Wapengo Lake Oyster Growers Environmental Management System

Southern Rivers CMA CATCHMENT MANAGEMENT AUTHORITY

ENVIRONMENTAL MANAGEMENT SYSTEM
REVISION STATUS

OWNER:	Wapengo Lake Oyster Growers	**REVIEW INTERVAL:**	Every AGM (~1yr)

REV No	Date	Description of Revision	APPROVALS		
			Originator	**Checked by**	**Approval Authority**
0	15/7/09	Risk Assessment performed by Wapengo Lake Oyster Growers at their AGM	Ana Rubio & Helen Davies	Wapengo Lake Oyster Growers	
1	Aug-09	1st Draft sent to Southern Rivers CMA for review	Ana Rubio	Helen Davies	
2	Jan 2010	Draft of EMS reviewed by Wapengo Oyster Industry	Ana Rubio & Helen Davies	Wapengo Lake Oyster Growers	
3	By July 2010	1st Audit			

Reference:
Wapengo Lake Oyster Growers (2010) Wapengo Lake Oyster Growers' Environmental Management System. A report prepared by Dr A. Rubio (Environmental consultant) for Southern Rivers Catchment Management Authority. 46 pages.

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WAPENGO LAKE OYSTER GROWERS–
ENVIRONMENTAL MANAGEMENT SYSTEM

'Wapengo Lake Oyster Growers working to ensure a growing and sustainable industry through environmental, socially responsible practices to produce a world class gourmet oyster'

In recent years, international agreements have been developed to ensure that our natural resources and the environment are managed on a sustainable basis. Primary industries, like oyster farming, play an important role in natural resource, use and management. Because of this close relationship, responsible primary industries aim to function as 'stewards' and ensure that future generations can enjoy the same foods and lifestyle enjoyed today. For this reason, the Wapengo Lake Oyster Growers have committed to implement an Environmental Management System (EMS) to ensure the long term viability of the environment and their industry in Wapengo Lake.

An EMS is a structured system designed to help the Wapengo Lake oyster industry to reduce any environmental impacts from their operations ensuring best practices and ensuring that no detrimental effects impact the catchment's environment. Through the EMS, oyster growers also aim to improve communication with the local community and stakeholders so that they understand the nature of the oyster industry and its environmental management role. One of the key drivers for the implementation and adoption of an EMS by the Wapengo Lake oyster industry is the ongoing environmental degradation of the catchment, particularly its effects on water quality and pollution. This is a result of the increasing development near coastal areas that often leads to increased nutrient loads and sedimentation, often through erosion, into the waterways. Enhanced nutrient levels are potentially detrimental to oysters and to the overall health of the lake.

Oyster farming has a series of positive aspects that Wapengo Lake Oyster Growers would like to promote among the local community and catchment users:

- Oyster cultivation is one of the most ecological forms of farming because oysters do not require artificial food compared with finfish cultivations. Oysters feed on the particles that are available in the water. Therefore oyster growers rely on Mother Nature to look after their oysters, bringing the right supply of nutrients and food particles, together with the right amount of sunlight to produce an optimum food mix for oysters to thrive on.
- Oysters gather their food by filtering large volumes of water from the waterways. This filtration capacity results in clean waters as oysters remove particles from the water column enhancing water clarity and promoting seagrass, saltmarsh and mangrove survival. Oysters are the 'canaries' of the waterways as if the waterways are healthy, the oysters will be healthy too.
- Oysters are a healthy seafood full of vitamins, minerals and omega-3 fatty acids

Consequently, the Wapengo Lake oyster industry is a key indicator of the health and performance of the Wapengo catchment. It is important to keep in mind that certain activities in the catchment could have an impact on other users, in this case the local oyster industry. Wapengo Lake Oyster Growers have been monitoring intensively through the years the quality of the water and the oysters. As a consequence of their diligence in checking the water quality, it has meant that any unexpected pollution source in the lake has been very quickly identified and managed ensuring that Wapengo catchment is clean and safe for users such as fishers, swimmers and of course, oyster consumers. This demonstrates that oyster growers are good stewards of the local environment to the community.

Wapengo oyster growers undertook a risk assessment exercise as part of the EMS process in which industry-related and external risks were identified and prioritised. Growers developed an action plan to address, firstly, the high risk activities impacting on their industry. Wapengo growers' goal for this year

2009-10 is to manage the activities below that are significantly impacting on the sustainability and long-tenure of their industry.

Industry-related activities include:

1. Working towards upgrading oyster cultivation techniques by eliminating the use of treated timber, upgrading old infrastructure and using environmentally friendly materials. Growers will ensure that old and damage infrastructure is regularly and appropriately disposed. The NSW oyster industry is currently adopting best practice cultivation methods and as part of this process there is a need to replace old infrastructure with new environmentally friendly materials.
2. Upgrading oyster vessel outboards to meet the DEECW emission standards in order to minimise fuel and oil leaks and noise pollution.
3. Negotiating new agreements with Land and Property Management Authority for 25-year tenure for the oyster Land-based sites, which results in further security for the oyster growers.
4. Improving communication across members of the oyster industry in order to combine effort and strategies for improving product-value, community education and marketing.

External activities impacting the oyster industry in Wapengo include:

1. Presence of unsealed roads in the catchment that results on run-off and sedimentation diverted to the waterways. In most cases there is no riparian vegetation along the edge of road.
2. Deterioration of water quality in Wapengo as a result of sewage pollution (septic tanks, private camping and livestock); increased nutrient loads (horticulture and agriculture products) and fine sediments (catchment unsealed roads).
3. Changes in the hydrology of the lake as a result of sediment loads from catchment activities.
4. Recreational fishermen and lake users mooring on oyster leases, damaging infrastructure and creating boat wash resulting in shore erosion impacting shell middens and impacting on oyster cultivation structure.

Oyster punts parked in Wapengo Lake

The Wapengo Lake Oyster Growers are committed to protecting the health of Wapengo Lake. However, many of the risks cannot be tackled by the industry alone. Help us maintain this important shellfish industry and protect Wapengo Lake!

For any further information on the Wapengo Lake Oyster Growers' EMS, please contact Wayne Tupper, the Wapengo Lake Shellfish Quality Coordinator (m: 042 8355 107)

2 ACKNOWLEDGEMENTS

The EMS coordinator would like to acknowledge the outstanding effort that has been made by the Wapengo Lake Oyster Growers in developing this EMS. Additional thanks to all those involved in various activities in the catchment, who were approached by the EMS coordinator, for their time and support in this process. This document represents an ongoing process that will be updated every year. Please forward any comments you might have to the Wapengo Lake Coordinator (Mr. Wayne Tupper) in order to be included in the upcoming version of the document.

The development of this project has been a steep learning curve for all involved and has resulted in bringing together most of the individual oyster enterprises into a unique powerful group representing the Wapengo Lake oyster industry.

The project was funded by the Australian Government's Natural Heritage Trust, through the Southern Rivers Catchment Management Authority, 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 commented on by several.

3 WAPENGO LAKE GROWERS COMMITTED TO AN EMS FOR THE LAKE

Oyster growers in Wapengo Lake share aquatic and land resources with many other users through activities including water sports, fishing, forestry, tourism, cultural and historical activities. All users of the environment have some degree of effect on it. They can also impact on each others' activities, and this can result in positive or negative relationships. Consequently, it is important to be aware of the potential cascade-effect that some users/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 if no precaution is taken.

Like many other sectors of the seafood industry, oyster farming in NSW is currently moving towards greater efficiency and environmentally friendly systems. Wapengo Lake Oyster Growers agreed to implement an Environmental Management System (EMS) in Wapengo Lake to ensure a professional and environmentally responsible management of their industry and to demonstrate their commitment to the wider community. The objectives of this EMS are to highlight all environmental issues relevant to oyster farming and to provide recommendations to assist growers and stakeholders to meet their legislative requirements under relevant environment protection policies (EPPs), the *Environment Protection Act* 1993 and to work together towards a healthy catchment. In doing so, Wapengo Lake Oyster Growers would like to ensure that oyster farming activities in their respective areas do not cause environmental harm and secure the long term sustainability of the industry.

3.1 Need for an EMS

Currently there is an increased pressure on coastal industries as a result of increased coastal development and recreational use of waterways. In recent years, international agreements have been developed to ensure that Australian natural resources and the environment are managed on a sustainable basis. As part of this international push towards environmental sustainability the Wapengo Lake oyster industry would like to strengthen their position through this EMS to ensure the protection of optimum environmental conditions required in estuaries for oyster growing. Many initiatives towards responsible business practices are already underway in Wapengo Lake with some initiatives being taken up faster than others by the various individual growers in Wapengo. Through the commitment to this EMS in addition to the various on-going activities that are already taking place in the catchment, this industry will ensure its long term sustainability in Wapengo Lake.

The main aim of this EMS is to establish a means to formally demonstrate the industry's resource management capability to regulatory agencies, oyster processors and consumers, and the general community. This EMS sets out best environmental practices in oyster cultivation, identifies potential impacts on the health of the catchment and provides means for the protection of water quality within

Wapengo Lake. The EMS for the Wapengo Lake oyster industry will also promote the industry's role as a legitimate and responsible user of the public waterways.

3.2 Oysters as indicators of coastal lake 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)

Oyster Aquaculture ⇨ Water Quality + Oyster Food + No Oysters + Filtration rates

Aquaculture these days plays a major role in meeting the growing world demand for fishery products as this supply requirement has not been achieved through increasing fishery captures, mainly due to stock collapse. Consequently best practices and sustainable development in oyster farming needs to be ensured.

Oyster farming has a series of positive aspects that the community should acknowledge:

- Ecological product (3.2.1)
- Oysters, the 'canaries' of the estuaries (3.2.2)
- Oysters, ecosystem engineers (3.2.3)
- Increased employment in rural areas (3.2.4)
- 'Green' oyster product (3.2.5)

3.2.1 Ecological product

Oyster cultivation is potentially one of the most sustainable forms of mariculture because it uses extensive rather than intensive cultivation and targets species with a low trophic position in the aquatic food webs, compared with finfish cultivation. Oyster cultivation does not require artificial food input as the animals extract their nutrition principally by the filtration of microscopic particles available in the water column: 1) phytoplankton (microscopic plants) and different types of organic detritus available in the water column (mangrove debris, organic matter, etc) and, 2) microphytobenthos which are microscopic particles resting on the surface of the sediment which temporally form part of the water column through processes of resuspension induced by wave action (Wisely & Reid, 1978; Richardson, 1991; Rubio, 2008). Consequently, oysters only feed on what is available in the water column in the oyster growing area. These food components are naturally produced in the lake based on the natural resources available in the catchment land, waterways sediment and shore line vegetation in addition to the local biological, physical and chemical characteristics of the oyster cultivation area.

3.2.2 Oysters the 'canaries' of the estuaries

It is been estimated that on average a cultivated Sydney rock oyster could filter approximately 0.5 Mega Litres of estuarine river water and could remove large quantities of suspended matter in their lifetime (White, 2001). As a result of their massive filtration capacity oysters clean the water, enhance water clarity, promote seagrass growth and accelerate nutrient recycling processes in the lake. Oysters are very sensitive to changes in the physical and chemical characteristics of the water. Consequently, oysters are key indicators of the health and performance of aquatic systems. Oysters are the canaries of the estuaries: if estuaries are not healthy, the oysters will be unhealthy too.

The oyster's biological processes are vulnerable to detrimental environmental conditions having to adapt their processes according to surrounding conditions. For instance, if levels of pollution increase in the water ways as a consequence of urban effluent discharges, agriculture run-off or fuel spills, oysters will quickly react to these conditions, in most cases reducing filtration and therefore feeding.

3.2.2.1 Coastal Lakes

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

Nutrients in these coastal growing lakes are derived from natural ecological events such as upwelling, run-off, litter fall, storm events and weathering. In some cases it is also a result of human activities such as sewage outfalls, leaching of nitrogen and phosphorous from cleared land, fertiliser run-off, industrial effluents, agricultural effluent, etc. This anthropogenic input is typical of urban or intensive farming type-catchments. Consequently, different catchment land-use can have a dramatic impact on the lake ecosystem, particularly on the environmental characteristics and water column composition (particles and nutrients).

3.2.2.2 Factors Affecting Oyster Production

Local factors

- Environmental parameters:

The basic requirements for oyster growth and survival are the availability of space, food levels and maintenance of good/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, unlike land-based farming systems. Consequently oyster growers rely on Mother Nature to look after their oysters, bringing the right supply of nutrients and particles, together with sunlight and heat to produce an optimum food mixture for oysters to thrive on.

Australian temperate estuaries typically exhibit large spatial and temporal variability of food particles primarily due to variable flows. Consequently, oyster production in most coastal areas is highly variable due to geographically-related environmental factors and it is also seasonally variable.

- Stocking densities:

Oyster cultivation systems in Australia operate at low trophic levels and require no external food inputs, consequently, having negligible impacts on aquatic systems. High oyster stocking densities, however, could significantly alter both the natural ecology and the health and growth of the cultivated species, particularly when the carrying capacity of the cultivation region is exceeded.

Wapengo Lake Oyster Growers are aware of the ecological limitation of Wapengo Lake and factor in the number of active growers and the approximate number of oysters being cultivated in the lake at one time. They have been informed about the recommendations provided by Australian oyster research studies (Crawford*, et al.*, 1996; Underwood*, et al.*, 2002; Troup*, et al.*, 2005; Rubio, 2008) and the NSW Oyster Industry Sustainable Aquaculture Strategy.

Larger scale factors

- Anthropogenic activities:

In addition to the natural factors, oyster production can also be affected indirectly by altering the water quality in an oyster producing area through anthropogenic activities such as logging, agriculture, vegetation clearing, and development. These activities could result in increased particle loads in the waterways increasing the turbidity and nutrients levels; increased levels of heavy metals and other toxic chemicals; alterations of the acidity of the waters, etc. Consequently, there is an urgent need to identify all activities taking place in the catchment of an oyster growing lake and evaluate which ones are resulting in environmental degradation impacting the waterways, which will ultimately affect the oyster production of the area.

- Global warming:

Human activities have increased atmospheric concentrations of carbon dioxide by 36% since the start of the industrial revolution. This has lead to a number of significant changes to the physical, chemical and biological systems.

Some of the potential impacts from climate change on oyster farming:

-Australia temperatures have already increased by ~0.8°C over the last century, 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 the oyster cultivation: extreme warm conditions can stress the oysters reducing overall productivity. Higher temperature induced evaporation implies less soil moisture and can lead to exacerbated drought conditions. Less rainfall in an area results in minimum land-nutrient input to waterways, minimising nutrient levels and in some cases, productivity of the area

-Sea level has risen globally by about 20cm as a result of oceanic thermal expansion and melting of land ice. Sea level will continue to rise impacting on some cultivation systems, in particular intertidal systems

-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 their 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). As pH is measured on a log scale, small changes actually have major impacts. As more CO_2 is released, oceans are slowly becoming more acidic, and shellfish, like oysters, are especially vulnerable to this kind of change. Oysters rely on steady carbonate ion concentrations in order to produce the calcium carbonate needed to develop their shells.

3.2.3 Oysters as ecosystem engineers

Oysters have been described as ecosystem engineers (Margalef, 1968) due to their massive filtration capacity and the “top-down” control that oysters exert on the overall aquatic ecosystems. Oysters are important in coupling pelagic (water column) and benthic (substrate/sediment) processes by consuming suspended particles from the water column and depositing wastes and unwanted material in the sediment. As a result of the oyster feeding mechanisms and the metabolic processing of food particles, oysters excrete dissolved inorganic and organic waste back into the water column, and thus, oysters become a major component in the recycling of essential elements in the oyster growing areas. These animals not only trap suspended material but also regenerate and remineralise materials in the water column, resulting in nutrient recycling in the aquatic ecosystem. The importance of oysters to the biological and chemical dynamics in coastal areas is widely recognised (Review of ecological roles of filter feeders in Dame & Olenin, 2005).

