

BROKEN BAY OYSTERS

ASSOCIATION INCORPORATED



Environmental Management System

TIDE TO TABLE
RESTORING AQUATIC HABITAT
Hawkesbury Nepean & Hunter Central Rivers

OCEANWATCH
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**HAWKESBURY
NEPEAN
CATCHMENT
MANAGEMENT
AUTHORITY**



Australian Government

Prepared by the Broken Bay Oyster Association Inc. and OceanWatch Australia Pty Ltd
SeaNet and Tide to Table Program – 5th Draft March 2011.

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BBO thanks OWA in the organisation of Environmental Management System (EMS) meetings, compilation of the document and committed efforts in supporting the Broken Bay and NSW oyster farmers. In particular BBO thanks Michael Wooden working with us through OWAs SeaNet and Tide to Table programs. BBO also thanks Dr Ana Rubio for her advice and assistance.

The building of our EMS, which is currently in its 5th version has improved our engagement and subsequent input into the management of the Hawkesbury River catchment. The EMS has improved awareness and resulted in the adoption of best practice within our oyster growing operations. Through the process of risk assessment, we are now taking actions to help mitigate environmental issues.

This document was officially launched by the Parliamentary Secretary for Agriculture, Fisheries and Forestry, Dr Mike Kelly on Thursday, 14th April, 2011.



Figures 1 and 2. Adult Broken Bay Pacific oysters.

BBO are proud to highlight our environmental standards within this document. BBO growers endeavour to provide a sustainable production of healthy oysters into the future for the benefit of Australian seafood consumers, and for the benefit of the Hawkesbury River catchment.

1.0 INTRODUCTION

In 2005 oyster growers in the Hawkesbury River catchment united to form one association, Broken Bay Oysters Association Incorporated (BBO), consisting of twelve oyster farming businesses. The formation of this association allows growers to work as a team on current and future challenges, and continue to improve business stability. The BBO growers aim to pursue goals and outcomes of common interest, which benefit all BBO members and other users/stakeholders of the river. BBO are formally committed in achieving environmental sustainability in their industry and consequently decided to develop an EMS that incorporated all BBO members. This document complements the CE&Y Moxham Oyster EMS previously prepared by OWAs SeaNet program in July, 2003.

This is an industry driven initiative, aiming to contribute to the sustainability of oyster farming and the health of the Hawkesbury River estuarine environment. In addition, the EMS aims to increase community understanding of the methods we use to cultivate oysters in the Hawkesbury River, management and regulations applied to the oyster industry, importantly to the harvest areas.

The EMS highlights how BBO farmers are united in responsibly providing fresh and high quality oysters on behalf of the community. Oyster farmers are striving to achieve sustainability in their industry, and recognise the consequence and value of utilising the most 'environmentally sound' materials and methods in the cultivation of oysters within the Hawkesbury River catchment. The EMS also documents an ongoing process of environmental management, requiring periodic reviews approximately every 6 - 12 months.

1.1.0 Environmental Management System: A Broken Bay Oyster Farmer's environmental initiative

An EMS is a continual process of improving environmental management by developing actions that identify and address risks and reveal opportunities. An EMS is a tool that can be used to identify issues relating to the environment, food safety, product quality, occupational health and safety, profitability, public relations or other aspects of the organisation. This is achieved through regular reviews and updating of the document as new technologies, methodologies etc are incorporated into business activities.

This EMS describes how the business members of BBO will continue to improve, adapt and progress with new developments. It also demonstrates their willingness to co-operate with natural resource managers and the community, to assist in the management of estuarine resources.

1.2.0 The Hawkesbury River

The Hawkesbury River is NSW largest estuary and is located approximately 50 km north of Sydney. The Hawkesbury River catchment area is approximately 21,500 km².

The Hawkesbury River tidal limit is located approximately 145 km upstream of Broken Bay, e.g. to Yarramundi road-bridge. Upstream of the road-bridge the Hawkesbury becomes the Nepean River. The Hawkesbury River's salinity limit is 80 km upstream from the river mouth, around lower Portland. The Hawkesbury catchment includes seven national parks, five nature reserves and two state recreation areas that assist as a natural filtration system in maintaining the water quality of the river. The catchment also contains extensive mangrove stands estimated at (11km²) and is surrounded by steep sloping riparian vegetation in the northern and western areas of the Hawkesbury valley. The major tributaries that flow into the Hawkesbury River include the MacDonald, Colo and Grose Rivers.



Figure 3. The Hawkesbury River catchment and the Brooklyn Bridge.

1.2.1 Oyster farming history prior to 2004 – cultivation of the Sydney rock oyster and QX disease

The Sydney rock oyster (SRO) (*Saccostrea glomerata*) was the traditional oyster species harvested and cultivated in the Hawkesbury River. In 2003, the Hawkesbury River was the third largest production area for SRO cultivation in the state.

In June 2004 whilst attending the first EMS workshop, BBO became aware that SR oysters had become infected with a damaging parasite, Qx (*Queensland unknown*). Qx is a protozoan parasite *Marteilia sydneyi*, which resulted in mass mortality and the decimation of Hawkesbury River's cultivated and wild SRO populations. Since the outbreak, BBO and Hornsby Council have collaborated in a monitoring program which identifies the time of year Hawkesbury River SRO become infected with the Qx disease. This period of time is referred to as the 'window of infection'. A leading expert from the Queensland Museum and I&I NSW provided BBO growers training in the identification and analysis of the QX disease.



Figure 4. BBO operator taking samples for Qx research partnered with I+I NSW.

The challenges of Qx in 2004 impacted on the Hawkesbury River oyster grower's business stability, and additionally affected oyster growers on a personal and social level. The number of oyster farmers that were actively cultivated SROs were reduced from 23 to 3 businesses.

In efforts to allow Hawkesbury River oyster farmers to stay afloat financially during this difficult period, the government played an essential role in offering oyster farmers a role in environmental stewardship and management. This consisted of extensive clean up operations (as described in sections 1.4 and 6.0 Action 2.3). Hawkesbury River oyster farmers were paid a bounty per tonne for the removal of derelict and degraded infrastructure from the river.

In addition to the extensive clean-up operations undertaken by the remaining growers, BBO partnered with Industry and Investment NSW (I&I NSW) (prev. Department of Primary Industries, DPI) and found some success trialling Qx resistant strains of SRO. The grow out of Qx resistant strains were not enough to keep the members and the industry economically viable, resulting in vast changes from historical techniques and the livelihoods of growers cultivating SRO.

Further work was initiated in partnership with I&I NSW utilising single seed, triploid aquaculture technology on PO. This partnership has established a sound base for the sustainable production of oysters within the Hawkesbury River into the future. Triploid strains of PO have a genetic composition that does not allow natural spawning (i.e. they are naturally sterile). Therefore, these strains of PO should have no resulting impacts on remaining SRO, or with the environment.

1.2.2 Post 2004 – triploid cultivation of the Pacific oyster

By December of 2006, twelve oyster farming businesses were operational in the Hawkesbury River, cultivating triploid PO.

The PO (*Crassostrea gigas*) an oyster species endemic to Japan, has been utilised throughout many countries including Australia, for the purposes of aquaculture. In Australia, diploid strains of PO were originally cultivated in Western Australia and Tasmanian waters. However, the species quickly moved into NSW estuaries, taking advantage of their rapid reproduction and growth rates. Diploid strains of PO (capable of spawning), allowed the species to establish and displace the native SRO in some areas.

Diploid PO can spawn as a male before transforming into a female. A single female Pacific oyster can release up to 100 million eggs per spawning event. Diploid PO are declared a noxious fish species in NSW waters, with the exception of Port Stephens (www.industry.nsw.gov.au). The PO can additionally withstand a wide range of salinities and water quality parameters.

Throughout the Hawkesbury River, the triploid Pacific oyster species now accounts for the majority of production. Supplemented with successful marketing, BBO farmers are once again standing on their own two feet. Wild diploid populations of PO are found within the Hawkesbury River catchment and in consequence, BBO members practice a 'find and remove' mentality in efforts to minimise over catch.

1.2.3 Spat origin, selective breeding and feral population management

BBO farmers purchase triploid Pacific oyster spat (at a size of approximately 2mm) from Shellfish Culture Ltd (SCL), located in Tasmania. SCL have been producing triploid oysters since 1988. Initially, using a technique which involved chemical induction, however the success of this technique was highly variable. Current technologies focus on the production of triploid strains of PO. These are produced by breeding 'diploid' (normal- 2 sets of chromosomes) oysters with 'tetraploid' oysters (4 sets of chromosomes). 'Brood-stock'

parents are used in the production of triploid spat. The methodology is a patented process partnered with 4Cs Breeding Technologies Inc in the USA.

Triploid oysters are reproductively sterile, differing to the spawning diploids, and therefore cannot result in feral populations outside of farmed areas. The high growth rate and meat yield of triploid oysters, supplemented with quality, year round meat condition, provides a competitive advantage over diploid and chemically induced triploids. The selective breeding of triploid PO has been assessed by I+I NSW through a Review of Environmental Factors (REF) and subsequently, grow-out of the triploid PO has been approved. There is debate regarding the potential of triploid oysters to revert to a diploid state, termed 'reversion' or having both diploid and triploid genes, termed 'mosaicism'. Anecdotal evidence indicates that reversion or mosaicism in individual PO is very uncommon and additionally is usually infertile (John Stubbs, pers. comm. 2010).

1.3.0 Oyster farming and the environment

Oyster farmers have an intimate understanding of the estuarine environment and production is therefore dependent on the health of the river. Ultimately, this is the most important factor for the successful growth of oysters. In respect of this, the oyster farmers of Broken Bay operate according to the simple equation.

Good water quality = healthy oysters = regional employment and investment



Figure 5. BBO growers assist in the installation of a water quality monitoring buoy.

BBO oyster farmers have extensive experience and expertise in their industry, continually developing and implementing best practice techniques that encompass both environmental and production requirements.

1.3.1 River Health

The Hawkesbury Nepean Catchment Management Authority (HNCMA) released the Hawkesbury Nepean River Health Strategy in March of 2007 (HNCMA, 2007). The strategy was developed to deliver the objectives and resource targets identified in the 2006 Metropolitan Water Plan (NSW Department of Infrastructure, Planning and Natural Resources, 2006). BBO members support and congratulate the efforts of the HNCMA in their commitment to maintain and improve river health. In particular: improving and upgrading sewage treatment, reducing nutrient loading, stormwater management, sedimentation and erosion control and riparian rehabilitation and restoration. BBO representatives also form part of the Lower Hawkesbury Estuary Management Committee, an additional measure to ensure BBO growers provide input into the overall management of the catchment. BBO also plays an important stewardship role in monitoring and reporting estuarine ecosystem health, in partnership with Food Safe NSW.

BBO growers recognise there are significant pressures on the river which include: clearing and/or alteration of aquatic habitats, nutrient loading, runoff and sedimentation emanating from urban and rural development. BBO recognise the importance of their on-ground actions (clean-up activities) undertaken in partnership with OWA, HNCMA and I+I NSW in improving and setting goals for river health.

BBO members acknowledge that a challenge still exists in balancing the pressures of increasing development and the health of the catchment environment. Predicted population growth in areas that bound the Hawkesbury Nepean catchment may add further pressures to water quality and the overall health of the estuary. BBO aims to continually improve operations and apply techniques and materials that will minimise environmental impacts. BBO growers in respect, seek a similar commitment from all users and industries within the Hawkesbury Nepean catchment.

1.4.0 Recent environmental achievements of BBO growers

BBO were pleased to showcase oyster production within the Hawkesbury River at the official launch of the NSW oyster industry EMS project, facilitated by OceanWatch Australia in April 2011.

The honourable Dr Mike Kelly, Parliamentary Secretary for Agriculture, Fisheries and Forestry additionally launched this BBO EMS document at Mooney Mooney land facilities.

BBO were proud to showcase the efforts of oyster growers in working with various partners to achieve improved environmental management.

<http://www.thefarmtrader.com.au/articles/sustaining-our-oyster-industry>

BBO have demonstrated increased in environmental awareness through the uptake of new technologies and techniques, improved communication with governmental departments and the community, and input into various estuary management processes. BBO have assisted OWAs Tide to Table program, OWAs sustainable seafood program 'SeaNet' and HNCMA; by participating and delivering presentations at educational events and field days. This involvement has helped to improve the community's knowledge of the oyster industry and the Hawkesbury catchment, through informed discussions regarding activities and practices that can result in negative impacts on water quality. These awareness raising events have short and long term flow on effects to downstream industries, importantly oyster cultivation and fishing operations.



