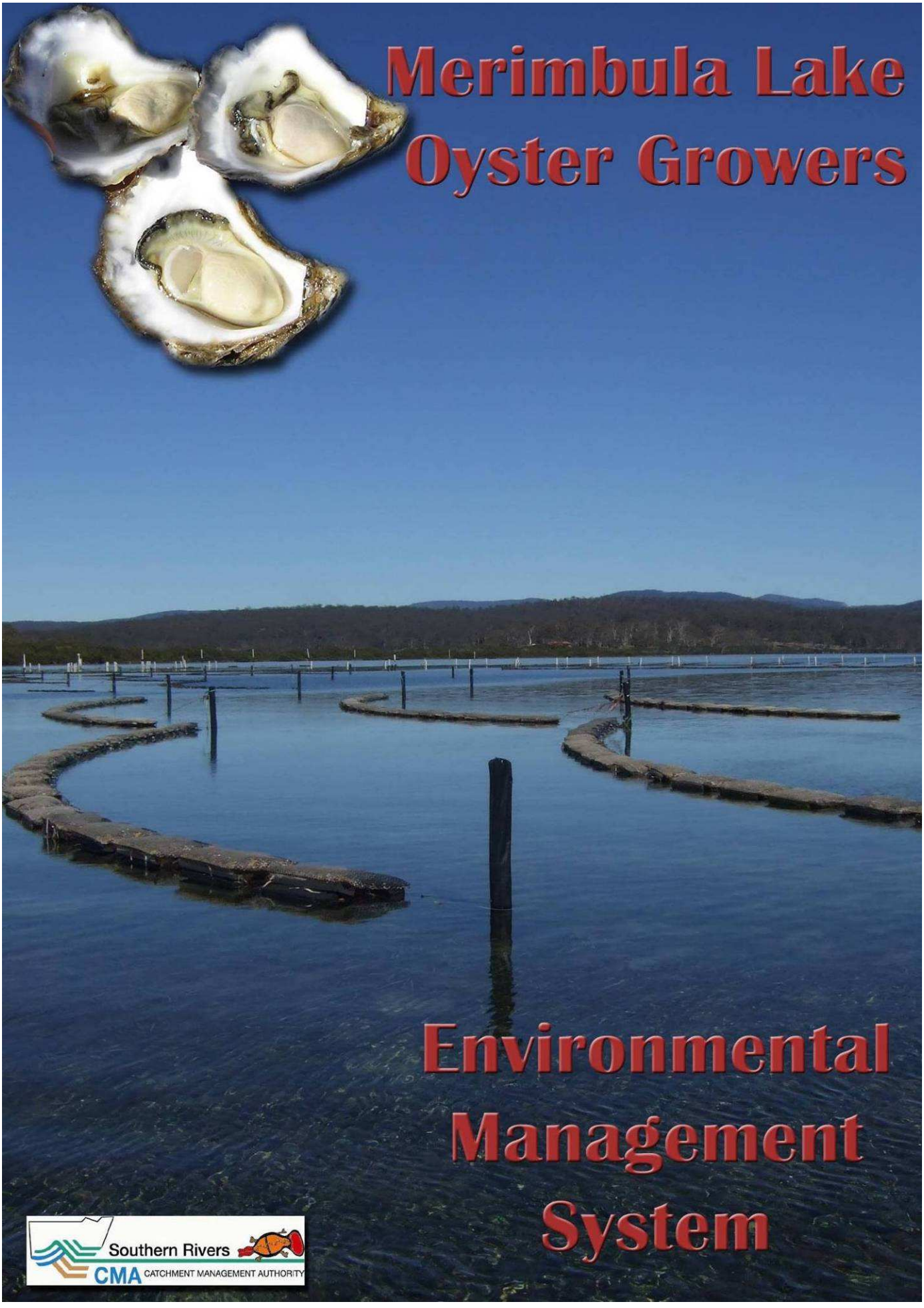
Merimbula Lake
Oyster Growers
Environmental
Management
System
Southern Rivers
CMA
CATCHMENT MANAGEMENT AUTHORITY

ENVIRONMENTAL MANAGEMENT SYSTEM -2010/2011 REVISION STATUS

OWNER	Merimbula Lake Oyster Growers	REVIEW INTERVAL	Every AGM (~1yr)

Rev No	Date	Description of Revision	APPROVALS	
			Originator	Checked by
0	Apr 2010	Draft sent to SRCMA for review	Ana Rubio	Helen Davies
1	Jul 2010	Draft sent to Merimbula Lake Oyster Growers for review	Ana Rubio	MLOG
2	Jul-10	Review of Action Table by MLOG	Helen Davies	MLOG
3	June-11	Finalisation of document	Helen Davies	Angelika Erpic
4	Jul-11	Review of Action Table by MLOG	Helen Davies	MLOG

Citation:
Merimbula Lake Oyster Growers (2010) Merimbula Lake Oyster Growers' Environmental Management System. A report prepared by Dr A. Rubio (Environmental Consultant) for Southern Rivers Catchment Management Authority on behalf of the Merimbula Lake Oyster Growers. 48 pages

Special note: The term 'Merimbula Lake Oyster Growers' refers to those growers who have undertaken this EMS process and are committed to undertake best practices in the management of their local industry in order to maintain and improve the health of Merimbula Lake.

Merimbula Lake Oyster Growers may be referred to in the document as MLOG.

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1 EXECUTIVE SUMMARY

Vision:
To ensure a growing, profitable and sustainable oyster industry through environmentally friendly, socially responsible and innovative management benefiting the whole community.

Aquaculture, which includes oyster farming, is playing an increasing role in meeting the growing global demand for food security in the form of high protein fishery products. As a result, it is of the utmost importance to minimise impacts of oyster farming on the environment to guarantee the industry's long term survival. Increased pressure on coastal industries is also occurring as a result of increased coastal development and recreational use of waterways. The Merimbula Lake Oyster Growers would like to strengthen their position through the implementation of an Environmental Management System (EMS) to ensure the protection and maintenance of the optimum environmental conditions required for oyster production.

This EMS is a structured system designed to help the Merimbula Lake oyster industry ensure minimal or no detrimental impact on the catchment's environment through best practices in all its operations. Catchment activities have also been considered and actions developed to reduce potential impacts.

One of the key reasons for the adoption of an EMS by the Merimbula Lake oyster industry is the potential for future environmental degradation of the Merimbula catchment particularly in relation to water quality. This stems from increasing human population in the area, an increase that commonly results in increased nutrient loads and sedimentation levels in waterways, both of which are detrimental to the overall health of the lake, including the oysters.

Oyster farming has a positive impact on the lake that Merimbula Lake Oyster Growers would like to promote among the local community and lake users, for example:

- Oyster cultivation is an ecologically sound form of farming because, in contrast to fish farming, oysters do not require artificial food sources, feeding instead on particulate matter available in the water column. Oyster growers therefore rely fully on the natural environment to supply nutrients and food particles, together with sunlight, to produce the optimum food mix on which oysters thrive.
- Oysters gather their food by filtering large volumes of water from the waterways. This filtration capacity helps to clean the water by removing particulate matter, enhancing water clarity and promoting seagrass, saltmarsh and mangrove health. Oysters are the 'canaries' of the waterways – if the oysters are healthy, it indicates the waterways are healthy.
- Oysters are not only delicious they are considered to be one of the most nutritionally balanced foods available, containing an extensive range of vitamins, minerals and omega-3.

The presence of an oyster industry in Merimbula Lake indicates that the lake is healthy. Oyster growers monitor the quality of the water and the oysters and their diligence means that any unexpected pollution entering the lake can be identified and managed promptly. This ensures that lake water is clean and safe for other users of the lake including fishers, swimmers and of course, oyster consumers. Oyster growers play an important role as stewards of the local environment but the community also needs to play its part to help maintain the health of the water and therefore, the oyster industry. Hence it is important for the community to keep in mind that activities in the catchment can have an impact on other users, in particular local oyster growers.

The aim of this EMS is to identify risks to the industry, develop and implement actions to minimise their impact, and ensure that the actions are having their desired effect. As part of the EMS process, the growers undertook a risk assessment in which industry-related and external risks were identified and prioritised. As a consequence, growers developed an action plan to address the high risk activities impacting on the sustainability and therefore long-term tenure of their industry. Merimbula Lake Oyster Growers are now working to manage directly or assist with management of high risk activities through the following actions.

For industry-related activities:

- Upgrading oyster cultivation infrastructure by using environmentally-friendly materials.
- Adopting best practice cultivation methods to ensure that no overstocking of oysters occurs, thereby minimising the potential impact on the sediment under farms.
- Negotiating new agreements with the Land and Property Management Authority to increase the length of tenure for oyster land-based sites, providing more security for growers.
- Improving communication between growers in order to combine effort and strategies for improving product-value, community education and marketing.
- Improving communication with the local community and other stakeholders to increase awareness of the nature of the oyster industry and its role in environmental management.

For external activities:

- Appropriately managing and maintaining unsealed roads in the catchment to reduce run-off and sedimentation of waterways.
- Minimising deterioration of water quality as a result of sewage pollution (septic tanks and private camping) and urban stormwater, increased nutrient loads (horticultural and agricultural products) and fine sediments in run-off (from forestry activities and/or land clearing).
- Monitoring hydrological changes in the lake, including changes at the lake's entrance.
- Reducing the frequency of mooring on oyster leases by recreational fishers and lake users, an activity that damages infrastructure.
- Minimising boat wash which results in shore erosion thus impacting on fragile cultural heritage sites as well as oyster industry infrastructure.

The NSW Oyster Industry is a significant and developing aquaculture industry which relies on the maintenance of good water quality and other environmental standards for its success.

Help us maintain the health of Merimbula Lake!

For more information please contact the Merimbula Lake Shellfish Quality Assurance Program Coordinator, Stirling Cullenward on 6494 3347

2 ACKNOWLEDGEMENTS

The Environmental Management System (EMS) coordinator would like to acknowledge the outstanding effort that has been made by the Merimbula Lake Oyster Growers (MLOG) in developing this EMS. Additional thanks to all who were approached by the EMS coordinator, and who gave their time and support as they became involved in various activities in the catchment to support this process.

The project was funded by the Australian Government's Natural Heritage Trust through the Southern Rivers Catchment Management Authority (SRCMA) as part of their Oyster Industry Partnership Program. The project was initiated by Helen Davies, whose essential role in looking after the catchment and its users has been acknowledged by oyster growers and other stakeholders in the catchment.

3 MERIMBULA LAKE GROWERS COMMITMENT TO AN EMS

Vision: ***To ensure a growing, profitable and sustainable oyster industry through environmentally friendly, socially responsible and innovative management benefiting the whole community.***

For the purposes of the EMS, Merimbula Lake Oyster Growers (MLOG) includes all growers listed in Appendix 1. These members agree to uphold their responsibilities under the environmental policy and action plan described in this EMS.

Oyster growers in Merimbula Lake share aquatic and land resources with many other users through activities including water sports, fishing, forestry, tourism, and cultural and historical activities, or by simply living in the same catchment. All users of the environment have some effect on it. They can also impact on each other's activities which can result in positive or negative relationships. Consequently, it is important to be aware of the potential cascade effect that some users and activities might have on others within the same catchment. For instance, an activity in the upper catchment of a river could potentially have a significant impact on the downstream lake, hence the need for a precautionary management system such as this EMS.

Like many other sectors of the seafood industry, oyster farming in NSW is moving towards greater efficiency and optimal, environmentally-friendly systems. MLOG agreed to implement an EMS in Merimbula Lake to ensure professional and environmentally responsible management of their industry and to demonstrate to the wider community their commitment to sustainability.

3.1 Need for an EMS

Increasing levels of coastal development and recreational use of waterways increases pressure on coastal industries. By implementing an EMS, MLOG have set out best environmental and industry practices in oyster cultivation, identified potential impacts on the health of the catchment and provided a means of monitoring and protecting water quality within Merimbula Lake. Described in this report is the means to formally demonstrate the oyster industry's resource management capability to regulatory agencies, oyster processors, consumers and the general community. The EMS also promotes the industry's role as a legitimate and responsible user of public waterways.

Oysters as indicators of water health

> If NSW coastal waterways are fit to support oysters which are healthy for consumers, they will pass muster on any more general water quality grounds. (ACIL, 1997)

Diminishing world wild caught fisheries together with rapid growth in the global population has led to a reliance on aquaculture to meet growing world demand for fish protein. Consequently, best practice and sustainable development in aquaculture, including oyster farming, needs to be ensured.

Oyster farming has a number of positive outcomes and benefits, including:

- It results in an ecological product (3.1.1.1)
- Oysters are the 'canaries' of the estuaries (3.1.1.2), ecosystem engineers (3.1.1.3) and a 'green' product (3.1.1.4)
- Increases in employment in rural/regional areas (3.1.1.5).

3.1.1.1 Ecological product

Oyster cultivation is potentially one of the most sustainable forms of aquaculture because, in comparison with fish cultivation, it uses species with a low trophic position in the aquatic food web and does not require artificial food input as the animals extract their nutrition principally by the filtration of microscopic particles available in the water column (e.g. phytoplankton – microscopic plants and organic detritus). That is, oysters only feed on what is available in the water column in the oyster growing area. These food components are produced in the lake based on the natural resources available in the catchment, waterways sediment and shore line vegetation, in addition to the local biological, physical and chemical characteristics of the oyster cultivation area.

3.1.1.2 Oysters - the 'canaries' of the estuaries

Oysters are very sensitive to changes in the physical and chemical characteristics of the water, and as key indicators of the health of aquatic systems have been referred to as the 'canaries' of the estuaries: if oysters are healthy, it indicates that the waterways are also healthy, just as canaries indicated the health of the air of underground mines in days gone by.

3.1.1.3 Oysters as ecosystem engineers

Oysters have been described as ecosystem engineers due to their massive filtration capacity (Margalef, 1968). It has been estimated that on average, a cultivated Sydney Rock Oyster (SRO) can filter approximately 0.5 megalitres of estuarine river water and remove large quantities of suspended matter in its lifetime (White, 2001). As a result of their filtration capacity, oysters can clean the water, enhance water clarity, promote seagrass growth and accelerate nutrient recycling processes in a lake. Oysters are therefore important organisms in connecting processes in the water column and in the substrate/sediment by consuming suspended particles from the water column and depositing wastes and unwanted material in the sediment.

As a result of oyster feeding mechanisms and metabolic processing of food particles, oysters excrete dissolved inorganic and organic waste back into the water column, and therefore are a major component in the recycling of essential elements in the areas in which they grow. The importance of oysters to the biological and chemical dynamics in coastal areas is widely recognised (Dame & Olenin, 2005).

3.1.1.4 'Green' product

One of the benefits from implementing an EMS is that oyster growers will be able to maintain and improve market access through a form of 'eco' or environmental labelling. The EMS confirms that oyster farming in Merimbula Lake is low impact and that growers aim for environmentally sustainable practices. This reinforces the clean, green image of the industry which in turn improves the oyster industry profile. MLOG will aim to maintain close ties with the community, in particular with commercial partners such as processors, wholesalers and retailers, promoting the oyster farmers' environmental policy and updating them with progress on the EMS and its outcomes.

3.1.1.5 Increases employment in rural/ regional areas

As an indicator of employment potential, the historical Sydney Rock Oyster industry directly employs about 800 people, more than any other form of aquaculture in Australia. While the oyster industry has experienced a decline in production since the mid 1970's, it has stabilised and is set to achieve a sustainable annual production of 120,000 bags of premium oyster products by 2013 (NSW Department of Primary Industries, 2006).

As an employer, the oyster industry in the Bega Valley Shire is of high economic and social importance in spite of threats from a range of environmental factors to the viability of the industry in some other areas of NSW. The industry is widely spread across six estuaries, from the south to the north of the Bega Valley Shire, and therefore provides valuable employment and economic opportunities to a large area. The long-term viability of the local industry can be improved, and this is slowly occurring through better farming practices, advances in technology, more capital input, expansion of the Sydney Rock Oyster market and protection of local water quality (Chen, 2006). Hence the importance of this EMS for Merimbula Lake.

