6 Ecology Action Plan

6.1 Outline

6.1.1 Why is managing ecology important?

When the Estuary Management Manual was being prepared fifteen years ago, considerable effort was expended on preparation of technical appendices detailing what little was known at that time about estuarine ecology and about catchment management. It was clearly recognised that the health of NSW estuaries was dependent on healthy ecosystems within the estuary, on the foreshore surrounding it and on the streams draining into it from the catchment.

The ecological problems faced by the Tuggerah Lakes system are extreme, as detailed in the Estuary Management Study, and implementation of identified solutions has historically been largely unfunded and unattended outside of National Park and reserve areas. This omission essentially flows from the fact that the NSW Government puts most of its ecological allocation into the National Parks system, which largely caters for coastal dry land holdings and not estuaries.

Several local councils in coastal areas have been successfully addressing ecological problems outside the parks system in recent years using funds raised from a local environmental levy. In this regard, Wyong Shire Council has not raised such a levy and can therefore only make limited financial contributions to ecological improvements in the Tuggerah Lakes system. This is despite the pressure on the lakes and their iconic status in the minds of the local community.

In other areas of coastal NSW, the NSW Government has given approval to local Councils to impose environmental levies on their ratepayers to address ecological problems. In this regard, because of competition for limited funds from necessarily higher priority water quality and socio-economic areas of concern, it is believed that the important ecological aspects of this Estuary Management Plan cannot be properly addressed until Wyong Shire Council takes such an initiative.

For the Tuggerah Lakes estuary, the Estuary Management Plan envisages a high priority need for work in the catchment, on foreshores and in adjacent wetlands. It also identifies a need to exclude public access from some of the more fragile natural systems, particularly where endangered species are at risk.

6.1.2 Who should be involved and what should they be trying to achieve?

The Action Plans are an annual document that will help meet the Estuary Management Plan goals for Water Quality, Ecology, Social and Economic Opportunities, and Strategy for the next 5 years. Every financial year, each Action Plan should be reviewed to see if targets have been met, and this review should influence planning the actions for the following year. The Action Plan will need to be implemented by a number of stakeholders, who could form an “Ecology Action Team” and should be involved in guiding the actions, priorities and budgets each year. It is expected that the estuary

management entity/manager will be ultimately responsible for delivering the action plan. The Ecology Action Team should be relatively small, focussed and involve the following stakeholders (Table 12).

Table 12. Stakeholders for the Ecology Action Plan

Stakeholder	Why are they important for Ecology actions?
NSW Department of Natural Resources	Responsible for State Catchment Management - Review proposed actions and provide funding opportunities. Where beneficial consult with other agencies such as: • DEC (National Parks) • DPI (Fisheries) • DPI (Forestry) • Department of Lands • Department of Planning
Hunter-Central Rivers Catchment Management Authority	Provide advice on linking to the Hunter-Central Rivers CAP programmes to access grant funding
Council Staff	Representatives from Natural Resources, Engineering and Strategic Planning should be involved to provide expert review guidance on the actions that they are expected to implement. (This should include representation from the Water Authority as needed).
Community Groups (as required)	*Rehabilitation* A significant amount of rehabilitation and management of catchment habitat is undertaken by community groups like Landcare. They should be consulted and where appropriate guided on projects they could be involved in. *Heritage* Indigenous groups (e.g. Darkinjung) should be consulted to ensure that proposed actions do not impact on significant sites or cultural activities. In some cases it may be possible for traditional land management practices to be reinstated as part of ecological management. *Special Interest* A number of community groups have unique knowledge about local ecology and should be consulted about common issues (e.g. Bird Watching groups)
Committee/Advisory Board	Important for review of the proposed actions and how they relate to Estuary Management Plan goals and objectives.
Local residents	Any actions that involve on-ground works near to, or affecting local residents, must involve robust consultation with the residents. This allows for local knowledge to be incorporated into the design process and gives residents an opportunity to comment on the proposal.

Action plans are the primary tool for getting estuarine management happening “on the ground”. They describe how to meet estuarine objectives and address priority estuarine issues within budget and time constraints. It is important to identify the overarching objectives that the action plan needs to satisfy, so that subsequent revisions remain consistent (Table 13).

Table 13. Relevant Estuary Management Study Components

Principles (Catchment Blueprint)	• The physical structure and vegetation of river, lake and wetland riparian zones are protected (and rehabilitated where required) to sustain healthy ecosystems • Conserve the diversity of all ecological habitats and viable populations of their constituent species and protect and assist the recovery of threatened and endangered communities and species
Objectives (EMS)	• Protect, maintain & restore freshwater wetland vegetation • Protect, maintain & restore aquatic and semi-aquatic estuarine vegetation • Protect, maintain & restore floodplain vegetation • Protect, maintain & restore aquatic and riparian riverine vegetation • The biodiversity and ecological function of the catchment shall be maintained in a manner that protects the estuary • Minimise human disturbances that affect ecological function • Maintain and protect environmentally significant areas and threatened species/communities • Ensure fishery is sustainable
Priority Issues - Why can't the objectives be met? (EMS)	• No existing plan for identifying, rehabilitating and managing significant foreshore habitats (VE1) • No active monitoring and management of important wetlands (VW1) • Activities in upstream catchments can change downstream wetlands (VW2) • Inadequate understanding of riverine ecological processes and riverine water quality to allow for environmental flow management (VR5) • Invasive species can degrade important habitats (VW3, VF3) • Loss, fragmentation or degradation of habitat (DC1, DF5) • Assigning responsibility for managing environmentally significant areas (DS2) • Human disturbance and built structures can threaten estuarine habitats (DF4) • Some local processes are threatening sensitive ecological communities and species but are not legally defined (DT1) • Limited funding for works to rehabilitate and manage land (LS4)

6.1.3 How will these actions help?

The Estuary Management Study identified 27 programmes to address priority issues. Of these, 7 relate to improving the health of ecology in the catchment, foreshores and estuary. The proposed programmes (called Priority Programmes and designated with a prefix of "PP") have been grouped according to estuarine management goals for ecology over the next 5 years:

- Improve foreshore habitat
- Protect and restore catchment habitat

- Protect estuarine habitat
- Learn how changes to flow in the rivers affects plants and animals in the estuary

These goals are aimed at creating sustainable estuarine habitats, healthy, productive and less odorous foreshores, robust catchment habitats that link with the estuary, and further support for improved connections between the rivers and the lakes.