Figure 6. BBO staff member, John Stubbs, educates the public during an awareness raising field day partnered with OceanWatch Australia's and the Tide to Table program.

The association have additional achievements which include:

- Contributing in a CSIRO taste testing program whereby participants, whom included chefs Chase Kojima, Shaun Langdon and Jeffery Derome, Parliamentary Secretary Agriculture, Fisheries and Forestry Dr Mike Kelly, OceanWatch Australia Executive Chair Brad Warren, BBO oyster farmer Rob Moxham and freelance journalist John Newton, assessed regional influences in oyster the taste (similar to that of wine tasting).
- Inducted into the Sydney Magazines annual Food Hall of Fame in October 2010. Selected for furthering excellence in food (article written in Issue#90, October, 2010, *Sydney Morning Herald - Sydney Magazine*).
- Finalists Australian Government Innovation in Sustainable Farm Practices Award.
- Winner of the RAS Fine Food Award for their cultivated PO at the first attempt.
- Nominated in the NSW State Landcare Award, 2009.
- Winner of the Hawkesbury Nepean Landcare Primary Producer Award, 2009.
- Extensive clean-up activities, removing over 8000 tonnes of redundant oyster related infrastructure from the river since 2006. These activities involved the use of BBO oyster growers' general labour and use of business owned equipment; including: oyster punts, cranes, trucks and excavators.
- Removal of contaminated materials, for e.g. 80 tonnes from the Marramarra site, and transported back to land facilities and disposed of appropriately. Contaminated materials were loaded onto a truck and removed from site using a local specialised company, with non-contaminated materials used as landfill.
- Involved in on-ground works at Milson's passage, cleaning up and appropriate disposal of a derelict house site. This included asbestos materials, general rubbish and 20 tonnes of exotic plants e.g. lantana.
- Clean up Patonga Creek removing 3.5 tonne of derelict infrastructure (e.g. tar pots, tar and tarred trays).
- Successfully engaged government (local, state and federal) in a number of assistance initiatives with long term benefits to oyster growing and river health.
- Linked with numerous local environmental and business groups as an active stakeholder in the rivers future.
- Activated over 20 jobs in the local community with significant local flow on benefits and future opportunities.

2.0 WATER BASED ACTIVITIES

BBO oyster farmers utilise a variety of methods to commercially cultivate oysters in the Hawkesbury River. The techniques utilised mostly revolve around existing infrastructure that remained after QX destroyed the SRO growing industry. There were almost 800 hectares of poles, rails and trays on which SRO's were cultivated in the various tributaries of the HR. During the clean up, dead SRO's and unwanted/defunct and untended SRO's, poles and rail were removed. In total, approximately 400 hectares of lease was retained, with most of these areas retaining existing post and rail cultivation.

The majority of post and rail is built from plastic flumed hardwood posts with plastic coated timber rails attached between the posts. A few growers have moved to posts with a nylon rope suspension system supporting SEAPA or BST type baskets.

With the uptake of the triploid pacific oyster by Hawkesbury River growers after the demise of the SRO, it was incumbent on the remaining growers to develop appropriate farming techniques to suit. This resulted in the combined use of old techniques and significant trialling of new methodologies.

2.1.0 Oyster grow out techniques

2.1.1 Spat growth

Juvenile PO, termed 'spat' (juvenile oysters approximately 2mm) are ordered at different times of the year, sufficient for BBO requirements. The spat is purchased from Shellfish Culture Ltd in Tasmania. PO spat are collected by BBO from Mascot Airport in Sydney and transported back to BBO land based facilities, at Mooney Mooney. Spat are hand sieved and sorted into various sizes using sieves and placed onto sorting tables.



Figures 7 and 8. Sorting, juvenile pacific oyster spat.

The spat are further divided into measured amounts and placed into 1000 micron socks and sealed with zip ties. The socks are placed in plastic baskets (SEAPE, BST and others), and stacked in frames, termed 'stillages'. These are then loaded using a crane into oyster punts. The spat are then transported to nursery areas, where the baskets are clipped on to long-lines strung between solid posts that move up and down with the tide. Once clipped, the baskets are immersed in water at all times which allows the oysters to feed 24 hours per day.

Approximately 3 weeks later, juvenile oysters are taken back to the land facilities where further size grading is required. The process of returning to base and grading continues where oysters are thinned to more baskets or, if the oysters are big enough, placed onto recycled plastic trays.

QX resistant Sydney Rock oyster (SRO) spat are purchased from suppliers such as Port Stephens annually (November) at approximately 8-10mm carapace length. They take longer than triploid PO to mature (a further 2 years to mature). Handling single seed SRO's is similar to handling triploid Pacific's, except operations are further spaced, and smaller sized plastic trays are used to allow 'traying' of Sydney Rock oysters as soon as possible from baskets. Even though the SRO spat are "resistant" to QX, death can occur from prolonged exposure to the disease during the infection period (November and December). QX resistant SRO's are therefore farmed more in the lower reaches (in more saline areas closer to the river mouth) of the Hawkesbury River where the QX disease does not seem to be as damaging. Alternatively, SRO's are moved out of the upper reaches to the lower reaches during the high risk times of QX infection.

2.1.2 Juvenile oyster growth

Juvenile oysters are initially grown in 1mm nylon socks, until they reach a size that requires grading. Juvenile oysters are graded and placed in 3 and 6 mm rigid plastic baskets. Floats are attached to the baskets using clips, are attached to ropes suspended between vertical poles.

These oysters are not exposed to the air at low tide and spend all their time below water. The advantage of this method is that oysters can be worked at low and high tides – not possible with rack and rail and tray culture.



Figure 9. Juvenile pacific oyster spat growth.

Juvenile oyster growth rates are variable amongst individual oysters, with growth varying according to water temperature, i.e. warmer summer water temperatures usually result in faster growth rates and cooler winter water temperatures limit growth. In the Hawkesbury River, juvenile triploid PO grow rapidly.

2.1.3 Intermediate growth

Once the oysters begin to fill the volume of baskets and basket fouling prevents good water flow to the oysters, baskets are removed from stay lines and returned to shore for grading. The number of oysters per tray needs to be reduced over time as they grow (referred to as 'thinning out'). The process involves trays of oysters being returned to the land facilities, unloaded from the punt using a yard or gantry crane and placed onto (recyclable) pallets. A forklift is used to transport the trays around the yard. Oysters from trays are either tipped onto concreted areas or into large plastic bins for sorting and grading. Oysters are placed on clean trays and reloaded back onto oyster punts and transported back to the leases. This process is repeated over a period of 12 months or more until oysters reach maturity. Plastic baskets and trays are cleaned using a high pressure water hose, stacked and left to dry on shore.

Thinning out of baskets, results in the stocked volume measureable to about 1/6th of the basket volume. By the time the oyster grade e.g. (1mm, 3mm, 6mm or 12mm) are returned to shore for regrading, the volume can increase by 500%.

As a rule of thumb, oysters are placed in baskets of a mesh size equal to half the size of the stocked oysters. For example, a 3mm mesh basket will only be stocked with 6mm or larger oysters. This prevents the oyster tail from hanging through the holes and minimises exposure to fish predation.

2.1.4 Maturing oysters in trays

These are the primary methods of preparing oysters to maturity. Oysters are exposed to 2 tides per day, therefore spending a significant part of their life exposed to the air during low tide.

Oysters greater than 20 mm are placed on trays, and stocked at a density of approximately 10 to 12 dozen per 1.8m tray. The majority of Broken Bay oysters are matured in recycled plastic trays. Some trays are constructed entirely of recycled plastic; others are a combination of timber and plastic, or plastic sleeved timber. Some trays have a lid system, others are high sided. The most common mesh size used is 20mm. Some growers now use hanging rigid plastic baskets. Both trays tied to post and rail and hanging baskets are intertidal – i.e. oysters are exposed twice a day on low tide. The trays are secured to the rail with either bailing twine or wire.



Figure 10. Maturing oysters in trays.

2.1.5 Maturing oysters in hanging baskets

Hanging baskets are attached to a nylon cord adjoining vertical poles. These are generally smaller than trays and therefore are stocked at lower densities per unit. These are currently a minority in the group. Alternate maturing methodologies are currently being trialled, e.g. larger mesh plastic baskets.

2.2.0 Predator control meshing

Shade or predator mesh is spread over oyster trays on the racks (Figure 11). The cloth is stapled into place with commercial hand held stapler. This operation is performed from the punt as it moves along the rack.



Figure 11. Preparing protective meshing on oyster trays.

When oysters are <24mm, the predator mesh or cover cloth has a number of potential benefits:

- *Prevents fish accessing and predating on young oysters, for e.g. yellowfin bream (*Acanthopagrus australis*).*
- *Reduced oyster heat stress during hot days and or low tides.*
- *Reduces the loss of oysters from wash off (as the tide rises or falls through the rack). Smaller oysters are more vulnerable to loss through wash. Additionally, boat wash or storms can displace large oysters between tray segments or off the tray altogether.*

2.2.1 Raking oyster trays

Individual oysters, maturing on trays, are required to be irregularly redistributed, i.e. each tray bay is raked manually by the grower. The raking of oyster trays during maturation prevents oysters growing and fusing together and also allows fish to predate on fouling organisms. These include mussels and unwanted spat settlement (over-catch) from the shell of commercial oysters.

2.2.2 Washing oysters

Oysters can accumulate significant fouling through settlement of suspended sediment, i.e. mud. Mud can be advantageous when the weather is hot and during low tide, by keeping the oyster cool. There is a delicate balance to be maintained however, between the benefits of cooling and an increased susceptibility to mud-worm (*Polydora websteri*) infestations.

During summer, oysters are more susceptible to mud-worm infestations. These are a small parasitic worm that can enter and remain inside the oyster. An infestation results in an accumulated mud tunnel which influences oyster quality and marketability. Worm infestation is less likely when the oysters are kept relatively free of mud. Therefore washing of the oysters is required at specific times, using a high pressure water pump.

2.2.3 Pre-harvest cleaning and grading

Prior to harvest the oysters are washed on the racks to get them as clean as possible before taking back to shore for grading and bagging. Oysters are washed using a high volume water pump set up the punt. This is fed through an over the side high volume boom spray. The punt moves up the rack washing the mud from the oysters and if required, the cover cloth.

2.3.0 Post-harvest cleaning and grading

Once oysters have reached marketable size, trays are lifted into an oyster punt and returned to shore for grading and bagging. The grower removes the bailing twine or wire and lifts the tray and oysters using a wire crane or manually over the punt gunwale (alone or with assistance from another grower). Trays are stacked on the punt floor until the required amount is collected or a load is achieved.

2.4.0 Rack building and repair

All in water infrastructure needs to be constructed on site. This involves the use of punts and various in-punt equipment such as a small Hyab or wire cranes, towing, etc. These activities can be variable in terms of the type of activity, frequency, necessity and time of year. Some activities include:

- Pulling old post and rail
- Setting new post and rail
- Building and installing irrigation systems
- Building and installing lease marking infrastructure
- Building wave boards
- Sampling for the NSW Food Authority QAP

2.5.0 Harvest areas

BBO water based harvest areas, i.e. leases and infrastructure, are located at 5 locations within the Hawkesbury catchment. These are i) Conditionally approved (direct harvest): Marramarra Creek, Porto Bay, Coba Bay and Patonga Creek (see section 2.6.1); or ii) conditionally restricted (dual managed): Kimmerikong (see section 2.6.2). Figure 12 illustrates the 5 active harvest areas.