3.2 Aims of the EMS

The development of this EMS project has been a valuable learning experience for all involved and has brought together most of the individual oyster enterprises to form a powerful and committed group representing the Merimbula Lake oyster industry.

This MLOG Environmental Management System aims to:

- Manage the identification and adoption of new techniques and technologies to continually improve operations in a sustainable and responsible manner;
- Document how MLOG are meeting their responsibilities to operate sustainably;
- Provide a basis for MLOG to communicate and cooperate with natural resource managers and the community on the environmental management of oyster cultivation, Merimbula Lake and its catchment; and
- Provide a 'living' document that can be reviewed and updated at each Annual General Meeting to address and manage new risks and opportunities.

3.3 National ecologically sustainable development framework for aquaculture

As a result of the impacts of unrestrained economic growth and development on the environment, principles of sustainable development have been developed and described as: *today's needs which are met through current industry practices* (that*) should not compromise future needs* (Fletcher*, et al.*, 2004). The Merimbula Lake and Estuary Management Plan and the NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS) (NSW Department of Primary Industries, 2006), integrate the principles of ecologically sustainable development (ESD),

community expectations and the needs of other user groups in the management and operation of the NSW oyster industry. Consequently, MLOG continue to adopt and benefit from the principles of ESD by incorporating both the management plan and OISAS in this EMS.

3.4 EMS Scope

The scope of this EMS is limited to the:

- Environmental aspects of the operations of the MLOG; and
- Catchment activities in which the MLOG are involved, particularly activities undertaken in collaboration with other stakeholders, directed towards the improvement of the health of the catchment and the enhancement of the environmental quality of the Merimbula waterways and lake.
-

Future revisions of the EMS may broaden this scope to cater for wider issues such as OH&S and management protocols if required, and/or become more detailed concerning specific matters such as requirements towards international certification.

3.5 EMS in relation to other management mechanisms

This EMS is designed to complement the existing policies and laws that control or guide oyster farming and natural resource management in NSW, as follows:

- *Fisheries and Oyster Farms Act 1935*
- *Fisheries Management Act 1994*
- Fisheries Management (General) Regulation 2002
- New South Wales Oyster Industry – Sustainable Aquaculture Strategy (OISAS, by NSW DPI Fisheries)
- State Environmental Planning Policy 62
- *Environmental Planning and Assessment Act 1979*
- *Environment Protection and Biodiversity Conservation Act 1999*
- Environment Protection and Biodiversity Conservation Regulations 2000
- *Threatened Species Conservation Act 1995*
- *Crown Lands Act 1989*
- *Protection of the Environment Administration Act 1991* (for ecologically sustainable development)
- *Food Act 2003*
- Southern River Catchment Action Plan (developed by the Southern Rivers CMA)
- *Coastal Protection Act 1979*
- *Coastal Protection and Other Legislation Amendment Act 2010*
- Merimbula Lake Estuary Management Plan
- All other Codes and Policies adopted by Council relating to the development of land in the Bega Valley Shire

Details on the development of the EMS including the process undertaken are provided in Appendix 2.

4 OVERVIEW OF MERIMBULA LAKE AND CATCHMENT

Coastal oyster growing lakes are in the transition zone between terrestrial and marine environments and are among the most biologically productive and ecologically important ecosystems. Understanding the source of coastal ecological impacts is imperative to the conservation and future management of coastal lakes and local industries.

Nutrients in these coastal growing lakes are derived from natural ecological events such as upwelling, run-off, litter fall, storm events and weathering. In many cases it is also a result of human activities such as sewage outfalls, leaching of nitrogen and phosphorous from cleared land, stormwater, industrial and agricultural run-off etc. Different catchment land uses can have different levels of impact on the lake ecosystem, particularly on the environmental characteristics and water column composition (particles and nutrients). Merimbula-specific catchment activities are addressed in the following sections with particular emphasis on those related to the local oyster industry.

4.1 Merimbula Lake catchment

Merimbula Lake is an open coastal lake on the NSW Far South Coast (Lat. 36.895S, Long. 149.923E) located approximately 455km south of Sydney (Figure 1). The lake has a catchment area of approximately 40km^2 and tributaries include Boggy/Millingandi Creek and Bald Hills Creek. The waterway covers an area of 4.5km^2, equating to approximately 10% of the catchment area (Webb McKeown & Associates Pty Ltd, 1997). This high ratio is a significant advantage in terms of the tidal flushing capacity of the lake compared to catchment runoff.

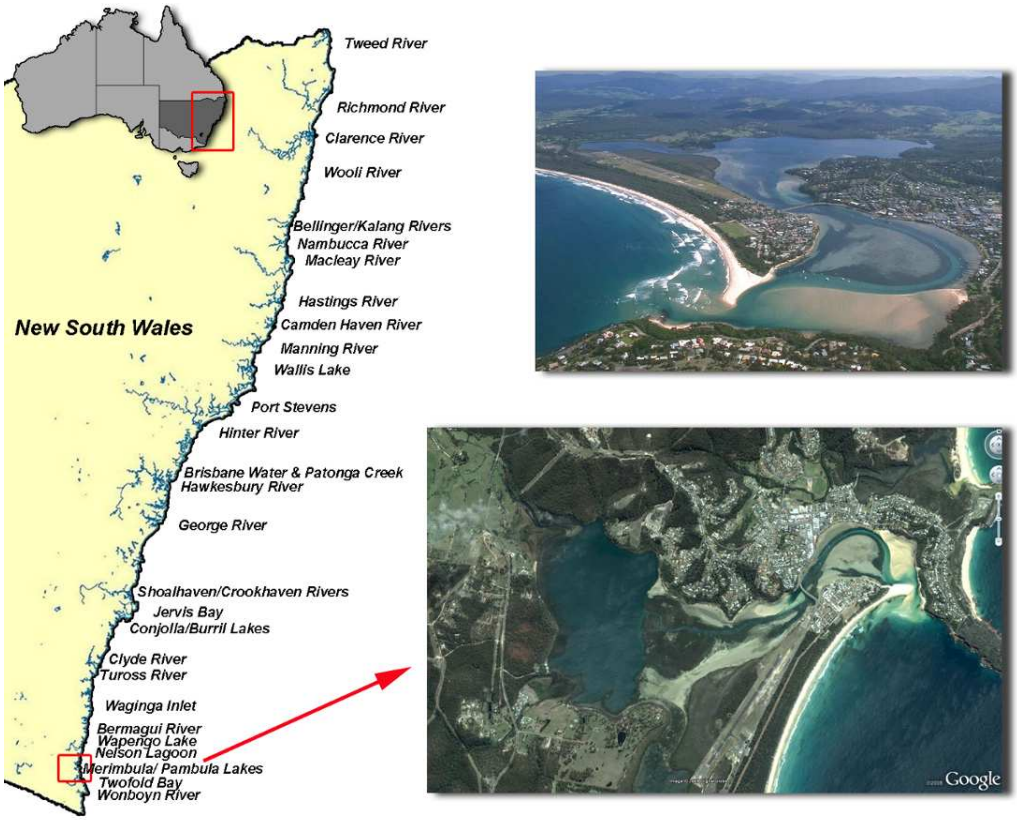


Figure 1: NSW map with location of Merimbula Lake, aerial vegetation map of the lake and part of the catchment (Source: Google Earth) and aerial photograph of the mouth of the lake (Source: NSW Government Natural Resources)

Land uses within the catchment include conservation, forestry, rural and urban areas. Urban areas represent 6% of the catchment, with the township of Merimbula located around much of the lake foreshore towards the entrance. Cleared land for rural use covers 34% of the catchment, while the remaining 60% (24km^2) of the catchment is forested. Of this 24km^2 of forested land, 21% is within State Forests, 11% within South East National Park, and the remaining 68% is on private land (ANU, 2006).

The terrain of the catchment consists of coastal river valleys, estuaries and cliffs. One of the most common soil landscapes in the catchment is 'Yellow Pinch' which comprises tertiary sediments rich in aluminium with high acid levels. The soil is very soft and particles have a loose consistency, consequently eroding quickly and easily reaching waterways through run-off. This may result in detrimental impacts on water quality and therefore the local oyster industry.

4.2 Catchment development

Merimbula is a thriving tourist destination, popular for its scenery, restaurants and recreational activities. Consequently, the population of Merimbula during the holiday periods increases by up to three times its off-season population of almost 7000. A most significant impact of this increase in population is the increased volume of human waste that must be managed.

In the urban areas, water-carried waste can be attributed to three main sources: town sewage processed at Merimbula Sewage Treatment Plant (STP), on-site sewage management systems (OSMS) and stormwater discharged into Merimbula Lake.

Merimbula Sewage Treatment Plant

BVSC is the regulatory authority responsible for management of sewage and disposal of treated effluent. The preferred options for disposal of treated effluent in NSW coastal towns has been through ocean outfall or exfiltration systems and, increasingly, through application on land as discharges to the ocean have been linked to algal blooms and skin irritations for swimmers. The Merimbula STP is an intermittent style, activated sludge plant with a tertiary lagoon, treating 700ML of sewage annually. The BVSC reports that sludge stabilisation and dewatering are managed through a 'sludge lagoon' and sludge drying bed with sludge being disposed of in landfill after stockpiling on site.

Approximately 75% of the effluent is discharged to the ocean or exfiltration ponds, with 25% reused as irrigation water on the golf course, which shares shoreline with an inlet of Merimbula Lake. The Merimbula STP is currently being upgraded, and options for disposal and reuse of treated effluent are under investigation. Certain areas on Pambula flats have been determined to be appropriate reuse sites for a proportion of the treated effluent. However it is unknown to what extent flow through these irrigation sites will remove contaminants to reduce the impact on the environment as a result of this treatment (personal communication, Dr Sara Beavis, ANU 2009).

On-site Sewage Management Systems (OSMS)

A significant number of residential dwellings, caravan parks and mobile villages have been constructed near and along the foreshore of the Lake, in particular close to the main town. Septic tanks and OSMSs are common and unless they are regularly checked and maintained, they present a significant potential risk of pollution via leaching of sewage to waterways.

Stormwater

Urban stormwater in the catchment is also creating significant erosion, sedimentation run-off and riparian vegetation damage, with subsequent indirect impacts on aquatic systems including the local oyster industry. However, significant rehabilitation and prevention work has already been undertaken to repair stormwater damage so that the local oyster industry and the ecologically important habitats along the foreshore of Merimbula Lake are protected.

Other potential sources of pollution may result from those areas in the catchment where land is irrigated with chemical compounds, and areas with Yellow Pinch soils that are disturbed present a high risk to the local aquatic ecosystems. These soils have high acidity and aluminium levels, and are very prone to erosion (Tulau, 1997) all of which are recognised as carrying high risk to water quality. In the Merimbula catchment, this could lead to significant impact on the sensitive areas of wetlands, floodplains and, in particular, on the local oyster industry.

4.3 Merimbula Lake

Merimbula Lake is an open coastal lake with a permanently open entrance and an inlet channel holding a large marine delta that opens into the main basin. The southern part of the lake is shallower than the main basin which has a deep centre, and there are deep navigational channels. Oyster leases occur mainly on the shallow areas. The lake also provides for a wide variety of recreational activities.

The mean lake level is super-elevated at 0.25m above the mean sea level which results in high speed tidal velocities through the ebb stage of the tidal cycle providing good flushing rates. It has been estimated that the water of the lake is replenished fully every week (Webb McKeown & Associates Pty Ltd, 1997) so water quality after a rain event recovers quickly.

Extensive seagrass meadows occupy over 50% of the lake bed, forming the fourth largest seagrass bed on the NSW South Coast. The beds consist mostly of strap weed (*Posidonia australis*), eel grass (*Zostera capricornia*) and paddleweed (*Halophila* spp) (West*, et al.*, 1985; Williams*, et al.*, 2006). *P. australis* is a protected species under the NSW Fisheries Management Act 1994, is particularly sensitive to disturbance due to its slow growth rates and is comparatively rare in NSW. The healthy seagrass growth evident in Merimbula Lake is considered to be supported by the good water quality of the lake (Haines and Rollason, 2009).

Fringing mangroves and saltmarsh, wetlands (as described by State Environmental Planning Policy No 14) and freshwater wetland areas are present along Merimbula Lake foreshores and tributary streams. Mangroves cover an area of approximately 35ha, with stands located along Boggy and Bald Hills creeks, the western foreshore of the Top Lake and near the airport and the 'Golf Course' lagoon. Saltmarsh covers an area of approximately 60ha with a significant stand located around the 'Golf Course' lagoon (Haines and Rollason, 2009). These areas have been identified as at high risk due to the increase in recreational activities and because of impacts of development in the lower catchment.

Merimbula Lake once contained a large number of Aboriginal sites along the shoreline and at the mouth of the lake. Mounded shell middens similar to those found in Pambula Lake were recorded in the late 1980's (Hughes, 1983) but casual observations by archaeologists since then have indicated significant disturbance, loss and/or destruction of these sites. This impact has been primarily linked to urban expansion in the catchment (Sullivan & Hughes, 2006).

As a result of the increasing population, a bridge was constructed in the early 1900's at the narrowest point of Merimbula Lake to connect Merimbula and Pambula. The area on the southern side of the lake was then actively developed with construction of holiday accommodation facilities, an airport, golf course and public boat ramp, in addition to several areas that provided land-base services to the local oyster industry. Although the causeway altered the hydraulic regime, records show the lower estuary channel and shoal patterns to be unchanged, suggesting the impact of the causeway on overall hydraulics was not great (DECCW, 2011).

Recent changes in the natural sedimentation processes of the lake have however been observed by the MLOG. Active sand transport appears to be taking place across the area of the lake from the bridge towards the mouth with some of the leases in this area reporting reduction in the water depth. It has also been noted that large flat areas of sand, that at low tide hosted large numbers of soldier crabs in the 1970s, have disappeared.

4.4 Catchment protection and rehabilitation

Several catchment protection and rehabilitation projects are underway or have been completed within the Merimbula catchment. These include the Merimbula and Back Lakes Estuary Management Plan, upgrades to unsealed roads and tracks, river rehabilitation, aquatic pest species control and lake foreshore clean up.

In 1997 an Estuary Management Plan and Management Study was developed for Merimbula Lake (Webb McKeown & Associates Pty Ltd, 1997). A working group comprising representatives from stakeholders in the catchment identified problems impacting the estuary and its catchment. Since then, BVSC and Southern Rivers CMA have been actively addressing stakeholders' concerns on the environmental health of the catchment. Some of the catchment projects that have already been undertaken include: fencing sections of the river bank to exclude livestock; minimising bank erosion; identifying potential chemical effluent sources (e.g. herbicide run-off); and improving roads, car parks and boat ramps located close to waterways in order to minimise run-off and subsequent siltation. As part of the Boggy Creek rehabilitation project undertaken by Southern Rivers CMA during 2003-2004, 350m of bank erosion control and/or riparian revegetation was completed.

Unsealed roads and tracks have been identified as a significant contributor to poor water quality within sensitive coastal waterways and their catchments. Road runoff increases the sediment load (turbidity) and in some cases, the nutrient load of these waterways. Several priority sites have been identified in the Merimbula catchment in recent years, and have formed the focus of road upgrade projects. In 2004 unsealed roads were identified by Millingandi residents as a significant sediment source for the creek, and resulted in upgrading of drainage along 1.8 km of steep roads through a partnership with Southern Rivers CMA. In 2009, the creek crossing and its approaches on Millingandi Shortcut Rd, together with Merimbula oyster sheds rd were identified as priority sites through the Southern Rivers CMA Roads and Tracks Program. Works were undertaken to reduce sediment loads entering creeks and drainage lines through a partnership between BVSC and Southern Rivers CMA.