6.2 Goals for 2006-2011

6.2.1 Improve foreshore habitat

At present there is no significant expenditure on rehabilitation of foreshore habitat. As this habitat is important to flora and fauna and nutrient cycling in the estuary, the plan provides for a significant "new" allocation to establish and rehabilitate natural foreshore areas (Figures 26 & 27). This would focus initially on re-establishment of the saltmarsh community that should surround much of a coastal lakes system. Species and habitat that are protected under international agreements and threatened species legislation (e.g. JAMBA and CAMBA) must be included in any overarching plan for protecting/improving foreshore habitat.

Given that areas of representative dune system foreshores on the eastern side of the lakes are already protected in National Parks and some of the remainder is already dedicated to public recreation, Council's focus should be on identification of major potential sections of foreshore that can be practically protected or where ecological function can be restored. This should be a shared responsibility with the relevant government agencies such as National Parks, Lands and DNR, however, any extensive assistance from such agencies is unlikely and Council must take primary responsibility if any positive outcome is to be achieved. In the first instance, foreshore areas to be protected and repaired should be identified and appropriately reserved from damaging activity. This is regarded as a first-order priority however it would be more appropriately funded under an environmental levy.

Consequently, initial action under the plan involves a review of foreshore status around the estuary and a report detailing prioritised sites appropriate for protection and rehabilitation. In light of this report, rehabilitation and maintenance of identified sites in priority order would be implemented over time. Use of "new" funds is proposed under the plan to allow this initiative to be delivered by Council's Natural Resources unit using contractors and consultants if necessary.

Figure 26. Saltmarsh meadow on council reserve.

Figure 27. Damage to saltmarsh from mowing a reserve.

Improve and protect natural foreshore areas (PP5)

Benefits of meeting the target
Foreshore areas will have fewer odours and be healthier. Council will also be meeting its legal obligations

Risks of doing nothing
Continued odour problem from wrack rotting in the water. Loss of saltmarsh and associated legal ramifications.

EMS Issues Addressed
Main Issue: (VE1) No existing plan for identifying, rehabilitating and managing significant foreshore areas.
Other Issues: VE3, DS1, DT1

Fixing a symptom/cause or providing an enhancement?
Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
5.1 Identify location of important foreshore habitats	Range of foreshore habitats have been identified. Need to decide on the scale of rehabilitation undertaken at each location.		$15,000		**WSC**	Foreshore	Yr 1	1 - Keystone
5.2 Assess threats and future uses to determine if rehabilitation is required and set objectives for rehabilitation	Not all areas will be suited for rehabilitation (e.g. acid sulphate, bad slope, public access etc). Need to assess adequacy of each site and consult with local community. Consider providing a boat access plan to stop launching through rehabilitation areas.		$10,000	$2,000	**WSC**	Foreshore	Yr 1	2 – Efficient planning
5.3 Develop and implement rehabilitation programmes and designate protective zones.	Saltmarsh rehab, fringing wetlands rehabilitation, informative signage, public access, viewing platforms, boardwalks etc. Education of surrounding residents is critical re: mowing, boat storage, exotic planting etc.	$50,000		$500,000	**WSC**	Map locations	Yr 1	1 – Keystone
5.4 Assess effectiveness of rehabilitation in meeting objectives	Look at community response, ecological response and aesthetic improvement			$20,000	**WSC**	Foreshore	Yrs 3 - 5	3 – Checking

Evaluation and Management

- Consider combining priority programmes 5, 6, 21 and 22 into a single foreshore management programme with an overarching foreshore management plan ($100,000) – use the Wyong Creek Management Plan as example.
- Could measure odour reductions, ha rehabilitated/yr and community reactions as performance indicators
- Must be an integral part of Council's foreshore management programme.
- Consider working closely with the Precinct Committees to obtain local support

Reporting

- Report back through Councils Mgt Plan (mostly because it may be contentious and will require significant resources)
- SOE

Funding

- H-CRCMA – Saltmarsh Rehabilitation Programme

Supporting Information

- 5.1 and 5.2 have been largely completed by Sainty et al. (2006), but only for Council managed foreshores. The recommendations from this report will assist with longer term planning for foreshore management.
- Where protection is required - the public access programme (priority programme 7) should be used for these rehabilitation areas.
- Rehabilitation programmes should consider multiple objectives such as informative signage, viewing platforms and rehabilitation works.
- The $15K cost in identifying the location of important habitats in council managed areas, is for groundtruthing & mapping the work that has already been undertaken (Sainty et al. 2006) and the current Comprehensive Coastal Assessment work.
- The $50K start-up cost covers the necessary approvals and the cost of preparing a brief for the rehabilitation projects.
- Wider education about foreshore rehabilitation should be covered under the estuary education programmes (priority programme 25). The rehabilitation may include edge modification.
- Be cautious about applying "zonings". Recent rationalisation of zonings may mean that a blanket zone applies across all rehabilitation areas which may not be appropriate for some habitat/locations.