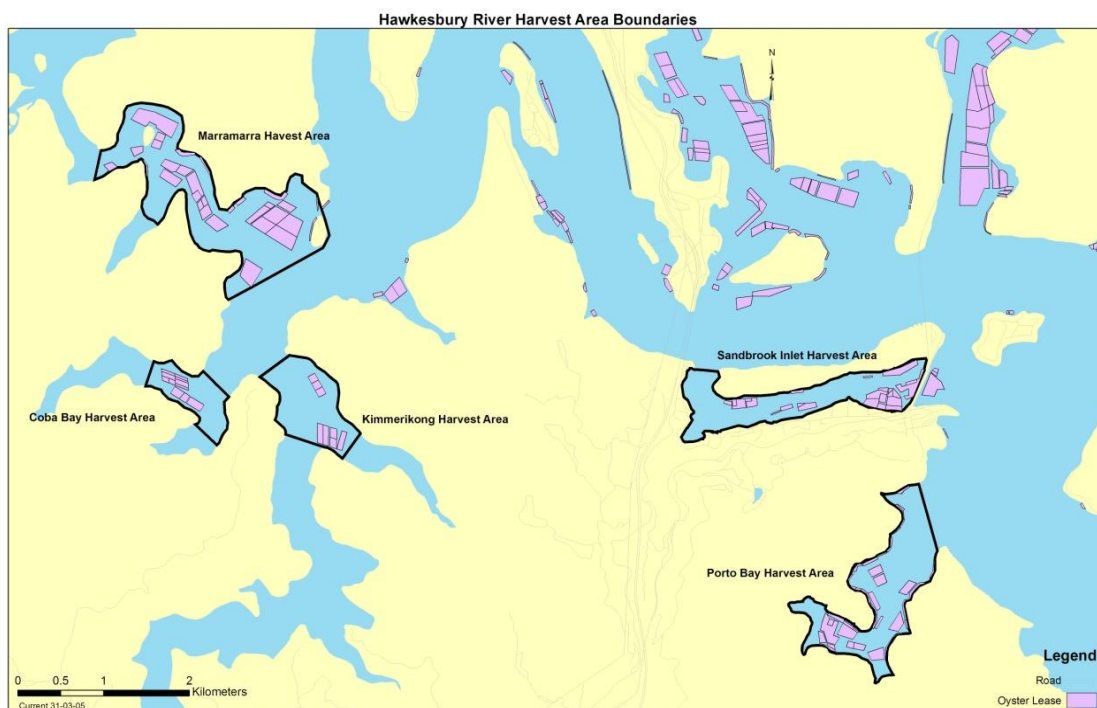


Figure 12. Hawkesbury River harvest area boundaries (NSW Food Authority, 2010).

Harvest areas are formally closed or opened by the NSW Food Authority, determined by strict environmental conditions (i.e. rainfall and salinity criteria) in each harvest area. However, it is ultimately the responsibility of BBO to ensure the areas are open prior to harvest. The NSW Shellfish Program flowcharts (see NSW Food Authority) describe the acceptable criteria in each harvest areas to allow direct harvest.

These environmental parameters are assessed through a number of programs, e.g. salinity and faecal coliform which are tested in the water, and E-coli testing of oyster flesh. Samples are analysed by laboratories approved by the NSW Food Authority. The Hawkesbury River generally uses Sonic Labs, based at Penrith, NSW.

Samples are collected on request from the land base area. Sampling can be part of the QAP to continually monitor harvest areas or as part of the requirement for regular meat testing by growers; with results telephoned (and later sent) to individual oyster farmers.

The harvest areas status can change from closed to direct harvest if the salinity and test results are not acceptable or if rainfall exceeds NSW Food Authority parameters. Salinity is sampled on mid ebb tides or at least three hours after high water, depending on the harvest area. Additionally, special and routine testing may also be required. For example, the Porto Bay harvest area is additionally required to test for faecal coliform levels during peak summer and Easter periods where there is a noticeable increase in recreational and house boat traffic. Samples are taken at three water testing sites, early morning on a run in tide, with additional

samples taken close to house boats. The Marramarra Creek and Kimmerikong harvest areas also have a special testing program, which is an optional salinity test assisting in the refinement of the Management Plan. The Kimmerikong harvest area is unique in the Hawkesbury River, using a dual management plan. Working under a dual management plan means the area can be approved, restricted or closed to direct harvest, based on acceptance of environmental parameters results. When a dual managed harvest area is restricted due to excessive rainfall and reduced salinity, depuration of all oysters is required prior to human consumption (section 2.6.2).

Mullet Creek is currently operating on a preliminary management plan, and is in the process of being classified for approved operations with NSW Food Authority.

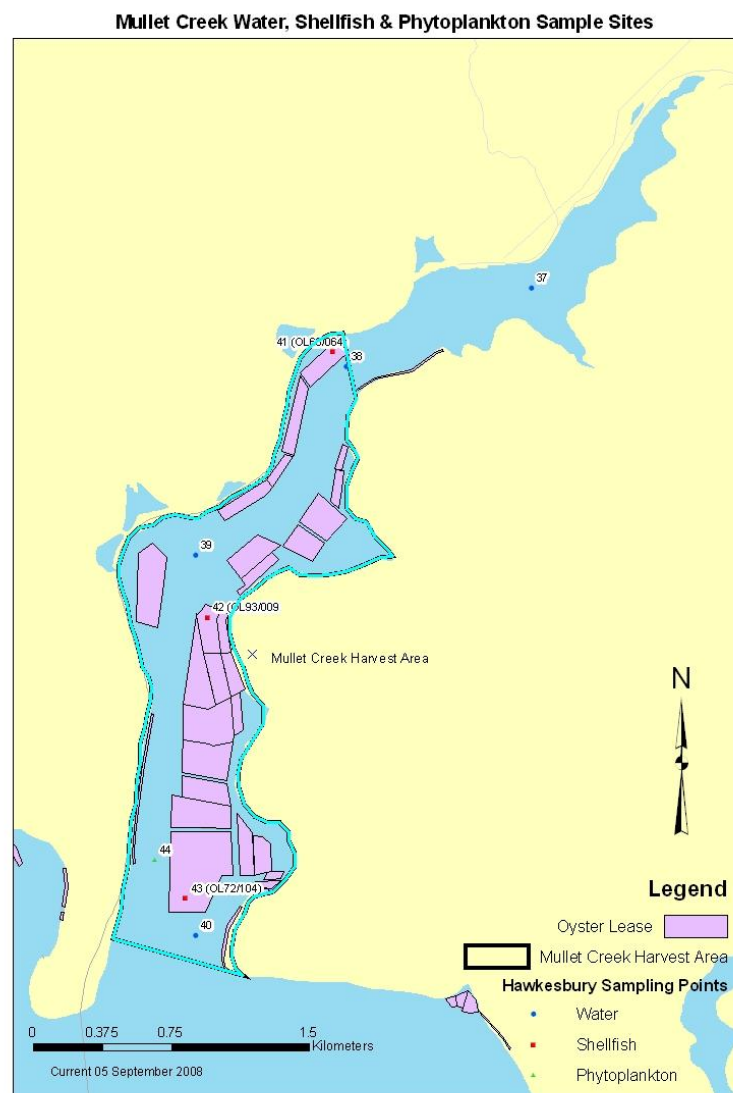


Figure 13. Mullet Creek shellfish and phytoplankton sample sites.

2.6.0 Quality assurance (water and oyster monitoring) program

2.6.1 Conditionally approved (direct harvest)

Under certain environmental conditions e.g. acceptable salinity and rainfall parameters; oysters can be sold direct to the public from the harvest area. However, if rainfall or salinity

parameters exceed acceptable levels as determined by NSW Food Authority, harvest areas are closed to direct harvest. In order for the direct harvest area to be re-opened, water and oyster (flesh) samples must be tested and deemed acceptable (i.e. faecal coliform concentrations must be below acceptable levels), in addition to acceptable salinity concentrations.



Figure 14. BBO grower collecting water quality samples.

2.6.2 Conditionally restricted (dual management)

In the Hawkesbury, the only dual managed area is the Kimmerikong harvest area. The area may be deemed conditionally restricted once rainfall or salinity levels exceed recommended levels. When the conditions are acceptable to food safety requirements, the dual managed area is classed as conditionally approved. Oysters harvested from the dual management area are treated the same as those harvested from conditionally approved harvest areas. However, where direct harvest is restricted due to non-acceptable environmental conditions but where harvesting is not closed, oysters are taken back to the depot and processed prior to human consumption. This is an additional food safety assurance- termed depuration. This process is carried out under controlled environmental conditions at the Mooney Mooney land facilities, utilising up to 4 operational 11 000L tanks (similar in appearance to a small swimming pool). Water is extracted at Mooney Mooney (water quality at Mooney Mooney is also monitored to meet environmental parameters to remain open for depuration) and pumped directly into depuration tanks or into holding tanks. Oysters are cleaned and graded, placed into trays and stacked into the depuration tanks. Water is pumped into the tanks until the oysters are covered. Here any potential contaminants are removed via purging. This process involves water being exposed to a high intensity ultra-violet light filter for a period totalling 36 hours. This reduces the potential viral and bacterial agents to food safe required levels. The depuration tanks have the capacity to handle between 5 and 27 bags of oysters during the treatment period. Oysters are rinsed with fresh water and packed into Hessian bags prior to sale.

3.0 LAND BASED ACTIVITIES

BBO have 12 operational land based facilities situated at Mooney Mooney and culture oysters in the majestic Hawkesbury River system (Figure 3) (see section 2.5 Harvest areas). The onshore depot serves multiple functions. The site is used to maintain and store farming equipment including: trays and baskets etc, loading equipment, hydraulic and reticulating cranes, forklifts, road vehicles, engines, and bulk fuel storage containers. Oysters are graded during various stages of their life history and are processed, stored and packaged for sale on site.

The Mooney Mooney land depot consists of: 4 offices; 12 grading sheds, construction and maintenance workshops and storage sheds. There are 7 depuration tanks (4 currently operational), 10 hydraulic and reticulating cranes (carrying capacities up to 12 tonnes) and one Gantry crane. Fuel is stored in 12 petrol and diesel tanks with up to 3000 litres capacity. There are 4 mooring jetties with approximately 30 – 40 aluminium punts, moored adjacent to the land bases. Sub-sections 3.10-3.15 describe the various activities that occur frequently on land.

3.1.0 Cleaning

3.1.1 Minimising runoff and sediment input

Rainfall and roof catch is currently directed back to the river either through surface flow or through stormwater pipes. BBO recognise the potential usage of collected rainfall in replacement of mains water supplies for wash down, e.g. cleaning baskets and trays. This has been included in the risk assessment table (Section 8) and subsequently created a milestone in their activities table. Mains water and power are used to operate a high pressure water hose to clean the workshop/grading shed floors. This usually comprises small fragments of oyster shell, sediment and other organic materials, which previously were returned back to the river by surface flow or pipes.

Through the risk assessment process, BBO recognised the need to implement siltation traps to control excessive runoff and sediment input, resulting in the capture and appropriate disposal of organic materials from oyster cleaning operations. This has been attempted with great success recently at three of the active land based sites at Mooney Mooney (Figure 15, Appendix 3).



Figure 15. Inspecting the sediment control drains implemented at the land based facilities.

3.1.2 Cleaning oyster baskets

A 240 volt or 3 phase power unit and mains water is used to operate a high pressure water hose to remove organic waste from plastic baskets and trays. Baskets and trays are then stacked away for drying and storage. The use of environmentally friendly plastic (or plastic coated) trays and baskets is now common practice with BBO members, replacing the out-dated practice of tarring timber products for preservation. BBO operators are interested in sourcing appropriate disposal techniques, e.g. waste materials utilised by landscape suppliers etc.

3.1.3 Cleaning oyster punts

Punts are removed from the river at Mooney Mooney, using reticulating cranes and placed onto 2.1m steel stands. Mains water and power are used to operate a high pressure water hose to blast fouling (weed, soft coral, barnacles and oyster spat) from the hull. Barnacles and algae are washed into a holding drain, lined with heavy duty hessian bag to allow removal of shell particles, weed etc left over following cleaning of punts. No anti –fouling materials are used. Punts that are yet to be injected with close cell foam (see section 3.2.0) require bungs to be removed allowing the punts hollow cell planks (walls and floors) to drain. Bungs are then re-inserted and the punt lifted by crane back into the river. The removal of punts from the water allows the removal of fouling organisms whilst utilising existing sediment drains. BBO recognise this area can be improved.

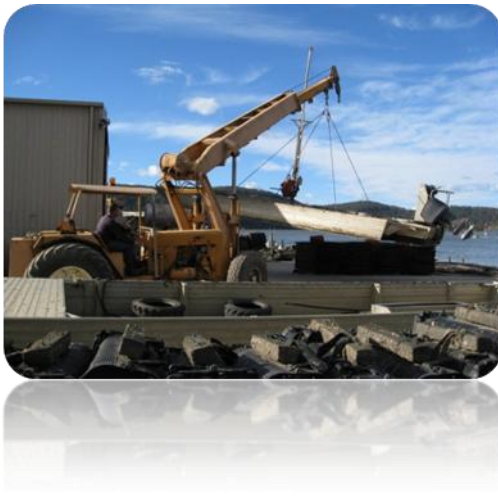


Figure 16 and 17. Removing an oyster punt from the river to service the hull.