MLOG, together with Industry and Investment NSW (NSW I&I) and Southern Rivers CMA, have been actively controlling aquatic pests including Pacific oysters (*Crassostrea gigas*), a declared noxious species. During 2011, a working bee led to the removal of approximately 500 Pacific oysters from the lake foreshore and bed. Oyster growers also monitor the presence of the European Green Shore Crab (*Carcinus maenus*) as part of a project within the larger oyster industry aimed at controlling and managing this pest species on the NSW Far South Coast.MLOG have been conscious of the presence of waste around the Merimbula Lake foreshore. From 2008 to 2010, oyster growers removed and disposed of more than 85m^3 of derelict oyster infrastructure as part of an industry clean up

funded by the Australian Government and Southern Rivers CMA. In 2011, with Southern Rivers CMA support, oyster growers instigated a foreshore clean-up day resulting in $1m^3$ of rubbish being collected and removed.

Due to the significant urban development around Merimbula Lake foreshore, stormwater is an important issue impacting on the health of the lake. In 2010, the Pambula Estuary and Catchment Group were successful in obtaining funding from the Australian Government to undertake community stormwater education in Pambula and Merimbula catchments, and a project officer commenced in 2011. Aims of the project include raising awareness amongst local businesses, schools, local community and tourists regarding impacts of stormwater on local lake water quality, undertaking audits of local businesses, reviewing current stormwater infrastructure and undertaking on-ground works to improve stormwater quality.

4.5 Other industries within the catchment

Merimbula Lake offers a wide range of activities for local people and visitors, a number of which are water-based, including boating, canoeing, kayaking, fishing, prawning, swimming and dolphin/whale watching. Several charter companies operate from a large marina near the town centre. Commercial fishing is permitted within the lake and there are three commercial cockle catch licences.

Mermbula Lake is a particularly popular recreational fishing destination. To enhance recreational fishing and create new habitats within the lake, consultation was undertaken with recreational fishers and other estuarine user groups regarding suitable lake sites for artificial reefs. Following this consultation, artificial reefs were deployed in the lake in 2009 by NSW Dept Primary Industries (Figure 2).

Figure 2: Artificial reefs deployed in Merimbula Lake to promote recreational fishing by creating new habitat (Source: NSW DPI Recreational fishing)

This deployment is part of a pilot study to investigate the benefits of artificial reefs as an enhancement tool in recreational fishing areas (http://www.dpi.nsw.gov.au/fisheries/recreational/saltwater/artificial-reefs). 'Mini-Bay Reef Balls' have been used which, when placed together in varying numbers, form small artificial reefs of different sizes. The individual reef ball modules have been designed specifically to provide habitats for fish, algae and crustaceans and can be moved or retrieved if necessary. Evidence to date suggests that these reefs can attain at least 80% of the natural species diversity and population density of nearby natural reef systems within just a few years of deployment (www.reefball.com). Following monitoring studies before deployment, the reefs will continue to be actively monitored now that they are installed.

5 OVERVIEW OF MERIMBULA OYSTER INDUSTRY

Diminishing world wild-caught fisheries together with rapid growth in the global population has led to a reliance on aquaculture to meet growing world demand for fish protein. Aquaculture is the fastest growing primary industry in Australia. Edible oysters are one of the five highest value species in Australian production with edible oysters contributing around 80% of the total Aquaculture GVP (Gross Value of Production) in NSW for 2006-07 (ABARE, 2008). The SRO industry is the state's most valuable fishery and it is also one of the most valuable agricultural enterprises on an area basis with long term gross average annual production of $8,000/ha across the state, reaching values as high as $35,000/ha in some NSW estuaries (White, 2001).

The current NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS) has as a primary goal the sustainable production of 120,000 bags of premium oysters by 2013 (NSW Department of Primary Industries, 2006). This strategy will work towards establishing the regulatory environment in order to achieve this production target (Figure 3). Therefore there is also a need to ensure best operational and management practice within oyster farming, including a commitment to protect and secure the environment.

SRO cultivation in Australia commenced simultaneously in NSW and southern Queensland around the 1870s (Malcolm, 1987; Nell, 1993; Fletcher*, et al.*, 2004). However there is a much longer history of the use of natural stocks of oysters in NSW with Aboriginal middens along the NSW coast containing shell deposits carbon-dated to 6,000 B.C. (Malcolm, 1971).

Following European colonisation, oysters were not only collected for food but also to provide lime for building mortar by burning oyster shells (alive and dead). Consequently by the mid 1800's, when natural oyster stocks were depleted and the burning of oyster shells was prohibited, a regulated commercial oyster industry in NSW was established (Malcolm, 1971).

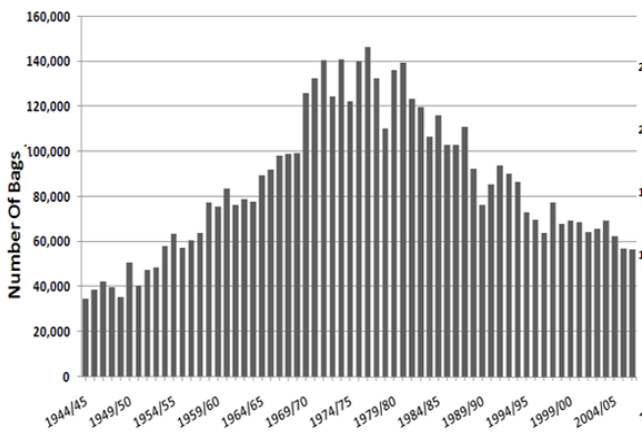


Figure 3: Total NSW SRO production (Number of bags sold) from 1944/45 to 2006/07

(Source: NSW DPI Fisheries from annual production reports by permit holders)

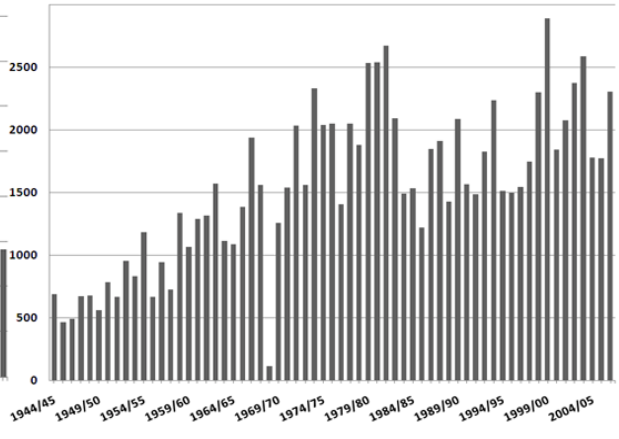


Figure 4: Total SRO production for Merimbula Lake (Number of bags sold) from 1944/45 to 2006/07

(Source: NSW DPI Fisheries from annual production reports by permit holders)

NSW Sydney Rock Oyster production grew steadily for 30 years reaching approximately 140,000 bags by the mid 1970s (Figure 3). This peak was attained mainly through a peak production of 43,000 bags in Port Stephens (NSW Department of Primary Industries, 2006). For approximately a decade oyster production volume was stable, however this was followed by a consistent decline despite the efforts of oyster growers and the introduction of new technologies.

The long term declines have been attributed to: disease outbreaks such as QX with major outbreaks in the Georges River in 1994 and the Hawkesbury River in 2004 wiping out two of the major oyster producers in NSW; introduction of the Pacific oyster; degradation of water quality in many coastal areas; and market competition from oysters grown in other Australian states. The last factor is clearly reflected in the recent changes in edible oysters GVP and production value across the various Australian states (NSW Department of Primary Industries, 2007). Annual production has now stabilised at around 60,000 bags (~8 million dozen oysters, Figure 3).

This report will concentrate on those activities associated with the commercial cultivation of the edible oyster, the Sydney Rock Oyster (*Saccostrea glomerata*). Native Flat oysters are also cultivated in small numbers in Merimbula Lake and there is also some interest in growing Triploid Pacific oysters.

5.1 Oyster production

In 2010, the Merimbula oyster industry comprised 19 growers, some of whom also hold oyster leases in neighbouring estuaries such as Bermagui River and Pambula Lake. A small proportion (2-3 growers) are small part-time enterprises. Merimbula oyster production contributes 4.1% to overall NSW production and 11% to south coast production (NSW Department of Primary Industries, 2007).

NSW Department of Primary Industries mapped 129ha of priority oyster leases in the lake (Appendix 4) currently producing around 2000 bags of oysters per year. Some growers hold a large number of leases which are used on an alternating basis, somewhat similar to crop rotation in a paddock: lease areas are able to be rested which also helps to limit the number of cultivated oysters present in the lake at any one time.

The historic peak in oyster production for Merimbula Lake was recorded for the period 1999/2000 with 2,888 bags of oysters sold (OISAS). Historically, Merimbula oyster production increased steadily from the early 1940's to the early 1980's. During this period a few years had annual production levels of less than 500 bags. This was most likely the result of low proportions of wild catch and/or death from 'winter mortality' (personal communication, Reg Warne, 2011). Although relatively stable since the early 1980's, overall production was slightly lower between the mid 1980's and mid 1990's. In 2006/07, oyster production reached the levels of the early 1980's but some variability in production from one year to the next persists (Figure 4).

Merimbula oysters reach the Sydney and Melbourne markets and local markets along the Far South Coast. A few growers have outlets and/or restaurants which are highly regarded and regularly visited by large numbers of people. Plate (large) size oysters represent approximately half of the 2010 production, however prior to 2005 this proportion was between 60% and 70%. Overall the production of bistro (medium) size oysters has been consistent at around 25-30% of total production.

5.2 Factors affecting oyster production

5.2.1 Local factors

5.2.1.1. Environmental parameters

The basic requirements for oyster growth and survival are the availability of space, food levels and maintenance of optimal environmental conditions. Food availability depends mainly on what is available in the water for the oysters to grow – oyster growers cannot fertilise the water to increase the food source - so growers rely on the environment to provide the right supply of nutrients and particles, together with sunlight and heat to produce an optimum food mix for the oysters. However, Australian temperate estuaries typically exhibit large spatial and temporal variability of food particles, primarily due to variable flows and rainfall events, which creates significant challenges to growers.

5.2.1.2 Stocking densities

Well managed oyster cultivation systems in Australia operate at low trophic levels and require no external food inputs thereby having generally very low impact on aquatic systems. However, cultivating oysters at too high densities could significantly alter both the natural ecology and the health and growth of the cultivated species.

5.2.2 Anthropogenic and global factors

5.2.2.1 Anthropogenic activities

In addition to the natural factors, oyster production can be affected indirectly by altering the water quality through anthropogenic activities such as logging, agriculture, vegetation clearing and urban development. Consequently, there is an ongoing and urgent need to identify all activities taking place in the catchment to assess ones causing environmental degradation leading to impacts on the waterways - these will ultimately affect oyster production.

5.2.2.2 Climate change

There is widespread agreement that human activities have significantly increased atmospheric concentrations of carbon dioxide (CO_2) since the start of the industrial revolution. This has led to a number of significant changes to physical, chemical and biological systems. Some of the changes and the potential impacts on oyster farming are:

- Australia's air temperatures have already increased by approximately 0.8°C over the last century (IPCC, 2007), and based on model projections, temperatures could go up considerably more over the coming century. Raised temperatures can have major direct and indirect effects on oyster cultivation, such as: inducing rapid growth, varying reproduction cycles, and interfering in spawning events. Higher temperature-induced evaporation implies less soil moisture and can lead to exacerbated drought conditions. Less rainfall in an area results in minimal nutrient input from land to waterways, reducing nutrient levels and in some cases, productivity of the area. Changes in rainfall and temperature can also impact the frequency and severity of fire events which can also have a significant negative impact.

- Sea levels have risen globally by about 20cm as a result of oceanic thermal expansion and melting of land ice (IPCC, 2007). It is predicted that sea levels will continue to rise impacting on some oyster cultivation systems particularly those in intertidal areas.

- About one third of all anthropogenic CO_2 has been absorbed by the oceans, reducing pH by about 0.1 of a unit and significantly altering carbonate chemistry (Miller*, et al.*, 2009). Projections suggest that it could fall by a further 0.4 units by the end of the century (IPCC, 2007). As more CO_2 is released oceans are becoming more acidic, and shellfish like oysters are especially vulnerable to this kind of change. Oysters rely on constant carbonate ion concentrations in order to produce the calcium carbonate needed to develop their shells.

5.3 Farming methods

Merimbula Lake is home to third-generation oyster growers as well as growers new to the industry. The cultivation techniques used in this lake reflect this: the older, more historical techniques are still used by the long-term oyster growers while newer techniques have been quickly implemented by the newcomers. A brief summary of the history of oyster farming in Merimbula Lake was published in 2010 in the Australasia Aquaculture magazine (Cole, 2010).

5.3.1 Spat collection

Different methods have been used to collect natural spat (oyster larvae), including the use of wooden sticks and plastic slats and sticks. Farmers may also choose to supplement their own spat collections with single seed oysters grown in hatcheries or wild spat sourced from other estuaries. Descriptions of these different methods are provided in the following sections:

Plastic slats and sticks: The majority of SRO stock in Merimbula Lake can be sourced from natural spatfall using plastic slats and/or sticks (Figure 5). This technique has quite variable rates of success. The slats are made of arced or soft plastic so that they can be twisted to remove the oysters that settle on them. The plastic slats are arranged in layers onto a frame that sits on the catching lease (Figure 5). These structures are arranged in a way that they offer an optimum substrate for oyster larvae to settle by providing large available surface areas, which in some cases are grooved, shelter from predators like fish and shade resulting from the stacking of the units.

Plastic sticks or "French sticks" are grooved to enhance a high settlement rate of oyster spat (Figure 6). Oysters are removed from the French sticks by sliding the sticks through a special machine that scrapes off the oysters. The catching units are placed in oyster leases that represent good catching areas where oyster larvae recruitment is high. Oyster spat are normally caught in the more saline lower reaches of the estuary/lake and subsequently moved to less saline, higher nutrient areas for growth and fattening.

As wild catch in the NSW south coast is quite variable from year to year, growers have alternative sources to ensure sufficient supply. Consequently, single seed spat can also be purchased from the northern estuaries where spat recruitment is large unless flooding takes place.

Wooden sticks: Prior to the plastic units, oyster growers used wooden sticks that needed to be tarred or cemented to prolong their life in the water. The tar poses a potential risk to the water quality and sediment by gradually leaching toxic chemicals such as hydrocarbons. Around 75% of the oyster farmers in Merimbula Lake have fully replaced tar-coated infrastructure with recycled plastic materials. MLOG have agreed not to use tarred products and within the next three years all tarred products will be replaced by more environmentally-friendly materials.

Figure 5: Plastic slats for catching oyster spat

Figure 6: Plastic sticks used in stick oyster cultivation- referred to as "French sticks"

Hatchery spat: A recent alternative source for oyster spat is hatchery produced oysters from existing breeding programs for SROs designed to improve growth and disease resistance (especially to QX and winter mortality diseases). Breeding programs have been running for only a few years and are working towards maximising oyster yield and growth. Growers are currently accessing spat from both hatchery and natural stocks. Research and development programs are now in place to improve hatchery protocols and breeding lines.

Oyster spat leave the hatchery (size 800-100µm) to be grown in upwellers, nursery rearing systems based at farms in estuaries (Figure 7). Oceanic/estuarine, nutrient-rich water is actively pumped and pushed through the tanks holding the upwelllers. This intense flow of water allows oysters to grow more quickly and increases survival rates. These seawater flow-through systems are feasible for land base operations (Figure 7).

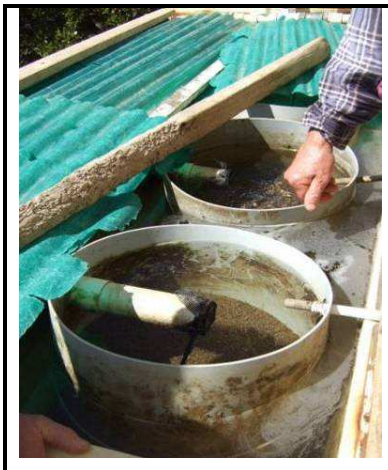


Figure 7: Upweller nursery system to grow oyster spat

5.3.2 On-growing techniques

This section presents a brief description of the cultivation techniques used in Merimbula Lake. The selection or combination of certain cultivation techniques depends on the personal preference of the grower.