Maintain the rehabilitated natural foreshore areas (PP22)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Rehabilitated natural foreshores are likely to remain health and improve foreshore appearance	The rehabilitated areas will become dominated by weeds and impacted by human activity like mowing.	Human activities can damage sensitive habitats (VE3, VE4, DS1)	Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
22.1 Develop a maintenance schedule for rehabilitation sites	Consider including this as part of an all encompassing foreshore management plan		$10,000		**WSC**	Foreshore	Yr 1	2 – Efficient planning
22.2 Implement the maintenance schedule	Likely to require bush regeneration/signage. Where Landcare/community groups will help with the implementation, ensure they are provided with advice and resources to assist them in doing this job.			$85,000	**WSC**	Foreshore	Yr 2	2 – Implementation
22.3 Review the effectiveness and longevity of the rehabilitation programmes	Very important as new projects			$5,000	**WSC**	Foreshore	Yrs 3 – 5	3 - Checking

Evaluation and Management

- Link with overall foreshore maintenance schedule
- Look to the report by Sainty et al. (2006) to identify types of rehabilitation maintenance required (e.g. passive or active rehabilitation)
- Develop key performance indicators for maintenance of natural foreshores

Reporting

- Report back to the community and raise awareness – signs, letterbox drops for surrounding residents
- Many of these places will be trialling new rehabilitation techniques, so reporting back is important
- Technical advisory group should closely monitor success

Funding

- H-CRCMA programmes on foreshore rehabilitation

Supporting Information

- The maintenance covers rehabilitation sites identified as part of PP5 and also existing foreshore areas that are considered to be passive recreation sites (since there is no active rehabilitation, areas like Tuggerah Bay are passively rehabilitated through minimising disturbance. Passive rehabilitation sites should have strong links to the public access options in PP7.
- The $85,000 is based on $15,000 of regeneration at 5 sites each year, and costs for the replacement of fencing, signposts etc.

6.2.2 Protect and restore catchment habitat

This Estuary Management Plan recommends managing catchment habitats that are important for the estuary. This is not a link that is commonly found in estuary management programmes. For Tuggerah Lakes, the health of some catchment habitats has implications for estuarine health and diversity. Fringing and catchment wetlands are known to contain levels of sediments and nutrients that wash into them from the catchment. Loss of such wetlands means that these pollutants end up further downstream and require expensive removal from the stormwater system (e.g. Porters Creek Wetland). This is seen primarily as an H-CRCMA/Council responsibility. However, identifying where such work will benefit the wellbeing of the Lakes and then influencing H-CRCMA priorities is seen as an essential component of estuarine management. As with most other ecological issues, this is seen as an element of the plan that should be funded by way of an environmental levy. One exception in this arena will be sites where catchment rehabilitation can have a major impact on the delivery of nutrients and sediments to the estuary. In such cases a first order priority is appropriate.

These habitats also provide “green corridor” links between the catchment and the estuary. This link is becoming increasingly tenuous and limits animal migration to and from the estuary. It is far more cost-effective to protect and manage these habitats in the first place. Monitoring of key wetlands is proposed in this Action Plan so that any degradation can be minimised early, preventing costly rehabilitation later. This has both ecological and water quality significance, particularly if the essential features of existing wetlands are lost. This is a relatively inexpensive activity and therefore one which should be accorded first order priority by Council because of its importance to the impact wetlands have on stormwater.

These habitats fit into two categories; those already degraded and needing improving, and those not degraded but in need of strategic protection. Council has made attempts in the past to strategically protect these important catchment areas, however much of it remains in private ownership which can be seen as an impost if the landholders are asked to render areas of their property un-developable. This is seen as a second or third order priority, depending on the extent to which it benefits the estuary. In terms of habitats that are already being degraded, rehabilitation programmes are proposed that may involve Landcare groups, bush regenerators, Council staff or a combination of these. The priority for Year 1 should be Porters Creek Wetland which has already been degraded by increased runoff and weed infestation. Overall, degraded habitats should be given a first-order priority to avoid irreversible damage. Species and habitat that are protected under international agreements and threatened species legislation (e.g. JAMBA and CAMBA) must be included in any overarching plan for protecting/improving catchment habitat.

Identify and protect important remaining catchment habitats (PP17)

Benefits of meeting the target
Healthy habitats are protected from future damage

Risks of doing nothing
These areas are likely to be damaged by activities in their catchment, breaking an important link with the estuary. Problems can also be exported downstream.

EMS Issues Addressed
Main Issue: (DC1) Loss, fragmentation or degradation of habitat.
Other Issues: VW1, VF2, VR4, DC2, DC3, DT1, DT2, DS2

Fixing a symptom/cause or providing an enhancement?
Enhancement

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
17.1 Identify sensitive threatened habitats in the catchment that are important to the estuary and require strategic protection	Much of this has been mapped. A desktop study could be used to identify where these habitats are likely to be.		$10,000		**WSC**	Catchment	Yr 1	2 – Keystone
17.2 Develop strategic policies and plans that protect these habitats	Any plan should involve rigorous and open consultation especially if any of these areas are on private land.	$10,000	$250,000		**WSC** Agencies	Catchment	Yr 2	2 – Implementation
17.3 Implement the programmes	Use strategic planning tools such as the LEP, DCP's etc.			$100,000	**WSC** Agencies	Catchment	Yr 2	2 – Implementation
17.4 Assess the effectiveness of strategies and plan future programmes				$10,000 (2 yrly)	**WSC**	Catchment	Yrs 2 – 5	3 - Checking

Evaluation and Management

- Success could be measured by the number of voluntary agreements reached, or by ha estuary buffer protected, or by ha of estuary links/habitat protected.
- Work closely with all relevant agencies including DPI (Forestry), Delta Electricity, Landcare, Landholders, Department of Lands, Department of Planning, National Parks
- Outcomes from assessing the effectiveness includes feeding new information back into overall estuary/catchment management planning.

Reporting

- Report through Council Mgt Plan, SOE and strategic planning documents.

Funding

- H-CRCMA programmes (Biodiversity)

Supporting Information

- The primary objective is to protect important links between the catchment and the estuary before they are damaged/degraded.
- A catchment management plan could be developed that combines the strategies in this priority programme (17) with priority programme 4.
- The programmes may include limiting development in sensitive habitats that are significant for the estuary (e.g. Spring and Wallarah Creeks).

Restore degraded habitat in the catchment (PP4)

Benefits of meeting the target
Restoration of natural areas upstream so they can filter pollutants and provide homes for animals important to the estuary (e.g. birds).

Risks of doing nothing
Damaged areas of the catchment can reduce habitat and add weeds and eroded sediment to the creeks and lakes.