3.2.4 Increase of employment in rural or remote areas

The ancient Sydney rock oyster industry directly employs about 800 people, more than any other form of aquaculture in Australia. However the industry has been in a state of decline since the mid 1970’s resulting in the loss of hundreds of jobs in regional NSW coastline and the decline in gross annual revenue by $20 million (White, 2001). This decline was a result of the combined effect of environmental, economic and social factors. Despite these impediments being ever present, oyster production has now stabilized through great efforts from regulatory agencies and growers. The industry is set to achieve the sustainable annual production of 120,000 bags of premium oyster products by 2013 (NSW Department of Primary Industries, 2006).

The oyster industry in the Bega Valley Shire is of high economic and social importance, however its viability in some areas of NSW, is potentially threatened, by a range of environmental factors. The long-term viability of the local industry can be, and is currently slowly being improved through better farming practices, advances in technology, more capital input, expansion of the Sydney rock oyster market and protection of the local water quality (Chen, 2006). This industry is widely spread across 7

estuaries, from the South to the North of the Shire and consequently provides invaluable employment and economic opportunities.

3.2.5 'Green' oyster product

One of the benefits for oyster growers from implementing an EMS is that they will be able to maintain and improve market access through a form of eco or environmental labelling. The EMS confirms that oyster farming in Wapengo Lake is low impact and that growers aim for environmentally sustainable practices. This enforces the clean green image of this industry which improves the oyster industry profile. In these days of greater environmental awareness this activity can lead to greater demand and allow for higher prices. It is in the Wapengo Lake Oyster Growers best interest to maintain close ties with the community promoting the oyster farmers' environmental policy and updating them with progress on the EMS and outcomes, in particular to their commercial partners such as other producers, processors, wholesalers and retailers.

3.3 National Ecologically Sustainable Development (ESD) framework for aquaculture

Australia is involved in several international activities and agreements for implementing sustainable development at the local level and adopting the principles of Ecological Sustainable Development (ESD) for the management of natural resources and the ecosystems supporting them.

The principles of "sustainable development" were set as a result of the impacts that unrestrained economic growth and development were having on the environment (Fletcher*, et al.*, 2004). These principles state that – *today's needs which are met through current industry practices should not compromise future needs*. The NSW Oyster Industry Sustainable Aquaculture Strategy, OISAS (NSW Department of Primary Industries, 2006), integrates the principles of ESD, community expectations and the needs of other user groups in the management and operation of the NSW oyster industry. Consequently, Wapengo Lake Oyster Growers continue to adopt and benefit from the principles of ESD by implementing OISAS.

EMSs are an effective and practical tool to assist oyster farmers in transforming the principles of the ESD into actions that result in environmental awareness and sustainability. The aim of the EMS is to validate and manage only those processes that the oyster industry has identified as a potential impact to their industry through a risk assessment analysis (see Appendix 3).

4 OVERVIEW OF WAPENGO LAKE AND CATCHMENT

4.1 Wapengo Lake catchment

Wapengo Lake (Lat 36.629S, Long 150.021E) is a typical shallow, wave dominated coastal lagoon on the NSW far South Coast, 418km from Sydney. The lake has a medium size mouth, attached to a long shallow neck ending in the main water basin with an average depth of 7m. Wapengo Lake has relatively efficient tidal flushing. Oyster growers have reported shifts of the distribution of fine sediments, including some accumulation at the mouth. The main channels in the main section of the lake are very dynamic. Some of these sediments originate from the hill slopes and upper valley.

The Wapengo catchment (Figure 2) is a largely natural catchment with 70% forest area. A variety of activities occur in the catchment, including commercial agricultural operations, forestry, tourism, recreational fishing and, of course, a valuable aquaculture industry based on the Sydney rock oyster (SRO) cultivation.

The Wapengo catchment is approximately 12km long and 6km wide with a catchment area of ~70 km^2 and waterway area of 3.6km^2 (source: NSW Government Natural Resources & Southern Rivers CMA). Within the catchment:

- 55% is the natural Mumbulla State Forest predominantly in the upper steeper sections;
- 35% is private land (with 20% cleared for farming & 15% either forested or wetlands), mostly clustered around the lower lake and adjoining slopes;

- 5% is National Park, mainly on the coast and
- 5% is (lake) water surface.

4.2 Other industries within the catchment

Forested areas in the catchment have active timber harvesting and silviculture operations. The Wapengo community was recently informed about potential forestry activities (e.g. logging) that might result in impacts on the water quality of the lake. A major clearing already occurred in the 1970's and plans for further clearing by the end of 2009/10 financial year has been announced. An additional impact of the proposed logging in the Wapengo catchment is to the small but sustained population of Koalas that live in the Mumbulla State Forest. Ongoing negotiations with forestry operators are in place to ensure a best management approach to the logging activities.

Commercial fishing is also present in the lake. This activity mainly concentrates in the catch of bream, flathead and sea mullets.

As a result of the large fish stocks present in the lake there is also an active recreational fishery in the area. There are predictions that the Wapengo recreational fishery will keep increasing in the future as a result of the pristine conditions of the area and the close proximity to Mimosa Rocks National Park, one of the most visited parks in the south coast. Recreational fishermen currently access the lake through the oyster growers' land base.

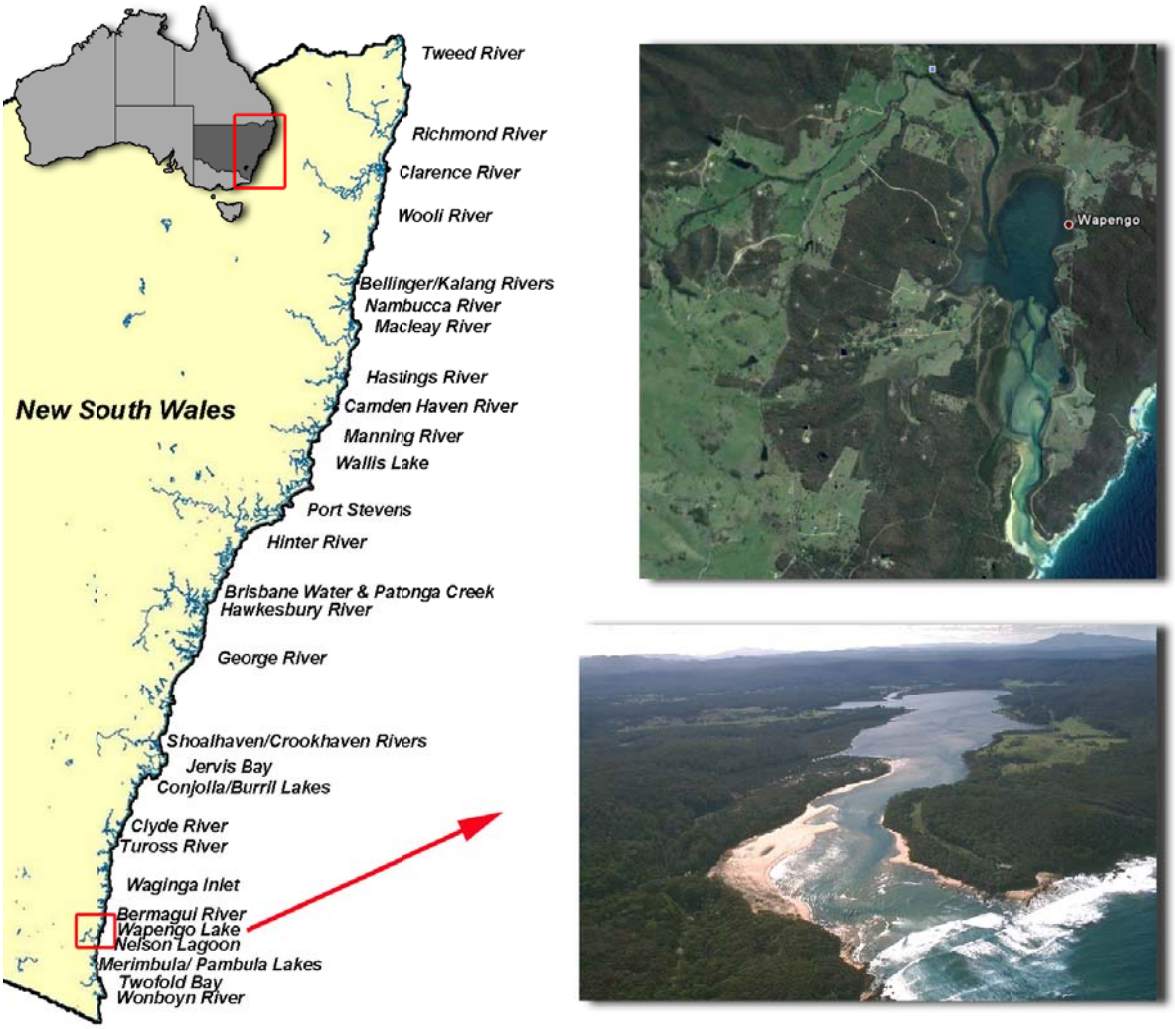


Figure 1: NSW map with location of Wapengo Lake, aerial vegetation map of the lake and part of the catchment (source: Google Earth) and aerial photograph of the mouth of the lake (Source: NSW Government Natural Resources)

4.3 Catchment protection and rehabilitation

All activities in the Wapengo catchment potentially affect the quality of Wapengo Lake water and it was with this understanding that, in 2005, the Wapengo oyster growers approached Southern Rivers Catchment Management Authority (CMA) for assistance with catchment protection. Prior to this time, projects had been undertaken with several landholders in the catchment, including river rehabilitation projects and the development of four Voluntary Conservation Agreements (VCAs) to protect high conservation value native vegetation.

However, with the impetus of the oyster industry's concerns, during 2005/06 Southern Rivers CMA undertook a rapid catchment assessment focusing on faecal and sediment pollution sources. This assessment led to the development of a hotspot 'hit list', with sites such as unsealed roads and road crossings, uncontrolled stock access to waterways, and bank and gully erosion topping the list.

Targeting these 'hotspots' then became the aim of the Wapengo Catchment Protection and Rehabilitation Project, with the focus of maintaining or improving the Harvest Area Classification in Wapengo Lake. Representatives from Southern Rivers CMA, Wapengo Lake Oyster Growers, the newly formed community group Wapengo Watershed Association (WWA), Bega Valley Shire Council and Far South Coast Landcare Association formed a steering committee, the Wapengo Working Group, to oversee implementation of works on the high priority hotspots.

Local community involvement was considered essential, so with funding from the National Landcare Program, Far South Coast Landcare engaged a local project officer to more intensively engage landholders in the catchment. The formation of the local community group Wapengo Watershed Association also played a key role in increasing community engagement. As part of this engagement, additional groups have become actively involved in the project, including Bega Local Aboriginal Land Council, Forests NSW, National Parks and Wildlife Service, Department of Environment, Climate Change and Water, Bega Cheese and Livestock Health and Pest Authority.

Three years on, results from this project include:

- A total of 9.25km of waterways protected, and 80 hectares of riparian vegetation protected or planted
- 13 landholders directly involved in on-ground works on their properties
- Employment opportunities provided for the Bega Koori community through their involvement in brush bundle construction to protect eroding banks, and a significant midden site
- Large community working bees to complete fencing and planting of a 500m stretch of Wapengo Creek
- More than 800m of road upgrades completed, involving sealing and drainage improvements on a road and crossing immediately adjacent the Lake, with plans underway to seal the remaining 1100m of gravel road which is also immediately adjacent the Lake
- 8.5 ha of pest plant control completed, and baseline information on pest animals provided through sandplot monitoring of a 3000ha area
- Community catchment monitoring program underway, with the aim of monitoring changes in water quality and wetland and seagrass health.

A summary of some of the works undertaken throughout the catchment is provided in Figure 2.

To date, more than $700,000 has been invested in these catchment projects. Funding has been obtained from numerous sources including: Southern Rivers CMA; Bega Valley Shire Council; the Australian Government's Natural Heritage Trust, Envirofund, Coastcare and National Landcare Program; NSW Environmental Trust; and NSW Fisheries.

The Wapengo Working Group will continue to oversee the implementation of catchment protection projects into the future. However oyster growers are already seeing the benefits of this project. The number of days that the industry is closed for harvest due to poor water quality following rainfall has been reduced, and this has been attributed to the rehabilitation projects completed in recent years.

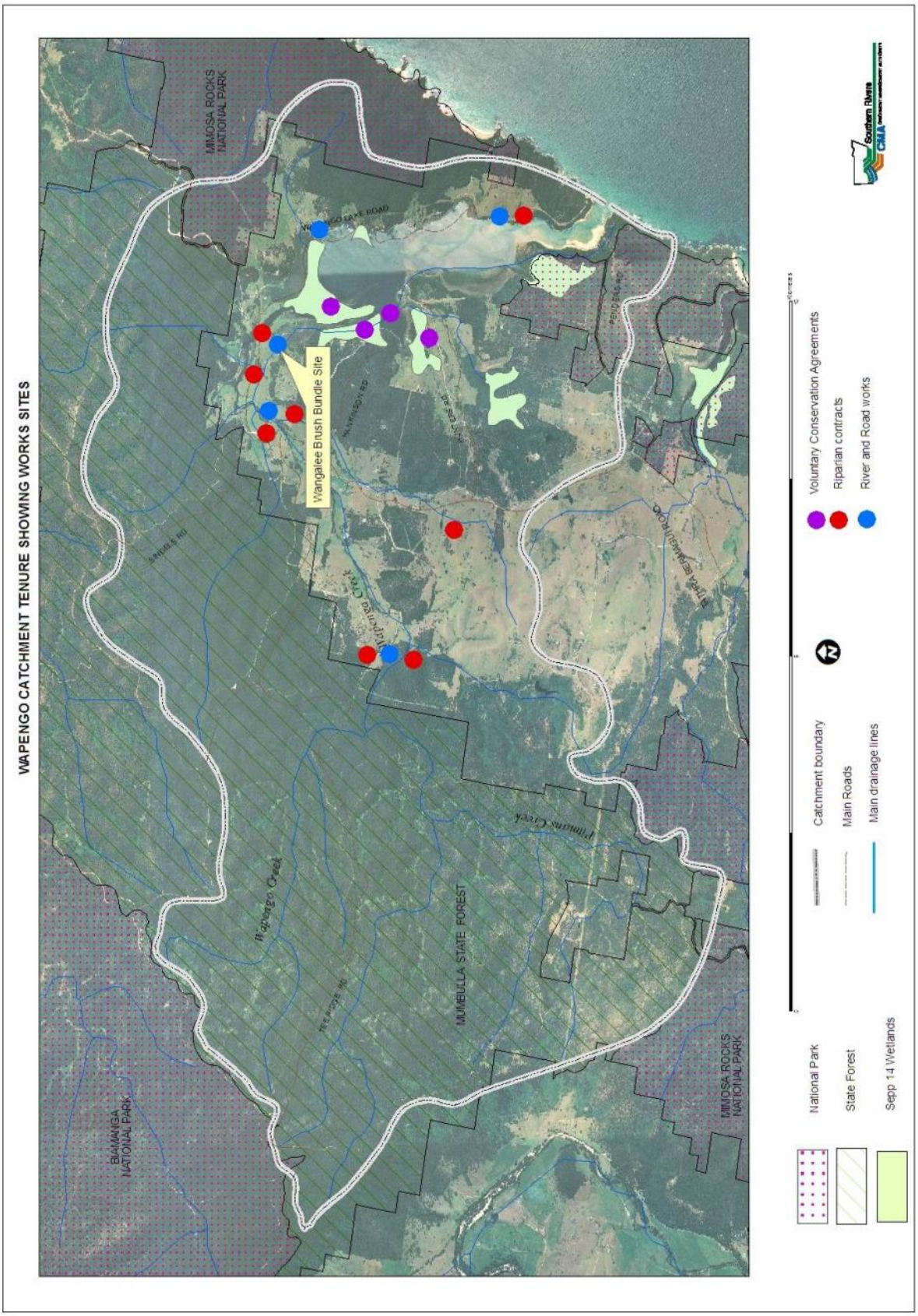


Figure 2: Map of the Wapengo Lake catchment showing location of work sites

5 OVERVIEW OF WAPENGO 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. Edible oysters in NSW contributed around 80% of the total Aquaculture GVP (Gross Value of Production) in the state for 2006-07 (ABARE, 2008). The oyster 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 total area under oyster production in NSW was 3,100 ha with 380 permit holders and approximately 2,600 oyster leases (by June 2005, NSW Department of Primary Industries, 2006).