5.3.2.1 Long-line systems

Long-line cultivation systems are a relatively recent innovation and are becoming increasingly popular. Different types of units are used in this system (Figures 8, 9 and 10) but all units are hung on a wire suspended by vertical posts. This system is designed to minimise handling as the baskets can easily be unclipped, processed and returned rapidly to the lines with minimal labour. These growing systems offer practical, efficient and durable alternatives to old cultivation units. The method is also well suited for rough and weedy conditions.

Some of the cultivation units used in this system are:

Tumblers or cylinders (100 x 15cm; *l* x *r,* volume of ~70L): made of polypropylene mesh and tied to the long line allowing continuous rotation that is facilitated by a floater that sits inside (Figure 8). The rotation is driven by the moving tide and currents and results in oysters that do not cluster together, which is considered to lead to a more marketable cupped shape. These units are typically used for very small size oysters.

Floating bags or pillows: made of polyurethane plastic mesh that may have some form of polyurethane flotation device attached to the outside of the bag (Figures 9 and 10). The bags are designed to hang on a wire and move with the water currents. In some cases, growers arrange bags on opposite sides of the long line so that they can flip bags from one side of the long line onto the other to dry the oysters instead of pulling or adjusting the line.

Figure 8: Floating tumblers or cylinders

Figure 9: Floating bags running in parallel

Figure 10: Floating bags drying, one lot resting on the top of the parallel line of bags

SEAPA baskets: frequently used in the industry as they are purpose-built to simplify and increase the efficiency of oyster farming. These types of baskets have a hard defined frame with proper lids on both sides that help to reduce oyster loss by giving a positive, easy seal (Figure 11).

5.3.2.2 Intertidal systems

Oyster racks are made of posts which are drilled upright into the seabed and act as the main supporting structure. Attached to these, additional posts run parallel to the seabed and hold up the various intertidal cultivation units described below. Old rail materials made of tarred and treated timber are currently being replaced with PVC posts and plastic sheathed wooden rails made of recyclable materials. Oysters grown in these systems are exposed at low tide twice a day.

The rack and basket method: rectangular shaped baskets, handmade from tough polypropylene mesh, are secured to the racks by two wooden sticks (Figure 11).

Figure 11: Intertidal rack & basket method.

Figure 12: Intertidal trays – partitioned wooden trays.

Polyurethane **intertidal trays** (180 x 91 x 4 cm; *w* x *l* x *d*): lightweight and require little maintenance compared with the old wooden trays (Figure 12). These trays are partitioned to ensure equal oyster spacing on the tray. Trays also have lids to provide protection from predation by marine animals such as rays, fish, starfish and octopus, and birds.

As described above there are a number of different methods used for oyster cultivation in Merimbula Lake. The variety of methods has been developed to best suit the physical factors of the site as well as the size of oysters transferred on to the farm. Each grower has the option of utilising any of these methods to grow their oysters as long as best practice is used in each case.

5.4 Land-based activities

Commercial oyster cultivation requires both water-based infrastructure (oyster leases) and a functional land base where some of the oyster operations, such as oyster grading, washing down and drying stock, infrastructure storage, packing and marketing take place. A large proportion of the land-based area is occupied by oyster sheds and machinery such as oyster graders (Figure 13). Near Merimbula Lake there are two main land-base areas: at the end of Millingandi Road on the western shore and off Arthur Kaine Drive opposite the Golf Course (behind Wheeler Oysters Restaurant). However, a significant number of oyster growers work in sheds off their houses or in other available areas.

Figure 13: Examples of some of the grading and sorting machines that are currently used in the oyster industry

A small proportion of the oyster enterprises in Merimbula Lake have a lease arrangement with the Land and Property Management Authority (LPMA). LPMA holds a bond that is paid by the farmers when taking over a lease, and tenures are renewed on an annual basis when payments are received. Growers are currently in negotiations with LPMA to ensure long term tenures which would provide them with more security for their business investments and growth.

5.5 Environmental monitoring

5.5.1 NSW Shellfish Quality Assurance Program

Oysters have been associated with outbreaks of a range of human disease because of their ability to bio-accumulate pathogens and toxins derived from the water in which they grow, and because they are typically eaten raw. As a result, MLOG must monitor the quality of the water and the oysters for a range of parameters such as faecal coliforms, salinity, temperature, microalgal biotoxins and heavy metals.

The NSW Shellfish Quality Assurance Program is administered by the NSW Food Authority under the umbrella of the ASQAP (Australian Shellfish Quality Assurance Program). MLOG maintain a regular water and meat quality monitoring regime as part of the NSW Shellfish Program ensuring that immediate action can be taken if pollution

levels threaten the health of the lake and the safety of oyster consumers. This program identifies pollution generated from septic tank leachate, any malfunctioning sewage network system and other sources of faecal matter. Monitoring is a requirement of growers' seafood licences, as issued by NSW Dept Primary Industries, and is obviously also of vital importance for public health protection.

After the occurrence of extreme events (e.g. heavy rainfall which becomes a source of pathogenic micro-organisms from inappropriately treated or untreated faecal material), an oyster growing area may be closed for harvest as per specifications of the local management plan and the NSW Shellfish Program until the system becomes 'clean' for harvest. During the closure period oyster farmers are unable to harvest oysters for sale which, along with the monitoring costs, can significantly affect their cash flow and profits. Specific information on the Merimbula Lake procedure for sampling programs and closure times can be found in Appendix 3.

5.5.2 Water quality

Estuarine health depends on a large range of factors over which, in many cases, growers have little control. However, oyster farmers are usually the first people to become aware of poor water quality because of their regular monitoring of water quality in their harvest area (Section 5.5.1). Microalgae samples are also taken fortnightly from one site within the main area of the lake. Consequently, the monitoring that oyster growers undertake contributes to protecting water quality for safe human consumption and viable oyster production.

Unless growers are part of a research study or a community-based monitoring program, no further broad environmental parameters are monitored. Due to the quite specific and somewhat limited environmental monitoring information collected, it can be difficult to identify the specific impact that catchment activities such as logging or urban development, and/or large scale processes such as climate change (Section 5.2.2.2) might have on the local oyster industry. In order to detect broader impacts on water quality in Merimbula Lake, an intensive environmental monitoring program should be put in place immediately to gather baseline data against which to measure any future impacts. MLOG will seek funding for catchment monitoring programs that include intensive environmental programs to assist growers in maintaining the health of the lake.

The water level of the lake is monitored using a continuous logger located on the jetty in the Front Lake. Data is maintained and managed by Manly Hydraulics Laboratory (NSW Department of Commerce).

5.5.3 Seagrass beds

Seagrass beds are one of the most important parts of the aquatic ecosystem and play a vital role in its health. Seagrass beds provide shelter, habitat, feeding grounds for fish and other aquatic fauna, improve water quality and aid in sediment control by decreasing sediment within the water column. They occur in sheltered areas and shallow waters, growing in soft sediments such as sand or mud. These habitats are common in the area adjacent to oyster cultivation zones, and therefore play an important role in maintaining conditions suitable for oyster growth.

Seagrass beds are extremely fragile habitats. In some cases, 'natural' factors such as storms, floods, sediment and nutrient runoff cause seagrass decline while in others, beds are damaged by boat-related activity, dredging and reclamation of foreshore for structures such as pontoons and jetties, and stormwater outlets that cause physical scouring.

In 2009, MLOG took part in a community seagrass training session designed to enhance the monitoring of the distribution and condition of seagrasses in the lake so that any decline in the health of the lake could be identified as early as possible. Development of an appropriate monitoring technique is being considered so that long-term trends can be captured.

Activities associated with oyster aquaculture located over or adjacent to seagrass beds should take into consideration the best practice standards listed in the NSW OISAS. Cultivation practices that reduce potential impacts, in particular shading, are encouraged. It is acknowledged however that there are large areas of healthy seagrass under oyster leases in NSW and a change to cultivation methods may not be warranted if it means a reduction in productivity would not benefit the beds.

The NSW Aquaculture Research Advisory Committee has identified oyster/seagrass interaction as a priority research area and is working with NSW Dept Primary Industries to review this issue.

5.6 Recent environmental achievements by Merimbula Lake Oyster Growers

The Merimbula oyster industry is one of the best examples of good stewardship of the local environment as it is proactive in activities to protect the lake including:

- Partnership with Southern Rivers CMA identifying sediment sources to the lake and potential rehabilitation sites in the catchment
- Participation in marine pest monitoring studies (eg European Green Shore Crab, Pacific oyster control efforts)
- Establishment of an oyster industry education program in local schools ('Grow your Own Oysters')
- Securing funding for a stormwater education program in Pambula and Merimbula townships
- Merimbula Lake foreshore and oyster industry clean-up efforts.

6 ACTION PLAN

As part of the risk analysis, MLOG undertook an environmental audit of operational and infrastructure risks for all the Merimbula Lake oyster enterprises. Additional environmental, social and economic impacts on the industry were also considered. The major objective for using the 'consequence and likelihood' risk assessment technique was to assist in the separation of the minor acceptable risks from the major unacceptable risks.

Through a series of workshops, MLOG identified industry-related and external factors that they considered a risk to the industry and ranked them according to the level of impact based on the 'consequence' and 'likelihood' scores used in the risk analysis (Figure 15). A summary of the risk analysis table and ratings used to score each activity has been included in Appendix 5 and Appendix 6. 'High' and 'Medium' risks have been targeted as priorities for the first years of EMS implementation. A comprehensive explanation and background of high and medium risks is provided in Section 6.

Appendix 6 summarises the risks identified by growers and the rank of each risk. The risks have been split into two main categories: industry-related activities, which are those primarily controlled and managed by the oyster industry; and external activities, which are those impacting the oyster industry but in most cases, beyond its control. The MLOG will liaise with community and stakeholders in order to work collaboratively towards minimising the external risks.

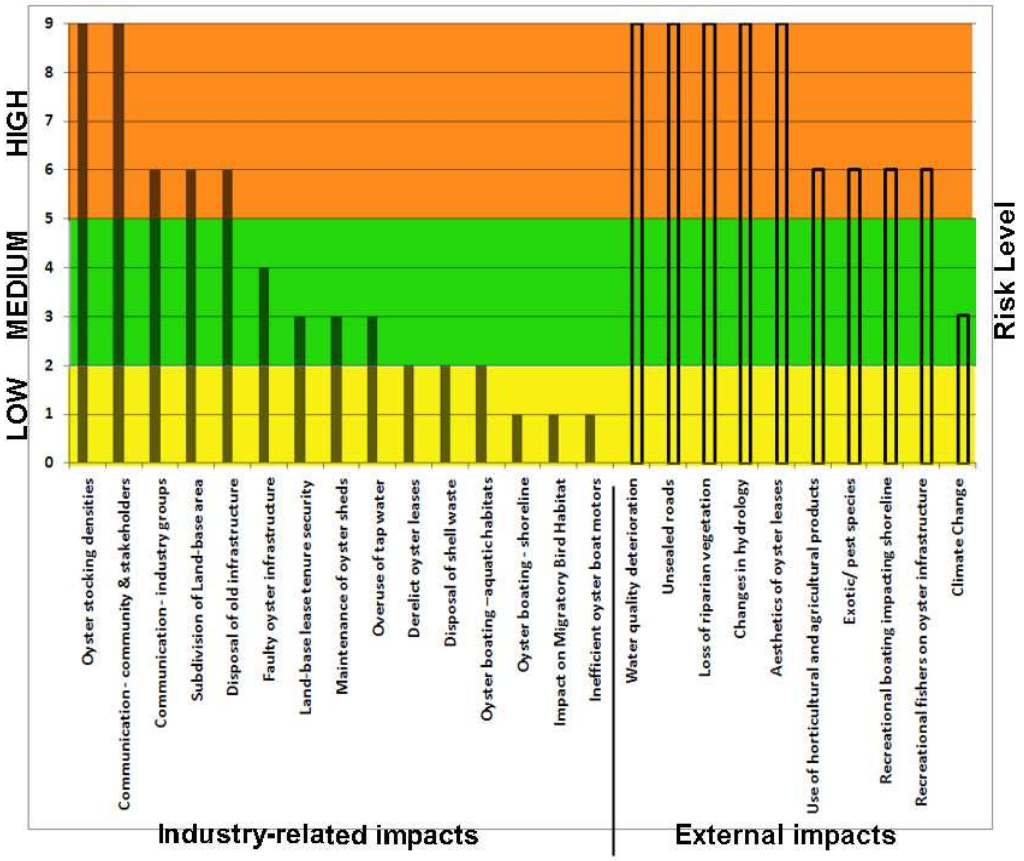


Figure 14: Schematic summary of risks impacting the Merimbula Lake oyster industry. Each risk was scored through a risk analysis in which Low risks corresponds to scores 0-2; Medium risks to scores 3-5; High risks to scores 6-9

6.1 High risks

This section focuses on the high risks impacting the sustainability of the industry as per the risk matrix. Risk values that ranked between 6 and 9 (out of a maximum possible score of 9) are considered 'Not desirable' (Appendix 5). The response for these types of risks requires continued strong management action with a full performance report and immediate/specific response with urgency. A summary of the actions to which the MLOG have committed in order to minimise these high risks has been included in the risk table (Appendix 6 - column "Future Actions").

6.1.1 Industry-related activities

6.1.1.1 Oyster stocking densities

Oyster farming techniques generally employed in Australia have not been identified as impacting on the environment (Crawford, 2003). Oysters are not cultivated using intensive farming systems, and by appropriate stocking of their lease areas growers ensure maximum productivity and a healthy site. When growers try to cultivate more oyster stock than their enterprise or the environment is capable of managing, environmental damage is likely to follow with subsequent negative impact on their enterprises.

In 2010, MLOG participated in a research project managed by Dr Ana Rubio under a Science and Innovation Award for Young people in Agriculture, Fisheries and Forestry granted by the Department of Agriculture, Fisheries and Forestry (DAFF) and sponsored by the Fisheries Research Development Corporation (Australia) (FRDC) (http://www.daff.gov.au/brs/science-awards/winners_2009/ana_rubio-zuazo). Growers gathered information on growth performance and survival rates of oysters by comparing three stocking densities at three different locations in Merimbula Lake: the back, middle, and front/mouth of the lake. Floating bags on a long-line cultivation system and a sophisticated automatic grader to quantify oyster productivity and oyster lease performance were used. In conjunction, chlorophyll-a measurements were taken in order to validate some of the project results and to assess water productivity across the oyster leases (Rubio 2010).

MLOG will incorporate the project findings and the recommendations provided by other oyster research studies (such as Crawford*, et al.*, 1996; Underwood*, et al.*, 2002; Troup*, et al.*, 2005; Rubio, 2008) as well as the guidelines from the NSW OISAS (NSW DPI, 2006) into the management plans to ensure optimum production and long-term sustainability of the Merimbula Lake oyster industry.

6.1.1.2 Lack of communication

A major aim of the EMS is to strengthen communication links with the local community and other stakeholders in order to solve any potential issues arising from their activities in the upper catchment. MLOG, as downstream catchment users, are highly impacted by the activities that take place in the catchment. There is a need to educate other catchment users so that they manage their activities to minimise impact on the health of the lake and their local oyster industry. In order to assist with this awareness-raising, MLOG will distribute their EMS among stakeholders and produce media releases to inform the community of their commitment to the EMS.

Poor communication also exists between members of the industry across oyster growing areas in NSW and other states. Industry events are good meeting points for growers to pass on ideas, knowledge or to network and promote partnerships between members of the oyster industry, fishery groups, NSW Farmers Association, oyster consortia and research institutions. These partnerships can achieve positive environmental, economic and social outcomes for the oyster industry and as such, need to be actively supported by members of the MLOG.