EMS Issues Addressed
Main issue: (DC1) Loss, fragmentation or degradation of habitat
Other issues: (DT1, VW3, VF3, VR3)

Fixing a symptom/cause or providing an enhancement?
Enhancement

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
4.1 Identify catchment habitats important to the estuary that require active rehabilitation and management	Initially undertake a desktop study and follow-up with ground truthing		$100,000		**WSC**	Catchment	Yr 1	1 - Keystone
4.2 Assess rehabilitation requirements and plan the approach to habitat management	Detailed management plans (possibly Plans of Mgt) should be created for each habitat		$100,000		**WSC**	Catchment	Yr 2	2 – Efficient planning
4.3 Implement the rehabilitation/bush regenerators programme	Focus on Porters Creek in Year 1. It has already been degraded by flows and weeds. Other areas can be added to the programme following completion of 4.1 and 4.2	$20,000		$300,000	**WSC**, Landcare	Porters Creek Wetland	Yr 1	1 – Urgent
4.4 Assess effectiveness of habitat rehabilitation				$5,000	**WSC**	Rehabilitation sites	Yr 2 – 5	3 - Checking

Evaluation and Management

- Technical working group suggested that this requires better co-ordination between all implementers (Landcare etc) – Co-ordination planning should be a focus. Also suggested avoiding spending money on “lost causes”.
- Assessments of before conditions are needed before regeneration to assess its effectiveness
- This programme may have a limited life if there are a small number of habitats that are not “too far gone”
- Liaise with Catchment Management Officer, Bush Management Officer, Landcare groups

Reporting

- Report back through relevant stakeholders, SOE
- The scale of the task will be better understood following 4.1
- Once the “estuary important” habitats have been identified and managed, other habitats which are important but not related to the estuary could be transferred to a catchment/biodiversity-based management operation.

Funding

- H-CRCMA Programs (especially biodiversity)
- Encourage Landcare groups to undertake the work and provide them with support and resources

Supporting Information

- The cost for identifying these habitats is largely related to the size of the catchment and therefore the area that needs to be covered. It could be revised down if existing data are available.
- The increase of $250,000 for rehabilitation depends on the scale of rehabilitation required. It is understood current costs are $50,000 p.a. The total 5yr costs could be as high as $3-$5 million ($600,000 – $1,000,000/yr respectively).
- The costings are based on using rehabilitation contractors.

Monitor key wetlands for signs they are being damaged (PP11)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Early detection of problems prevents long-term degradation and loss of important runoff filters and linking habitat	Wetlands would fail allowing sediments and nutrients to pass through, degrading more habitats downstream through smothering and weed invasion	No active monitoring and management of important wetlands (VW1)	Symptom

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
11.1 Identify key natural wetlands important for the estuary and investigate appropriate monitoring programmes (qualitative and quantitative)	Much of the wetlands have been mapped but need to identify those that have significance for the estuary. Where they are not damaged, but may become so, address using programme 17	$10,000	$10,000	$7,000	**WSC**	Catchment	Yr 2 – 5	2 – Efficient planning
11.2 Provide an ongoing monitoring programme and develop series of triggers that indicate when urgent action is required	Focus on Porters Creek Wetland in Year 1	$5,000	$5,000	$40,000	**WSC**	Porters Creek Wetland	Yr 1	1 – Urgent
11.3 Review wetland conditions and revise management accordingly	Where wetlands under pressure, adapt management and incorporate rehabilitation under programme 4.			$3,000	**WSC,** Landcare	Porters Creek Wetland	Yr 2	2 – Checking

Evaluation and Management

- Important to measure pollutant loads and changes to type and size of flows
- Use to evaluate effectiveness of upstream catchment controls

Reporting

- SOE
- Estuary Management Committee, Landcare groups

Funding

- Explore use of developer contributions or development consent conditions to get monitoring support where wetlands may be damaged by development stormwater
- H-CRCMA programmes may support use of preventative monitoring

Supporting Information

- Where this monitoring identifies degradation, tie to the assessment of degraded habitat. Where this is no degradation, but there is pressure, consider using programme 17 to strategically protect the wetlands.
- Important wetlands are those that benefit the estuary either by performing a water quality improvement function or as connective habitat.
- NB: Degradation or changes in the condition of an “important wetland” will likely have an effect on the estuary (e.g. Porters Creek Wetland).
- Consider treating wetlands differently depending on their association with the estuary (e.g. assessment of wetlands that contribute flow to the estuary should be focussed on their outputs , that is loads to the estuary, whereas wetlands that provide connective habitat should be monitored for degradation rather than output).

6.2.3 Protect estuary habitat

Many of the areas within the Tuggerah Lakes estuary are sensitive. Some are so important that they require a high level of protection from human interference. Two key habitats that will likely require increased protection are the saltmarshes of Tuggerah Bay and Budgewoi Sandmass (Figure 28).

In the case of Tuggerah Bay, the saltmarsh community is being threatened by continued disturbance from horses and cross-country car and motorbike use. Restricting access to these users is the main form of protection being proposed, however it should be remembered that excluding all people from a site is a last resort. A more preferable approach could be to vest the land in a community body (possibly a “Friends of”) who would have care and control of the site under a Plan of Management. Before adopting a particular approach, the precise requirements of the site would need to be considered including existing ownership (Council or Crown Land).

Whilst difficult for a Council to achieve without the co-operation of relevant government agencies (i.e. DPI (Fisheries) in aquatic habitat and the Department of Lands on public land) it is not an expensive activity and it should therefore be pursued by Council and accorded a first order priority because of the critical threat of loss faced by the few remaining natural areas.

Figure 28. Damage to the saltmarsh in Tuggerah Bay by vehicles.