3.2.0 Fuel efficiency schemes

A recent innovation introduced into the industry which is common practice in fishing style boat hulls, is the injection of foam into the punts hull and side panel cells, to prevent water logging in cavities. The elimination of unnecessary weight in the punt hull and improved buoyancy consequently increases fuel efficiency, punt performance, structural strength and reduces the wake (wave) height created by the vessel whilst moving. This is important in minimising disturbance and erosion to the shoreline. Most BBO members have additionally replaced older 2 stroke engines with new 4 strokes, further enhancing fuel efficiency whilst minimising emissions to the environment.

3.2.1 Fuel storage

Fuel is bulk stored on land (unleaded) in 200L and diesel (5000L) containers. Bulk fuel containers are refilled on demand using a fuel tanker delivery service. Most fuel areas are bunded with a rendered block wall, which aims to prevent leakage in the event of fuel spillage.

The remainder of BBO operators will construct bunding walls in accordance with the recently established 25 year lease agreement with Lands Department. This risk is also addressed in the risk assessment process and resolving actions are being implemented.

3.2.2 Fuel preparation for punts

Fuelling of vessels done using two methods, 1) portable tanks are filled on land (either at the BBO depot in Mooney Mooney utilising bulk fuel containers or at the nearby Mooney Mooney Marina) and placed back into the punts or 2) a long hose is used to fill the punts with larger fuel tanks utilising bulk fuel stored at the depot.

3.3.0 Servicing engines

Site cranes are used to lift punts and engines from the river and transfer to the workshop for maintenance. A communal (BBO member) waste oil drum is used for storage of used oil. A waste removal company is employed to remove the waste drum from site when full. BBO land based facilities use numerous engines which comprise of: 2 stroke outboards, 4 stroke outboards, 4 stroke motors operating hydraulic cranes, 4 stroke motors operating high volume portable pumps, diesel and petrol motors in forklifts and diesel cranes. All of the engines described require individual oil changes and fuelling. Oil changes for all motors are generally done on land, but not necessarily in designated areas.

3.4.0 Grading juvenile oysters

There are a number of machines that are used in grading juvenile oysters at the land based facilities. These consist of rotating cylindrical drums, manual hand sieves, and water grading machines. The rotating cylindrical drum is an oyster grading machine powered by 240V volt main sorting spat into various size classes. Once graded into sizes, oyster are placed back into baskets using scoops and returned back to the lease site for re-attachment to long-lines. Manual hand sieves are used to grade oysters into two specific size classes. The larger oysters are removed and placed into the larger mesh size, e.g. from 3 to 6mm. Water grading involves placing oysters onto stainless steel sieves, which move back and forth in the water, grading as the oysters move along the sieves.

3.4.1 Grading oysters for sale

Oysters are washed down with saltwater prior to removal from the lease and then transported back to the Mooney Mooney land based facilities. Trays/baskets are unloaded from punts using a site crane and forklift and stacked. Oysters are removed from the pallet and hand or machine graded into 5 different size classes, according to the Tasea oyster grading standards. Oysters are hand graded or graded using SED grading machines into appropriate size classes. Oysters are subsequently 'counted out' into their respective size classes and placed into Hessian bags. The SED oyster grading machines count, grade and bag oysters in one operation, resulting in reduced labour and handling.

Bags are placed on pallets ready to be picked up by processors or transport companies, for delivery to various locations as suits individual farmers. Pallets are stacked onto processor trucks using a fork lift. Oysters that are held for longer than 24 hours are place in a cool room which operates at less than 10°C. There are 5 cool rooms operational on the Mooney Mooney land base.

3.4.2 Packing oysters ready for collection or storage

Oysters are graded into size classes: Grande, Jumbo, Large, Standard, Buffet and Bistro. Sizes and condition are defined in the Tasea pacific oyster grading standard and followed by all BBO

growers. The numbers per bag vary with the size of the grade. Generally 20 dozen standard oysters will be placed into a hessian bag, 25 dozen buffet, but only 15 to 17 dozen large. Oysters are then counted and bagged and either loaded onto couriers truck with a forklift or manually carried to the cool room for storage.

3.5.0 Land facility sewage connection

The land facilities at Mooney Mooney are now connected to the Gosford sewerage system. Sewerage includes sink wastes and sewerage from each site shed.

4.0 BROKEN BAY OYSTER FARMERS ENVIRONMENTAL MANAGEMENT SYSTEM

4.1 Aims of the EMS

This Environmental Management System (EMS) aims to:

- Document how BBO farmers currently operate in a responsible and sustainable manner,
- Provide information regarding BBO operations and methodologies which aims to improve communication with natural resource managers and the community regarding the environmental management of oyster cultivation within the Hawkesbury River and its catchment,
- Be a 'living' document that can be reviewed and updated to adapt and manage new risks and opportunities, and
- Manage the identification and adoption of new methods and technologies to continually improve operations.

4.2 EMS development

The eight easy to follow steps that were derived from intensive consultation with the representatives of the seafood industry who have experience developing EMSs (Seafood Services Australia, 2005) has been used to guide the development of the BBO EMS.

4.3 EMS scope

The BBO EMS is currently in its fourth draft, including risk assessment and action plans on internal and external environmental risks.

The scope of this EMS is limited to:

- The environmental (internal and external) risks associated with the operations of BBO,
- The ways in which BBO may work with other stakeholders on improving the environmental quality of the Hawkesbury River and associated waters.

4.4 EMS and its connection with existing regulations, strategies

This EMS is designed to complement the existing policies and laws that govern oyster farming and natural resource management in NSW. They are

- *The Fisheries Management Act 1994,*
- *The Fisheries Management (General) Regulation 2002,*
- *The Environmental Protection and Biodiversity Conservation Act 1999,*
- *The Environmental Protection and Biodiversity Conservation Regulations 2000,*
- *The Hawkesbury Nepean Catchment Action Plan, and*
- *The NSW Oyster Industry Sustainable Aquaculture Strategy 2006.*
- *NSW Shellfish Program Operation Manual 2001.*
- *Food Production (Seafood Safety Scheme) Regulation 2001*

- *NSW Shellfish Program Coordinator's Workbook 2009.*
- *Code of Practice for Depuration of NSW Oysters 2005.*

The BBO EMS aims to compliment the NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS) through commitment to environmentally sustainable practices, communicating with the public and complying with regulated standards. BBO members working under this EMS also recognise the importance of operating under the OISAS best practice standards. Members within BBO aim to implement voluntary provisions as described in Chapter 7 of OISAS (NSW OISAS, 2006), which is incorporated in BBO tenants (see section 5.0).

4.5 Estuary management plans

For further information regarding the requirements that relate to the management plans for shellfish harvested areas for human consumption, see – Safe Food NSW, 2001. *New South Wales Shellfish Program Operations Manual*.

4.6 EMS review and communication

This EMS documents an *ongoing* process of environmental management, and therefore requires a periodic review. This allows the policy objectives to be checked to determine whether they are still relevant, adequate; and that the actions being introduced, or maintained, are in line with relevant responsibilities, timeframes and targets. The review process is outlined in Section 6.0, Objective 4, Action 4.0).

An important aim of this EMS is to provide a document that natural resource managers and the community can access, allowing transfer of BBO's environmental management; and to increase BBO's knowledge and experience with these stakeholders on the development of environmental management initiatives. The community communication process and the associated actions are described in Section 6.0 (Objective 4, Action 4.2).

4.7 EMS emergency response

The risk assessment Section 8.0 did not identify the operations of BBO leading to potential environmental emergencies (i.e. significant environmental impacts occurring over a short period of time).

The Broken Bay Oyster Farmers are unlikely to contribute significantly to water pollution. BBO growers have identified through risk assessment and action plan, the importance of protecting and enhancing the habitat of the Hawkesbury River and its catchment. This includes, but is not limited to assisting the HNCMA in identifying priority areas requiring on-ground works, identifying potential solutions and funding opportunities to control land based erosion, minimising effects on seagrass and communities, assisting in the identification of potential solutions to control sedimentation. Risks have been assessed and actions applied to minimise noise, and a continued role of maintaining an extensive water quality monitoring program.

4.8 EMS contravention

The BBO EMS is a voluntary commitment by the Broken Bay Oyster Farmers to document and maintain environmental best practice.

Incidents where the BBO farmers fail to reasonably comply with this EMS will be recorded and investigated by the BBO EMS representative. Failures may be:

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

Responses might include: a review of the EMS, training for the BBO farmers, or no action. Any EMS contravention will be noted in the following EMS report.

BBO cannot be responsible for the actions of oyster growers in other estuaries but will encourage all oyster growers operating within the catchment area to work with the same duty of care as outlined in this EMS.

5.0 ENVIRONMENTAL POLICY

The key objectives of the BBO association are to unite oyster farmers and producers in the Hawkesbury River and Broken Bay environs, to pursue goals and outcomes of common interest and benefit to their members, businesses and the environment. These objectives have been considered when compiling this EMS.

Broken Bay oyster farmers environmental policy.

Broken Bay Oyster Farmers Environmental Policy

Our vision:

To continue to cultivate oysters for the benefit of seafood consumers in a manner that is environmentally sustainable, commercially viable and universally respected.

The Broken Bay Oyster Farmers recognise that the Hawkesbury River and its catchment is a shared resource.

The Broken Bay Oyster Farmers will continually monitor for improvements in environmental best practice relevant to their operations and work to adopt them.

In addition to complying with all relevant regulations and management mechanisms the Broken Bay Oyster Farmers will strive to meet the following objectives.

1. Protect and enhance the habitat of the Hawkesbury River and its catchment.
2. Cultivate oysters in a sustainable manner - minimising resource consumption, waste production and pollution.
3. Recognise and protect the cultural and aesthetic values of the Hawkesbury River and its catchment.
4. Conduct environmental management in a transparent and cooperative manner.
5. Contribute to scientific research and management innovation relevant to oyster cultivation and estuarine environments.

*These objectives form the basis of our EMS action plan (section 4).

Other objectives of Broken Bay Oysters are:

- (a) To apply for and manage appropriate grants and assistances deemed appropriate by membership relating to oyster farming production and marketing.
- (b) To encourage and promote the development of the oyster farming industry and all matters relating to oyster farming production.

(c) To make representations to or arrangements with any Government or authority, supreme, municipal, local or otherwise, that may seem conducive to the Association's objectives, or any of them.

(d) To provide a forum for discussion and development of technical issues (production, management, etc) and to inform, counsel and advise members of the public and members of the Association in all matters relating to oyster farming production.

(e) To provide a forum for discussion and development of business issues (financing, debts, etc) and to inform, counsel and advise members of the public and members of the Association in all matters relating to oyster farming production.

(f) To provide a forum for discussion and development of marketing issues (QA, sales, packaging supply, etc) and to inform, counsel and advise members of the public and members of the Association in all matters relating to oyster farming production.

In addition, key to membership of Broken Bay Oysters is agreement with and adherence to in principal and practice, the following tenets.

1. Quality product

Broken Bay Oysters agree to sell quality premium product that meet defined standards and exceed all industry, food health, quality and marketing standards. These standards are to be defined and are subject to updates and change as agreed by the members.

2. Fair stocking density management practices

Broken Bay Oysters recognise the importance of appropriate oyster stocking levels in Patonga Creek and Hawkesbury River and their various bays and tributaries for the long term sustainability and viability of member businesses and the rivers. Broken Bay Oysters have an agreed oyster stocking plan. The plan is subject to updates and change as agreed by the members.

3. Over catch management

Broken Bay Oysters recognise the importance of management of feral or wild oysters and poorly maintained infrastructure as issues affecting the potential for over catch. Broken Bay Oysters will develop an agreed over catch management strategy. The strategy is to be defined and is subject to updates and change as agreed by the members.

4. Sustainable management practices

I&I NSW have produced the NSW Oyster Industry Sustainable Aquaculture Strategy currently for public comment. The strategy outlines the principals of good river citizenship, oyster growing strategies, practice sustainability and environmental awareness and compliance actions which constitute an overall best practice base for oyster farming in NSW. Broken Bay Oysters members agree with such best practice principals and undertake to have their businesses comply over time. The NSW Oyster Industry Sustainable Aquaculture Strategy is currently a draft and final acceptance will be subject to agreement by members.

6.0 ACTION PLAN

Objective 1: Protect and enhance the habitat of the Hawkesbury River and its catchment.

Catchment Action / on-ground works

Action 1.0 Assist the Hawkesbury Nepean Catchment Management Authority and OceanWatch Australia in identifying priority areas requiring on-ground works.

Responsibility	Performance indicator	Target	Timeframe
HNCMA	Work with the Broken Bay Oyster Farmers to identify high priority works	Yes	Current and ongoing
Broken Bay Oyster Farmers	Number of projects assisted	Yes	Current and ongoing

Background

BBO oyster growers have successfully engaged in partnerships with the HNCMA and OceanWatch Australia, resulting in extensive on ground works to remove and dispose of derelict infrastructure, additionally achieving construction of environmentally friendly toilet facilities at Twin Beaches.