5.1 History of oyster farming in Australia

There are between 700 and 800 licensed Edible Oyster farms in Australia, about half of which are commercial operations. The total value of oyster production in Australia is about $57 million per year.

Sydney Rock Oyster cultivation in Australia commenced simultaneously in New South Wales (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. Aboriginal kitchen middens, commonly found along the NSW coast, contain shell deposits carbon-dated to 6,000 B.C (Malcolm, 1971). Shell middens are present in the shoreline of Wapengo Lake and have significant cultural and heritage values for the traditional owners of the area (the Merrimans).

With the European colonisation, oysters were collected for food and to provide lime for building mortar from burning oyster shells (alive and dead). Consequently by the mid 1800's, natural oyster stocks were depleted and the burning of oyster was prohibited. This resulted in the establishment of a regulated commercial oyster industry in NSW (Malcolm, 1971).

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 4). Consequently there is a need to ensure best operational and management practice within oyster farming, including a commitment to protect and secure the environment. As previously mentioned, Wapengo Lake Oyster Growers believe that an EMS is the best tool to achieve this.

This report concentrates on those activities associated with the commercial cultivation of one of the edible oysters cultivated in Australia: the Sydney Rock Oyster, SRO, (*Saccostrea glomerata*). SRO, is endemic to Australia and extends from the Victorian/NSW border on the east coast, across the tropics and along the west coast in Western Australia to latitude 25°S. SRO is frequently found on rocky substrates in the intertidal zone but can also survive and grow well on the bottom, depending on the type of substrate. This oyster changes sex throughout its life. The majority of young oysters are males first changing to female later on in life. In many occasions the same oyster reverses sex a few times before ending as a female. The gonads form a significant proportion of the body tissue, especially when ripe as they fill the gonads with gametes resulting in 'fat' condition, a premium product for marketing. SRO in Wapengo Lake tend to spawn during the warm months of the year: between summer and the end of autumn, when water temperatures are generally below 20°C. Once an oyster has spawned, the gonad shrinks and becomes watery. Oysters release their male and female gametes in the water column where fertilisation takes place. The eggs develop into a series of planktonic larvae stages until they metamorphose into a benthic larvae that settles on a substrate known as 'spat'. SRO embryo, larvae and spat relies on optimum environmental conditions for a successful development.

5.2 Oyster Production-Nationally

As shown in Figure 4, NSW SRO production grew steadily for 30 years reaching ~140,000 bags by the mid 1970's. This peak was driven mainly by a peak production of 43,000 bags in Port Stephens (NSW Department of Primary Industries, 2006). For approximately a decade, oyster production stabilized, however this has been followed by a consistent decline despite efforts from oyster growers and the introduction of new technologies. Currently, the annual production has stabilized at around 70,000 bags (~8 million dozen oysters, Figure 4).

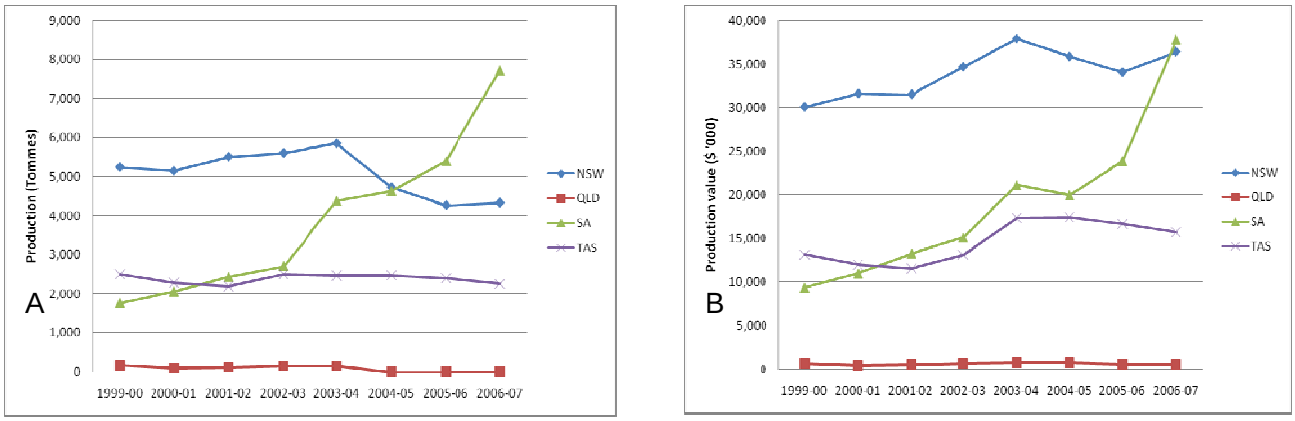


Figure 3: Production of edible oyster by Australian states: A) quantity: Tonnes; B) value: $'000

Source: (ABARE, 2008)

A series of factors potentially contributed to the long term decline. These include disease outbreaks (i.e. QX major outbreaks in the Georges River in 1994 and in the Hawkesbury River in 2004, wiping out major oyster producers in NSW), the Pacific Oyster introduction, the degradation of water quality in many coastal areas and market competition from oysters grown in other Australian states. The latter factor is clearly reflected in the recent changes in edible oysters GVP and production value across the various Australian states. As presented in Figure 3, the NSW edible oyster industry was the largest producer of oysters in Australia up to 2004/05. After this period South Australia, where Pacific Oysters are the predominant oyster type, overtook oyster production in NSW and is currently seeing its highest ever production levels. For a long period the value of oysters in NSW (mainly from SRO production) were significantly higher than in any of the other oyster producer states. However, in the financial year 2006/07 GVP (Gross Value Production) values for oysters in SA reached those in NSW and it is likely that these values will continue rising along with production levels.

5.3 Oyster production –Wapengo Lake

Wapengo Lake oyster industry is currently comprised of 11 growers, 3 of them are small businesses, 1 of them is a part-time farmer. Wapengo Lake Oyster production contributes 1.1% to the overall NSW production and 2.9% to the south coast production (NSW Department of Primary Industries, 2007). DII Fisheries mapped 76.3ha of priority oyster aquaculture in the lake (Appendix 5) currently producing 600-700 bags of oyster per year. The historic peak in oyster production for Wapengo Lake was recorded for the period 1988/89 with 1,812 bags of oysters sold (extract from OISAS). Wapengo Lake Oyster production increased steadily from the early 1970's to the late 1980's. Then a dramatic decline in production occurred to a low of 392 bags in 1996/97. Since then production has stabilized at around 700 bags (Figure 5).

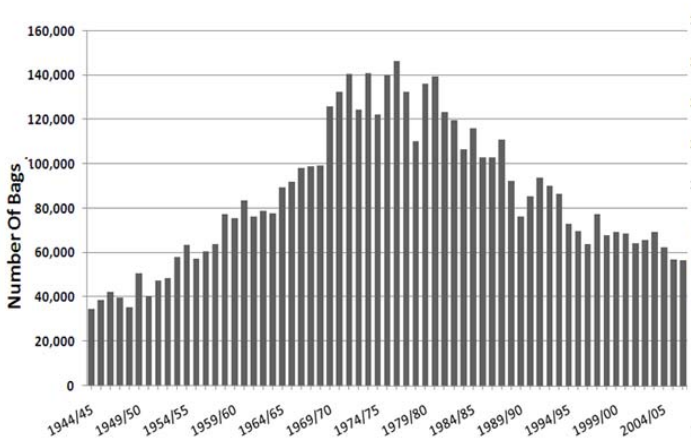


Figure 4: Total NSW Sydney rock oyster production (Number of bags sold) from 1944/45 to 2006/07

(source: DII Fisheries from annual production reports by permit holders)

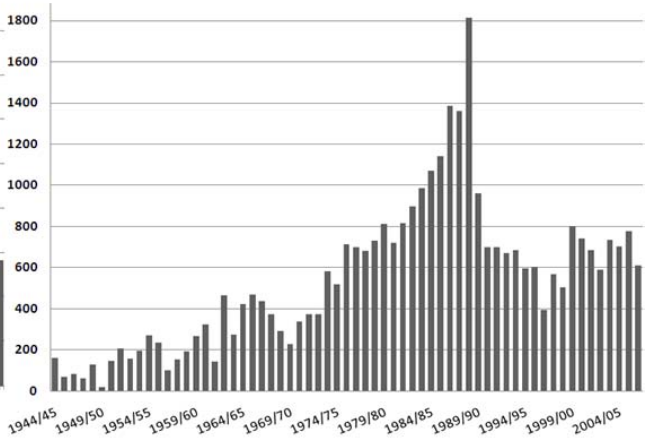


Figure 5: Total Sydney rock oyster production for Wapengo Lake (Number of bags sold) from 1944/45 to 2006/07

(source: DII Fisheries from annual production reports by permit holders)

Oyster production in Wapengo still produces few stick oysters which are slowly being replaced by single seed cultivations. In upcoming years, a large proportion of leases will be changed from rack and rail to long line systems. Most Wapengo Lake Oysters reach the Sydney market, although there is a local processor in Bega who distributes Wapengo Lake Oysters locally in the South Coast. Most growers in the area send their crops to Sydney late in the year once the Northern estuaries have run out of marketable oysters and during the Christmas period. Plate (large) size oysters used to represent approx 70% of the total production back in the mid 1990's. These days a shift in the size of the marketable oysters has lead into a production composed of 20% plate (large), 50% bistro (medium) and 30% bottle (small) grade oysters.

A major challenge for growers in Wapengo has been the unpredictable tides because of weather conditions and often winds as a result of the orientation of Wapengo Lake - *it has been a continuous fight against nature*- as local growers described it.

5.4 Farming methods in Wapengo Lake

Cultivation methods in NSW have changed considerably since the early days. Initially, sandstone rocks or stone leases were used on which oyster spat were captured and grown out. Later, mangrove and wattle sticks took over as movable clutch material that could be easily transferred to different areas and different estuaries. Later, other materials such as fibrous cement – slats, tarred hardwood stakes and cement-coated stakes have been used to catch and growout oysters. These days most of the oysters are removed from the catching substrate early on so that oysters develop a more regular shape which results in increased market value.

Over the last 5 years there has been trend in oyster farming to implement single seed techniques. This process promotes a more regular oyster shape, which is highly valued when marketing the product. Overall, cultivation techniques range from the modern subtidal 'long line and floating bag' techniques to the more traditional intertidal tray techniques. Each method has its pros and cons and growers decide on techniques based on personal preferences taking into consideration the scale of their business, investment and geographical characteristics of their oyster leases (depth, substrate type, slope, current and flows).

Physical factors such as temperature and salinity set limits on the spatial distribution of oyster species. These parameters have a profound effect on both the biology of the oyster (effect on processes like

feeding, reproduction, growth, respiration and parasite-disease interactions) and on optimum site selection for different farming grounds to host the different stages of the oyster farming cycle (farming areas for catching, depot or nursery, grow-out and harvest). As a result of the differences between sites , some growers hold leases in different estuaries or lakes to maximise production at the different stages of cultivation- in some cases the catching leases are a few hundred kilometres away from the finishing-off leases.

Figure 6: Plastic slats for catching oyster spat

Figure 7: Wooden sticks used in stick oyster cultivation

5.4.1 Spat collection

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

Plastic slats/ 'French sticks'

The majority of natural spat fall of the Sydney rock oyster in Wapengo Lake is collected using plastic slats/French sticks (Figure 6). This technique has quite variable rates of success. These slats/sticks are made of arced or soft plastic so that they can be twisted to remove the oysters that settle on them. Oyster spat are normally caught in the more saline lower reaches of the estuary/coastal lake and subsequently moved to less saline, higher nutrient areas for growth and fattening.

The plastic slats and French sticks are arranged in layers onto a frame that sits on the catching lease (Figure 6). These structures are arranged in a way that they offer (1) an optimum substrate for oyster larvae to settle by providing large available surface areas, which in some cases are grooved, (2) shelter from predators like fish and (3) shade resulting from the stacking of the units. Oysters remain on the catching units for a period of 8 to 12 months.

Wooden sticks

Prior to the plastic units, oyster growers used to use wooden sticks that needed to be treated (e.g. tarred or cemented) to prolong the life of the wooden sticks in the water. The tar poses a potential risk to the river's water and sediment by gradually leaching toxic chemicals such as hydrocarbons. However, oyster farmers in Wapengo Lake are phasing out the use of tar and infrastructure is being replaced with recycled plastic materials. Around 70% of the Wapengo Lake Oyster Growers have already undertaken this.

Hatchery spat

An alternative source is hatchery produced oysters from an existing breeding program for Sydney rock oysters that was designed to improve growth and disease resistance (QX and winter mortality diseases). Unfortunately recurrent larval and spat mortality (>80%) occurring in most SRO hatchery-runs since 1980 has prevented reliable commercial hatchery supply of spat and ultimately precluded the industry from accessing stock from these breeding programs. However, recent research has explored a wide range of temperature and salinity levels for optimising embryo, larvae and spat development for SRO in hatcheries (Dove & O'Connor, 2007). Based on these research outputs hatcheries are able to optimise rearing conditions and maximise oyster yield and growth.