Control damaging activities in sensitive parts of the estuary (PP7)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Sensitive places get sufficient protection so they can be managed for future generations.	Important areas of the estuary may be damaged beyond recovery.	Main Issue: (DF4) Human disturbance & built structures can threaten sensitive habitats. Other Issues: DT1, DS1, VE3, VE4)	Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
7.1 Identify points of public access to sensitive habitats and assess appropriate controls	Determine the need for access control and assess how this could be achieved in some areas.		$5,000		**WSC**	Tuggerah Bay Budgewoi Sandmass	Yr 1	1 - Urgent
7.2 Implement access controls and educate the community and key stakeholders	Control may mean vesting ownership in a community body (like a “Friends Of”). Appropriate education and signage will be very important so people understand why the area is important. Tuggerah Bay needs immediate protection.		$10,000	$15,000	**WSC,** Maritime, DPI (Fisheries), Lands, NPWS	Tuggerah Bay	Yr 1	1 – Urgent
7.3 Assess recovery/protection of the sensitive habitats and feed back into management decisions	Universities may be able to run student programmes to establish recovery of these areas.				**WSC**	Protected locations	Yr 2 – 5	2 - Checking

Evaluation and Management

- Limiting access might be contentious and difficult to implement. Likely to be a need for compliance if it stays in Council control (“Friends of” model relies more on community oversight to limit harmful activities).
- Consider using a Plan of Management as the instrument for ongoing management of these areas (including “lock out” mechanisms if required)
- Work with Lands NSW to establish appropriate controls (consider moving some areas to National Park to provide more rigorous protection if required)

Reporting

- As many of these areas are on or above Crown Lands, need to liaise strongly with Lands NSW
- SOE, overseen by Estuary Management Committee

Funding

- For Budgewoi Sandmass, there may be opportunities for linking it with recreational fishing grants
- H-CRCMA funding may be available for protecting sensitive habitats
- Link to Landcare programmes for implementing

Supporting Information

- Technical working group recommended taking a community ownership approach rather than locking up/denying access to land. May need a combination of both.
- The $15,000 ongoing cost comprised of $10,000 towards the cost of installing fences, signage etc, and $5,000 towards education of the community and key stakeholders (production of brochures, notices in local papers etc).
- Fencing costs are approximately $10/metre.
- Ensure protection of seagrasses in accordance with DPI (Fisheries) habitat protection plan #2.
- Consider providing maps/brochures to boat users indicating areas that are “no go zones” (as a guide approximately $15,000 to produce 10,000 colour brochures including artwork).

6.2.4 Learn how changes to flow in the rivers affect plants and animals in the estuary

The link between riverine and estuarine ecology is particularly poorly understood. The two largest tributaries of the Tuggerah Lakes estuary also provide water for agriculture and water supply for the Gosford-Wyong area. This has significantly reduced the amount of water that reaches the estuary under dry weather or low flow conditions. Given the potential significance of the creeks feeding into the estuary, support for research in this area should be given by Council, whilst the work could be undertaken either by Universities or by Consultants.

Water Sharing Plans have recently been created for Ourimbah and Jilliby Jilliby Creek (tributary of Wyong River) systems, which allocates proportions of flow for environmental purposes. It is not known if the volume, frequency or type of flow is suitable for the river environment or sufficient for the downstream estuary.

The Estuary Management Plan proposes additional assessments be made to establish whether the current environmental flows are improving the condition of plants and animals in the rivers and the estuary (Figure 29). This will assist in filling a major estuarine knowledge gap – how has the flow in rivers affected the estuary, and can changes be made to improve health in the rivers and estuary without impacting on water supply and agriculture requirements.

Figure 29. There is a need to understand the ecology of creeks and rivers.

Learn how changes to flow in the rivers affect plants and animals in the estuary (PP24)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Better understanding of whether environmental flows in rivers will help the estuary and creeks	Existing environmental flow regime will remain	Insufficient understanding of riverine ecological processes and riverine water quality to inform environmental flow management (WF5, VR5)	Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
24.1 Assess the ecology of tributaries to determine how regulation is affecting riverine and estuarine health	Change in flows has removed a large source of base flows to the estuary. It could be more significant flow that those moving through the entrance.	$10,000		$150,000	**WSC**, Water Authority, DNR	Ourimbah Ck, Wyong River	Yr 1	2 – Implementation
24.2 Determine flow requirements for river/estuary health		$10,000	$250,000		**WSC**, Water Authority, DNR	Ourimbah Ck, Wyong River	Yr 1 – 2	2 – Implementation
24.3 Examine ways of improving flow without impacting on water supply (e.g. by modelling changes to requirements from water cycle mgt planning)		$10,000	$200,000	$50,000	**WSC**, Water Authority, DNR	Ourimbah Ck, Wyong River	Yr 2 – 3	2 – Implementation

Evaluation and Management

- Work closely with DNR and Water Authority. It may be more appropriate for the Water Authority to take the lead in this programme.
- It may be appropriate to link this with university programmes to ensure the estuary focus of environmental flows is retained.
- The objective is to check the existing environmental flows and whether they are appropriate for the estuary. The outcomes should be used to refine existing Water Sharing Plans.

Reporting

- Successes should be reported in the scientific/environmental management literature
- Council Management Plan (as one half of the Water Authority – this is important)
- Water Sharing Plans
- SOE

Funding

- Water Fund?
- H-CRCMA Programmes for River Management

Supporting Information

- This will help determine the scale of impact that modifying flows may be having on the estuary

Figure 30. Map showing locations of Ecological Programmes

6.3 Implementing this action plan

6.3.1 Budget

The current Council expenditure on ecological improvement activities is approximately $50,000 p.a. This Action Plan identifies approximately $1.51 million of annual ecological improvement funds, which means approximately **$1.46 million p.a. of new funds** are required.

6.3.2 Assigning Priorities

The priority programmes under this action plan are all important. Their relative priority is very difficult to judge and will change depending on current knowledge, available budget etc. As such, an assumption has been made that their relative priority should be equal. However, priorities have been assigned within each priority programme to guide which action should be implemented first and why. These are ranked from 1 (most important/urgent) to 3 (least important/urgent).

6.3.3 Agreeing to responsibilities

An important part of working with stakeholders is reaching agreement on which organisation has responsibility for implementing the various actions. As the largest land manager in the catchment, it is expected that Council will assume responsibility for at least co-ordinating a significant number of the actions in the ecology plan.

6.3.4 Liasing with affected residents/stakeholders

When works are proposed as part of this action plan, affected residents, businesses and stakeholders should be involved at the earliest opportunity. This will ensure that local knowledge is made available to the design process, and that affected parties have every opportunity to provide comment on actions that impact on them.