OceanWatch Australia's *Tide to Table* program has been building over the past 5 years, initially working within the Sydney, Hawkesbury and Hunter regions of NSW, but now employs officers in the Bundaberg and Townsville regions of Queensland. The program is a model which allows facilitation and coordination between government agencies and community groups for the benefit of commercial fishers and oyster growers. The program draws the connection between activities that occur in the catchment to the delectable seafood on our dinner plates. This is achieved through successful applications for funding, in efforts to support actions on ground. These concentrate on restoring fish habitat and improving water quality. Industry, both water and land based, are approached to gather civic knowledge (unwritten information from people out in the environment all the time), which together with scientific data paints a picture allowing allocation of funds towards projects most relevant to the seafood industry. The Tide to Table program provides essential community engagement and awareness raising events leading to change in behaviour and practice. This highlights the importance of 'What is done on land having a flow on effect to estuarine wetlands and water quality, and thus the local productivity of the seafood industry'.

The classification of estuaries for oyster harvesting, as part of the Shellfish Harvest Area Classification (HAC) scheme compiled by the NSW Food Authority required comprehensive studies of each estuary to assess influences and risks regarding water quality. BBO see the potential in using this information as a benchmark of river status, to which a database of water quality (collected and maintained by the oyster growers, described in action 1.5) could be compared to over the long-term, to observe the benefits of completed on-ground works on water quality.

Broken Bay Oysters Road

Action 1.1 Work with the HNCMA to identify potential solutions and possible funding sources to control land based erosion problems at BBO facilities.

Responsibility	Performance indicator	Target	Timeframe
BBO	Practical and economically viable solution found to control erosion	Yes	12 months
BBO / HNCMA	Funding source found and application submitted	Yes	On completion of above task
BBO	Remediation work commenced on BBO Road	Yes	24 months

Background

The Hawkesbury Rivers water quality can be affected by sediment runoff and/or bank erosion, impacting on water clarity and consequently, light penetration through the water column; an essential requirement for phytoplankton and seagrass growth.

Sediment associated with runoff generated from the land based facilities access road was an issue regarded with high priority by BBO members. Recently, this road has been re-graded and resurfaced to minimise dust and sediment input. Sediment input through land based activities, e.g. cleaning oysters, baskets and trays, was additionally noted with concern.

Several remediation measures have been examined and adopted to reduce the likelihood of these issues impacting on BBO operations. BBO have assessed the Broken Bay land facilities and access road and developed plans to manage runoff and sedimentation. BBO growers have pro-actively established a sediment erosion plan, in which sediment catching drains have been installed in front of land based work sheds to mitigate sedimentation and runoff input into the catchment.

BBO are working closely with the Hornsby Council to remove noxious weeds and establish native flora as a buffer zone between Mooney Mooney Workers Club and the land based facilities.

Seagrasses and benthic communities

Action 1.2 Minimise effects on seagrasses and benthic communities. Report significant changes in seagrass to I&I NSW.

Responsibility	Performance indicator	Target	Timeframe
BBO	Reports of changes in seagrass beds	n/a	Current and ongoing
BBO	Removal and disposal of derelict infrastructure	Yes	Current and ongoing

Background

Oyster farming methods of the past, have been known to affect seagrasses and benthic communities (i.e. groups of plants and animals living on the floor of a water body) via the placement of infrastructure, the shade that infrastructure casts on the floor of the water body, and the waste products produced by the oysters. In present times, this concern now focuses on derelict and unused infrastructure. Some of these areas are already removed and disposed of appropriately during the consolidation of lease areas following the QX outbreak in 2004.

Stick and tray farming methods have been used on the Hawkesbury River for many years. Studies completed in other estuaries, for e.g. Crawford, 2003; Lasiak and Underwood, 2002; Porat, 2001, indicate oyster growing activities do not have any widespread impacts on seagrass or benthic communities, with any dieback or community change strictly localised to the immediate vicinity of the oyster leases.

It should be noted that while seagrass dieback is of major concern in NSW, oyster farming is very rarely identified as one of the causes. The National Oceans Office, 1997 states 'Increased sedimentation and nutrients from catchments have been linked with massive die-back of seagrasses in many areas.' Oyster farming is a critical component in removing excessive nutrient loads and additionally the larger particles suspended in the water column, hence improving conditions for sustainable seagrass communities.

The extensive removal of large volumes of derelict infrastructure throughout the Hawkesbury catchment has reduced shading and allowed regrowth of seagrass, however more work needs to be achieved in this area.

PO have differing requirements throughout various life stages to maximise productivity. This means that trays are rotated between areas, additionally rotation of oysters occurs during times of fluctuating salinity. As a direct result, this process rests certain areas, which allows seagrass areas shaded by trays or sticks to grow or re-establish.

Sedimentation

Action 1.3 Minimise effects on natural sedimentation. Report significant changes in sedimentation to I&I NSW.

<i>Responsibility</i>	<i>Performance indicator</i>	<i>Target</i>	<i>Timeframe</i>
BBO	Reports of changes in sedimentation	n/a	Current and ongoing

Background

The oyster farming industry of the Hawkesbury River has not lead to any apparent changes in the local sedimentation regime. More widely, sedimentation is rarely considered as a significant environmental effect associated with the types of oyster farming generally employed in Australia (Crawford, 2001; NOO, no date). Derelict infrastructure contributes to siltation of lease areas if left. As mentioned in action 1.2, new methods being employed by a number of BBO members have reduced seafloor-based infrastructure, further reducing the potential of oyster cultivation to affect natural sedimentation processes.

Noise pollution

Action 1.4 Minimise noise associated with operations, especially between the hours of 6pm and 7am.

Responsibility	Performance indicator	Target	Timeframe
BBO	Number of reasonable noise complaints	0	Immediate and ongoing

Background

The hours on which leases can be worked are restricted by tide and weather conditions. However, within 200m of private residences, programmed lease construction and unduly noisy operations should only be conducted during the period 7:00am to 6:00pm Monday to Friday (I&I NSW, 2005). Emergency repairs and emergency stock management operations are exempt from this restriction (I&I NSW, 2005).

Operations of the BBO rarely take place between the hours of 6:00pm and 7:00am and due to the isolated harvested areas and location of land facilities. Therefore, noise pollution is unlikely to affect catchment residents.

Water quality monitoring

Action 1.5 Maintain existing water quality monitoring program. Report detected or suspected pollution incidents immediately to the NSW Food Authority.

Responsibility	Performance indicator	Target	Timeframe
Hawkesbury River and Patonga SQAP (Shellfish Quality Assurance Program)	Water quality monitoring program maintained	Yes	Current and ongoing
BBO	Number of pollution incidents reported	n/a	Current and ongoing
BBO	Investigate potential to lessen expense of WQ monitoring	Yes	Current and ongoing

Background

The BBO maintain a regular water and meat quality monitoring regime to ensure that immediate action can be taken should pollution levels threaten the health of the Hawkesbury River and oyster stocks. Currently the monitoring program consists of 22 water testing sites, 10 meat testing sites which is inclusive of 4 composite bio-toxin sites and 4 algal sampling sites; in accordance with the Food Authority regulations. Anecdotal evidence suggests that NSW oyster growers are often the first group to detect local pollution events, i.e. sewage spills, algal blooms and chemical and fuel spills. Such pollution events not only threaten the local oyster industry, but also have severe implications for public and ecological health within the catchment. Additionally, the SQAP uses set parameters, which are standardised and comparable among all NSW estuaries. This is not the case with other water quality monitoring programs, such as those conducted by local governments which vary considerably in terms of

the parameters measured and the frequency of sampling. The intensive testing that is required comes at a considerable cost to each individual grower.

BBO will investigate the possibility of being compensated to broaden their water quality monitoring regime to cover other agency standards (councils, CMA's etc) in an attempt to offset expenses incurred by each grower.

Water pollution incidents

Action 1.6 Report all suspected pollution incidents to I&I NSW, and Department of Environment and Conservation (DEC).

Responsibility	Performance indicator	Target	Timeframe
BBO	Number of incidents reported	n/a	Immediate and ongoing
BBO	Investigate cost of purchasing a fuel containment kit	Yes	12 months

Background

Agricultural and urban runoff, acid sulphate soils, fuel and chemical spills may lead to water pollution incidents. Oyster farmers have a unique understanding of the estuary in which they work, with an ability to identify point sources of pollution through their rigorous water quality regime.

The local council and NSW Maritime are responsible for dealing with events which involve oil and/or fuel spillages. It may be beneficial for such agencies to equip BBO representatives with spill containment kits, to enable and inhibit the spread of pollutants. This may be through provision of absorbent barriers to apply to affected areas etc.

Fuel storage area

Action 1.7 Construct 'bunded' walls to surround fuel storage facilities.

Responsibility	Performance indicator	Target	Timeframe
BBO	Fuel storage facilities modified to prevent fuel spillages	Yes	12 months

Background

Fuel is stored at most land-based facilities. BBO, in accordance with the land tenure agreement with the Lands Department, encourages all operators to construct efficient fuel containment 'bunded' walls around fuel storage facilities. This will prevent any potential fuel spillages reaching the catchment, affecting water quality and posing a threat to marine life.

Fire policy

Action 1.8 Ensure that the best possible fire policy is implemented around the shed area.

Responsibility	Performance indicator	Target	Timeframe
BBO	Development of a fire policy for shed area.	Yes	12 months

Background

The native vegetation surrounding the land-based facilities at Broken Bay, including the volume of gear stored on-site, pose a significant risk in the event of a fire. BBO is working towards development of a fire policy to minimise these risks. The creation of buffer zones, e.g. extensive removal and correct disposal of waste and disused infrastructure in and around the Broken Bay land facilities, will help prevent any fire spreading to native bushland.

Marine Pests

Action 1.9 Ensure all BBO members have a copy of marine pest identification cards being developed by the National Introduced Marine Pest Coordination Group (NIMPCG). Report any detection of an unusual plant or animal (collect sample if possible). Follow requirements of government agencies in combating marine pests.

Responsibility	Performance indicator	Target	Timeframe
SeaNet NSW	Marine identification material distributed	Yes	Upon completion
BBO	Number of marine pest incursions reported	n/a	Current and ongoing

Background

Translocation of marine pests and subsequent settlement is an increasing risk in Australian waters as populations become more mobile and exposure to potential sources increase (e.g. contaminated bilge water from merchant vessels, translocation of species from other regions by travelling vessels). Introduction of such species can have severe impacts on native species and lead to deterioration of natural ecological processes.

Education in the identification of pest species and correct reporting mechanisms of those with a unique understanding of the estuarine environment, such as commercial fishers and oyster farmers, will greatly assist in early identification of such species. This has been identified as a key process in preventing the spread of marine pests. A National System for the Prevention and Management of Marine Pest Incursions has been developed by the National Introduced Marine Pest Coordination Group (NIMPCG), which includes members from Commonwealth and State agencies, scientific organisations, and industry representatives.

Minimise harm to protected or threatened species, whales, dolphins or turtles

Action 1.10 Suspend operations immediately in the event of an interaction with a protected or threatened species, whale, dolphin or turtle. Allow the animal to escape without harm.

Responsibility	Performance indicator	Target	Timeframe
BBO	Number of interactions with protected or threatened species, whales, dolphins or turtles.	0	Immediate and ongoing

It is highly unlikely that any commercial oyster farming activity will interact or harm a protected or threatened species, but has been included to list the actions that would be taken by the BBO in the rare event of this happening.

Note: Protected and threatened species include those listed, at a state level, under Part 2 Div 1 of the *Fisheries Management (General) Regulation 2002*, and Schedules 1 and 2 of the *Threaten Species Conservation Act 1995*. At a Commonwealth level, approximately 2000 species are listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

Protected species education

Action 1.11 Ensure that BBO members have copies of The Protected Species Handling Manual and The Protected Marine Species Identification Guide.

Responsibility	Performance indicator	Target	Timeframe
SeaNet NSW	BBO have copy of both publications	Yes	1 month

Background

Both publications are available from OceanWatch Australia and will be distributed by SeaNet NSW.

Interaction reporting

Action 1.12 Report any interactions to I&I NSW.

Responsibility	Performance indicator	Target	Timeframe
BBO	Interactions reported	0	Current and ongoing

Background

Any interaction with protected or threatened species must be reported to I&I NSW.

Bird habitat

Action 1.13 Provide information to conservation and management organisations regarding important bird habitats.