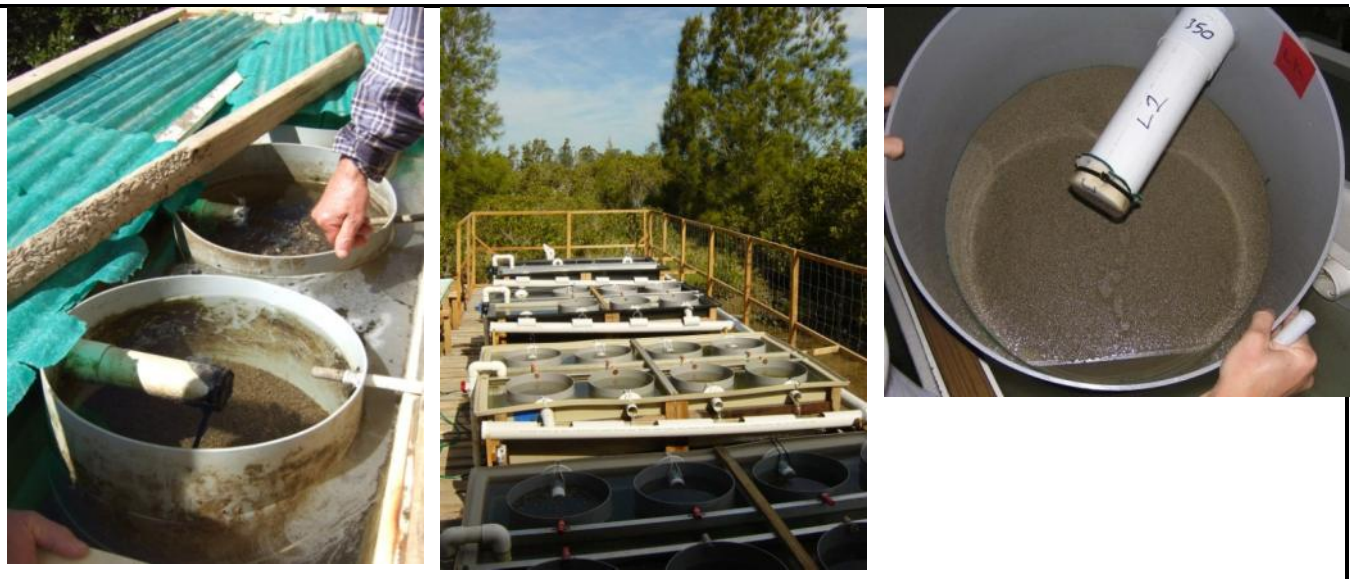


Figure 8: Upweller nursery system to grow oyster spat

Soon after oyster larvae have metamorphosed out of the planktonic stage in the hatchery, oysters are placed on screens of fine mesh (~250-500 microns). Oyster spat leave the hatchery (size 800-100µm, retained on 500µm mesh) to be grown in upwellers which are nursery rearing systems based at farms in estuaries (Figure 8). Oceanic/estuarine, nutrient-rich water is actively pumped from close-by and pushed through the tanks holding the upwelllers. This intense flow of water allows oysters to grow more quickly and have higher survival rates. These seawater flow-through systems are feasible for land base (Figure 8), however depending on the geographical location of these (local water quality and, temperature and salinity levels) some nurseries might perform better than others. As oysters grow, they are graded and placed on larger mesh until they reach a manageable size for the cultivation systems described below (>1 cm shell length). In general, enhancing the grow-out abilities of oysters reduces the time needed by the animals to reach market size, and this is a major benefit for the grower's business. SRO nurseries are well spread along the NSW oyster growing estuaries.

5.4.2 Cultivation techniques

Once oyster spat is flexed off the catching units or single seed oysters are received from other growers or sourced by a hatchery, they are placed in tumblers, SEPA baskets, floating bags or trays in Wapengo Lake. These units have different mesh sizes to accommodate for the different oyster sizes from juvenile to market size. Once again the selection or combination of certain cultivation techniques depends on personal preference.

Long-lines

The long-lines cultivation system is a relatively recent innovation and is becoming increasingly popular (Figure 10). Different types of bags are used in this system. The bags are hung on a wire suspended by vertical posts. A benefit of this system is that the height of the wire can be easily adjusted so the height at which oyster bags lay can be varied according to tide, water temperature or as a simple way of drying the oysters without having to transport them to the land base. This system is designed to minimize handling as the baskets can easily be unclipped, processed and returned rapidly to the lines with minimum manpower. The method is also well suited for rough and weedy conditions.

Tumblers or cylinders (100 x 15cm; *l* x *r,* volume of ~70L) are made of polypropylene mesh and are tied to individual PVC posts or to a long line that runs along the lease area in such a way that allows continuous rotation that is facilitated by a floater that sits inside (Figure 9). The rotation is driven by the moving tide and currents. As a result of this rotation, oysters do not cluster together and it is believed that oyster adopt a more marketable cupped shape. These units are typically used for very small size oysters for approximately 6-8months.

Floating bags or pillows are made of polyurethane plastic mesh that has some form of polyurethane floatation device attached to the outside of the bag (Figure 10). The bags are designed to hang on a wire and move with the water currents. This movement enhances the rumbling of oysters promoting removal of excess shell growth. In some cases, growers arrange pillows 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 11).

Intertidal racks and baskets

The 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 are currently being replaced with PVC posts and plastic sheathed wooden rails made of recyclable materials.

The rack and basket method: Rectangular shaped baskets, handmade from tough polypropylene mesh, are secured to the racks by two wooden sticks (growers tend to re-use old catching sticks - Figure 13).

Polyurethane **intertidal trays** (180 x 91 x 4 cm; *w* x *l* x *d*) are light and require little maintenance compared with the old wooden trays (Figure 14). These trays are partitioned to prevent oyster overcrowding. They also have lids to provide protection from marine animals (rays, fish, starfish, octopus) and birds. Tray cultivation is part of the original rack and rail oyster cultivation system. Oysters grown in trays are exposed at low tide, twice a day.

As described above there are a number of different methods used for oyster cultivation in Wapengo Lake. These methods have 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 using either of these methods to grow their oysters as long as they are used in best practice

Figure 9: Floating tumblers or cylinders

Figure 10: Floating bags running in parallel

Figure 11: Floating bags drying, one lot resting on the top of the parallel line of bags

Figure 12: Hard frame baskets with different mesh size and volume for adult and spat oysters

Figure 13: Intertidal rack & basket method

Figure 14: Intertidal wooden trays. Trays can have different partitions and these days are made of polyurethane

5.5 Land based activities

Commercial oyster cultivation involves both water based infrastructure (oyster leases) and a functional land base where some of the oyster operations take place including: oyster grading, drying stock, infrastructure storage, packing and marketing. Most oyster enterprises in Wapengo Lake have a lease arrangement with the Land and property Management Authority allowing them to use their land bases for performing oyster operations. The Land and property Management Authority holds a bond that is paid by the farmers when taking over the lease, and tenures are renewed when payments are received. In some cases, a large proportion of the land based area is occupied by machinery such as cranes, tractors and oyster grading machines (Figure 15).

Figure 15: Examples of some of the grading and sorting machines that these days are used in the oyster industry

Oyster growers are in charge of the stewardship of both the estuarine and land areas. To ensure a sustainable industry, same ecological and management principles applied to water activities and oyster leases also need to be applied to land bases.

5.6 Environmental monitoring

5.6.1 NSW Shellfish Program

A large proportion of the NSW population lives or holidays close to the coast and estuaries. Consequently a wide range of factors impact these ecosystems which, in turn, may have detrimental effects on the local oyster industry. As a result of the various activities taking place in the catchment and the lake, oyster growers intensively monitor the quality of the water and the oysters. This is a requirement of their seafood licence that it is issued by Industry & Investment NSW to ensure that oysters are safe for human consumption. This involves the monitoring of a wide range of parameters such as: faecal coliforms, salinity, temperature, microalgae biotoxins and heavy metals. Faecal coliforms are used as an indicator of enteric bacterial and viral pathogens in shellfish growing waters. Oysters have been associated with outbreaks of a range of human diseases, as a consequence of their ability to bioaccumulate pathogens and toxins derived from growing waters and because they are typically eaten raw. Consequently, the monitoring that oyster growers perform is of vital importance for public health protection. Overall growers take an enormous amount of samples which involves the payment of a significant local levy to fund costs involved with this monitoring. However a 47%/53% government/industry cost-sharing has been arranged due to the beneficial outcomes of the monitoring by the oyster industry to both, the oyster industry and public.

After the occurrence of extreme events (e.g. heavy rainfall— as a source of nutrient and pathogenic micro-organisms from inappropriately treated faecal material — or sewage spills) an oyster growing area might be closed for harvest as per specifications of the local management plan and the NSW Shellfish Program administered by the NSW Food Authority under the umbrella of the ASQAP (Australia Shellfish Quality Assurance Program) until the system becomes 'clean' for harvest. Specific information on the Wapengo Lake procedure for sampling programs and closure times can be found in Appendix 4. During the closure period the oyster farmers are unable to harvest the oysters for sale. This can significantly affect their cash flow and profits.

Oyster harvest areas in NSW have been classified by the NSW Food Authority into approved, restricted or prohibited according to its sanitary status (http://www.foodauthority.nsw.gov.au/industry/industry-sector-requirements/shellfish). The Wapengo Lake harvest areas (Front and Back Lake- see Appendix 4) have been classified as a "Conditionally Approved" harvest areas. When the Wapengo Lake harvest areas are open, oysters may be harvested and sold directly for human consumption. The harvesting area is open to harvesting when the faecal coliform concentrations meet the approved area classification bacteriological criteria, but is closed when concentrations exceed these criteria.

5.6.2 Water quality

As explained previously (section 3.2) estuarine health depends on a large range of factors, over which, in most cases, growers have little control. Oyster farmers are the first people to become aware of poor water quality as they are required to regularly monitor water quality in their harvest area. As part of the NSW Shellfish Program, growers collect water temperature and salinity levels at various points around the oyster growing lake. Unless growers are part of a research study or a community-based monitoring program, no further environmental parameters are monitored. This results in an unfortunate waste of resources that for years could have collected an enormous amount of environmental data (concomitant to the length of the Shellfish program duration) that could have led to the establishment of baseline data for oyster growing areas. Due to the lack of this information, it becomes very hard to identify effects that the potential threats from climate change (Section 3.2.2.2) and other catchment activities (i.e. logging and development) might have on the local oyster industry.

The Wapengo Lake Oyster Growers have been working in close collaboration with the local community (Wapengo Watershed Association, WWA) and local associations such as Far South Coast Landcare, Bega Valley Shire Council, local Koori community and Southern Rivers CMA in order to develop projects that improve the catchment processes and enhance the long term security of the local oyster industry. One of these projects, 'Wapengo catchment sustainable community monitoring' involves a water quality monitoring program consisting of monthly samples collected under normal conditions and additional sampling aimed at post-rain events. The program covers 11 sampling sites across the lake and in most waterways in the catchment and measures levels of coliforms, E.coli, pesticides, herbicides and 15 different environmental parameters (water temperature, conductivity, dissolved oxygen, turbidity, suspended matter, pH, salinity, dissolved potassium, oxidised nitrogen, dissolved inorganic phosphorus, ammonia, total phosphorus, nitrate, nitrite and chlorophyll-a). A carefully designed and targeted program will ensure that these monitoring activities are achievable and sustainable within limited resources, and are scientifically meaningful. Volunteers, including at least one oyster farmer, were trained in water quality, seagrass and phytoplankton monitoring by staff from the University of Wollongong. It is also anticipated that this project will work in with the Southern Rivers CMA's Estuary Health Monitoring Program.

This monitoring will provide a baseline against which to measure environmental change (including effects of logging activities and impacts of global warming). It will also contribute to protecting water quality for safe human consumption and viable oyster production. An environmental monitoring program like this one should be mandatory in most coastal catchments as it provides vital baseline data against which to measure any potential detrimental changes in the catchment.

5.6.3 Benthic sampling: seagrasses

Seagrass beds are one of the most important parts of the aquatic ecosystem and they play a vital role for the functioning of a healthy system. Seagrasses occur in sheltered areas and shallow waters, growing in soft sediments such as sand or mud. Seagrasses are important components of the ecosystem as they provide shelter, habitat, feeding grounds for fish and other aquatic fauna, improve water quality and aid in sediment control. The presence of seagrass improves water quality by decreasing sediment within the water column (http://www.cen.org.au/seagrassmonitoring/). Consequently, seagrasses like oysters, are good indicators of water quality.

Seagrass beds are extremely fragile habitats that can be easily destroyed if care is not taken. In some cases, external factors are the cause of the seagrass decline. Examples of these are natural pressures such as storms, floods, sediment and nutrient runoff, etc. On other occasions seagrass beds are often damaged by anthropogenic activities like boat-related actions, dredging and reclamation, foreshore structures such as pontoons and jetties that can share the beds or stormwater outlets causing physical scouring of seagrass beds. Out of these causes, oyster growers could impact on the seagrasses through: boat-related activities (seagrass entangled in engine propeller) and large areas covered by oyster infrastructure shading the underlying seagrass beds. However, Wapengo Lake Oyster Growers are aware of the ecological role that seagrasses have in the lake and the need to protect them. In fact, Wapengo Lake Oyster Growers, together with Wapengo Watershed Association, recently took part in a community seagrass monitoring program in order to monitor the distribution and condition of seagrasses in the lake so that early warning of the decline in the health of the lake could be identified. This program also included training on habitat assessment of mangroves & mudflats (if present), saltmarsh and riparian zones.

6 THE WAPENGO LAKE OYSTER GROWERS EMS

6.1 Aims of the EMS

With increased environmental awareness in society and industry today, more pressure is being applied to reduce impacts on the environment from everyday activities. This pressure has encouraged industries like the Wapengo Lake oyster industry to implement an Environmental Management System, EMS, with the following aims:

- Manage the identification and adoption of new techniques and technology to continually improve operations,
- Provide a basis for Wapengo Lake Oysters Growers to communicate and cooperate with natural resource managers and the community on the environmental management of oyster cultivation, Wapengo Lake and its catchment,
- Document how Wapengo Lake Oysters Growers are currently meeting their responsibility to operate sustainably and responsibly,
- Be a ‘living’ document that can would be reviewed and updated at each Annual General Meeting to address and manage new risks and opportunities.

6.2 EMS Vision

Wapengo Lake Oyster Growers working to ensure a growing and sustainable industry through environmental socially responsible practices to produce a world class gourmet oyster

6.3 EMS development

Initial development of the EMS was initiated by Wapengo Lake Oyster Growers exploring the options for a secure and sustainable industry in the future. Currently Wapengo Lake Growers are involved in a series of projects taking place in the catchment that aim to protect the environment and enhance water quality. While this was happening in Wapengo Lake, the 2008 Environmental awards were announced at the Annual Oyster Field Day (September 2008). The Clyde River Farmers Cluster Group won the group award for the implementation of their EMS in the estuary two years before: growers worked in collaboration with the Department of Lands and Southern Rivers CMA on various sediment control, clean-up and revegetation projects. This well recognised award resulted in great interest from the oyster growers from the south coast. Subsequently Southern Rivers CMA organised a workshop with Dr. Ana Rubio and Mr Kevin Mc Ash and, members of the oyster industry in the south coast. Ana was one of the coordinators that assisted in the development of the EMS in the Clyde River and Kevin is one of the most active members from the Clyde River Cluster Group. At the workshop the idea of an EMS was explained together with how it was developed and implemented in the Clyde River and how it could benefit the oyster enterprises. Wapengo Lake Oyster Growers realised the benefits of setting up an EMS for the Lake and decided to move forward with the initiative.

The Wapengo Lake Oyster Growers were provided funds by the Southern Rivers CMA to develop the EMS. These funds were used to engage a consultant, Ana Rubio, to assist with the development of the EMS and writing of the document. Ana has been involved with the NSW oyster industry for 6 years, 4 of which while she was doing her PhD on environmental influences on the sustainable production of the SRO. Most of her research took place in the Clyde and Crookhaven/Shoalhaven Rivers in the South Coast.

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. An EMS is defined by the ISO as 'the part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy.

The following steps were followed in the development of this EMS:

1) An initial one day onsite workshop was conducted explaining the concept of EMS, the benefits of operating under such a program, and what steps are required for the initial implementation of an EMS within the selected company.
2) A second one day site visit was carried out performing an environmental audit, identifying operational and infrastructure risks for each oyster enterprise. At least 90% of the Wapengo Lake Oyster Growers were consulted at an individual level
3) A third visit was conducted with the whole group of oyster growers with a workshop explaining the concept of the Environmental Risk Matrix, how it is developed and it's operational implementation within the selected company. Growers then rank their risks and add additional measures to implement in upcoming years (Risk scores and Risk Assessment Table have been included in the Appendix for transparency).
4) Report on progress of implementation process
5) Final report to funding body (Southern Rivers CMA) on project outcomes, including a brief non-technical summary on the benefits of industry and how it is addressing the high risks and public concerns. This document will be made public and would be used to promote the profile of the Industry as a whole.