6.4 Reviewing and adapting

6.4.1 Review

This action plan should be reviewed in time for the budget planning process that precedes each financial year. The review should focus on:

- Management and Ecological targets met
- How much of the budget was spent
- Whether projects succeeded or failed and the lessons learnt
- Government changes, new funding opportunities, latest research
- Prioritising and budgeting next years work

6.4.2 Reporting

It is important that the success of these programmes be reported back to Council, appropriate agencies, organisations part funding the programmes, and most importantly the community. In terms of linking with key documents, it is recommended that Council's Management Plan reflect these Action Plans as the primary vehicles for delivering estuarine management outcomes on a year-by-year basis, guided by the 5-yr Estuary Management Plan.

7 Socio-economic Action Plan

7.1 Outline

7.1.1 Why is the estuary important for business and recreation?

Tuggerah Lakes, like most estuaries, are public places that provide a key visual and recreational resource for the surrounding population. They also have commercial value as a fishery, as a source of cooling water for power generators and as a tourist attraction.

The public amenity of the Tuggerah Lakes has been augmented by Council over time through the provision of foreshore parks, beach maintenance, boat launching ramps (30), picnic areas, walking tracks, bicycle tracks, jetties etc. At present, provision of new facilities to cater for a rapidly expanding population has ceased and whilst effective maintenance is clearly seen as a first order priority, it is suggested that targets be set for the expansion of important facilities. To this end the main goal of this Action Plan is to provide facilities that bring people back to the foreshores and waterways. This includes better boat ramps, playgrounds and landscaped picnic and BBQ areas. The condition of some lakes beaches will also be improved with a focus on beach nourishment to provide sandy beaches, wrack collection and beach cleaning. In the first instance, high profile expenditure on iconic new initiatives such as a track all the way around the Tuggerah Lakes is suggested if funding and/or grant funds can be found. In addition, it is suggested that iconic projects be undertaken to give a positive public amenity face to the Estuary Management Plan. These could include provision of a bicycle and/or walking track all the way around one or more of the three lakes (provided these types of projects would in no way degrade the health of the estuary).

One of the issues identified in the Estuary Management Study was a historic lack of communication between Council as the estuarine manager, and local business. This is an important relationship to cultivate because the estuary can provide many business opportunities and these should be encouraged where this is no risk to estuarine health.

7.1.2 Who should be involved and what should they be trying to achieve?

The Action Plans are an annual document that will help meet the Estuary Management Plan goals for Water Quality, Ecology, Social and Economic Opportunities, and Strategy for the next 5 years. Each financial year, each Action Plan should be reviewed to see if targets have been met, and this review should influence planning the actions for the following year. The Action Plan will need to be implemented by a number of stakeholders, who could form a “Socio-Economic Action Team” and should be involved in guiding the actions, priorities and budgets each year. It is expected that the estuarine management entity/manager will be ultimately responsible for delivering the action plan.

The Socio-Economic Action Team should be relatively small, focussed and involve the following stakeholders (Table 14).

Table 14. Stakeholders for the Socio-Economic Action Plan

Stakeholder	Why are they important for Socio-Economic actions?
Business Leaders	Representation from the Chambers of Commerce is important to build partnerships and identify business opportunities. Central Coast Tourism should also be involved in identifying opportunities for increasing tourism.
NSW Department of Natural Resources	Responsible for State Estuary Management - Review proposed actions and provide funding opportunities. Other agencies will need to be consulted for approvals and/or funding. These may include: • DPI (Fisheries) • Department of Lands • Department of Planning • Maritime Authority
Hunter-Central Rivers Catchment Management Authority	Provide advice on linking to the Hunter-Central Rivers CAP programmes to access grant funding.
Council Staff	Representatives from Natural Resources, Engineering and Strategic Planning should be involved to provide expert review guidance on the actions that they are expected to implement. Of particular importance is the need to link with strategic documents like the Cultural Plan.
Community Groups (as required)	*Recreational users* The estuary is used by a variety of recreational groups. These groups should be consulted to determine their needs and guide concept designs for particular locations.
	Precinct Committees These are an important local group who should be consulted where works/changes are proposed in their locale.
Committee/Advisory Board	Important for review of the proposed actions and how they relate to Estuary Management Plan goals and objectives.
Local residents	Any actions that involve on-ground works near to, or affecting local residents, must involve robust consultation with the residents. This allows for local knowledge to be incorporated into the design process and gives residents an opportunity to comment on the proposal.

Action plans are the primary tool for getting estuarine management happening “on the ground”. They describe how to meet estuarine objectives and address priority estuarine issues within budget and time constraints. It is important to identify the overarching objectives that the action plan needs to satisfy, so that subsequent revisions remain consistent (Table 15).

Table 15. Relevant Estuary Management Study Components

Principles (Catchment Blueprint)	• Human settlement, primary production and other land uses take place while protecting and enhancing Aboriginal cultural heritage, soil, water and ecosystem health • The coastal zone environment is protected whilst providing for the social and economic needs of the community.
Objectives (EMS)	• Ensure management of the estuary and catchment protects and enhances indigenous & non-indigenous cultural heritage • Provide economically and socially justified levels of development whilst containing ecological impacts • Support forestry, agriculture and other industries in the catchment while viability of downstream ecology is maintained • Support existing industry where it is ecologically compatible • Ensure any new commercial venture is socially and economically justified and is ecologically compatible with the estuary • Provide for public access and amenity at designated beaches and in designated recreation areas
Priority Issues - Why can't the objectives be met? (EMS)	• No ecologically sustainable target for catchment development (DC2) • Protective measures applied to development are difficult to monitor and enforce (DC3) • Human disturbance and built structures can threaten estuarine habitats (DF4) • Insufficient programmes or plans to determine land capability for the catchment (LS3) • Market forces drive development more than environmental protection (LD4) • Insufficient settlement, employment and conservation strategies (SC1)

7.1.3 How will these actions help?

The Estuary Management Study identified 27 programmes to address priority issues. Of these, 6 relate to socio-economic improvements for the estuary and catchment. The proposed programmes (called Priority Programmes and designated with a prefix of "PP") have been grouped according to estuarine management goals for socio-economic improvements over the next 5 years:

- Improve recreational facilities around the lakes and creeks
- Provide estuary positive business opportunities
- Develop sustainable targets for development
- Maintain creek mouths for navigation and water flow
- Maintain flow through the entrance

These goals are aimed at creating sustainable estuarine habitats, healthy, productive and less odorous foreshores, robust catchment habitats that link with the estuary, and further support for improved connections between the rivers and the lakes.