Responsibility	Performance indicator	Target	Timeframe
BBO	Intellectual knowledge provided to relevant organisations to identify key habitat areas	Yes	Current and ongoing

Background

Estuaries provide important habitat for nesting and breeding birds, including local and migratory species. Broken Bay oyster farmers have a unique understanding of the Hawkesbury River catchment and will assist organisations such as WWF's Shorebirds Association and National Parks and Wildlife Service, if required, in the identification of areas that provide important bird habitat.

Bird entanglements

Action 1.14 Report incidents of bird entanglements to W.I.R.E.S. and I&I NSW.

Responsibility	Performance indicator	Target	Timeframe
BBO	Number of incidents reported	n/a	Immediate and ongoing

Background

Birds can become entangled in litter and lost fishing line. Oyster farmers spend extended periods of time on the water, and are in an ideal position to report bird entanglements. BBO will assist in seabird rehabilitation and release where able and report sightings of entangled or injured birds to W.I.R.E.S (Wildlife Information and Rescue Service). Some operators are equipped with identification guides to improve this process.

Objective 2: Cultivate oysters in a sustainable manner - minimising resource consumption, waste production and pollution.

Emissions - outboard motors

Action 2.0 Upgrade outboard motors to meet the current USEPA fuel efficiency and emissions standards.

Responsibility	Performance indicator	Target	Timeframe
BBO	Proportion of outboard motors in use that meet USEPA emissions standards.	100%	48 months

Background

The Department of Environment and Conservation (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 level set in other countries are quite high, and the OEDA (Outboard Engine Distribution Association) in Australia through discussions with the Department of Environment and Heritage (DEH) has formed a rating benchmark, similar to energy ratings seen on electrical appliances. BBO members have upgraded from older style 2-stroke engines, to those with a superior emission standard which reduces the use of fossil fuels and eliminates contaminants entering the waterways.

Emissions – reduce fuel consumption

Action 2.1 Minimise fuel consumption, and improve vessel stability and longevity.

Responsibility	Performance indicator	Target	Timeframe
BBO	Proportion of BBO vessels that have been injected with foam	100%	48 months

Background

Traditionally, timber punts were used in the oyster industry. However, the use of aluminium style punts is now considered the norm. Aluminium punts are constructed generally from hollow cell aluminium planks welded together. In the past 2 years, improvements in marine foam applications has resulted in the direct injection of older/ wearing punts with marine foam. These changes mitigate water absorption into the aluminium cells, reducing the weight of the punt and reducing fuel consumption. This proved to be very effective, and consequently improved floatation, stability and visually reduced the wake/wash, helping to control river bank erosion.

Nature of water-based infrastructure

Action 2.2 Work toward eliminating the use of tarred timber and treated timber.

Responsibility	Performance indicator	Target	Timeframe
BBO	Percentage of trays converted from treated timber to polyurethane	100%	60 months and ongoing
BBO	Percentage of lease area using tarred/treated timber rails	0	48 months
BBO / SeaNet	Investigate potential funding sources to provide assistance in disposal of tar based infrastructure.	100%	48 months
BBO	All tarred/treated timber disposed of correctly	Yes	48 months

Background

For many years, tarred or treated timber has been used for the sticks and trays on which oyster larvae are caught and grown into oysters. This increases the durability of the timber and protects it from marine borers and pests. There is no evidence indicating that this contaminates the oysters or neighbouring species (White, 2001), however, there is potential for chemicals to leach into the surrounding waters.

Oyster farmers throughout NSW are now phasing out the use of tarred and treated timber by using specially produced polyurethane trays, plastic sleeves around timber posts and sticks, or adopting alternative farming methods.

Collectively, BBO have phased out the use of chemically treated (tarred timber) through the utilisation of new technologies. All BBO operators now utilise extruded plastic products (built from recycled materials) for use in oyster cultivation infrastructure, including extruded plastic

rails, plastic sleeves, posts and trays. The price/metre is cheaper than using timber products. The use of these recycled materials will eliminate ongoing maintenance and potential contaminants entering the river. This was achieved through an ongoing infrastructure maintenance program ensuring active replacement at opportune stages of production. The process of changing over technologies was costly, time consuming and a labour intensive task. However, conversion to non-degradable products will ultimately save time and money in the longer term.

Clean up / waste management

Action 2.3. Recycle or reuse incoming and generated waste

Responsibility	Performance indicator	Target	Timeframe
BBO	Percentage of recyclable product disposed of responsibly	100%	Ongoing
BBO	Percentage of waste oyster shells reused	100%	Ongoing

Background

As a result of various influences including the Qx outbreak in the Hawkesbury catchment, there was an accumulation of derelict infrastructure, including old trays, sticks, posts and various pieces of equipment. BBO members have been involved in large clean-up activities, in partnership with HNCMA, I&I NSW and OWA's Tide to Table program. This has resulted in the removal over 8000 tonnes of redundant oyster related infrastructure from the river since 2006; including removal of some contaminated materials. 80 tonnes of materials were removed from the Marramarra harvest area and transported back to the land base. These materials were then loaded onto a truck and removed from site, with non-contaminated materials used as landfill. BBO members have also been involved with on-ground works at Milson's passage, clean-up of a derelict house site including asbestos materials, general rubbish and 20 tonnes of exotic and introduced plant species.

During the clean-up activities, BBO members utilised crushed waste shell as a road-base around land-based activities to improve erosion control.

Today, BBO no longer has significant quantities of waste oyster shell, as oysters are sold whole including the shell.

Toilets

Action 2.4 Work in partnership with the NPWS, HNCMA, Hornsby Council and OceanWatch Australia to research the installation and maintenance of composting toilets at the Fruit Orchard at Marra Marra Creek. Investigate potential funding sources to assist with the cost of achieving this action.

Responsibility	Performance indicator	Target	Timeframe
NPWS, HNCMA, Hornsby Council, OWA	Assist BBO to investigate potential funding sources	Yes	When required
NPWS, HNCMA, Hornsby Council	Most suitable type of toilets installed	Yes	3 months

Background

As well as spending considerable amount of time on the water tending their leases, the nature of commercial oyster cultivation also requires the growers to spend extended periods at their shore based facilities, whether it be culling, grading or maintaining equipment. To cater for

the groups sanitary requirements, BBO farmers were successful in establishing composting toilets at Twin Beaches, an area also frequented by families for picnics etc. During 2007, in partnership with HNCMA, NPWS, Hornsby Council and OceanWatch Australia; funding was sourced to build and maintain these composting toilet facilities.

BBO members are currently in negotiations with the above to install similar facilities at the orchard, near the Marra Marra Creek Harvest area.

Grey water facilities

Action 2.5 Research the cost to install and maintain grey water facilities at Broken Bay land based facilities. Investigate potential funding sources to assist with the cost of achieving this action.

Responsibility	Performance indicator	Target	Timeframe
BBO	Most suitable type of holding tanks found for the application and installed	0	Current and ongoing
SeaNet NSW	Assist BBO to investigate potential funding sources	Yes	When required

Objective 3: Recognise and protect the cultural and aesthetic values of the Hawkesbury River and its catchment.

Appearance of leases

Action 3.0 Keep all leases tidy and uniform.

Responsibility	Performance indicator	Target	Timeframe
BBO	Number of reasonable complaints regarding untidy or non-uniform leases	0	Current and ongoing

Background

The leases used by the Broken Bay oyster farmers are integral to the industry that has been part of the economy, appearance and culture of the Hawkesbury River for over 100 years.

The development of the NSW Oyster Industry - Sustainable Aquaculture Strategy, outlines criteria for an acceptable lease site e.g. materials, maintenance and visual amenity. BBO take great pride in the appearance of their leases. Extensive work has already been initiated on infrastructure improvements and derelict infrastructure removal; in adherence to this strategy. BBO recognise that more work needs to be done through-out the catchment to remove derelict infrastructure.

Navigation

Action 3.1 Maintain all navigation and marking requirements in line with NSW Maritime and NSW Department of Primary Industries requirements.

Responsibility	Performance indicator	Target	Timeframe
BBO	Infringements of navigation and marking regulations	0	Current and ongoing

Derelict infrastructure can become a navigational hazard. BBO members are pro-actively removing disused and derelict infrastructure from the catchment, left behind after previous oyster business owner's removal from the industry.

BBO recognise that current members play a key role in the removal of derelict infrastructure (disused racks, trays and posts etc). BBO have partnered with the state government in the extensive removal of derelict infrastructure in previous programs, further work is needed in this area.

BBO will communicate with local councils on this initiative, and approach with the intent of establishing a partnership which will allow the appropriate disposal of removed derelict infrastructure. Currently, it is not economically feasible to appropriately store or dispose of derelict infrastructure. To assist in reducing the economic burden to individual BBO members achieving environmental clean-up activities in the catchment, BBO will require the removal of disposal fees e.g. Council tipping fees removed for derelict infrastructure disposal. This proposal needs to be discussed with appropriate authorities.

The ongoing practice of adopting recycled plastic materials, e.g. replacing damaged infrastructure (previously tarred posts and racks) will eliminate any further introduction of these problems).

Theft

Action 3.2 Report occurrence of theft to police and I&I NSW.

Responsibility	Performance indicator	Target	Timeframe
BBO	Alert authorities of any theft or vandalism	0	Current and ongoing
Community	Alert BBO members and the NSW Food Authority to unregulated sale of oysters	n/a	Current and ongoing

Background

Unregulated sale of oysters can pose a serious health threat to unsuspecting consumers as they may have been stolen during times when it was unsafe to directly harvest from the leases. The NSW Police are currently implementing a state wide program to reduce oyster theft, titled 'Operation Trident'.

Indigenous culture

Action 3.3 Respect the indigenous culture of the Hawkesbury River catchment.

Responsibility	Performance indicator	Target	Timeframe
BBO members	Conduct operations with respect to the indigenous culture and heritage in the Hawkesbury River and catchment	Yes	Ongoing

Other users

Action 3.4 Respect other users of the Hawkesbury River system.

Responsibility	Performance indicator	Target	Timeframe
BBO members	Complaints made to the BBO members or Industry and Investment NSW	0	Current and

	regarding conduct of oyster farmers		ongoing
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Background

BBO members realise the importance of maintaining and promoting a harmonious relationship with other uses of the Hawkesbury River catchment, indigenous culture and history, commercial fishers, recreational anglers, locals and tourists.

BBO members are happy to educate the broader community and give a detailed explanation of their operations to interested people. BBO representatives have been involved in numerous field trips on the Hawkesbury River catchment. Examples include involvement on the 'Berowra field trip' organised by OceanWatch Australia, numerous field trips with the Coastal and Environment Centre of Narrabeen, and various events held in partnership with the HNCMA. Representatives have delivered informative presentations to groups of people of diverse backgrounds (up to 140 per event), that enjoy the Hawkesbury River and its catchment. Key issues discussed in these presentations are the connections between land and water based activities, importance of water quality, and improving awareness of the oyster industry and grow-out operations.

Objective 4. Conduct environmental management in a transparent and cooperative manner.

EMS report, stakeholder comment and review

Action 4.0 Report on progress of EMS annually. Allow stakeholders to comment on EMS report. Review EMS annually.

<i>Responsibility</i>	<i>Performance indicator</i>	<i>Target</i>	<i>Timeframe</i>
BBO	EMS report documented and circulated	Yes	12 months
BBO	EMS reviewed	Yes	12 months

Background

Continual improvement, fundamental to the success and implementation of EMS actions, requires regular reporting and review of the document by BBO business members. Each year, the BBO will report on the progress and maintenance of each action in relation to their responsibility, performance indicator(s), target(s) and timeframe(s).

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 BBO. Following documentation and circulation of the report, BBO will review the EMS considering:

- Stakeholder comments,
- An assessment of the adequacy and relevance of the environmental policy (see environmental policy, Section 5.0),
- Changes in oyster farming technology and management, and
- Emerging issues in the environmental management of the Hawkesbury River and its catchment.

One or more of these events may trigger a review outside of the annual review process. In response to a review, any part of the EMS may be changed and reports and past versions of the EMS will be kept as records.

Stakeholder comment

Action 4.1 Compile a record of stakeholders. Provide a process for all stakeholders to comment on the EMS generally and the annual EMS report.

Responsibility	Performance indicator	Target	Timeframe
BBO	Postal and e-mail addresses for stakeholder comments established	Yes	Upon completion
BBO	Comments received	n/a	Upon completion

Background

Stakeholders will include:

- Industry and Investment (formerly Department of Primary Industries, Fisheries),
- Relative departments involved in catchment and natural resource management
- Lower Hawkesbury Estuary Management Committee
- Community groups and community members

Community education

Action 4.2 Establish a process that provides the community information on the operation and environmental management of the Hawkesbury River oyster industry.