The Seafood EMS Chooser by Seafood Services Australia was used through the process and a similar template to the Clyde River Oyster farmers EMS was used in this report:

Figure 16: Eight easy-to-follow steps of the EMS

(Figure taken from Seafood Services Australia, 2005)

1. Planning = identifying the scope of the enterprise's operations, its major environmental impacts and developing 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 have been developed with the aim of allowing growers to continue their own 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.

6.4 EMS Scope

The scope of this EMS is limited to:

- the environmental aspects of the operations of the Wapengo Lake Oysters Growers, and
- the catchment activities that the Wapengo Lake Oysters Growers are involved in, in particular those in collaboration with other stakeholders towards the improvement of the health of the catchment and the enhancement of the environmental quality of the Wapengo waterways and lake.

Future revisions of the EMS may broaden this scope to cater for wider issues (i.e OH&S) if required and/or become more detailed concerning specific matters (e.g. written procedures towards international certification).

6.5 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 and are relevant to the Wapengo Lake Oyster Growers, they are:

- *Fisheries and Oyster Farms Act 1935*
- *Fisheries Management Act 1994*
- *Fisheries Management (General) Regulation 2002*
- *New South Wales Oyster Industry – Sustainable Aquaculture Strategy* (by DII 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 Ecological Sustainable Development)
- *Food Act 2003*
- *The Southern Rivers Catchment Action Plan* (developed by the Southern Rivers Catchment Management Authority)
- Various management plans being developed by Bega Valley Shire Council

7 ACTION PLAN

Wapengo Lake Oyster Growers performed an environmental audit as part of the risk analysis where operational and infrastructure risks were identified for all the Wapengo oyster enterprises. Additional environmental, social and economic impacts of the industry were also considered. The major objective for using risk assessment techniques is to assist in the separation of the minor acceptable risks from the major unacceptable risks. This assessment requires the determination of two factors for each issue – the potential 'consequence' arising from a risk and the 'likelihood' that the consequence will occur.

Through a series of workshops Wapengo Lake Oyster Growers firstly identified those aspects, industry-related and external, that they considered a risk to the industry and, secondly they ranked them according to the level of impact based on the consequence and likelihood scores used in the risk analysis. A summary of the risk analysis table and ratings used to score each activity identified by the Wapengo Lake oyster industry have been included in Appendix 2 and Appendix 3.

The group decided to target firstly all the high risks and some of the medium risks identified through the risk analysis in the first year of EMS implementation by developing action plans to address them. The risk table presented in Appendix 3 includes a summary of the current and future measures that Wapengo Lake Oyster Growers have/ will put in place for each high risk. A comprehensive explanation and background of each of the high and medium risks impacting the Wapengo Lake oyster industry is provided in Section 7. Figure 17 summarises the risks identified by growers and the rank of each risk. The risks have been split in two main categories: 1) industry-related activities, which are those primarily controlled and managed by the oyster industry and 2) external activities, which are those impacting the oyster industry but, in most cases, they are beyond the control of the oyster industry. The Wapengo Lake Oyster Growers will aim to liaise with community and stakeholders in order to work collaboratively towards minimising the external risks.

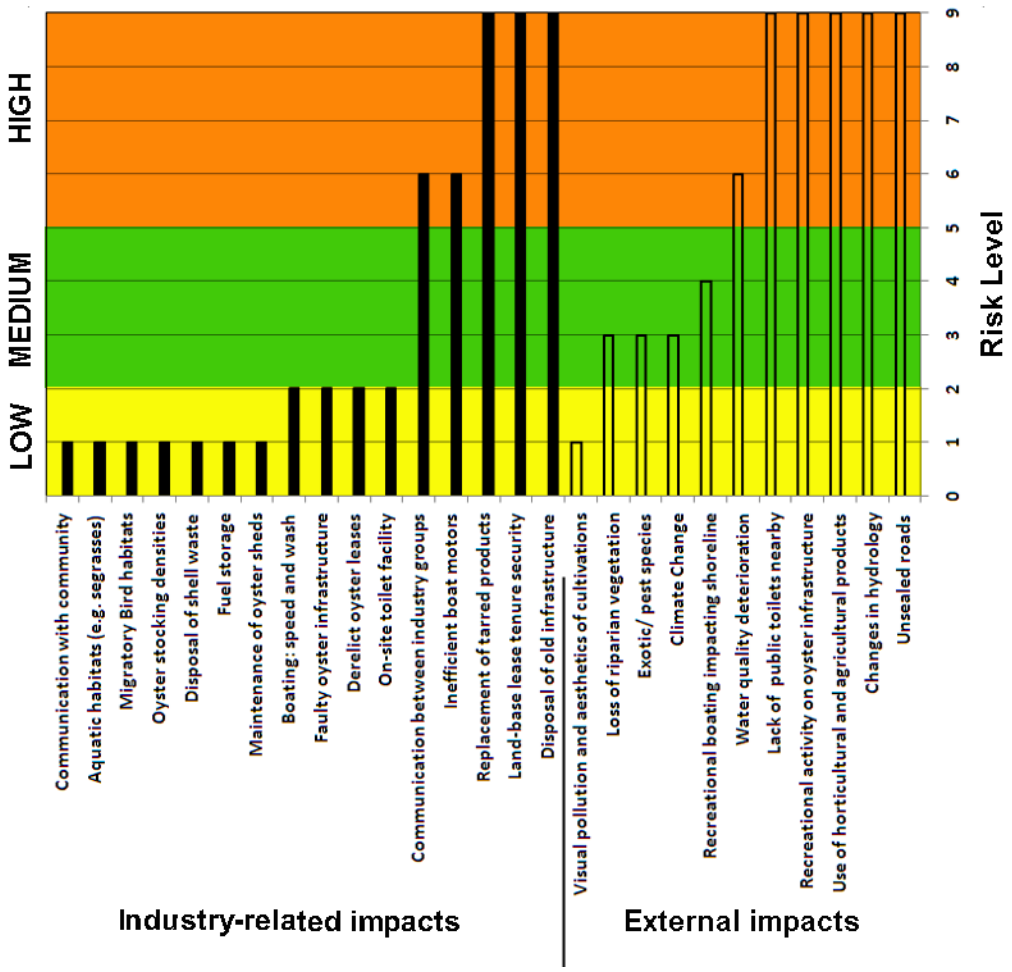


Figure 17: Schematic summary of risks impacting the Wapengo Lake oyster industry. Each risk was scored through a risk analysis in which Low risks corresponds to scores 0-2; Medium risks to scores 3-5; High risks to scores 6-9

7.1 High risks

This section focuses on the 'high risks' impacting the sustainability of the industry as per the risk matrix (Appendix 2). Risk values that ranked between 6-9 (out of a maximum possible score of 9) are considered 'Not desirable'. The management response for these types of risks involve continue strong management action that require a full performance report and immediate/specific response with urgency. A summary of the actions that the Wapengo Lake Oyster Growers have committed to in order to minimise these high risks have been included in the risk table (Appendix 3), column "Future Actions".

7.1.1 Industry-related activities

7.1.1.1 Phasing-out tarred products

Oyster farmers used to use timber posts to set up frames for cultivation units and posts to mark the lease limits. The timber posts were treated to ensure long tenure in the marine environment and protection from marine borers and pests. Wood treatments consisted of using chemicals such as creosote or tar. These products are hazardous substances with carcinogenic, mutagenic and toxic properties that have severe impacts on marine organisms. It has been observed that these types of components can remain in the estuarine environment for more than 40 years (Smith, 2008) embedded in the sediment. There is no evidence indicating that this substance contaminates the oysters or

neighbouring species (White, 2001), however, there is potential for chemicals to leach into the surrounding waters. Wapengo Lake Oyster Growers are aware of this process and try to minimise the impact that might be caused by the removal of treated wood infrastructure.

Oyster farmers throughout NSW are now phasing out the use of tarred and treated timber by using specially produced polyurethane trays or adopting alternative farming methods (as described in section 5.4). Wapengo Lake Oyster Growers are slowly phasing out the use of tarred and treated timber. This process requires large investment that in some cases could not be met by the growers due to the lack of funds.

7.1.1.2 Disposal of old infrastructure

The phasing out of tar (as per section 7.1.1.1) results in large volumes of old infrastructure which requires appropriate disposal. Due to the cost of disposing waste in landfill, old infrastructure tends to pile up in their land-base areas. Recently, Southern Rivers CMA provided funds from the Australian Government to help the industry clean up, resulting in 60 m^3 of waste being removed. Wapengo Lake Oyster Growers were grateful for being offered this opportunity, however, growers are already anticipating the need for similar keep clean up as they adapt their leases to further new technologies. Consequently, a protocol is required for appropriate disposal of waste periodically. This includes a separate protocol for those products that can be recycled.

7.1.1.3 Inefficient boat motors

Wapengo Lake Oyster Growers identified the impact that old boat motors could have in the water quality of the lake due to small fuel and oil spills and in the surrounding wildlife and neighbours due to loud and disturbing noise. Currently, Wapengo Lake Oyster Growers are maintaining the outboards frequently and limiting the unnecessary boat use.

The Department of Environment, Climate Change and Water (formerly the EPA) currently adopts the USEPA emissions standards as a means of rating the environmental performance of outboard motors. Motors meeting these standards have significantly lower air and water emissions than conventional outboard motors and are also more fuel efficient.

Australia does not manufacture any outboard motors and subsequently we have no control over the development of standards specific to Australian conditions. Fortunately the levels set in other countries is quite high, and the OEDA (Outboard Engine Distribution Association) in Australia through discussions with the Department of Environment and Heritage (DEH) has recently formed a rating benchmark similar to energy ratings seen on electrical appliances (http://www.environment.gov.au/atmosphere/airquality/publications/pubs/marine-outboard-engine.pdf)

As outboard motors need replacing, Wapengo Lake Oyster Growers will source motors that conform with EPA regulations for noise and emissions. Oyster growers and Southern River CMA will seek for potential sources of funding from EMS Incentive Programs or others to facilitate the purchase of outboard motors in use that meet the emissions standards. Consequently, Wapengo Lake Oyster Growers have decided to invest some of the industry budget collected through their annual fee contribution to the group in replacing the motor, and possibly the boat, that the independent sampler uses to collect the water and oyster samples as part of the food quality control protocol required by NSW Food Authority.

7.1.1.4 Water and land lease tenure

As mentioned in section 5.5, commercial oyster cultivation requires both water and land bases as a result of the various activities involved in oyster cultivation, husbandry and marketing. Currently Wapengo Lake Oyster Growers have a 15-year agreement for their water-based areas but have a shorter agreement for the land-based areas which results in business insecurity.

The Department of Lands completed a series of assessments in late 2005. This recognized that many of the sites are in areas not fit for other commercial uses, that the oyster industry has a logistical need

for close proximity to its leases, and that these enterprises need to comply with legislation requiring housed post harvest facilities with water access (Extract from Ocean Watch Pty Ltd, 2007).

Growers, through their oyster committee have been in negotiations with the Department of Lands addressing the lack of consistency in the past and the corresponding differences in rental charges between the various regions on the NSW coast. The Department of Lands wanted to implement a uniform method for rental determination across the coast. This was unsuccessful due to the significant increases in land based rents. The Oyster Committee came up with an agreed outcome on rental prices and tenure of leases. A summary of this information could be found at the latest NSW Farmers Association Newsletter
http://www.nswfarmers.org.au/__data/assets/pdf_file/0004/55786/Oyster_Update_0509.pdf
The Department of Lands has agreed to establish a mediation process, involving Departmental and oyster industry representatives to resolve any issues that cannot be resolved between the oyster farmer and the Departmental officers.

Overall, growers are in continuous communication with the Department of Land to ensure long term tenures which would provide them with more security for their business investments and growth.

7.1.1.5 Communication with the rest of the NSW Oyster industry

Wapengo Lake Oyster Growers have expressed their concerns regarding poor communication across oyster growing areas in NSW and with other states. Oyster growers tend not to attend industry events which are good meeting points for growers to pass on ideas, knowledge or to network. These events promote partnerships between the oyster industry, fishery groups, NSW Farmers Association, Oyster consortium, research groups allowing groups to work together to achieve positive environmental, economic and social outcomes. Establishing formal meetings and strong network paths will benefit the Wapengo Lake oyster industry to gather latest news on research, methods, funding sources, training opportunities and so on. Joining existing industry-related associations (i.e. NSW Farmers Association), industry newsletters (i.e DII Fisheries, ORAC, Seafood CRC, FRDC) and attending industry-related conferences (i.e Australasian Aquaculture Conferences) will provide with an additional forum for wider communication and as a source for new ideas.

7.1.2 External activities

Wapengo oyster growers recognise that numerous external activities can impact on the water quality of Wapengo Lake. For this reason, the growers approached Southern Rivers CMA for assistance with catchment protection. This has led to the development of the Wapengo Catchment and Rehabilitation Project (see Section 4.3). This has resulted in numerous projects being undertaken through the catchment, with flow-on benefits to the lake water quality, evidenced through a reduction in closure to harvest times. However, further work, and ongoing monitoring and vigilance is required to ensure the water quality of the lake is maintained.

7.1.2.1 Deterioration of water quality

Factors affecting water quality in Wapengo Lake that have been identified by the oyster growers include:

1. Unsealed roads. Work to address this issue is discussed further in section 7.1.2.2
2. Uncontrolled stock access to waterways
3. Camping close to waterways
4. Lack of public toilets close to main lake access point
5. Forestry activities
6. Agricultural runoff

Uncontrolled cattle access

Several projects have been undertaken in recent years to improve management of stock near waterways and have resulted in 9.25km of waterway being protected through fencing (see Section 4.3). Further work is still required in this area, and will continue through the Wapengo Catchment and Rehabilitation Project.

Camping close to waterways

Another concern for water quality is that during holiday periods large numbers of campers inhabit areas in the catchment, some of which are close to the waterways. These unofficial campsites usually do not have toilet facilities and ad hoc waste disposal measures (e.g. digging holes) may lead to effluent reaching the waterway. Wapengo Lake growers would hope that stakeholders allowing this type of camping on their premises would be sensitive to these issues.

Lack of public toilets close to main lake access point

Wapengo Lake has no public boat ramp despite the high number of recreational fishermen visiting the lake. At present these fishermen are accessing the lake via one or two private oyster depot areas. In general the farmers concerned do not object to this, however on occasion damage has been done to the oyster leases and rubbish left behind.

Recreational fishermen spend extended periods on the water fishing. In order to cater for the sanitary requirements of fishermen and other lake users, the oyster growers have identified the possible need for public toilet facilities. Oyster growers have their own portable toilet facilities at their sheds that are not for public use.

Growers are interested in discussing with community, recreational fishing groups, NSW Food Authority and council the option of building a public boat ramp and associated facilities (i.e. public toilets). Without suitable toilet facilities, untreated sewage may be entering the waterway potentially threatening the health of the lake and the safety of oyster consumption.

At a starting point, the oyster growers will negotiate with Land and property Management Authority and NPWS regarding the installation of signage at the oyster sheds to indicate the availability of facilities in the neighbouring National Park.

Forestry activities

The Wapengo catchment has 55% of the area covered by forest. A major clearing took place in the 1970's and plans for further clearing in 2010 have been announced. Logging activities have been previously identified as having serious pollution impacts on lakes as a result of increased sedimentation rates which can be detrimental to the oyster industries. As mentioned in section 3.2.2, oyster filtration rates change according to levels of inorganic material resuspended in the water column. Large amounts of suspended matter can clog oyster gills, reducing filtration rates and consequently oyster growth. Additional particle loads could reach the waterways increasing the nutrients levels, in particular for phosphorus, which could result in algae blooms. Forestry activities could also impact the hydrological processes of the lake (see section 7.1.2.3).