7.2 Goals for 2006-2011

7.2.1 Improve recreational facilities around the lakes and creeks

The lakes are an important recreational resource and it is appropriate for some public funds to go towards providing better facilities for lake users, including upgrading existing facilities where necessary, provision of new facilities and as mentioned above, a "flagship" project to highlight Council's focus on the long-term management of the lakes (Figures 31& 32).

In the first instance, it is proposed that Council document existing amenities and, based on this, commission consultants to detail a programme of new works using an extended community consultation process and including the citing of potentially available subsidies from State and Federal agencies. These new works should be aimed at attracting visitors, rather than simply providing basic facilities for people to use while they are visiting the lakes.

At present construction of new lakeside amenities has stopped and recommencement of construction and improvement will require a significant injection of funds over a long period of time. Once a programme has been agreed, implementation would be a matter for existing Council departments using contractors and /or consultants, as deemed appropriate. Whilst this is regarded as an area of second order priority, it is important because it provides the public with a direct association with the lakes and an obvious return for any expenditure they may be asked to incur because they live in the lakes catchment.

The existing foreshore recreational facilities already attract a large annual maintenance expenditure by Council. This is entirely a Council responsibility and one that is properly treated as a first order priority with an annual expenditure of $0.9 million per annum. This budget needs to be continued in perpetuity and if possible increased to cover renovation and/or improvement of ageing infrastructure. The principle methodology for the maintenance of these facilities should be based on the concept of life cycle asset management. It is proposed that maintenance expenditure be increased by an annual allocation of "new" money under this Socio-Economic Action Plan to address an outstanding backlog of necessary improvement and to cater for new facilities also proposed under the plan. It is believed that a higher standard of facilities would encourage the community back to the lakes and engender a sense of community pride that could be used to change the largely negative perception of estuarine health that has persisted for some years.

Figure 31. Recreational foreshore area in need of upgrading.

Figure 32. Sailing on the lakes.

Provide better facilities in foreshore recreation areas (PP6)

Benefits of meeting the target
Encourage the community to take pride in the estuary and gain an appreciation of how healthy it is.

Risks of doing nothing
Lack of community ownership, pride and support. Continued negative perceptions.

EMS Issues Addressed
Main Issue: (KC1) Existing community perceptions about estuarine health.
Other issues: SP5, SP1

Fixing a symptom/cause or providing an enhancement?
Enhancement
(addressing symptoms)

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
6.1 Undertake community consultation to determine interest groups and recreational requirements	Define what the community/users want at each location.			$5,000	**WSC**	Recreational sites	Yr 1	1 – Efficient planning
6.2 Identify and designate recreational locations. Develop prioritised works schedule addressing the interests of the various foreshore users	New facilities to match community/user demand. Programme should be revised annually. Consider providing moorings at select locations (Maritime Authority).		$10,000	$2,000	**WSC,** Maritime Authority	Recreational sites	Yr 1	1 – Efficient planning
6.3 Implement programme of works for new foreshore facilities and programme to encourage users back to the lakes (including boating facilities and business opportunities)	The facilities should be designed to bring people back to the foreshores. Facilities such as playgrounds, picnic/bbq facilities, sandy beaches, boat ramps (as noted in the EMS), sailing facilities, complete lake edge bike track and kite surfing.	$100,000		$1,000,000	**WSC**	Picnic Pt, Long Jetty, Berkeley Vale, Canton Beach, Elizabeth Bay, Wallarah Creek	Yr 1	1 – Locations known
6.4 Assess community response to the improvements	Determine community/user attitude towards changes and whether needs are being met.			$5,000	**WSC**	Modified recreational sites	Yrs 2 - 5	2 – Checking

Evaluation and Management

- Review community response to look for increase in use and improved community attitude towards the estuary. Community may not respond to this series of actions until work begins in these locations.
- Managed as part of Council's foreshore programme and events could be held as part of Council's Cultural Plan (e.g. kite surfing festival etc).
- This programme will need careful oversight to avoid a situation where all foreshores become recreation areas.

Reporting

- There is a need for strong publicity and reporting to the community on this part of the plan. The publicity/education material should highlight that the lakes and its activities are an essential part of their lifestyle,
- Council Management Plan, Cultural Plan
- Oversight by Estuary Manager, Estuary Management Committee and any Technical Advisory Body

Funding

- WADAMP
- Tourism/Business promotion opportunities?

Supporting Information

- Consider developing a vision and branding for foreshore areas (The Entrance Town Centre), rather than just providing facilities in the hope they get used.
- Works programmes include the provision of interpretive signage for education and compliance signage informing users about disposal of litter and waste.
- While Council has installed a number of recreational facilities on the foreshore, these are not part of a programme of new facilities, rather ongoing maintenance/upgrades of existing services (as covered in programme 21).
- The $100,000 start-up cost is based on the likely need for DA's, approvals from State Govt etc.
- The $1,000,000 is for works such as new amenities (picnic facilities, BBQ's, toilets), playgrounds, cycleways, paving, showers, boat/sailing/kayak/canoe launching facilities, sand importation and beach shaping.
- These funds could also be used to match with Govt grants.
- Any works should take into account appropriate environmental protection (e.g. erosion/boat wash protection/mitigation in boat launching areas).

Maintain foreshore recreation areas and beaches (PP21)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Ongoing provision of good beach conditions and facilities. People will continue to use the recreational areas in the long-term.	New facilities/monies are not managed	Some existing recreational facilities require upgrading (SP5)	Enhancement

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
21.1 Assess the maintenance required at each site to improve the visitor experience (clean beaches, wrack harvesting, beach nourishment)	The beachwatch/recreational water quality monitoring could be undertaken as part of foreshore maintenance, providing a strong feedback loop between conditions and mgt.		$10,000		**WSC**	Lakes beaches	Yr 1	2 – Efficient planning
21.2 Develop and implement a maintenance programme	Incorporate into an existing foreshore maintenance programme	$50,000		$1,150,000	**WSC**	Lakes beaches	Yr 1	2 – Efficient planning
21.3 Review the effectiveness	Revise appropriateness of maintenance schedules based on type and scale of usage				**WSC**	Lakes beaches	Yrs 2 – 5	3 - Checking

Evaluation and Management

- Management of these areas should be maximised for recreational enjoyment
- Review of community consultation to determine if maintenance routine is meeting the need (may need to develop key performance indicators for the “visitor experience”)
- Reviewing the effectiveness could be covered as part of the visitor surveys being conducted as part of PP 6.