Furthermore, establishing formal meetings and strong network paths will benefit the Merimbula Lake oyster industry to gather latest news on research, new methods, funding sources and training opportunities.

Growers could take on some responsibilities at an individual level by joining existing industry-related associations (such as NSW Farmers Association, ORAC), industry newsletters (such as NSW I&I, Seafood CRC, FRDC) and attending national seafood-related conferences (such as Australasian Aquaculture Conference, Seafood Directions). As a group, MLOG will aim to interact more with their nearby oyster counterparts by organising annual social events, such as a golf day with Pambula oyster growers, and by organising a 'Growers Day" at which hot topics, research outcomes and the latest farming practices and infrastructure could be discussed. In 2009 a member of MLOG organised a well-attended "Growers Day" that focused on increasing growers' knowledge about cultivating Triploid Pacific Oyster. This event was a success and was an important step towards unifying the oyster industry on the Far South Coast.

6.1.1.3 Sub-division of land-based areas

A large number of MLOG have set-up their land-based working areas away from the lake while others are in two lakeside locations (Section 0). This spatial fragmentation has contributed to poor industry communication within the group although an increasing number of growers are now using emails and mobiles. However there is still a proportion of the industry relying on contact when working at the water lease and almost all consider that this is still the optimum means of communication between members. As a result, in 2010 MLOG commenced negotiations with LPMA regarding an option to sub-divide the current land-bases so that more industry members could work from oyster-dedicated areas.

6.1.1.4 Disposal and removal of old infrastructure

In the past, oyster farmers used treated timber materials exclusively for lease infrastructure. Timber was treated with chemicals such as creosote and tar to ensure longevity in the water and to protect it from marine borers and pests. These chemicals are hazardous substances with carcinogenic, mutagenic and toxic properties that have severe impacts on marine organisms (Smith, 2008).

Cultivation techniques have changed and all growers now use plastic sticks and specially produced polyurethane trays and/or are adopting alternative farming methods (Section 5.3). There are still however, some treated pine and tarred trays in the lake holding older stock but growers are committed to remove these units as the production cycle allows the change to more environmentally friendly systems.

Adopting new technologies requires a large investment that in some cases cannot be met by growers due to lack of capital, a major constraint in the oyster industry. However, MLOG remain committed to remove all tarred products from Merimbula Lake by 2013. MLOG also recognise that the implementation of new and environmentally-friendly cultivation methods will result in large volumes of old infrastructure that will need appropriate disposal.

Due to the cost of disposing of waste, old infrastructure tends to accumulate in land-base areas. In 2008-10, Southern Rivers CMA obtained funding from the Australian Government to help the industry clean up, resulting in 85 m^3 of solid waste, and 1000L of liquid tar being removed. MLOG anticipate the need for similar assistance as they modify their leases to implement new technologies but in the meantime, growers have committed to regularly clean up and dispose of old infrastructure to avoid major accumulation on or near land bases.

6.1.1.5 Visual pollution and aesthetics

MLOG are aware of the potential visual impact and aesthetics that oyster infrastructure can have, in particular at low tide when oyster cultivation units are exposed. In some cases growers also require additional materials and infrastructure to improve the local conditions for example, to deal with waves that might be generated by strong winds and/or from the effect of boat wash. MLOG will ensure that oyster leases remain tidy and as uniform as possible, in particular for the lease markers, complying with the NSW OISAS. This strategy, amongst a number of other things, outlines the criteria for acceptable lease materials and maintenance as well as visual amenity.

MLOG as part of EMS communication and dissemination activities (Section 6.4) will promote the EMS through the local media with the aim of educating the community on their day-to-day activities, cultivation methods and current focus on improving their farming activities towards protecting the environment.

External activities

MLOG recognise that numerous external activities can impact on the water quality of Merimbula Lake. Through partnerships with Southern Rivers CMA, BVSC, NSW DECCW – National Parks and Forests NSW, several rehabilitation projects have been undertaken in the catchment (Section 4.4) with flow-on benefits to the lake water quality.

6.1.2.1 Pollution incidents

A major challenge for growers in Merimbula Lake is the increasing population and pressure that urban development places on the catchment, particularly through clearing and soil disturbance, which can potentially result in changes to the water quality and water flow in oyster growing areas. According to the NSW OISAS and NSW DECCW, any development such as urban sub-divisions and caravan/holiday parks, taking place in estuarine areas, should cause no deterioration of the environmental conditions of the catchment and therefore, no impact on the local oyster industry.

Urban development in the Merimbula catchment presents additional risks to the local oyster industry because of the volumes of human waste generated and methods of disposal implemented. In most coastal and rural areas sewage management is decentralised and domestic wastewaters are usually treated and disposed of on-site. Local reticulated sewerage infrastructure is currently expanding and new technologies are being implemented in order to minimise pollution incidents.

The most common water pollution incidents are related to sewage spills which occur when the wastewater being transported via underground pipes overflows through access holes, cleanout or broken pipes. In addition, Merimbula Marina provides service to a wide range of vessels, some with toilet facilities on board which require regular use of pump-out facilities which also carries significant risk to water quality. MLOG, as an action in this EMS, will monitor reporting by BVSC on sewerage pipe audits, Septic Safe Surveys and licences for sewage treatment plants in the catchment. Growers will collate information on the processes taking place in the catchment with the aim of maintaining current water quality levels.

Other water quality risks relate to fuel and/or oil spills from vessels, with spills in 2010 resulting in the closure of the lake and consequently, an inability to harvest. Such incidents are costly to the oyster industry because of lack of harvest and the need for additional water and meat sampling before the lake is cleared to reopen.

6.1.2.2 Siltation and acid soils run-off

Some unsealed roads located close to the main lake are a source of fine sediments impacting on water clarity (and also a source of dust contributing to local air pollution). This results in increased turbidity levels which has a detrimental effect on the aquatic ecosystem and on cultivated oysters. Consequently oyster growers are involved in the maintenance of unsealed roads in the Millingandi area by laying shell waste on these roads, in particular on those that are steep, and by improving drainage and water diversion.

MLOG have identified other areas along the shoreline of Merimbula Lake in which the rock retention used to hold the sediment and water and sewage pipes is loosening (Figure 15). This has resulted from traffic on the nearby road and boat wash. Remediation is urgently required in areas such as this and MLOG will work in collaboration with Southern Rivers CMA and BVSC to further identify and contribute to fixing these high risk areas (Appendix 6).

A Destruction of rock retention wall in the southern part of the road bridge that crosses Merimbula Lake at the entrance of the lake

B Rock retention wall area that requires improvement in order to ensure appropriate erosion control on the northern side of the bridge

Figure 15: Deterioration of rock retention walls

Another potential impact on the water quality of the lake is the presence of acid soils in the lower estuarine catchment. To date, acidic materials have been constrained to the in-stream sections of the estuary and the back end of Merimbula Lake and acidic soils run-off has not been reported to have had the major impacts of fish kills and diseases or low pH levels in the estuary. By managing these soils at their source, the magnitude and frequency of potential acidic discharges can be minimised and so any disturbance of acid soils should be avoided. Consequently the local community needs to be made aware of the location of these sediments and the care required with regard to any future activities that may disturb them.

6.1.2.3 Loss of riparian vegetation and uncontrolled livestock access to waterways

In 2002 MLOG raised concerns about the quality of the water in the lake due to the levels of faecal coliforms present even during periods without rainfall. Through their partnership with Southern Rivers CMA, the Boggy Creek Rehabilitation project was undertaken in 2003-2004, resulting in fencing along a proportion of Boggy Creek to manage stock, resulting in a dramatic improvement in the water quality as well as significant vegetation recovery, in particular saltmarshes and on lower floodplain creek banks. Additional planting of suitable trees and shrubs adjoining the creek has been undertaken to help stabilise the banks and to act as a buffer to trap fine sediments. Continuation of these activities throughout the catchment is needed to ensure maintenance of a healthy catchment and MLOG are working towards preserving and improving the health of shoreline vegetation by collaborating with relevant government and community groups. In addition the dissemination of the EMS among the community will highlight the importance of preserving the shoreline for the benefit of the overall lake.

6.1.2.4 Use of horticultural and agricultural products

MLOG have identified that some catchment users are currently using various chemical products to control pest species and increase soil nutrient levels. These activities are of concern as any of these products can easily reach the waterways through rainfall runoff, potentially having a significant impact on the flora and fauna of the lake, including of course the oysters which are particularly susceptible because of their large filtration capacity.

To raise awareness amongst landholders of the potential impacts of their land management practices on Merimbula Lake water quality, MLOG will ensure that they receive a copy of the EMS so that landholders consider some of the current practices taking place and the impact that these practices may have on the overall catchment.

6.1.2.5 Marine exotic species and fouling

Introduced species are a most significant threat to Australia's biodiversity and natural resources. Their impact on aquatic ecosystems are, in most cases, poorly understood. Consequently great effort needs to be applied to the identification of pest species and their preferred habitat so that management measures can be put in place. Education programs are underway and some material has already been being disseminated among oyster farmers. Southern Rivers CMA and NSW I&I also need to provide all MLOG with a copy of marine pest identification cards when available and in turn, MLOG need to report, with a sample if possible, any unusual plants or animals found, and strictly follow requirements of government agencies in combating marine pests.

In recent years the highest risk for the oyster industry has been the Green Shore Crab (*Carcinus maenas*). This crab is a voracious predator with a broad diet and has been implicated in the decline of shellfish populations including the SRO on the NSW Far South Coast. In 2009 the Sapphire Coast Marine Discovery Centr, in partnership with the Eden Local Aboriginal Land Council, NSW I&I and Southern Rivers CMA, commenced a monitoring program in those areas where oyster growers have reported the crabs presence. A large number of Green Shore Crabs have been reported at times in Merimbula Lake, resulting in full commitment from MLOG to assist in field work towards research on this pest species This includes the research commenced in 2010, under a PhD project through Macquarie University, to investigate the ecological impacts and dynamics of Green Shore Crabs in estuaries along the South Coast.

Another pest species that MLOG contend with is the Pacific Oyster (*Crassostrea gigas*), a declared noxious fish in all NSW waters (except Port Stephens) under the *Fisheries Management Act 1994*. MLOG comply with the Pacific Oyster Control Program managed by NSW I&I, under which the permit holder must make every effort to eradicate this species from oyster infrastructure. The Reef Balls deployed in Merimbula Lake have the potential to act as pest species recruitment areas unless properly surveyed and maintained. Hence MLOG will regularly follow-up with NSW I&I, monitoring and maintenance progress.

MLOG are also concerned about the introduction of the pest species *Caulerpa* which is known to exist in close-by lakes such as Wallagoot. Most recreational fishermen using Merimbula Lake also fish from Wallagoot Lake so there is potential for *Caulerpa* spread in Merimbula Lake if extra care is not taken. MLOG will increase awareness of the *Caulerpa* management plan, will work with NSW I&I in putting up signs at the boat ramp with regard to *Caulerpa* and will lobby for boat wash facilities at Wallagoot Lake in order to minimise the potential for transfer of the pest. MLOG will also assist NSW I&I in disseminating *Caulerpa* management brochures among the local community, in particular the recreational fishing industry.

6.1.2.6 Boat wash

As a result of the large fish stocks in Merimbula Lake, an active recreational fishery is present in the area. However large and powerful-engine boat users create significant boat wash in sensitive areas of the lake and on the oyster cultivation units particularly at low tide. Boat wash from recreational fishers has impacted/damaged oyster infrastructure by detaching cultivation units and washing oysters to one end within a cultivating unit which impacts feeding capacity. Consequently, there is a need to educate recreational users of the impact their boats may have through wash.

6.1.2.7 Mooring to leases

MLOG, as part of their oyster cultivation licences, are required to adopt best practice standards in regards to lease marking, navigational aids and lease maintenance as per the NSW OISAS. In order to ensure safe navigation across oyster aquaculture areas, individual oyster lease areas must be marked in a consistent and appropriate manner and growers must use white posts to mark the boundaries of their leases. These posts need to be constructed of materials that are long lasting, pose no risk to the environment and are recyclable and made from renewable resources (NSW DPI, 2006). Marking requirements are mandatory so non-compliance results in fines to growers.

Lease marker posts are currently used by some recreational fishers to moor their boats while fishing. As these posts are not designed to serve as moorings, this often results in loss and/or damaged infrastructure which can become a navigational hazard for lake users and/or result in a fine for the leaseholder. Consequently, MLOG are frequently undertaking repairs of their infrastructure where damage has been caused by other lake users. To help minimise this problem, MLOG will have larger signs printed and distribute them around the lake.

6.1.2.8 Changes in hydrology

Sedimentation is rarely considered to be a significant environmental problem associated with the type of oyster farming generally employed in Australia (Crawford, 2003). If the number of oyster leases and oysters cultivated in an area increases dramatically, this could result in higher levels of oyster bio-deposits and therefore increased accumulation of sediment underneath the leases. Large-scale intensive oyster farming may also affect natural sedimentation by accumulating sediments around infrastructure and through shell accumulation on the bottom of the lake, thereby altering water flow.

Oyster farming in Merimbula Lake is not intensive. Possible impacts of oyster leases on lake hydrology, sedimentation regimes or ecological process were not considered a significant issue in the development of the Merimbula Lake Estuary Management Plan (Webb, McKeown & Associates, 1997). This was supported by the investigation of possible impacts of oyster leases on tidal flows during the development of the Estuary Management Plan for Wonboyn Lake, a neighbouring oyster lake, in which it was concluded that the presence of oyster leases in Wonboyn Lake had not significantly affected flows within the estuary (WBM, 2001).

However, oyster growers have observed significant sediment transport processes that have shifted and accumulated sand in new areas (e.g. under some oyster leases at the lake entrance) including major changes in some areas of the shoreline at the entrance to the lake. This raises concerns among MLOG about the mouth of the lake and potential closures in the future. Currently Manly Hydraulics Laboratories (MHL) are taking measurements of the water level at the mouth. MLOG will also start monitoring water levels at the back of the lake around Boggy Creek and will explore the possibilities of expanding on the range of parameters that MHL are monitoring.

Merimbula Lake shoreline has been modified over the years as a result of land reclamation activities such as for the airport runway construction. This type of activity could potentially impact on shoreline vegetation, affect run-off and therefore, alter water flow and sediment accumulation around lease areas. MLOG are currently seeking expressions of interest from students to research the possible future impact of shoreline activities on riparian vegetation and natural sedimentation on the lake.

6.2 Medium risks

This section focuses on the 'medium risks' impacting the Merimbula Lake oyster industry as per the risk matrix (Appendix 5). Risk values that ranked between 3 and 5 are considered 'Acceptable'. The response for these types of risks involves the management of current risk control measures and a full performance report detailing current arrangements and in some cases, specific responses to minimise the risk.

6.2.1 Industry-related activities

6.2.1.1 Faulty infrastructure

Oyster cultivation units must be constructed of materials that will last in the marine environment. As infrastructure ages and cultivation methods change, there is an increased probability of breakage which could lead to navigational hazards and accumulation of faulty infrastructure on the bottom and shoreline of Merimbula Lake. In particular, modern cultivation units have floating devices which could drift if they become unattached. MLOG will undertake frequent maintenance checks of the water infrastructure, will organise annual shoreline clean-ups and will tag cultivation units for easy identification and retrieval.

6.2.1.2 Water and land lease tenure

Commercial oyster cultivation requires both water and land bases because of the various activities involved in oyster cultivation, husbandry and marketing (Section 5.3). From 2010, MLOG have 15-year agreements for their water-based areas but have only annual agreements for the land-based areas which results in business insecurity. LPMA is revising the land-based agreements with the NSW oyster industry, and Merimbula oyster growers are currently negotiating for longer-term lease tenures of 20-25 years to increase their business security. Growers, through a committee, have also been in negotiations with the LPMA about the lack of consistency and the corresponding differences in rental charges and lease lengths between the various regions on the NSW coast.