Agricultural runoff

Agricultural and urban runoff, acidic soils, fuel and chemical spills may also lead to water pollution incidents. Pollution sources in general can be quickly picked up by Wapengo Lake Oyster Growers who are diligent in both watching changes in the system and performing regular water quality monitoring. All suspected pollution incidents need to be reported to DII Fisheries and the Department of Environment and Conservation (DECC). See Section 7.1.2.4 for further discussion.

Monitoring

Wapengo Lake Oyster Growers maintain a regular water and meat quality monitoring regime as part of the NSW Shellfish Program (section 5.6.1) to ensure that immediate action can be taken if pollution

levels threaten the health of the lake and the safety of oyster consumption. In addition phytoplankton samples are taken fortnightly from two sites.

In addition to this sampling the Wapengo Lake Oyster Growers have been working in close collaboration with the local community, WWA, monitoring the water quality in the catchment as part of the EnviroFund '*Wapengo catchment sustainable community monitoring project'*. See Section 5.6.2 for further information on this project.

7.1.2.2 Unsealed roads

Gravel roads have been identified as a large producer of dust and fine sediments which have the potential of being transported easily until they reach a waterway. This results in increasing turbidity levels which have detrimental effects on the overall processes of the aquatic ecosystem but, in particular, on benthic organisms, including oysters.

Wapengo Lake Road, the main access road to the lake and to the scenic camping site of Picnic Point (within Mimosa Rocks National Park), located along the north shore of the lake was highlighted as a serious source of fine sediments into the lake impacting on water clarity and potentially affecting oyster filtration capacity. Indeed some oyster growers have observed detrimental effects on oyster production at some of the leases close to the shoreline adjacent to the road. The road was also identified as a 'hotspot' through the Southern Rivers CMA rapid catchment assessment. Consequently, an 800m section of this road immediately adjacent to the lake has been recently sealed with funds from Southern Rivers CMA, Bega Valley Shire Council, NSW Department of Primary Industries and NSW Department Environment and Climate Change. This partnership project aims to reduce sediment runoff into the lake through improvements in drainage and sealing where required. A series of sediment control devices have been put in place in those areas where the road diverts high flow of water after severe rainfalls.

Southern Rivers CMA estimated that the sediment plume from the originally unsealed road can potentially extend out to 50m from the bank forming sediment blanket up to 1cm thick at the bottom. Once the road is totally sealed, a sediment load reduction of 80% has been estimated. However it might take up to 20 years to flush the existing stock of fine particles that entered the lake before the road was sealed.

Wapengo Lake Oyster Growers have been working with Southern Rivers CMA participating in erosion control programs in high risk-identified areas. This process will continue in order to identify further sources of erosion from unsealed roads in the catchment. A further 1.1km of Wapengo Lake Road may be sealed as a result of this process.

7.1.2.3 Changes in hydrological processes

Sediment quality in the Wapengo Lake is typical of an undisturbed estuary with relative medium-low rates of tidal flushing and medium-low tidal velocities. Large-scale intensive oyster farming may affect natural sedimentation by accumulating sediments around oyster infrastructure and shell loss, and consequently altering water flow. However no significant changes in hydrology or ecological processes in the aquatic ecosystem due to oyster infrastructure have been detected.

Sedimentation is rarely considered to be a significant environmental impact associated with the type of oyster farming generally employed in Australia (Crawford, 2003). These days, growers are moving towards cultivation methods that require less infrastructure in the lake (section 5.4.2) and consequently low impacts on natural sedimentation processes are expected.

However, catchment activities could have an indirect impact on the hydrology of the waterways due to changes in the sedimentation processes. For instance, forestry activities might take place in the catchment with the potential of increasing the levels of fine suspended particles in the water column affecting the aquatic ecosystems in Wapengo Lake and potentially impacting on the local oyster industry. Wapengo growers through the '**Wapengo catchment sustainable community monitoring project**' are currently involved in research through the University of Wollongong that is looking into the

sediment history of the lake through the collection of sediment core samples. The aim is to assess the origin and age of the sediments in the Lake and try to determine rates of sedimentation so that, if logging activities were to happen in the catchment, sedimentation processes could be quantified and compared to prior activities.

7.1.2.4 Use of non-environmentally friendly horticultural and agricultural products in catchment

35% of the Wapengo Lake catchment is private land with 20% cleared for farming & 15% either forested or wetlands. As mentioned in previous high risk (7.1.2.1) related to the deterioration of the water quality in Wapengo Lake, current communication and collaboration with some stakeholders has resulted in significant improvement of the water quality levels in the catchment. However, there are still areas in the catchment that could improve their land management so that it minimises the impact of their operations in the downstream waterways. This is the case for those stakeholders using various types of non-environmentally friendly horticulture and agriculture products (e.g. fertilizers, pesticides, etc). Through rainfall, any products on land properties within the catchment will reach the waterways, potentially having an impact in the flora and fauna of the lake. As mentioned in previous sections of this document, oysters have a large filtration capacity that could easily result in mortalities if the water quality is not optimal (i.e presence of chemical products). It is important that stakeholders in a catchment recognise the post-effect that some of their activities might have in the overall catchment.

To raise awareness amongst landholders throughout the catchment of the potential impacts of their land management practices on Wapengo Lake water quality, the oyster growers will ensure that all landholders receive a copy of their EMS, and are kept informed of the oyster grower's progress on their action plan.

7.1.2.5 Mooring to leases by lake users

Wapengo Lake Oyster Growers, as part of their oyster cultivation licence are required to adopt best practice standards in regards to lease marking, navigational aids and lease maintenance as per the NSW Oyster Industry Sustainable Aquaculture Strategy. In order to ensure safe navigation across oyster aquaculture areas, individual oyster lease areas must be marked in a consistent and appropriate manner. Oyster growers 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 of significant environmental harm, be recyclable and made from renewable resources (NSW Department of Primary Industries, 2006). As compliance with marking requirements is mandatory, if this is not followed fines are applied to the oyster industry.

Lease marker posts are currently used by the recreational fishing industry to temporally mooring their boats while fishing. This results in most cases in loss and/or damaged infrastructure as these posts are not meant to serve as mooring places but markers. Consequently, Wapengo Lake Oyster Growers are continuously facing repairs of their infrastructure caused by external users. In some cases the resulting damaged infrastructure could become a navigational hazard for lake users. As a result growers are continuously exposed to receiving fines by the fisheries department. Wapengo Lake Oyster Growers have already placed signs "no tie-up" on their lease posts but there are still facing the problem.

Wapengo Lake Oyster Growers are committed to respect other uses of the lake including: commercial fishers, recreational anglers, or tourists as they realise the importance of maintaining and promoting a harmonious relationship with them. In return, Wapengo Lake Oyster Growers expect the same behaviour from the lake users.

7.2 Moderate Risks

This section focuses on the 'moderate risks' impacting the Wapengo Lake oyster industry as per the risk matrix (Appendix 3). Risk values that ranked between 3-5 are considered 'Acceptable'. The management response for these types of risks involves the maintenance of current risk control measures in place which require a full performance report detailing current arrangements and, in

some cases, specific responses to minimise the risk. This section has been structure in the same way as per the high risks (section 7.1).

7.2.1 Industry related activities

7.2.1.1 Marine pests and fouling

Introduced species are one of the most significant threats to all of Australia's biodiversity and natural resources. Their impacts on aquatic ecosystems are, in most cases, poorly understood. Consequently great effort needs to be diverted towards the identification of pest species and their preferred habitat so that measures can be put in the appropriate places. Southern Rivers CMA and DII Fisheries need to ensure that all Wapengo Lake Oyster Growers have a copy of marine pest identification cards being developed by NSW DPI Aquatic Biosecurity Unit. Wapengo Lake Oyster Growers need to report, with a sample if possible, any detection of an unusual plant or animal, and follow requirements of government agencies in combating marine pests.

Education programs have been put in place with material being disseminated among oyster farmers. At present, the highest risk for the oyster industry is 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. The Sapphire Coast Marine Discovery Centre in partnership with the Eden Local Aboriginal Land Council, DII Fisheries and Southern Rivers CMA has recently started a monitoring program in those areas where oyster growers have reported the crabs presence. Wapengo oyster growers are continuously monitoring their cultivation units, where the crab tends to be found.

Another pest that Wapengo Lake growers contend with is the Pacific Oyster (*Crassostrea gigas*). Pacific oysters are declared noxious fish under the Fisheries Management Act, 1994 in all NSW waters except Port Stephens. Wapengo Lake Oyster Growers comply with the Pacific Oyster Control Program manage by NSW DPI, under which the permit holder must make every effort to eradicate this species from the oyster infrastructure in the lease. In addition, formal Pacific Oyster Management Plans have been recently developed by the SRO industry and DII Fisheries. Currently these plans are only in operation in Wagonga (Narooma) and Batemans Bay. Consequently, Wapengo Lake Oyster Growers are encouraged to put this plan in place for their lake too. In some of the southern growing estuaries, industry clean-up campaigns have been organised in collaboration with diving clubs or navy groups. These groups look for and remove Pacific Oysters from the oyster infrastructure and shoreline. Wapengo Lake has not yet been involved in one of these activities but might need to organise one of these events if numbers of Pacific Oyster are increasing in the lake.

7.2.2 External activities

7.2.2.1 Boat wash by lake users

As a result of the large fish stocks present in Wapengo Lake, an active recreational fishery is currently present in the area. This industry is predicted to keep increasing in the coming years. At present large boat users are creating boat wash in sensitive areas of the lake that have national heritage. Consequently, there is a need to minimise this impact.

Shell middens are present in the shoreline of Wapengo Lake and have significant cultural and heritage values for the traditional owners of the area (Merrimans). A conservation project with the support of Southern Rivers CMA and the funds through NSW Environmental Trust was completed in 2009 to protect the eroding shell middens near the entrance of the lake. This work was achieved through the use of low-impact brush bundles, designed to dissipate wave energy enhancing the stabilisation of the lake bank adjoining the midden beds. Monitoring of the site to determine the success of the technique is underway. This project involved local Koori community members to undertake the work, and it is hoped will provide impetus for future Koori work around Wapengo Lake and other south coast estuaries. Consequently boat users will need to be reminded to slow down close to these sensitive

areas so that bank erosion is minimised through reducing boat wash. Wapengo Lake Oyster Growers in collaboration with Southern Rivers CMA will coordinate with NSW Maritime and NPWS to install 'no wash' signs close to midden and other sensitive areas in the lake.

7.2.2.2 Climate change

As mentioned in section 3.2.2.2, the NSW oyster industry could be severely impacted by the projected values of increasing atmospheric CO_2, which will result in acidic oceanic waters that will slow the production of calcium carbonate (i.e. shells) by oysters.

Several studies worldwide have already shown how pH decrease can slow the production of calcium carbonate by oysters especially within the range of atmospheric CO2 values projected by the Intergovernmental Panel on Climate Change (IPCC). Oyster larvae have significantly less shell area and reduced calcium content under current concentrations of CO2 compared with pre-industrial levels (Miller*, et al.*, 2009). Related research has been done with SRO & PO larvae at the University of Western Sydney and in collaboration with DII Fisheries (Parker*, et al.*, 2008). Current experiments using hatchery breeding line oysters compared to wild 'control' oysters have found that selective breeding of the oysters may be capable of ameliorating some of the impacts of acidification.

It is now apparent that some amount of adaptation to the problem is going to be required. Further research needs to be carried out into the oyster's ability to adapt to faster rates of long term environmental change. In addition, acidification will also affect some of the planktonic groups that oysters feed on and that constitute the main base of all the food webs in the marine ecosystem. Consequently, acidification levels would impact some of the biological processes of the oysters and indirectly, one of the large components of their food resources.

A comprehensive understanding of the effects of climatic change on the estuarine system requires a thorough understanding of the links between the biological and physical systems and the associated variability. This is still relatively poorly understood, in large part because we are still lacking sufficient, high quality environmental baseline data for estuaries and oysters (Ringwood & Keppler, 2002). 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 draught conditions is imperative to establishing baselines of data upon with anthropogenic impacts can be assessed.

7.3 Low risks

This section lists the 'low risks' impacting the Wapengo Lake oyster industry as per the risk matrix (Appendix 3). Risk values that ranked between 1-2 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 3). Wapengo Lake Oyster Growers have identified these activities as potential sources of risk, however, these activities are currently managed at an optimum level. Some of these risks were identified as potential risks in the future if current conditions changed. A list of low risks has been presented below:

7.3.1 Industry related activities

- Buildings (oyster sheds): External deterioration
- Fuel storage in land-based areas
- Disposal of shell waste in an environmental and applicable way
- Maintenance of toilet facilities in oyster sheds
- Maintenance of derelict oyster leases
- Maintenance and checks of oyster infrastructure
- Oyster stocking densities: cultivation at a sustainable level
- Appropriate boat handling and driving by industry

- Minimal impact on migratory bird habitat
- Minimal impact on seagrass beds
- Communication within members of the Wapengo Lake oyster industry

7.3.2 External activities

- Visual pollution and aesthetics of oyster leases
- Interaction with community and stakeholders

7.4 EMS implementation

7.4.1 EMS report distribution

The EMS report is an ongoing report that requires constant update with actions and activities being reviewed. Consequently the Wapengo Lake Oyster Growers will report on the progress and achievement of each action in relation to the responsibility, performance indicators and timeframes as per Risk Table of the EMS report (Appendix 3).

The EMS report will be made available to all stakeholders on request and to all stakeholders who have commented on, or shown interest in the operations of the Wapengo Lake Oyster Growers. Following documentation and circulation of the report, the Wapengo Lake Oyster Growers will review the EMS every year taking into consideration:

- Actions and timeframes suggested in previous version of the EMS report
- Stakeholder comments
- An assessment of the adequacy and relevance of the environmental policy (see environmental policy)
- Changes in oyster farming technology and management, and
- Emerging issues in the environmental management of the Wapengo Lake and its catchment.

7.4.2 Stakeholder review process

The stakeholder list should include those 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.

Wapengo Lake Oyster Growers will ensure that stakeholders are informed about the implementation of the EMS in the industry and given the opportunity to comment on the environmental management of their operations in an informed manner. Communication is one of the main aims of this EMS. This EMS is a forum for natural resource managers and the community to obtain information about the environmental management of the Wapengo Lake Oysters Growers and for the Wapengo Lake Oysters Growers to work with these stakeholders on the development of environmental management initiatives.

7.4.3 EMS Review

This EMS documents an ongoing process of environmental management, and therefore requires a periodic review to check 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 every year at the Wapengo Lake Oyster Growers Annual General Meeting. The “best practice” values and benchmarks will change from year to year in line with changes in production technology and consumer demands. Updates of the EMS report will be saved as a new version of the EMS report, logged in the revision status section of the report. Past versions of the EMS report will be kept as records.

7.4.4 EMS Contravention

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

Incidents where the Wapengo Lake Oysters Growers fails to reasonably comply with the EMS will be recorded and investigated. Failures may be:

- intentional or unintentional,
- a 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 Wapengo Lake Oysters Growers. Any EMS contravention will be noted in the following EMS report.

The Wapengo 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 outlines in this EMS.

8 BENEFITS OF THE EMS

Wapengo Lake Oyster Growers are currently in the process of putting in place a system that will help to: 1) care for the environment, 2) secure optimum oyster growing conditions, 3) inform the regulatory agencies, community and consumers about the industry's management framework and future aims.

Well before this process started oyster growers were already involved in many 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. The benefits of both the ongoing and future activities discussed in this EMS are summarised below.