Responsibility	Performance indicator	Target	Timeframe
BBO	One or more of the following established: Communication with community via education events. EMS circulation.	Yes	Ongoing

Background

BBO will ensure that stakeholders are given the opportunity to comment on the environmental management of their operations in an informed manner.

Objective 5: Contribute to scientific research and management innovation relevant to oyster cultivation and estuarine environments.

Research

Action 5.0 Provide assistance, wherever possible, to government agencies and researchers investigating improved farming practices and environmental management.

Responsibility	Performance indicator	Target	Timeframe
BBO	Number of projects assisted	n/a	Immediate and ongoing

Background

BBO members have been of great assistance to research projects completed and ongoing within the Hawkesbury River, including issues that affect the entire catchment. BBO members currently practice an extensive water quality monitoring program, which could prove valuable for external agencies concerned with river health. These attributes place the members in a unique position to assist catchment managers and working groups in the assessment of issues and any proposed remedial work. This has included works in partnership with Industry and Investment NSW; e.g. Qx resistance trials on Sydney rock oysters and work establishing triploid culture of PO. Negotiations and sampling programs are now underway to examine the potential of opening a new harvest area in Mullet Creek.

7.0 ENVIRONMENTAL MANAGEMENT SYSTEM RISK MATRIX- BROKEN BAY OYSTERS

Risk is the chance of something happening that will have an impact on the oyster industry, the wider industry and/or the environment).

Risk Analysis involves consideration of (1) the sources of risk and (2) the consequences and likelihood that those consequences may occur.

A risk assessment can help to separate and highlight major unacceptable risks from minor acceptable risks.

Each specified risk has been ranked, based upon the table below, according to the consequence and likelihood of the risk.

Likelihood ranking

Likelihood	Score	Definition
Rare	Low (1)	May occur in exceptional circumstances (i.e. once every 10 years)
Possible	Moderate (2)	Uncommon some evidence to suggest this may occur (i.e. once in 1-3 years)
Likely	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
Moderate	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 (3)	3	6	9

Management Response

Risk Level	Description	Reporting	Likely Management
Low (1-2)	Acceptable - no specific control measures needed but recommended	Short justification required	None specific
Moderate (3-5)	Acceptable - with current risk control measures in place	Justification required	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

8.0 ENVIRONMENTAL MANAGEMENT SYSTEM RISK ASSESSMENT TABLE

	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	LIKELIHOOD	CONSEQUENCE	RISK LEVEL
INTERNAL									
LAND -BASED ACTIVITIES	Unsealed Broken Bay land facility access road	Vehicular access causing erosion and increased sedimentation during times of heavy rain. Increased dust and air pollution during dry and windy conditions.	Increased suspended sediment and turbidity leading to reduced light penetration resulting in the smothering of seagrass and phytoplankton.	Utilise road base acquired through Hornsby Council to improve sealing of the road surface. Application for funding successful to help establish and regenerate required areas with native plant species (Starting 5 th October, 2010).	Work with the HNCMA and engineers to develop a stormwater and sediment control management plan. Examine drainage areas to manage and control sediment input from runoff. Construction of sediment traps in required locations as determined through sediment plan.	Contact HNCMA and discuss possible funding options for a sediment and stormwater control management plan. Create swales to divert water into sediment traps. Use pine bark, chip and oyster shell to filter sediment from runoff.	3	2	6
	Unsealed Broken Bay land facility access road	Runoff	Erosion and increased sedimentation.	Minimal control measures. Contact Gosford Council to review the access road to rectify erosion and runoff.	Improve runoff management from access road.	Contact Hornsby Council to work together in implementing runoff management measures in wash bays and from access road.	2	2	4
	Site toilet facilities.	Inappropriate sewerage system.	Pollution in event of sewer spill.	Worked with Gosford City Council in the installation of the town sewer system, at BBO land facilities.	Continue current control measures.	Maintain effective communication with council representatives.	1	3	3

	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
	Oyster sheds and land based offices.	Land facility aesthetics, i.e. weathered and deteriorated shed appearance.	Visual aesthetics and public perception.	<p>Utilise weekly rubbish service provided by the council.</p> <p>Utilise local private contractor to remove materials from site.</p> <p>Maintain facilities, e.g. equipment and storage sheds.</p> <p>Care for the surrounding environment and keep neat and tidy.</p> <p>Utilise BBO operator owned tip trucks for combined rubbish removal.</p>	<p>Continue current control measures.</p> <p>All facilities must comply as per lease tenancy agreements.</p>	<p>All members to clean general waste around their facilities e.g., oyster sheds and office amenities and dispose of appropriately.</p> <p>Find an appropriate location for temporarily storing rubbish at each business owners' premises.</p>	2	1	2
	Waste oil removal.	Disorganised management and disposal of used oil drums and containers.	Multiple storage areas; increased chances of spillage. Poor aesthetics.	Remove from site using professional service.	<p>Appropriate location for a temporary storage drum and disposed of using local contractor.</p> <p>To be located in appropriately bunded area.</p>	<p>Install storage drum at each facility to temporarily store used oil before disposal.</p> <p>Determine appropriate bunded location for storage drum.</p>	2	3	6
	Liquid tar removal	Disorganised management and disposal of liquid tar and containers.	Leaching, contamination and spillage. Poor aesthetics.	<p>Remove from site using professional service.</p> <p>Two tar pots removed from 2 businesses (1 remaining to be removed before end of</p>	<p>Appropriate location for a temporary storage drum and disposed of using local contractor.</p> <p>To be located in appropriately bunded</p>	<p>Determine appropriate bunded location for storing liquid tar.</p> <p>Dispose of all tar materials from site.</p>	3	2	6

				2010.	area. Removal of liquid tar from all Broken Bay facilities.				
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
	Disused, tarred and treated material storage and disposal.	Poor aesthetics, inefficient handling and disposal.	Leaching, waste of a resource. Limited landfill disposal and added cost to members.	Stack on site, remove from site intermittently. Utilise machinery and skip bins to dispose of infrastructure to appropriate landfill sites.	Work with councils on providing a moratorium on fees for oyster growers disposing of derelict and damaged infrastructure. Examine potential reuse of materials, mulched and mixed with pine park etc. Potential to reuse materials in gardens etc.	Discuss with council, potential to recycle tarred timber materials. Discussions with the HNCMA, DEC and council to waver tip levees to provide an extra incentive to oyster growers in cleaning lease sites and removal of derelict and damaged infrastructure.	3	3	9
	General waste disposal.	Non recyclable waste or non-recycled waste.	Limited landfill disposal and added cost to members.	Use materials that are recyclable.	Minimise the use of non-recyclable materials. Examine the use of alternative materials that can be recycled.		1	1	1
	Fuel preparation and fuelling vessels.	Fuel spills, explosion and fire event.	Physical injuries (burns), explosion.	Take care when fuelling. Ensure no naked flames. Portable tanks are filled on land in designated areas at each site. Larger fuel tanks are filled with a long hose attached to bulk fuel containers. Alert appropriate authorities in event of	Ensure an appropriate fuel containment kit or fire extinguisher is located at each fuel storage area and BBO staff are appropriately trained to deal with fire events, medical attention.	Each business should have a staff member appropriately trained to use fire fighting equipment and trained in first aid.	1	3	3

				fuel spillage.					
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
	Fuel storage.	Spillage and pollution of environment.	<p>Potential spills can leach into the marine environment leading to reduced water quality and hazardous to marine life.</p> <p>Potential fire, explosion, physical injuries.</p> <p>All operational fuel storage containers are adequately bundled.</p>	<p>The number of fuel storage areas on site is deemed appropriate and necessary for safe operations.</p> <p>Bulk fuel is stored in 200L (unleaded) and 5000L (diesel) containers.</p> <p>Bunded around most fuel storage areas to minimise fuel spillage.</p> <p>Alert appropriate authorities in event of fuel spillage.</p>	No fuel enters marine environment from fuel storage areas.	Remaining fuel preparation areas are appropriately bunded to prevent any unforeseen fuel spillage into the marine environment, following the appropriate selection for their placement (x2 remaining).	2	2	4
	Servicing outboard engines.	Fuel and or oil spillage.	Water pollution.	Reduced water quality, impacts on marine flora and fauna, negative perception of industry by other users of the river.	All oil changes and servicing of motors is done on land, and no closer than 10m from water edge.	Designate a general oil change and service area at each business no closer than 10m from water edge.	1	2	2
	Use of machinery.	Air pollution, noise pollution and oil leakage.	Reduced air and water quality.	<p>Minimal control measures.</p> <p>Attached oil catching device on required machinery.</p>	Improved maintenance of machinery.	Develop and implement a maintenance schedule for machinery.	1	2	2

	Wash down, cleaning baskets and oyster punts.	Increase suspended sediment in the water. Operational energy efficiency, water use may not be optimal; not all sites are fitted with a sediment drain.	Sedimentation and reduced water quality, bank destabilisation. Increased turbidity can smother marine animals and plants.	Clean baskets in areas where sediment cannot flow directly back into the marine environment. Most washing occurs on sealed ground or not within 10m of the water edge. Installation of three sediment catching drains (approx. \$4K) operator funded.	Build sediment drains at all Broken Bay land facilities to catch debris resulting from wash down activities, e.g. cleaning racks and baskets.	Implement water front sediment drainage facilities on each business premises.	3	2	6
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
WATER - BASED ACTIVITIES	Wash down, cleaning baskets and oyster punts.	Operational energy efficiency, water use may not be optimal. Inefficient water use.	Unnecessary pressure on resource. Unnecessary cost.	Use high pressure water blaster and town water.	Installation and use of rain tanks for cleaning down. Examine use of river water for cleaning.	Minimise town water use and pressure on water resource.	2	2	4
	Land facility fencing.	Unsafe, unfenced entry location.	Public safety.	Educate any people entering property of safety risks.	Discuss with the land department on allowing the fencing off unsafe entry locations. Improve signage.	Build fence at unsafe entry location. Erect appropriate signage.	2	2	4
	Derelict and unmanaged lease infrastructure.	Increased habitat for feral oyster populations, other fouling species and disease. Poor aesthetics. Lack of understanding of industry by the	Reduced resale value of leases. Reduced profitability and sustainability of the oyster industry. Poor and/or negative community perception of	Maintain tidy leases. I+I partnership on Hawkesbury clean up. Partnership with OceanWatch Tide to Table program removing derelict	Ensure industry related infrastructure on the river is working order, maintained and meet OISAS guidelines. Continue to improve community perception of	BBO members to work with HNCMA and INDUSTRY AND INVESTMENT NSW to design and implement a long term management plan in concert with the wider industry, to achieve	3	3	9

		community. Navigational hazard.	industry. Wild PO and over-catch of wild PO and other fouling species and disease.	infrastructure and appropriate disposal. Leases are required to be tidy as part of licence conditions and in meeting OISAS guidelines. Improve community perception through the promotion of oyster farming, developments through involvement in industry and catchment education in the Hawkesbury River. Promote the industries importance to the local economy and the catchment health.	oyster industry. Improve community knowledge of issues and activities that can negatively affect oyster harvesting and cultivation. Ensure members follow ESD principles.	the goal of maintaining and improving aesthetics. Identify areas where oyster leases are in poor condition and require works to improve aesthetics. Distribute EMS.			
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
	Derelict leases disposal.	Unmanaged areas are potential sites for feral pacific oyster populations and other fouling species.	Boat accident.	Broken Bay oyster farmers have been involved in extensive programs to remove derelict, disused, damaged and/or toxic materials from the Hawkesbury catchment. Continue to identify and remove materials no longer in use. Work with LHEMC and Gosford Council to remove fees associated	Environmentally responsible removal of all derelict infrastructures and tarred materials from the river. Examine potential to offset costs of disposal through recycling.	Discuss disposal costs with Council, DEC and SRCMA. One off disposal cost versus environmental costs. Examine alternative disposal methods e.g. recycling or mulching tarred timber (potential to cover costs of disposal).	3	3	9