6.2.1.3 Maintenance of sheds and surrounding areas

Merimbula Lake oyster sheds are located on Crown land and it is each grower's responsibility to maintain and repair them. MLOG will ensure that roofs and gutters are frequently cleaned and maintained in order to control stormwater and therefore, minimise erosion and sediment run-off into the waterway. Oyster growers will also ensure appropriate disposal of oyster shells and other by-products and will aim to keep the land-base sites tidy at all times.

6.2.1.4 Overuse of water

Most of the farmer's land-based facilities have basic amenities such as a sink and running potable water. Oyster enterprises selling opened oysters must have appropriate facilities and may have high levels of water use. At one of the oyster enterprises there is also an automated oyster grader that uses water to rinse the oysters prior to grading. MLOG are committed to minimising water usage at all times.

6.2.2 External activities

6.2.2.1 Impact of climate change

As discussed in Section 5.2.2.2, the NSW oyster industry could be severely impacted by projections of increasing atmospheric carbon dioxide (CO_2), which may result in acidic oceanic waters that will slow the production by oysters of the calcium carbonate needed to produce their shells.

Several studies worldwide have investigated how pH decrease can slow the production of calcium carbonate by oysters especially within the range of atmospheric CO_2 projected by the Intergovernmental Panel on Climate Change (IPCC, 2007). About one-third of anthropogenic CO_2 has been absorbed by the oceans, reducing pH by about 0.1 of a unit and significantly altering carbonate chemistry (Miller *et al*, 2009). Projections suggest it could fall by a further 0.4 units by the end of the century (IPCC, 2007). Oyster larvae have significantly less shell area and reduced calcium content under current concentrations of CO_2 compared with pre-industrial levels (Miller*, et al.*, 2009).

Related research has been done with Sydney Rock and Pacific oyster larvae at the University of Western Sydney and in collaboration with NSW I&I (Parker*, et al.*, 2008). Experiments using hatchery breeding line oysters compared to wild 'control' oysters have found that selective breeding of the oysters may be able to ameliorate some of the impacts of acidification of the water. Acidification of waterways will almost certainly also affect some of the planktonic groups on which oysters feed and that constitute the main base of all the food webs in the marine ecosystem. Further research needs to be undertaken not only into the oyster's ability to adapt to faster rates of environmental change but also to the impact on the broader marine ecosystem.

A comprehensive understanding of the effects of climate change on the estuarine system requires a thorough understanding of the links between the biological and physical systems and associated variability. This is still relatively poorly understood, in large part because there is a lack of sufficient, high quality environmental baseline data for estuaries and oysters. For a majority of systems, determining effects of climate change is difficult, however, taking advantage of current weather anomalies to gain insight into future impacts is critical. Understanding how environmental properties and nutrients behave in estuaries/lakes under drought conditions is imperative to establishing baselines of data upon which anthropogenic impacts can be assessed (Ringwood & Keppler, 2002).

6.3 Low risks

This section lists the 'low risks' impacting the Merimbula Lake oyster industry as per the risk matrix (Appendix 5). Risk values that ranked between 1 and 2 are considered 'Acceptable' with no specific control measures needed at this stage. The management response for these types of risks requires a short justification which has been included in the risk assessment table (Appendix 6). MLOG have identified these activities as potential sources of ris, however, and include:

- Derelict oyster leases
- Disposal of shell waste
- Oyster boating activities impacting on aquatic habitats
- Impact on migratory bird habitats
- Inefficient oyster boat engines.

There were no external low risks identified.

6.4 EMS communication and implementation

6.4.1 Report distribution

The EMS report is a 'living' document that requires updates as actions and activities are reviewed. MLOG will report on the progress and achievement of each action in relation to the responsibility, performance indicators and timeframes as per the Risk Table (Appendix 6).

The EMS report will be made available to all stakeholders and provided to all stakeholders who have commented on, or shown interest in the operations of the MLOG. Following documentation and circulation of the report, the MLOG will review the EMS each year taking into consideration:

- Actions and timeframes suggested in previous versions of the EMS report
- Stakeholder comments
- An assessment of the adequacy and relevance of the environmental policy
- Changes in oyster farming technology and management
- Emerging issues in the environmental management of the Merimbula Lake and its catchment.

Stakeholder review process

The stakeholder list should include groups that were contacted through the development of the EMS report, groups cited in the document in relation to activities ranked as high risk and any other groups that interact with the oyster industry and/or that participate in any of the catchment activities.

MLOG will inform stakeholders about the implementation of the EMS. Communication is one of the main aims of this EMS which is a forum for natural resource managers and the community to obtain information about the environmental management implemented by the MLOG, and an opportunity for MLOG to work with these stakeholders on the development of environmental management initiatives.

6.4.3 Report review

This EMS documents an ongoing process of environmental management and therefore requires periodic review to ensure that the policy objectives are still relevant and adequate, and actions are being maintained or introduced in line with the relevant responsibilities, timeframes and targets. The EMS will be reviewed each year at the MLOG Annual General Meeting. The 'best practice' values and benchmarks may change from year to year in line with changes in production technology and consumer and compliance demands. Updates of the EMS report will be saved as a new version of the EMS report, and logged in the revision status section of the report. Appendix 7 will be updated and used to track achievements against actions listed in Appendix 6.

6.4.4 EMS compliance

This EMS is not enforceable. It is a voluntary commitment to document and maintain environmental best practice by the Merimbula Lake Oysters Growers.

Incidents where the MLOG fail to reasonably comply with the EMS will be recorded and investigated. Failures may be:

- Intentional or unintentional;
- An indication of inappropriate policy or actions in the EMS;
- Due to highly unusual circumstances; or
- Some combination of the above.

Responses might include no action, a review of the EMS, and/or training for the MLOG. Any EMS contravention will be noted in the following EMS report.

The Merimbula Lake Oysters Growers cannot be responsible for the actions of oyster growers in other estuaries but will encourage all oyster growers operating in the area to work with the same duty of care outlined in this EMS.

7 BENEFITS OF THE EMS

MLOG are implementing a system that will help to:

1. Care for the environment
2. Secure optimum oyster growing conditions
3. Inform regulatory agencies, community and consumers about the industry's management framework and future aims.

Well before this process started, oyster growers were involved in monitoring programs and research activities for the benefit of both the industry and the environment. This EMS recognises and highlights these important activities, some of which are already benefiting the wider catchment community. A summary of the benefits of both the ongoing and future activities discussed in this EMS follows.

- Transparency of environmental performance
- Environmental programs implemented in Merimbula Lake providing for ongoing collection of information that will allow the measurement of changes over time, particularly water quality
- Maintenance and improvement of market access through a form of eco/environmental labelling in line with the EMS and its outcomes, particularly relevant for export markets as some countries are currently placing restrictions on imports that do not come from environmentally certified production systems.
- Improving industry morale and sense of stewardship
- Increasing the profile of the industry with the aim of enhancing community support
- Increasing dialogue with the community, consumers, suppliers and regulatory and research bodies
- Verification of practices against a credible process and system (Risk Assessment, EMS report)
- Reducing operational expenditure through improved management of inputs and outputs.

8 APPENDICES

Appendix 1: Merimbula Lake Oyster Growers' commitment

Oyster growers from Merimbula Lake in partnership with Southern Rivers CMA have developed this EMS for their oyster industry. The following list has been compiled to document those members who agree to their responsibilities under the environmental policy and Action Plan described in this EMS.

Name	Company	Address	Phone/Email	Signature / Date
Paul Alcock (PA)				
Chris Boyton (CB) Dominic Boyton (DB)				
John Chapman (JC)				
Greg Comerford (GC)				
Jack Cole (JC) Peter Cole (PC)				
Stirling Cullenward (SC)				
Gary Delacourt (GD)				
Michael Fulton (MF) Amanda Fulton (AF)				
Merve Hansen (MH)				
Bob Helicar (BH)				
John McKay (JMcK)				
Rod Rutter (RR)				
Bert Sherlock (BS)				
Andy Smith (AS)				
Brett Weingarth (BW)				
Hugh Wheeler (HW)				

Appendix 2: EMS development process

Over some years, Merimbula oyster growers have been involved in a series of projects in the catchment that aim to protect the environment and enhance water quality. In 2008 the MLOG became interested in the environmental awards announced at the Annual Oyster Field Day because the Clyde River Farmers Cluster Group won the group award for the implementation of their EMS in the estuary two years before. The Clyde River growers had worked in collaboration with the Department of Lands and Southern Rivers CMA on various sediment control, clean-up and revegetation projects. Because of MLOG interest, the Southern Rivers CMA organised a workshop with Dr Ana Rubio, one of the coordinators involved in the development of the Clyde River EMS. Following this workshop, MLOG decided to commence development of an EMS for their location in order to explore and document the options for a secure and sustainable industry into the future.

The MLOG were provided funds by the Australian Government's National Heritage Trust through the Southern Rivers CMA to develop the EMS. These funds were used to engage Dr Ana Rubio to assist with the development of the EMS. Dr Rubio has been involved with the NSW oyster industry for six years, four of which while undertaking a PhD on environmental influences on the sustainable production of the Sydney Rock Oyster.

The EMS is compiled with regard to *AS/NZS ISO 14001:1996 Environmental management systems – Specification with guidance for use (Standards Australia 1996),* the Australian and New Zealand guidelines which meet international standards. This EMS, particularly in its first two years of implementation, specifically refers to the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the sustainability and longevity of the Merimbula Lake oyster industry.

The following steps were, or will be, followed in the development of this EMS:

1) An initial one-day, onsite workshop explaining the concept of an EMS, the benefits of operating under such a program, and what steps are required for initial implementation.
2) A one-day site visit to undertake an environmental audit and identify operational and infrastructure risks for the Merimbula oyster enterprises. At least 65% of the Merimbula Lake Oyster Growers were consulted at an individual level.
3) A third day dedicated to explaining the concept of an environmental risk matrix, how it is developed and its operational implementation. Growers ranked risks and planned additional measures to implement in upcoming years. Action plans related to high risks were implemented immediately.
4) Report on progress of implementation process.
5) Final report to Southern Rivers CMA, including an Executive Summary, on the benefits of the EMS to the industry and how the industry is addressing the high risks. This document will be made public and will be used to promote the profile of the industry as a whole.

The Seafood EMS Chooser developed by Seafood Services Australia, 2005 (see below) was used through the process and a similar template to the Clyde River Oyster farmers EMS was used in preparation of this report.

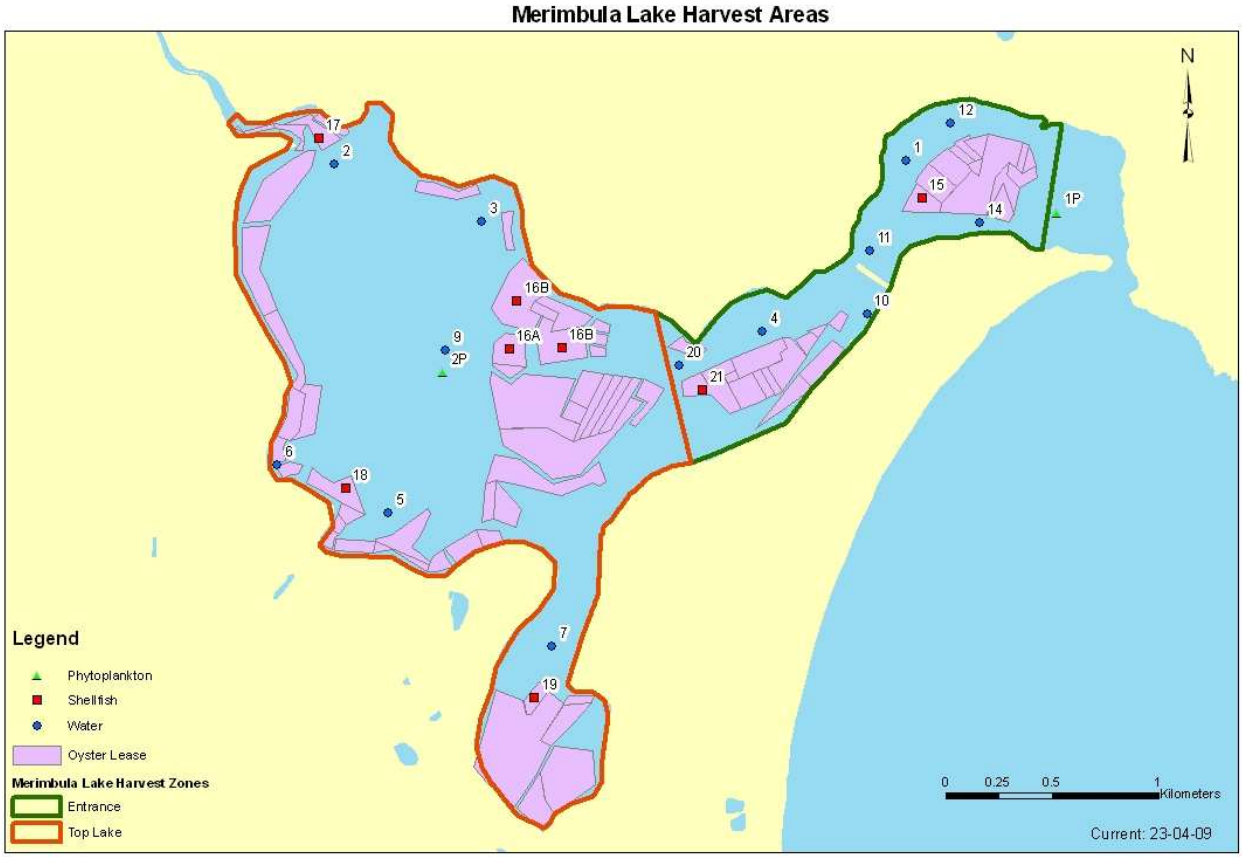
Figure 16: Eight easy-to-follow steps of the EMS (Seafood Services Australia, 2005)

1. Planning: identifies the scope of the EMS, major environmental impacts and develops a set of objectives
2. Implementation & Operations: puts in place a set of procedures for the achievement of the identified targets.
3. Checking & Corrective action: monitors the success of the EMS and implements corrective measures where protocols are not being followed or the system is in some way deficient
4. Management review: review the EMS and the degree of achievement of the goals that were created in the context of the environmental policy.

The actions outlined in this EMS has been developed with the aim of allowing growers to continue their individual methods of farming oysters as long as the overall environmental objectives described in the EMS are met. For instance, not all of the operational requirements listed in the Action Plan will be applicable to all growers; some growers may already be using alternative practices that achieve the same environmental aim.