- Transparency of environmental performance
- Environmental programmes implemented in the Wapengo Lake will provide for the ongoing collection of information that will allow the measurement of environmental changes over time – re. Water quality
- Maintain and improve market access through a form of eco or environmental labelling in line with the EMS and its outcomes. This is 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 self esteem and sense of stewardship
- Improving industry profile with the consequence of enhancing the community support for industry.
- Greater transparency and accountability
- Increased dialogue with the community, customers, suppliers, regulatory and research bodies
- Verification of practices against a credible process and system (Risk Assessment, EMS report)
- Reduce operational expenditure through improved management of inputs and outputs
- Reducing liabilities and insurance premiums – reduce risk of externalities

9 APPENDICES

Appendix 1: The Wapengo Lake Oyster Growers commitment

Oyster growers from Wapengo 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/ Business	Signature / Date
Wayne Tupper (WT)	
Geoff Hutley & Yvette Beurteaux (GH / YB)	
Colin Wren (CW)	
Don Ubrihien (DU)	
Rodney Rutter (RR)	
Doug Roberts (DR)	
Kevin Williams & Jan Mann (KW / JM)	
Shane Buckley (SB)	
Garth Pigram (GP)	

Appendix 2: 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 3: Risk assessment table for Wapengo Lake

(*) Bold Activities reflect High risks;

Responsibility = initials of growers as per Appendix 1

Industry-related risks

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level
Replacement of tarred products (*)	Leaching of tar into the water and sediment	Reduced water quality	Growers are currently phasing-out the use of tar.	Increase percentage of cultivation and infrastructure materials that are durable and environmentally friendly	Treated timber trays replaced with polyurethane	Wapengo Lake Oyster Growers	Dec 2010	3	3	9
					Replacement of tarred stick oysters	Wapengo Lake Oyster Growers	Dec 2010			
					Replacement of tarred or treated timber lease infrastructure with plastic material	Wapengo Lake Oyster Growers	Jun 2011			
Waste disposal of old Infrastructure (*)	Non-optimal disposal of old/damaged infrastructure	1.Use of limited landfill resources 2. Chemical leakage if tarred products stored for long periods in an area	SRCMA funded and co-ordinated a clean-up program	1. Growers at individual level will start collecting and storing infrastructure on their land-based. They will dispose responsibly. 2. Investigate recycling options: Look for alternative means of by-product disposal	Disposal of infrastructure Process in place	Wapengo Lake Oyster Growers	Every 3 months	3	3	9
						Wapengo Lake Oyster Growers	Jun 2010			

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level
Inefficient motors (*)	1. Fuel and oil pollution 2. Noise pollution	1.Reduce water quality 2. Impact on wildlife (birds) 3. Irritate water 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)	Proportion of outboard motors in use that meet USEPA emissions standards	Wapengo Lake Oyster Growers	June 2012	2	3	6
					Assist the Wapengo Lake Oyster Growers access seeking for appropriate funding	SRCMA	June 2010			
Lease tenure on land and water based sites on Crown Land (*)	Long term insecurity	Business insecurity	Annual agreements at present	New agreements have been put in place in other oyster growing areas. Chase up Dept of Lands to find out progress for Wapengo Lake. New agreements for 25 years should arrive in next 6 months (Robert Towler, Dept Lands)	Secured longer tenure	YB	Mar 2010	3	3	9
Industry communica-tion process (*)	Poor communication with NSW oyster industry (and from other states)	1. Slower industry development 2. Miss out in industry related opportunities		1. Get quote for development of website for Wapengo Lake 2. Link with South Coast estuaries (liaise with Greg C- Pambula Lake) 3. Explore marketing products (e.g. branding/ organic certified)	1. Increased network paths across the oyster industry 2. Increased participation in oyster events	(1) WT	Dec 2010	3	2	6
						(2) WT & SB	On-going			
						(3) WT & SB	May 2010			

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level
Exotic/ pest species (i.e. Pacific oysters, Green shore crab, Caulerpa)	1. Enhance exotic species settlement, growth and dispersion on oyster infrastructure 2. If predator of oysters- impact on oyster production 3. Transfer of pest between sites/ estuaries 4. Impact on overall ecology of aquatic ecosystem	1. Growers have been trained on pest species identification 2. Growers involved in pest monitoring program 3. Use of oyster shipment logbook/ Pest & disease control program by NSW DPI Fisheries when moving oysters across estuaries	Reduce exotic species settlement in area and minimise change of species translocation	1. Maintain pest monitoring program 2. Ensure that Pacific Oyster are continuously removed from infrastructure and shoreline	Marine identification material distributed	SRCMA	Oct 2009	1	3	3
					Number of marine pest reported	Wapengo Lake Oyster Growers	Current and ongoing			
					Minimum presence of fouling species by keeping up clean-up programs	Wapengo Lake Oyster Growers`	Current and ongoing			
Buildings (oyster sheds)	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 minimize 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	Buildings and surrounds are maintained at all times	Wapengo Lake Oyster Growers	Current & ongoing	1	1	1
Fuel Storage in land-based areas	Fuel and oil spills from oyster shed	1. Contamination of ground and/or waterways 2. Fire risk 3. Loss of surrounding habitat	1. Fuel is purchased as it gets used 2. Small amounts of fuel are kept in sheds	Identify an area where to set a centralised, properly equipped fuel storage area	Spills and/or contaminatio n are limited	Wapengo Lake Oyster Growers	June 2010	1	1	1
Disposal of shell waste	1. Inappropriate re-use of waste product 2. Devaluation of marketable oyster (if put back in water)	1. Use of limited landfill resources 2. Oyster shells with mudworm could potentially enhance spread of disease if put back in the water	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	Dispose shells in an environment al way	Wapengo Lake Oyster Growers	Current & ongoing	1	1	1

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level
Toilet facilities in oyster sheds	Lack of facilities (with a few exceptions)	Human fecal pollution entering water course and contamination of oysters- unsafe food consumption	1. Few growers have pumped out toilet facilities, others they use facilities in close by residential dwellings. 2. Regular maintenance of private toilet facilities at oyster sheds for grower/private use.	Continue implementing current measures	Minimise fecal contaminants entering waterway	Wapengo Lake Oyster Growers	Current & ongoing	1	2	2
Derelict leases	1. Inappropriate disposal of tarred or treated timber 2. Navigational hazard 3. Available substrate for feral oyster species and other fouling species	1. Potential chemical leache into waterways (from old tarred infrastructure) 2.Boat accident 3. Unmanaged fouling practice	1. Growers clean up of derelict leases 2. Appropriate disposal of tarred in DEC approved and controlled land fill sites	Reuse were able: look for alternative means of tarred by-product disposal	Clean-up of active derelict lease	Wapengo Lake Oyster Growers	June 2010	1	2	2
Faulty oyster infrastructure	Shoreline accumulation of old oyster infrastructure	Accumulation of oyster products on shoreline-visual amenity pollution	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	Reduce potential navigational accidents and visual pollution	Wapengo Lake Oyster Growers	Current & ongoing	2	1	2
Oyster operations-stocking densities	Reduction in oyster productivity	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. Comply with OISAS recommendations 2.Take into consideration other research outputs worldwide 3.Growers agreement to set up a maximum limit of stocking densities/ lease area- think about an appropriate method	Optimum oyster growth rates, no decline in production	Wapengo Lake Oyster Growers	Current & ongoing	1	1	1

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level
Boat driving	1. High speed& 2.High impact boat wash on shoreline	1. Loss of habitat 2.Reduce water quality 3. Destruction of ecological sensitive areas (i.e. protected areas with presence of aboriginal shell middens)	1.Holder of a NSW Boat License 2. Drive at low speeds close to sensitive and ecologically important areas	A. Put up signs “no wash”	Reduce accidents in waterways and minimize boat wash	Wapengo Lake Oyster Growers	Current & ongoing	1	2	2
Migratory bird habitat	Proximity of boat activity to bird habitat/activities	Loss of biodiversity	Current oyster farming practices have not been found to interfere with bird habitats	Continue implementing control measures. Keep in communication with local bird association for updates on local wildlife	Number of incidents reported	Wapengo Lake Oyster Growers	Current and ongoing	1	1	1
					Knowledge on bird habitat provided to relevant organisations	Wapengo Lake Oyster Growers	Dec 2012			
Aquatic ecosystems	Navigation over seagrass (*Zostera* spp) beds	Loss or damage of seagrasses- reducing habitats of juvenile fish and other animals, sediment stabilization	Lift engine so no entanglement occurs	1. Monitor seagrass growth and extension of seagrass beds 2. Continue with current control measures	Reports of changes in coverage of seagrass beds	Wapengo Lake Oyster Growers	Current and ongoing	1	1	1
Industry communication process	Lack of communication within members in a lake	1. Less potential for optimal development 2. Reduce opportunities for significant overall performance- no sharing ideas and effort	Infrequent formal meetings	Arrange bimonthly meetings to discuss activities happening in the growing area, in other growing areas and planning for future actions?	Increase interaction among growers	Wapengo Lake Oyster Growers	Current and ongoing	1	1	1
Interaction with Community & Stakeholders	Poor oyster industry representation in catchment activities	EMS Action Plan might not progress	Wapengo oyster growers are part of the community Wapengo Watershed Association which is involved in a large number of catchment activities	Keep active involvement with these groups Seek for new volunteers from time to time	Having a working group to help initiate and sustain works for identified sites	Wapengo Lake Oyster Growers	Current and ongoing	1	1	1

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level

External risks

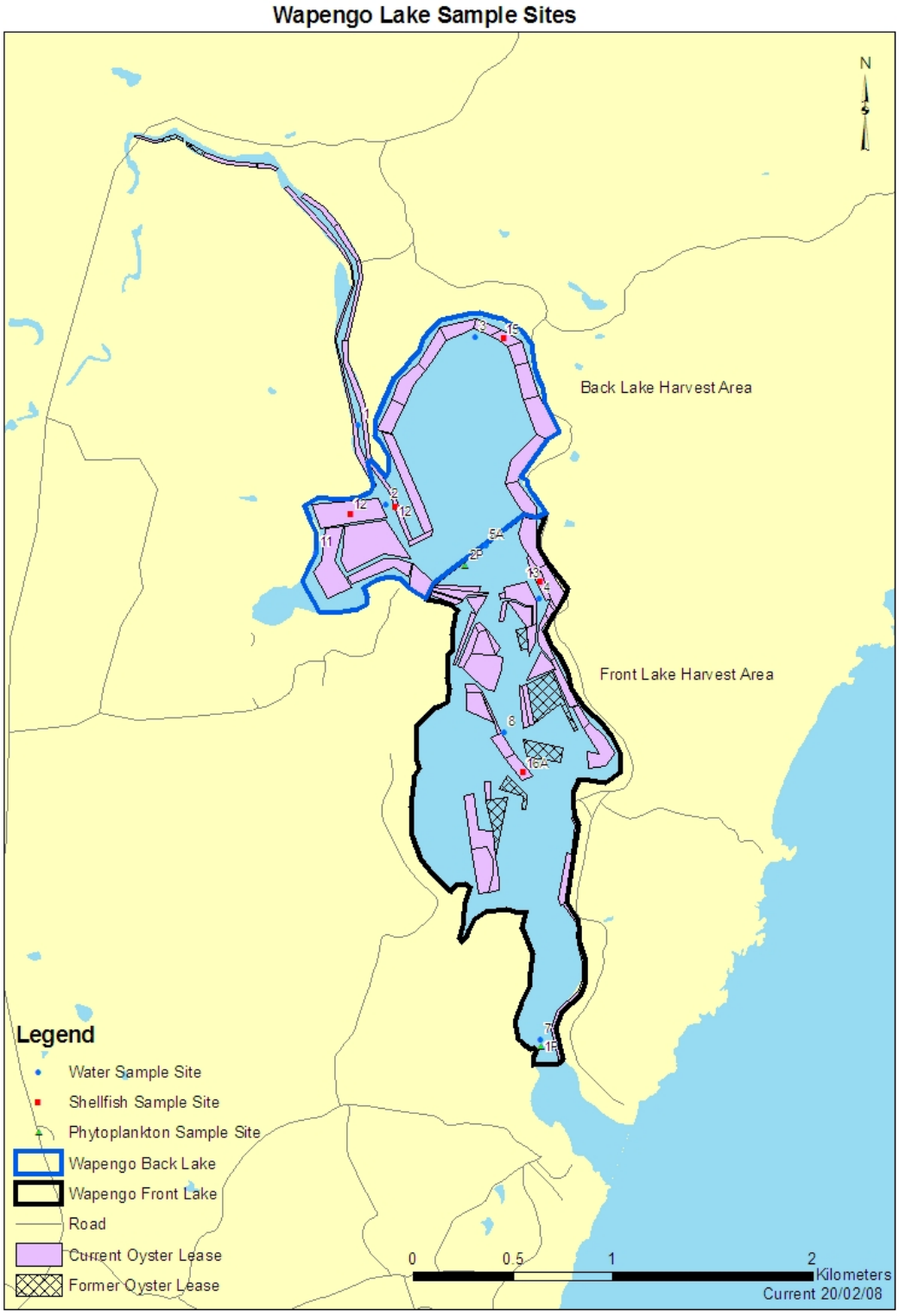
Deterioration of water quality (*)	1, Sewage pollution (i.e. septic tanks and private camping) 2Lack of public toilets close to boat ramp 3. Fine sediments entering waterway from catchment activities	1. Closure of harvesting area (i.e unsafe oyster consumption) 2. Pollution of waterways	1.WWA – water monitoring program (funds left for 1-event sampling) 2. On-going Shellfish Quality Assurance Program potential closure of oyster harvesting	1. Follow up water quality report, data results and recommendations for further sampling from WWA. Also core sampling by UoW-once gathered, re-assess continuity of water monitoring program 2. Chase up BVSC results on Septic Safe Survey Program 3. Organise signage close to boat ramp (Crown Land) for 'Public toilets in Nat Park' & 'Keep our waterways clean'. Coordinate with Dept of Lands (Noel Whittem) & NPWS (Steve Deck)	No pollution cases reported	(1) WT (2) GP (3) WT & HD	Dec 2010 Dec 2010 Feb 2010	2	3	6
Unsealed roads (*)	1. Run-off into waterways 2. Dust pollution 3. Increased sedimentation in waterways	1. Reduce oyster filtration ⇒ ⇓ production 2. Increased turbidity levels ⇒ ⇓ water quality and potential pollution of waterways	1. Some roads being sealed (through SRCMA funding), road side vegetated and water appropriately diverted 2. Oyster shell is being used as road base	1. Review of Environmental Factors (REF) managed by BVSC – underway for extension of sealing on Wapengo Lake Rd. Liaise with BVSC so water quality is considered in future grading of roads 2. Continue with current collaboration with SRCMA on identifying problematic roads-check sites during a rain event	Background turbidity levels and oyster growth rates in the lake Problematic sites identified after rainfall	(1) YB (2) SB & HD	Jan 2010 Next rain event or in 6 months	3	3	9