				with disposal of derelict materials.					
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
	Oyster stocking density	Inefficient or excessive stocking.	Reduced productivity profitability and sustainability of the oyster industry. Increased competition for available food resources.	Stocking is conducted according to OISAS and INDUSTRY AND INVESTMENT NSW guidelines.	Maintain efficient stocking densities to ensure oyster production is profitable. To be aware of neighbouring leases and apply a holistic approach to stocking density management.	Manage stocking densities in accordance with OISAS and the Broken Bay oyster growers’ tenant.	2	3	6
	Leases, boat use over seagrass.	Leases and cultivation methods negatively effecting seagrass.	Shading and negative effects on seagrass and the species that rely on it during their lifecycles. Decreased sediment stabilization.	Monitor seagrass growth and be aware not to disturb environmentally sensitive areas. Harvest areas are located in areas with muddy substrate.	Continue with current control measures by not interfering with environmentally friendly areas.	Report any noticeable changes in seagrass coverage and health to the Department of Primary Industries.	1	2	2
	Boat (oyster punt) use.	Outboard motor emissions.	Air and water pollution.	Most members use 4 stroke outboards with minimal emissions.	Engine upgrades will consider environmental emission standards and fuel consumption characteristics.	Any new engines that are purchased conform to EPA regulations. Follow OISAS recommendations 7.9.	1	3	3
	Boat (oyster punt) use.	Fouling on oyster punt hulls.	Marine pest translocation. Increased drag and fuel consumption.	Hulls are maintained regularly, every 3 months and cleaned with a high pressure hose.	Continue best practice anti fouling using environmentally friendly methods.	Keep a regular check out for fouling species and marine pests on oyster punts and hulls. Maintain regular cleaning	1	3	3

						of vessels. Identify the number of oyster punts that are in poor condition.			
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
	Boat (oyster punt) use.	Boat wash.	Erosion to shore line habitat.	The majority of members have had their oyster punts injected with marine foam. This has improved floatation, reduced vessel wash and reduced fuel consumption.	Most or all oyster punts are filled with marine foam or maintained in excellent condition.	Encourage members to improve condition of vessels. Identify the number of oyster punts that are in poor condition.	1	2	2
	Boat (oyster punt) use.	Migratory and local bird habitat.	Proximity to bird habitat and activities.	Interference with bird activity and habitats.	Oyster farming infrastructure provides additional habitat for migratory and local shore birds. Members do not interfere with birds or their habitats.	Continue current measures. Report any injuries to wildlife to appropriate authorities.	1	1	1
	Boat (oyster punt) use.	Effluent disposal.	Reduced water quality.	Farmers utilise land facilities before spending time on the water. Some members have a removable sealed port-a-potty on board the vessel.	All vessels fitted with sealed and an environmentally safe personal port-a-potty for extended periods spent on water.		1	3	3
	Non-recyclable material use.	Bailing twine and pollution.	Littering of foreshore. Toxic if swallowed by	Keep tie down materials and dispose of on land.	Reduce use of non-recyclable materials.	All members use recyclable tie down	3	1	3

			marine animals.			materials.			
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
EXTERNAL									
LAND -BASED ACTIVITIES	Lack of appropriate local toilet amenities	Poor effluent disposal, littering of foreshore with toilet paper and faecal materials.	Contamination of oysters, closing of harvest areas.	Work with the Council to implement composting toilets at Twin Beaches, completed 2008. Communicated with the Council to implement composting toilets at Marra Marra Creek.	Provide ample toilet facilities for the public. Improved education and improved management of effluent disposal.	Continue current control measures. Build awareness in community of importance of correct effluent management. Improved signage.	2	3	6
	Land-use activities, e.g., farming practices and nurseries.	Decreased water quality, cattle grazing on mangroves and near river edge. Increased faecal and nutrient input. Algal blooms, decreased water quality.	Contamination and mortality of cultivated oysters. Harvest area closures.	Continue to be involved in catchment management and education activities. Continue with partnerships that aim to improve water quality in the Hawkesbury river and its catchment.	Maintain communication with the HNCMA, council, INDUSTRY AND INVESTMENT NSW, OceanWatch Australia, HN Management Authority.	Improve and build awareness in the community of the downstream impacts from various land practices. Encourage best practice land management.	2	3	6
	Urban encroachment, residential houses near harvest areas.	Increased nutrient, sediment and faecal input into the river system.	Reduced water quality. Closure of harvest areas. Loss of business profitability and sustainability.	National Parks that surround the Hawkesbury River provides some respite from urban encroachment.	Lands department, council consider the consequences to industry of increased urban encroachment.	Build awareness in the community and relevant departments on potential impacts to the industry.	2	3	6
	Sourcing non-spawning Pacific	Limited/unreliable supply of oyster spat. Eg. One	No spat to on-grow. Collapse of business.	Liaise with I+I Minister for Primary Industries,	Reliable stock supply.	Continue to liaise with relevant authorities in	2	3	6

	Oyster spat and QX resistant Sydney Rock Oysters spat	active hatchery to supply non-spawning PO spat; two major active hatcheries for QX resistant Sydney Rock Oyster.		regarding the potential of additional hatchery staff at I+I NSW Port Stephens oyster Hatchery, to work with industry on mitigation measures to help solve this issue.		efforts to provide further staff at the Port Stephens Hatchery to improve spat supply.			
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
WATER - BASED ACTIVITIES	Town sewage management and sewage treatment plant capacity.	Heavy rain events leading to sewage overflow and bypass into the river. Old leaking sewage pipes.	Nutrient and faecal input into harvest areas, e.g., Berowra Creek. Reduced water quality. Closure of harvest areas. Loss of business profitability and sustainability.	None.	Council to improve sewage plant treatment capacity. Implementation of effective control measures by council, in the event of heavy rains to minimise overflow directly into the river or nearby lands.	Beyond the scope of Broken Bay Oyster growers.	3	3	9
	Recreational boat use.	Boat wash, erosion to shoreline. Disrupts growing areas e.g. displaces oysters in floating cages and damages infrastructure.	Erosion and increased suspended sediment in water. Damage to habitat, disruption to shorebird foraging.	Installation of wave boards. Other measures include tying down and covering up of racks.	Improved education and signage to minimise boat wash in harvest areas and the shoreline. Communicate with NSW Maritime to achieve improved signage.	Improved signage to increase recreational boat user awareness. Improved boat user education.	3	2	6
	Illegal harvesting.	Oyster theft.	Loss of income and products, infrastructure.	Waterways and INDUSTRY AND INVESTMENT NSW Fisheries Compliance patrols. Trident- an active NSW Police and industry	No theft or damage to oysters.	Distribute EMS. Improve community understanding and knowledge of the industry wide Water Quality Assurance program and oyster flesh	2	3	6

				<p>initiative to combat illegal harvest.</p> <p>Community awareness of inappropriate activity.</p>		sampling protocols.			
	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
	Recreational and house boat effluent and rubbish disposal and management	Poor understanding of the negative impacts of poor effluent and rubbish disposal on the oyster industry and overall catchment health.	<p>Water pollution.</p> <p>Closing of harvest areas, contamination and potential mortality of oysters.</p>	<p>Shellfish Quality Assurance program.</p> <p>OceanWatch/HNCMA signage to educate boat users.</p> <p>Regulations regarding effluent management on house boats.</p> <p>Work with OWA, Hornsby Council, INDUSTRY AND INVESTMENT NSW, HNCMA and boating industry bodies to provide appropriate educational signage for boat users.</p> <p>Worked with inshore vessel pump-out operators and Hornsby Council to ensure appropriate facilities are available for recreational and houseboat users.</p>	<p>No pollution to waterways.</p> <p>Increase community education on best practice effluent management to ensure good catchment health.</p> <p>Improve knowledge on potential negative impacts on water quality.</p> <p>Appropriate signage needs to be erected in priority areas.</p>	<p>Continue to be involved in education events and activities that increase the community understanding of the oyster industry and the environmental management that growers are involved in as part of their operations, e.g. Water quality monitoring.</p> <p>Distribute EMS.</p> <p>Appropriate</p>	1	3	3

	ACTIVITY	RISK DESCRIPTION BY EVENT OR CAUSE OF RISK	POTENTIAL IMPACT	CURRENT CONTROL MEASURES	TARGET	ACTIONS REQUIRED	L	C	R
Oyster growers.	Industry communication process.	Minimal communication with the NSW oyster industry, Difficulty in having regional industry conferences through extensive geographical ranges and few members.	Inefficient communication amongst the NSW oyster industry. Less potential for development and adoption of best practice materials and technology.	Attend NSW oyster industry field days and events. Involvement in industry newsletters and publications, Involvement in field days and industry education awareness raising events. Membership on NSW farmer's oyster committee.	Improve communication amongst the NSW oyster industry.	Oyster industry webpage has links to BBO webpage and EMS document. BBO update and upload webpage back on line for public viewing and education.	2	2	4

Appendix 1. Broken Bay Oysters Member List

SURNAME	NAME	COMPANY	STREET	SUBURB	POST CODE	TELEPHONE	MOBILE	FAX	EMAIL
Alford	Bruce	Bruce Alford	48 Patonga Rd	Patonga	2256	0243791468	0414791468		alford_bruce@yahoo.com.au
Barry-Cotter	Phil, Kae, Sheridan	Ozsea Enterprises Pty Ltd	7 Station Street	Pymble	2073	0294498106	0400498106		p.barry-cotter@bigpond.com
Johnston	Chris	Oystermen's Pty Ltd	Lot 1 Kowan Rd	Mooney Mooney	2083	0299859771	0411193557	95310799	johnno1@tpg.com.au
Jones	Steve	Agalign Pty Ltd atf Mattamatta Oysters Trust	19 Bridge Street	Mooney Mooney	2083	0299857007	0405382717	0299857391	smjones@agalign.com.au
Moxham	Rob	CE & M Moxham	119 Mooney Mooney Rd	Mooney Mooney	2083	0299859106	0405328784	0299859761	rmoxham@bigpond.net.au
Moxham	Paul	PD & H Moxham	9 Ross St	Mooney Mooney	2083	0299851565	0412763705		
Moxham	Jim	James Moxham	31 Cheerio Pt Rd	Cherio Pt	2083	0299859280	0432107913		
Moxham	Steve	S & K Moxham Oysters Pty Ltd	Kowan Road.	Mooney Mooney	2083		0412920287		
O'Sullivan	Peter	Hornsby Tree Service	72 Excelsior St	Mt Colah	2079	0294579939	0413808614	0294579939	
Richards	Reg	Oystermen's Pty Ltd	Lot 1 Kowan Rd	Mooney Mooney	2083	0299859771	0409325653		oyster1@tpg.com.au
Stubbs	John	J&S Stubbs (BBO president)	41 Berkeley Cr	Berowra	2082	0299861238	0404833194	0294564767	johnstubbs3@bigpond.com
Wadham	Les	L Wadham	9 Bridge St	Mooney Mooney	2083	0299857596	0410410551	0299857130	
Witchard	Dale	D & L Witchard	91 Australia Avenue	Umina	2257	024344284	0404015597	0243442804	

Appendix 2. Reference List

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Appendix 3. Photo gallery



(L) BBO display board used at community events.



(R) Maturing oysters



(L) Erosion and suspended sediment input generated from BBO land facilities was highlighted in the risk assessment process.



(R) Compacting and improving surface coverage to reduce dust and erosion.



(L) Addressing erosion and suspended sediment input by constructing sediment traps.



(R) Repairs made to retaining walls to improve erosion control.



(L +R) Working with Hornsby Council to improve highway maintenance and rubbish entering the Hawkesbury River.

(Below) Removing
'old school' tar pots



(R)
Abandoned
tar racks
and trays at
Patonga
Creek



(Above) BBO
staff loading
oyster punts
with
abandoned
infrastructure



(L) Transporting derelict infrastructure
back to Mooney Mooney for appropriate
disposal.



(R) The BBO boys are happy with their
efforts, a job well done!

Appendix 4. BBO media coverage

<http://theland.farmonline.com.au/news/state/agribusiness-and-general/general/about-turn-for-dying-hawkesbury-trade/2081775.aspx?storypage=0>

<http://www.abc.net.au/news/video/2011/02/04/3130600.htm>

<http://www.smh.com.au/environment/water-issues/about-turn-for-dying-hawkesbury-trade-20110220-1b13x.html>

<http://hornsby-advocate.whereilive.com.au/news/story/oyster-farmers-back-from-brink-and-now-exporting-internationally/>

<http://www.thecourier.com.au/news/national/national/general/about-turn-for-dying-hawkesbury-trade/2081708.aspx>

<http://www.dailytelegraph.com.au/oysters-approved-for-export/story-fn6b3v4f-1225999750403>

<http://www.adelaidenow.com.au/ipad/oysters-approved-for-export/story-fn6bqvzx-1225999902882>

<http://cookingfromtheheart.com.au/2010/12/08/the-world-is-your-oyster/>

http://www.getfarming.com.au/pages/farming/articles_view.php?fld=9200020080924121156