Appendix 3: Direct Harvest map for Merimbula Lake and operational procedure

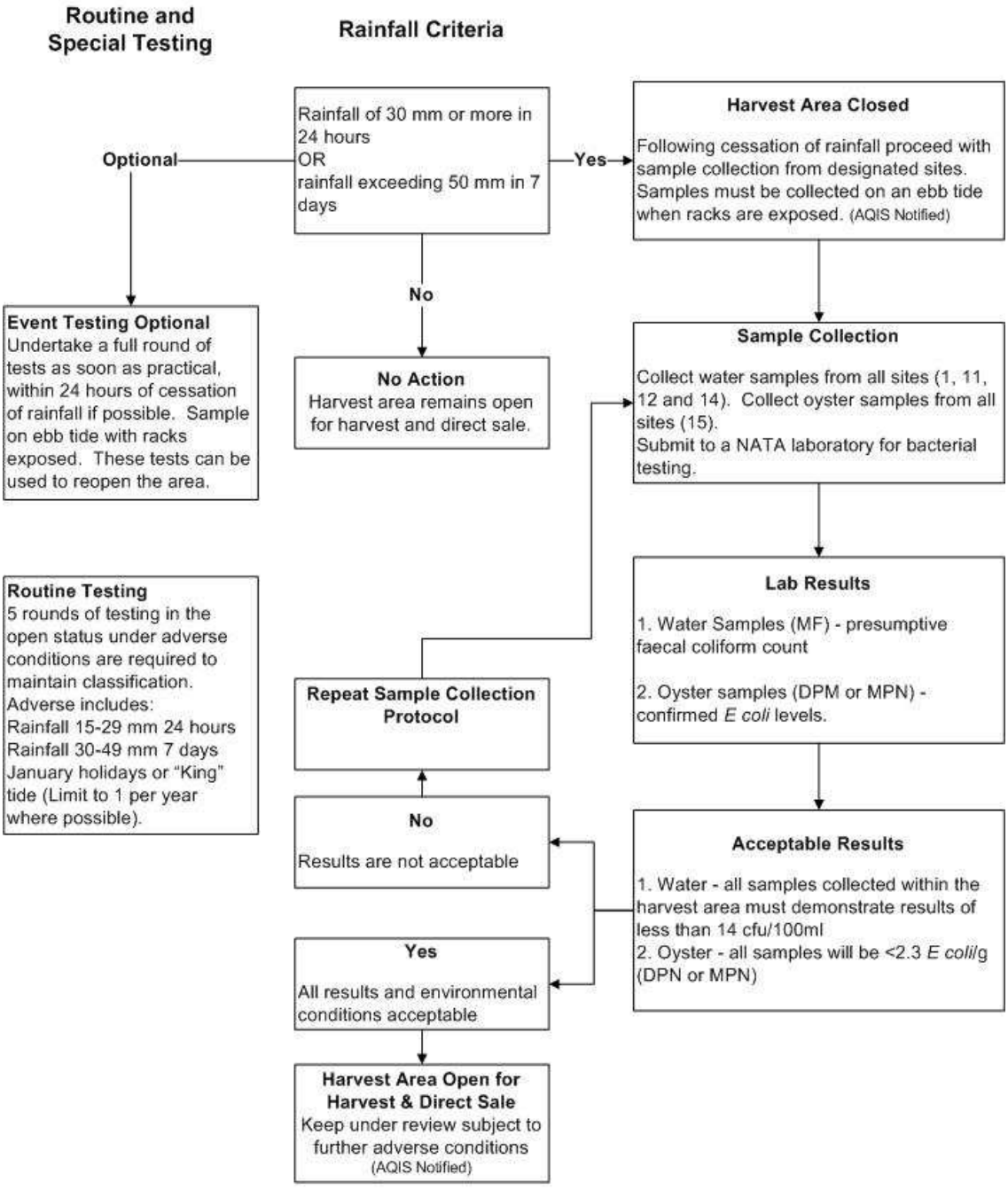
This classification has been made in accordance with the guidelines of the Australian Shellfish Quality Assurance Program by NSW Food Authority. Each area is managed slightly differently as per procedure outlined in this appendix.



Source: NSW Food Authority

April 2009

Entrance Harvest Area
(Conditionally Approved)
Merimbula Lake
Operation Under Rainfall Conditions



Notes:

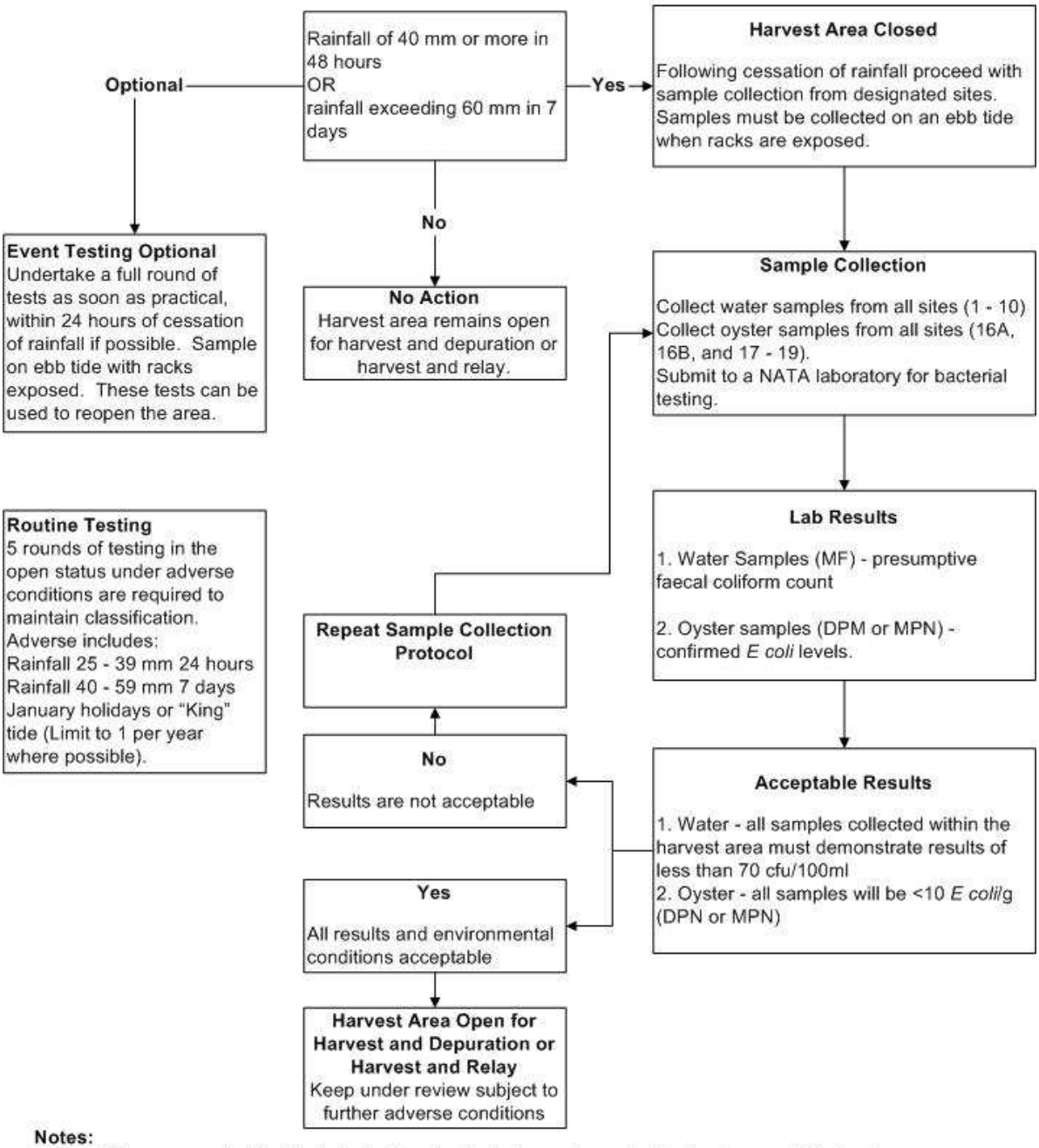
1. Rainfall is measured at the Merimbula Airport rain station and reported by the Bureau of Meteorology
2. Formal closure and re-opening of harvest area is the responsibility of the NSW Food Authority.
3. NSW Food Authority will enforce closure of the harvest area.
4. It is the responsibility of each farmer to ensure that the area is open prior to harvest.
5. The NSW SP and Merimbula Lake SP Coordinator will liaise regarding environmental conditions and sampling arrangements.
6. AQIS are to be notified of all openings and closures of the harvest area. Notification to les.johns@aqis.gov.au

June 2006

Top Lake Harvest Area
(Conditionally Restricted)
Merimbula Lake
Operation Under Rainfall Conditions

Routine and Special Testing

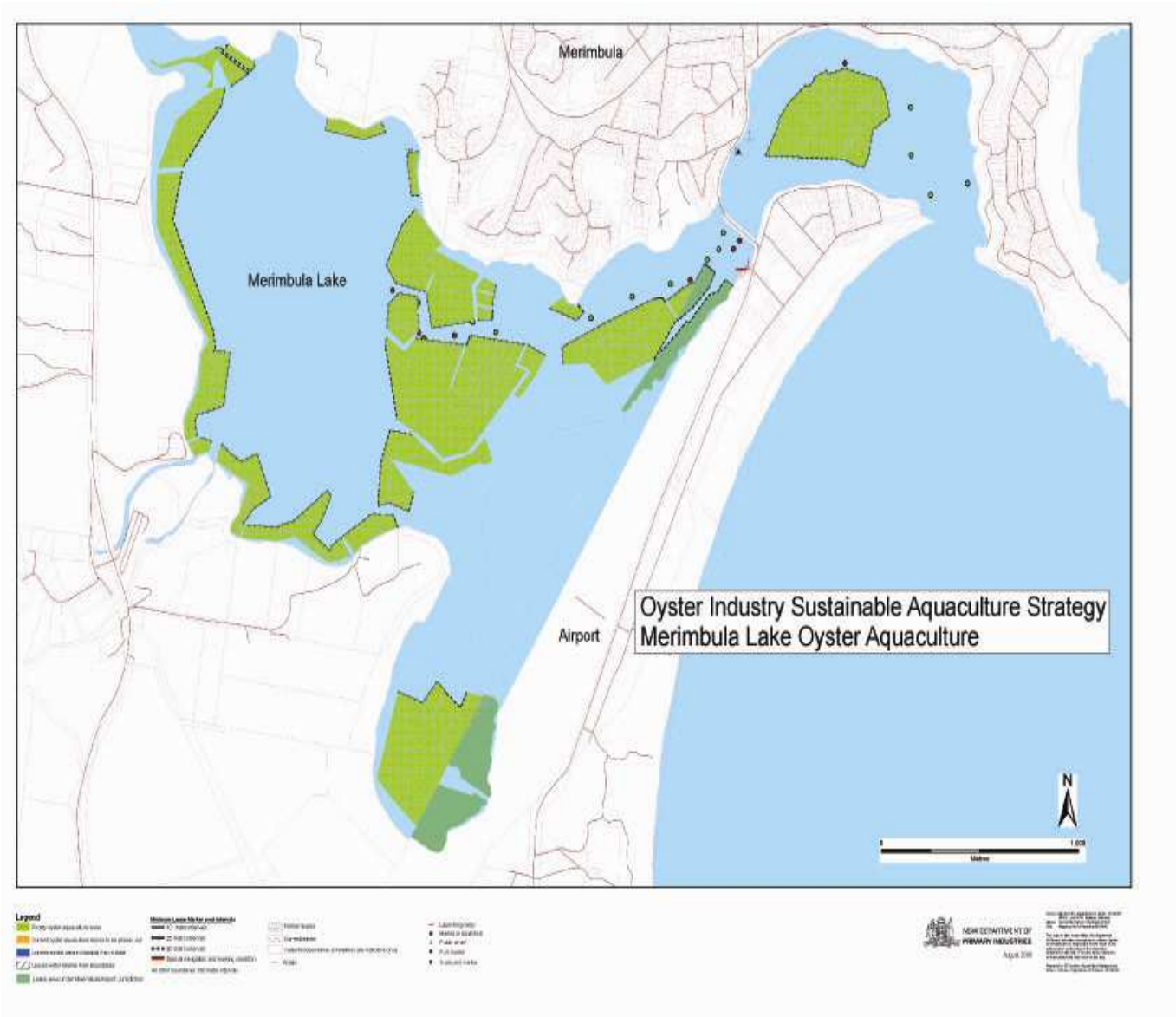
Rainfall Criteria



Notes:

1. Rainfall is measured at the Merimbula Airport rain station and reported by the Bureau of Meteorology
2. Formal closure and re-opening of harvest area is the responsibility of the NSW Food Authority.
3. NSW Food Authority will enforce closure of the harvest area.
4. It is the responsibility of each farmer to ensure that the area is open prior to harvest.
5. The NSW SP and Merimbula Lake SP Coordinator will liaise regarding environmental conditions and sampling arrangements.

Appendix 4: Priority oyster lease areas in Merimbula Lake



Appendix 5: Risk rating - likelihood and consequence values

Likelihood ranking

Likelihood	Score	Definition
Rare	Low (1)	May occur in exceptional circumstances, ie. once every 10 years
Possible	Moderate (2)	Uncommon, some evidence to suggest this may occur , i.e once in 1-3 years
Likely to occur	High (3)	Highly probable to occur in most circumstances, i.e. 2-4 times a year

Consequence ranking

Consequence	Score	Definition
Minor	Low (1)	Insignificant or minimal impact on structure/function dynamics. Unlikely to measure from the existing natural background variability
Severe	Moderate (2)	Maximum appropriate/acceptable level of impact on environment (recovery months/years)
Major	High (3)	Very serious impacts now occurring with relatively long time frame and/or permanent/irreversible damage or loss (recovery years/decades/unlikely to ever be fixed)

Risk Matrix

	Consequence		
Likelihood	**Minor (1)**	**Severe (2)**	**Major (3)**
Rare (1)	1	2	3
Possible (2)	2	4	6
Likely to occur (3)	3	6	9

Management Response

Risk Level	Description	Reporting	Likely Management
Low (1-2)	Acceptable - no specific control measures needed but recommendable	Short justification needed	None specific
Moderate (3-5)	Acceptable - with current risk control measures in place	Full performance report	Specific response required (Continue current arrangements)
High (6-9)	Not desirable - continue strong management action - new or further risk control measures to be introduced in near future	Full performance report	Immediate / Specific response with urgency

Appendix 6: Risk assessment table for Merimbula Lake

Risks have been organised on a high priority basis and split into Industry-related risks and External risks.

Responsibility:

Initials of growers as per Appendix 1.

Additional initials: HD, Helen Davies (Southern Rivers CMA); AR, Ana Rubio; MLOG, Merimbula Lake Oyster Growers

Where the action is the responsibility of MLOG, all growers committed to this EMS are expected to contribute to that action.