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level
Changes in hydrology (*)	Changes in natural sediment processes due to catchment activities (e.g. forestry)	1. Change of flow direction 2. Limitation of food availability in areas 3. shift of main navigational channels	1. Monitoring water level at entrance of lake (through MHL) 2.WWA community water monitoring program	Share water quality reports and copy of EMS at next Wapengo Working Group Meeting (ensure Forest NSW receives a copy)	Reports of changes in sedimentation	WT & HD	Dec 2009	3	3	9
Use of non-environmentally friendly horticulture & agriculture products (i.e. fertilizers, pesticides) (*)	Chemical (nitrogen and phosphorus) pollution of waterways	1. Increase nutrient levels entering waterways ⇒ potential algae bloom 2. Poor water quality	Some preliminary communication with community with minor success	1. Share results of water quality and core sampling with landholders in catchment- variables analysed and levels around sampling sites 2. Distribute EMS to stakeholders	Reduce chemical input in waterways	(1) WT & HD Wapengo Lake Oyster Growers	Feb 2010 Jun 2010	3	3	9
Rec fishers, water users, tourist (*)	1. Mooring to oyster leases 2. Navigation over oyster infrastructure	Loss/damage of oyster infrastructure	One-to one communication to those users mooring to leases	Get quote for larger prints of NSW DPI Fisheries signs to hang on major lease posts	Minimise reports on damage of infrastructure	SB	Jan 2010	3	3	9
Rec fishers, water users, tourist	Boat wash	1. Erosion of shoreline (e.g protected areas- aboriginal shell middens) 2. Impact on oysters- washed into corner of cultivation unit = oyster mortalities		1. Monitor midden brush bundles program (SRCMA) 2. Liaise with NSW Maritime (Darren Hulm) to install 'No Wash' signs in certain areas of lake	Reduce boat wash & shore erosion in the lake	(1) HD (2) SB	Dec 2009 Dec 2009	2	2	4
Climate change	1. Acidification of the waterways 2. Oyster incapable of adapting to environmental changes 3.Sea rise level	1. Decreased in 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 = oyster engineering role diminishes	1. Monitoring of local pH and other environmental levels through the community monitoring program	1. Set up intense environmental monitoring program 2. Growers to get involved in research activities on climate change	Monitoring program set up to build up base line data in order to identified drifts/variations in norm levels	Wapengo Lake Oyster Growers	Immediate and ongoing	1	3	3

Activity	Risk description by event or cause of risk	Potential Impact	Current Control Measures	Further Measures/ Actions	Performance Indicators	Responsi-bility	Time-frame	Like'hd	Cons.	Risk Level
Visual pollution and aesthetics of oyster leases	Community unhappy with industry due to appearance or presence of oyster leases	Negative attitude to oyster farming	1. Maintain neat and tidy premises 2. Involvement in activities that promote the health of the lake	A. Educate community about oyster farming ecological role in lake, employment opportunities and economic benefit for the area B. Ensure oyster operations follow ESD principles C. Distribute EMS D. Growers to be involved in community activities/groups (i.e conservation groups)	Maintain good relationship with community	Wapengo Lake Oyster Growers`	Current and ongoing	1	1	1
Loss of riparian vegetation from clearing and/or poor cattle infrastructure	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 close to shoreline 3. Destroy important ecological habitats: mangroves and saltmarshes	1. Livestock has been exclude from waterways by implementation of fences (SRCMA funding) 2. Re-vegetation of the shore line (Landcare activities, SRCMA funds)	1. Work in collaboration with dairy farmers and SRCMA to keep improving catchment health 2. Engage more oyster growers in re-vegetation projects on the catchment with Landcare groups	Stop 100% of livestock impacting foreshore vegetation and polluting water quality	Wapengo Lake Oyster Growers`	Current and ongoing	1	3	3

Appendix 4: NSW Food Authority – Direct Harvest map for Wapengo 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 slight different as per procedure enclosed in this appendix

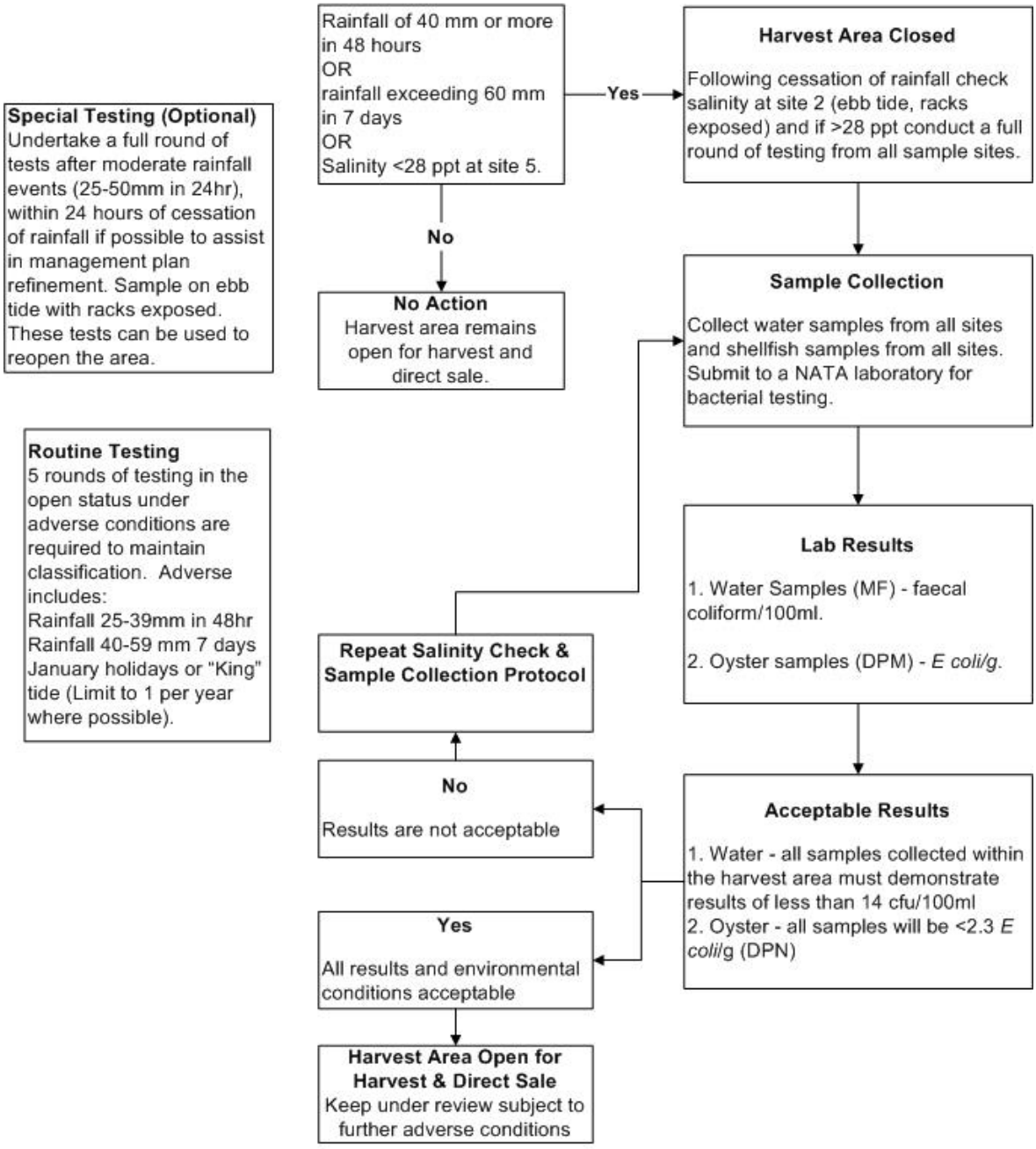


February 2008

Wapengo Lake
Front Lake Harvest Area
(Conditionally Aproved)
Operation Under Rainfall Conditions

Routine and Special Testing

Rainfall Criteria



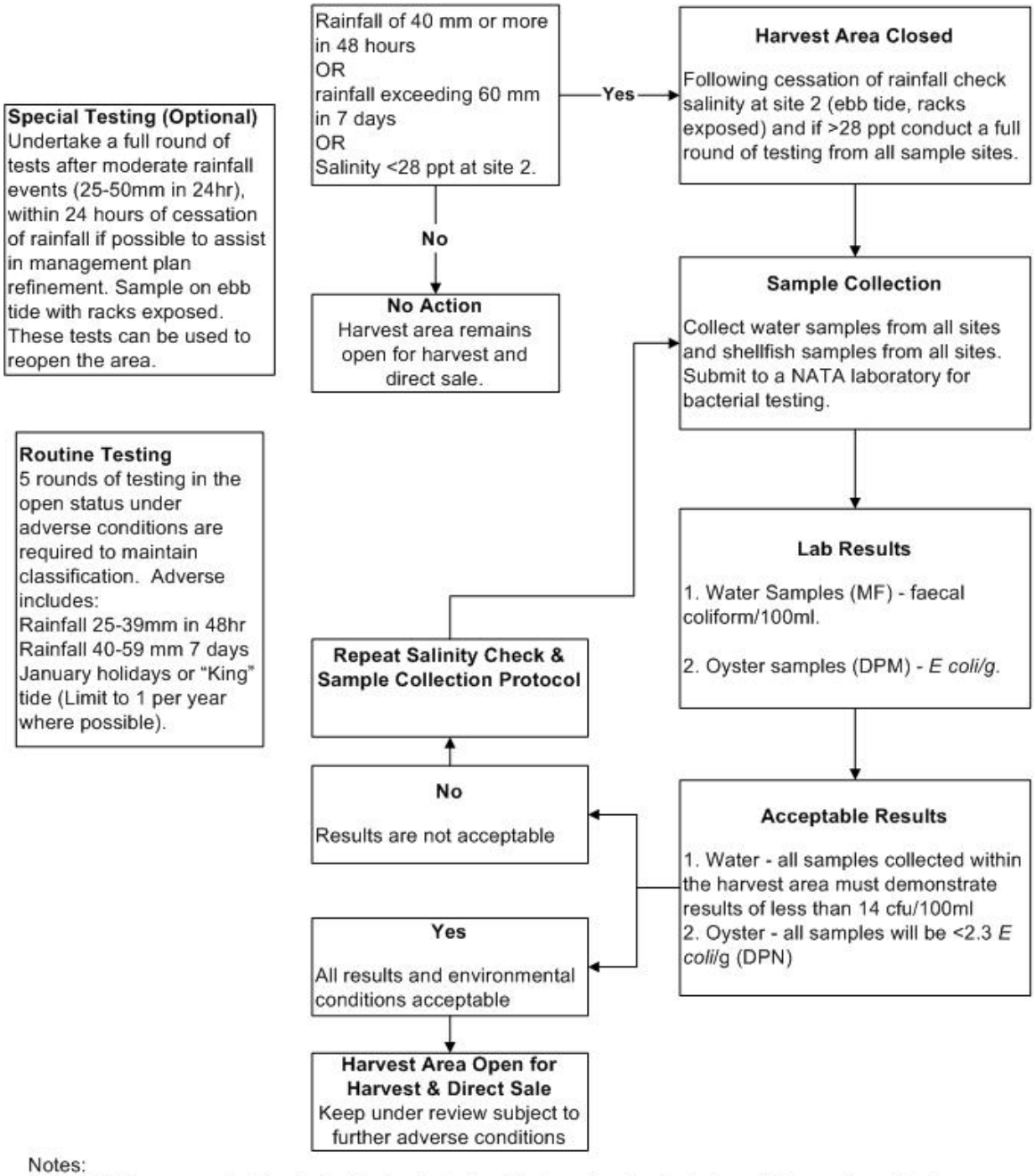
Notes:
1. Rainfall is measured at the Lake Road rain station, Hunters Road rain station will be used as a back up.
2. It is the responsibility of each farmer to ensure that the area is open prior to harvest.
3. The NSW SP and Wapengo Lake SP Coordinator will liaise regarding environmental conditions and sampling arrangements.
4. Salinity is measured on an **ebb tide at Site 5A**.
5. Required Water sites are **4, 5A, 7, 8.**
6. Required Shellfish sites are **13 & 16A.**

February 2008

Wapengo Lake
Back Lake Harvest Area
(Conditionally Aproved)
Operation Under Rainfall Conditions

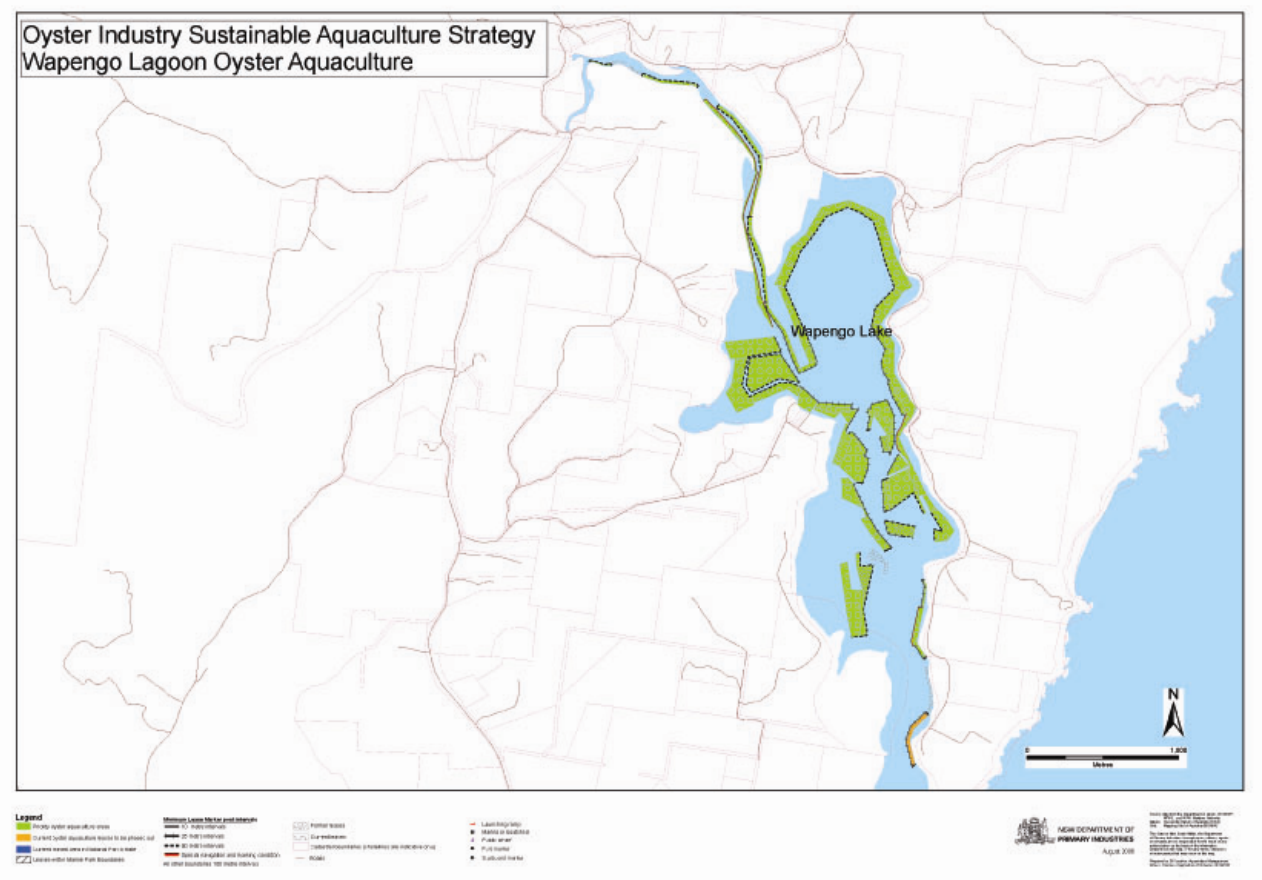
Routine and Special Testing

Rainfall Criteria



Notes:
1. Rainfall is measured at the Lake Road rain station, Hunters Road rain station will be used as a back up.
2. It is the responsibility of each farmer to ensure that the area is open prior to harvest.
3. The NSW SP and Wapengo Lake SP Coordinator will liaise regarding environmental conditions and sampling arrangements.
4. Salinity is measured on an **ebb tide at Site 2**.
5. Required Water sites are **2, 3, 5A, 11. Site 1 is outside the harvest area boundary but will be considered when re-opening.**
6. Required Shellfish sites are **12 & 15.**

Appendix 5 Priority oyster lease area in Wapengo Lake (figure taken from OISAS)



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