All actions will be reviewed at the AGM audit session and if completed and risks mitigated, will be moved to Appendix 6 or modified accordingly

Industry-related activities

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Respons ibility	Time-frame	Like'hd	Cons.	Risk Level
Oyster operations-stocking densities (6.1.1.1)	Reduction in oyster productivity (growth & condition)	1. Depletion of food resources due to high stocking densities 2. Increased of oyster disease (easily transfer) 3. Reduced oyster growth rates, longer period to reach market size	1. Stocking as per management plan 2. Good husbandry	1. Expand on water parameter monitoring (i.e. Chl-a) and link to stocking density research underway with UoW (Related actions on water quality degradation)	Avoid overstocking	AR & SC	In progress	3	3	9
Communicati on with community & stakeholders (6.1.1.2)	Poor oyster industry representation in catchment activities	Lack of engagement in catchment activities/decisions	Oyster growers are participants of the Coastal Management & Planning Cttee represented by Caroline Henry and Greg Carton	1. Distribution of EMS to stakeholders on completion of final report 2. Article in local newspaper, radio (3) Pursue oyster festival for Pambula	Oyster industry present in catchment committees	(1&2) By final version of EMS (3) by next AGM	(1&2) HW &SC (3) HW &BW	3	3	9

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Responsibility	Time-frame	Like'hd	Cons.	Risk Level
Industry communication process (6.1.1.2)	Poor communication within oyster members in Merimbula Lake and with the rest of the oyster industry	1. Slower industry development 2. Reduce opportunities for significant overall performance- no sharing ideas and effort	Commenced social events eg Xmas party	1. Organise golf day against Pambula growers 2. Organise a Growers Day, potentially at Wapengo	Increase interaction among growers and network paths across the oyster industry	(1) Oct 11 (2) To be decided	(1 &2) SC	3	2	6
Subdivision of land-based working area (6.1.1.3)	Fragmentation of Merimbula Lake oyster industry	1. Poor networking among growers 2.Lack of storage/on-ground working space 3. Lower business value	At present only a few growers have access to land-based areas. There is available space to share this resource between current growers	Further conversations/ negotiations with the Dept of Lands	A stronger unified/ coordinated industry group	CB	By next AGM	3	2	6
Disposal of old infrastructure and replacement of tarred materials (6.1.1.4)	1.Non-optimal disposal of old/damaged infrastructure 2. Leaching of tar into the water and sediment	1. Use of limited landfill resources 2. Reduced water quality	1. Clean-up programs organised & funded by SRCMA 2. Growers are already phasing-out the use of tar	1. Clean-up programs will be managed at individual enterprise. Growers have committed to keep up with regular clean-ups 2. Negotiate landfill fee through council 3. Seek funding options to assist with clean-up and purchase of environmentally friendly infrastructure	(1) Reduce disposal to landfill. Reuse and recycle as much as possible. (2) Replace & dispose of all tarred products by 2013	(1) MLOG (2) HW (3) HD	(1) On-going (2) By next AGM (3) On-going	3	2	6
Faulty oyster infrastructure (6.2.1.1)	1. Broken floating cultivation units float away 2. Shoreline accumulation of old oyster infrastructure	1. Navigation hazard 2. Accumulation of oyster products on shoreline - visual amenity	1. Check soundness of infrastructure 2. Repair damage as soon as problem is observed	1. Annual shoreline patrols to collect float away oyster infrastructure 2. Equipment tagged for easy identification of owner 3. Put signs up for community to help retrieving oyster bags	Reduce potential navigational accidents and visual pollution	MLOG	Current & on-going	2	2	4
Tenure on land and water based sites on Crown Land (6.2.1.2)	Insecurity of long term tenure	Business insecurity	Current implementation of new strategy proposed by LPMA- secures tenure for 25yrs	Appropriate management of land and water space- need more security Growers to get information on current situation	Longer tenure agreement	MLOG	Current & on-going	1	3	3

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Respons ibility	Time-frame	Like'hd	Cons.	Risk Level
Buildings (oyster sheds) (6.2.1.3)	1.Deterioration of sheds and untidy appearance 2. Stormwater run-off/ Localised erosion	1.Visual impact and aesthetics 2. Waterways contamination	1. Utilise appropriate building materials to minimise visual impact. 2. Grounds / facilities kept well maintained / tidy	Continue current control measures 1. Maintain and clean roofs, gutters 2. Remove any redundant material or equipment from premises 3. Biannual building maintenance check	Tidy buildings and surrounds	MLOG	Current & on-going	3	1	3
Tap water usage (6.2.1.4)	Overuse of potable water while washing oysters etc (eg. grading)	1. Misuse of water resource 2. Unnecessary cost and waste	1. Limit usage to necessary action 2. Use low flow and high pressure hose fittings 3. Ensure that taps do not leak	1. Regular maintenance of water taps	Minimum water usage	MLOG	Current & on-going	3	1	
Disposal of shell waste	1. Inappropriate use of waste product	Use of limited landfill resources	Shell waste use as road base and as run-off control around land based activities and in other roads in the catchment	Look for other potential users (as road base) and alternative means of by-product disposal	Disposal of shells in an environmental ly friendly way	MLOG	Current & on-going	2	1	
Derelict leases (6.3)	1. Inappropriate disposal of tarred or treated timber 2. Navigational hazard 3. Available substrate for pest oyster species and other fouling species 4. Visual impact	1. Potential chemical leach into waterways (from old tarred infrastructure) 2.Boat accident 3. Unmanaged fouling practices 4. Public against oyster industry	1. Appropriate disposal of tarred products in DEC approved and controlled land fill sites 2. Keep up cleaning/ maintaining leases	Reuse where possible	No derelict lease in the lake	MLOG	Current & on-going	2	1	
Oyster boating activities – shore line (6.3)	High impact - boat wash on shoreline	1. Navigation collision 2. Loss of habitat 3. Destruction of ecological sensitive areas (i.e. saltmarshes, unstable banks)	1.Holder of a NSW Boat License 2. Drive at low speeds close to sensitive and ecologically important areas	Put up signs "no wash"	Reduce accidents in waterways and minimise boat wash	MLOG	Current & On-going	1	1	1

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Respons ibility	Time-frame	Like'hd	Cons.	Risk Level
Oyster boating activities – aquatic habitats (6.3)	Navigation over seagrass beds	Loss or damage of seagrasses- reducing habitats of juvenile fish and other animals, sediment stabilisation	1.Lift engine so no entanglement occurs 2. Growers commitment to preserve seagrasses	1. Monitor seagrass growth and extension 2. Continue with current control measures	Minimise seagrass damage	MLOG	Current & on-going	1	2	2
Inefficient motors (6.3)	1. Fuel and oil pollution 2. Noise pollution	1.Reduce water quality 2. Impact on wildlife (birds) 3. Irritate neighbours	1. Limit unnecessary use of outboard 2. Regular maintenance of oyster vessels	1. When outboard motors need replacing, will source motors that conform to EPA regulations for noise and emissions. 2. Follow OISAS recommendations (7.9)	Change all boat engines to conform to EPA	MLOG	Current & on-going	1	1	1
Migratory bird habitat (6.3)	Proximity of boat/leases activity to bird habitat	Loss of biodiversity	Current oyster farming practices have not been found to interfere with bird habitats	Continue implementing control measures. Keep in communication with bird groups for updates on local wildlife	Minimum impact on wildlife	MLOG	Current & on-going	1	1	1
Visual pollution and aesthetics of oyster leases (6.1.1.5)	Bad community perception of industry/ Community unhappy with industry due to appearance or presence of oyster leases	Negative attitude to oyster farming	1. Maintain neat and tidy premises	1. Promotion of EMS (ie. Media) 2. Lease marking standards- check OISAS	Good relationship with community	(1) SC (2) SC	(1) Once EMS finalised (2) By next AGM	3	3	9

External activities

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Responsibility	Time-frame	Like'hd	Cons.	Risk
Pollution of water (6.1.2.1)	1, Sewage pollution (i.e. septic tanks, pipe leaks, manhole) 2. Effluent of untreated sewage entering water way (i.e. vessel holding tanks) 3. Disturbance of acid soils (e.g. Yellow Pinch) or areas of heavy metals accumulated in sediment	1. Contamination of waterways = Closure of harvesting area (unsafe oyster consumption) 2. Water acidification and/or chemically polluted and oyster mortalities	1.Shellfish Quality Assurance Program 2. Regulations for sewage control and management	(Actions linked to Stocking densities risk) 1. Pursue using Pambula's catchment monitoring-multi-probe for additional testing 2. Seek further funds for catchment monitoring program 3. Obtain data from SEWQ program 4. Obtain BVSC sewerage pipe audits and licence for sewage treatment plant 5. Community education/ promotion on natural algal bloom process	No closures No pollution of waterways	(1) SC (2) HD & SC (3) HD (4) HW and BW (licence) (5) JMck	(1) . In progress. Chl-a being monitored (2) By next AGM (3) By next AGM (4) By next AGM (5) By next AFM	3	3	9
Run-off and siltation (6.1.2.2)	1. Run-off into waterways 2. Dust pollution 3. Increased sedimentation in waterways	1. Reduction of oyster filtration -> Reduction in production 2. Increased turbidity levels – impact on water quality and pollution of waterways	Work in collaboration with SRCMA: identifying problematic roads, sealing and improving roads (i.e Millingandi crossing), diverting run-off, vegetating road side/banks	1. Work on Council's gravel depot near airport 2. Maintenance of drains in Millingandi Rd-shortcut: liaise with BVSC 3. Millingandi Ck-catchment run-off 4. Work with SRCMA to prioritise problematic areas	Minimise most of the run-off going into waterways	(1) HD (2) HD (3) All (4) CB& HD	(1-2) By next AGM (3) On-going (4) On-going			

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Responsibility	Time-frame	Likeh'd	Cons.	Risk
Loss of riparian vegetation from clearing and/or cattle infrastructure (6.1.2.3)	1. Increased sedimentation in waterways 2. Shore erosion due to livestock pathways down to the intertidal zone	1. Poor water quality 2. Loss of buffer zone in shoreline 3. Destroy important ecological habitats: mangroves and saltmarshes	Some areas in the catchment have been fenced off and re-vegetated with assistance of SRCMA	1. Include Millingandi and Boggy Ck in CMA Catchment Program 2. Circulate EMS to land owners and promote issue in media using aerial photo of Boggy Ck 3. Preserve shoreline vegetation habitats: liaise with DPI, local bird groups	Stop all livestock impact on foreshore vegetation and polluting water quality	(1) HD (2) SC (3) JMcK	(1) By next AGM (2) Once EMS finalised (3) By next AGM			
Changes in hydrology (6.1.2.8)	Changes in natural sediment processes due to ocean and catchment processes	1. Change of water flow quantity/ direction 2.Limitation of food levels in areas 3. Shift of main navigational channels	Manly Hydraulics monitoring water level at mouth of lake	1. Monitor water level changes in Boggy Ck & others – need instrumentation 2. Contact ANU to organise presentation of research findings and data sharing with growers 3. Potential impacts on shoreline vegetation, run-off, water flow and lease area due to re-claimed land-airport extension: uni student to assist in collection of baseline data (4) Causeway degradation: liaise with council	Minimum sediment impact/ change	(1) CB (2) AR (3) GC (uni/TAFE),AF (Marine Discovery), CB (ANU-Earth Science) (4) JMcK	(1) On-going (2) By next AGM (3) By next AGM (4) By next AGM	3	3	9

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Responsibility	Time-frame	Like'hd	Cons.	Risk
Use of non-environmentally friendly horticulture & agriculture products (6.1.2.4)	Chemical (nitrogen and phosphorus) pollution of waterways through run-off	1. Algal bloom (eutrophication) - turning into anoxic conditions and impacting on oyster's health 2. Poor water quality		Communicate with community about the consequences fertilizers have in the downstream areas of the catchment (i.e. Oyster farming)- disseminate EMS	Reduce chemical input in waterways despite their distance to a water course.	SC & HD	Once EMS finalised	2	3	6
Exotic/ pest species (i.e. Green shore crab, Pacific oysters, Caulerpa) (6.1.2.5)	1. Enhance exotic species settlement, growth and dispersion on oyster infrastructure 2 Transfer of pest between sites/ estuaries 3. Impact on overall ecology of aquatic ecosystem	1. Competition for food sources by pest & fouling species 2. Oyster mortalities (i.e. Green shore crab),decrease in production leads to economic losses 3. Impact on overall aquatic ecosystem	1. Growers have been trained on pest species identification & they are taking part in pest monitoring programs 2. Growers participants of green shore crab research through SCMDC 3. Use of oyster shipment logbook/ Pest & Disease control program	1. On-going collaboration with Green Shore crab coordinator -PhD student to support project (2010) 2. Oyster growers made aware of Caulerpa presence in nearby areas & read Caulerpa Management Plan 3. Investigate boat management at other lakes e.g. signage & wash down facilities at Wallagoot 4. Follow-up monitoring of animals and plants settled on and around artificial reefs deployed by DPI- growers to be informed by DPI	Commitment & involvement of growers to pest monitoring programs & research activities	(1) All (2) All (3) HD (4) JMcK	(1) on-going (2) By next AGM (3) By next AGM (4) By next AGM	2	3	6
Water users (i.e. large vessels) (6.1.2.6)	Boat wash - high boat speed & wave generated by large vessels	1. Erosion of shoreline (i.e. protected areas) 2. Impact on oyster infrastructure (i.e. displacement of units increases oyster mortality) 3. Potential capsize of heavy loaded oyster punts or small vessels		A. Put 'No Wash' signs up at the entrance of Lake - Work with NSW Maritime Authority	Minimise boat wash in areas close to oyster leases and close to shore line	SC	By next AGM			

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measure/ Actions	Performance Indicators	Responsibility	Time-frame	Like'hd	Cons.	Risk
Waterway users & tourists (6.1.2.7)	Mooring/ tie-up boat to lease markers/ vessels driving over oyster leases at high tide	Loss/damage of oyster infrastructure	NSW DPI Fisheries signs "No tie-up" have been hung on major lease posts NSW Maritime regularly undertakes patrols on lake	1. Print larger size of Fisheries signs and install around oyster leases 2. Educate the fishing community (3) Signage at boat ramp	Minimise damage of infrastructure by lake users	(1-3) SC	(1-3) By next AGM	3	2	6
Climate change (6.2.2.1)	1. Acidification of the waterways 2. Oyster incapable of adapting to rapid environmental changes 3.Sea rise level	1. Decreased oyster production as a result of oyster mortalities- due to calcification problems 2. Severe effect on calcification rates in other marine organisms 3. Overall change of aquatic ecosystem processes and reactions as oyster engineering role diminishes		1. Set up long-term environmental monitoring program 2. Growers to get involved in research activities on climate change	Set up appropriate monitoring program to build up base line data in order to identified drifts/variations in norm levels	MLOG	Current & On-going	1	3	3

Appendix 7: Actions completed by MLOG since 2009

Activity	Risk description	Potential Impact	Control Measure/s Implemented	Date Completed	Personnel involved	Follow up required
Oyster operations-stocking densities (6.1.1.1)	Reduction in oyster productivity (growth & condition)	1. Depletion of food resources due to high stocking densities 2. Increased of oyster disease (easily transfer) 3. Reduced oyster growth rates, longer period to reach market size	(1) Conduct research to monitor oyster performance at different stocking densities	(1) Nov 10	AR & HW	Further research currently underway on growth and mortality
Pollution of water (6.1.2.1)	1, Sewage pollution (i.e. septic tanks, pipe leaks, manhole) 2. Effluent of untreated sewage entering water way (i.e. vessel holding tanks) 3. Disturbance of acid soils (e.g. Yellow Pinch) or areas of heavy metals accumulated in sediment	1. Contamination of waterways = Closure of harvesting area (unsafe oyster consumption) 2. Water acidification and/or chemically polluted and oyster mortalities	(Actions linked to Stocking densities risk) (1) Pursue using Pambula's catchment monitoring-multi-probe for additional testing (2) Contact MHL for quote on additional sensors added at MHL site (i.e. Temp, Sal) (3) Promotion with schools – competition. Link with Pambula Festival. (4) Seek funding for stormwater treatment upgrades, and stormwater education (5) Ensure BVSC is following up Septic Safe Surveys with landowners	(1) In progress (2) June 10 (3) June 10. Grow Your Own Oysters Program underway in 4 schools in 2011 (4) June 2010. Stormwater project officer commenced Jan 2011 (5) June 2010. 13 properties in critical risk category	(1) SC (2) HD (3) SC, BW, MF, HD, Marine Discovery Centre (4) BW. SC, HD (5) BW	(1) Monitoring to continue with growth and mortality research underway with UoW (2) Instrumentation not wanted (3) Secure funding to ensure continuation of program in 2012 (4) Secure funding to ensure continuation of program in 2012 (5) Ensure BVSC maintain program
Run-off and siltation (6.1.2.2)	1. Run-off into waterways 2. Dust pollution 3. Increased sedimentation in waterways	1. Reduction of oyster filtration -Reduction in production 2. Increased turbidity - impact on water quality and pollution of waterways	Work in collaboration with SRCMA: identifying problematic roads, sealing and improving roads (eg Millingandi crossing), diverting run-off, vegetating road side/banks	Work on unsealed road access to Boyton's and Cole's sheds. Drainage upgrade completed.	CB,PC, IN, HD	Growers to undertake ongoing maintenance of structures I
Exotic/ pest species (i.e. Green shore crab, Pacific oysters, Caulerpa) (6.1.2.5)	1. Enhance exotic species settlement, growth and dispersion on oyster infrastructure 2 Transfer of pest between sites/ estuaries 3. Impact on overall ecology of aquatic ecosystem	1. Competition for food sources by pest & fouling species 2. Oyster mortalities (i.e. Green shore crab),decrease in production leads to economic losses 3. Impact on overall aquatic ecosystem	(1) SCMDC Green Shore Crab display- growers to provide feedback/information & dead shells (2) Liaise with NSW DPI to manage Caulerpa (i.e. signs at boat ramp, oysters coming from Caulerpa-lakes). Info at tourist info centre etc	(1) JMc, SC (2) NSW DPI, HD	June 2010	

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