Reporting

- Budget implications of this maintenance should be added into Council’s management planning

Funding

- Existing Council programme – additional funds unlikely from stormwater levy. Look to ordinary Council revenue.

Supporting Information

- If extended periods of no use are expected, consider installing removable facilities so that in quieter months, vandalism is minimised.
- Identifying the uses of the recreational areas could be documented with visual symbols and used to educate tourists about which recreational sites are suited to which activities.
- The $50,000 start-up cost is intended to cover the approvals required for some of the maintenance activities (particularly for seagrass wrack harvesting etc).
- The existing $900,000 annual budget is comprised of $280,000 for beach cleaning, $314,000 for the wrack harvester and $23,500 at each of the 13 foreshore maintenance areas.
- An additional $250,000 p.a. has been allocated to cover an enhanced maintenance programme (refurbishments where necessary) and the maintenance of any new works undertaken as part of PP6.

7.2.2 Provide estuary positive business opportunities

The estuary is a resource for humans as well as other animals and plants. While the preceding actions were focussed on providing recreational facilities for lakes users, the following actions are aimed at engaging business in order to provide opportunities and seek co-operative solutions to problems. Historically, estuarine-based business needs have not been well documented, and consequently business proposals are not considered as part of an overall programme. Tourism is often touted as a driver for work in the lakes however, there is no information from tourism groups on why people visit Tuggerah Lakes, what they do when they get here, and what improvements they would like to see.

It is expected that the establishment of a “Friends of the Lakes” business group would provide a forum for discussing lake-based business opportunities within the context of maintaining a sustainable lake environment. It is expected that the budget for this programme could also be used to address key knowledge gaps (such as lake-based tourism) that will help identify with future business opportunities and guide the implementation of new facilities and services. This action could bring significant benefits both to the lakes wellbeing and to ongoing funding. It is again an initiative that needs to be addressed by the estuarine manager in the first instance but one that may be carried entirely by the private sector once opportunities are identified.

Figure 33. Promote and enhance existing business opportunities.

Develop partnerships with business to solve common problems and improve economic opportunities (PP14)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Opportunities for business that are also good for, and encourage more use of, the catchment and the estuary.	Business is not a partner and so opportunities are lost to solve common problems and encourage compatible business	Main Issue: (SE1) Little understanding of what existing industries need from estuary Other Issues: LA1, LA2, LD2, LS1, WE3, WP1, DC1, DC3	Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
14.1 Establish a "Friends of the Lake" business forum	This is important to recognise the role that business plays around the estuary and catchment. Their partnership is important.	$5,000		$5,000	**WSC** Business leaders		Yr 1	1 – Urgent
14.2 Devise initiatives/programmes that solves estuary/catchment management problems and still integrates business with estuary requirements	Look for business opportunities, and obtain business input/advice on solving estuary and catchment problems through partnership and sponsorship			$20,000	**WSC** Business leaders		Yrs 2 – 5	2 – Implementation
14.3 Assess the initiatives and field test them	Assess the programmes that are then put in place to determine if they benefit both the estuary and business.	$5,000		$100,000	**WSC** Business leaders		Yrs 2 – 5	2 - Checking

Evaluation and Management

- Review is important to show profitability and achievement of good estuary outcomes
- Business groups have requested opportunities for sponsorship but not administered by Council. This was part of a larger concern about Council managing the relationship with business.
- Such a problem would be overcome by an independent estuary manager, or a Council manager with independent oversight by an advisory group.

Reporting

- Allowance for logos on signs/brochures etc for programmes that businesses sponsor
- Success should be reported by Chambers of Commerce and Council
- Good media coverage of business partnerships is also important

Funding

- Sponsorship from Business
- Resources from Council

Supporting Information

- This is a very important relationship. In the Estuary Management Study, it was identified that business needs were not well understood, and there is a historic lack of dialogue over catchment and estuary management issues.
- There are a number of opportunities for encouraging business on the lake.
- Business may also provide some unique and sustainable solutions to estuary and catchment management problems.

7.2.3 Develop sustainable targets for development

During the development of the Estuary Management Study, a number of groups including the Estuary Management Committee made the observation that regional planning for new development does not consider the impact of the resulting pollutant load on the creeks and estuary. It was felt that a key part of estuary management should involve identifying the likely “carrying capacity” of the estuary and its catchment. This would minimise the likelihood that the estuary will return to the eutrophic state of the late 1980’s.

The observation has been made in focus groups, that the regional planning process is often based on whatever information is available at the time, rather than a defined set of pre-requisite studies (environmental impact, social impact, economic impact, infrastructure impact etc.) that could be used to develop an optimal number for new development sites. While identifying the “carrying capacity” will be a difficult process, it was felt that it should be undertaken so that it can inform this regional planning programme. It is important to consider that such a strategy could also designate the increases in carrying capacity associated with good environmental practices such as the installation of high quality stormwater management devices.

Ensure development is based on sustainable catchment and estuary management principles (PP12)

Benefits of meeting the target
New development will be compatible with long-term estuary health. Understanding the limits will give more certainty to development

Risks of doing nothing
Estuary may pass critical threshold and turn eutrophic again, resulting in degradation of existing estuarine and creek habitat

EMS Issues Addressed
Main Issue: No ecologically sustainable target for catchment development (DC2)
Other Issues: SC1, VF2, SC2, DF3, SE2, SE3, LS3, WF1

Fixing a symptom/cause or providing an enhancement?
Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
12.1 Assess the need/feasibility for determining the limits of impact the lake can sustain before irreversible change	Likely to be difficult to determine and implement locally. However, outcomes could be made available for planning at a regional level.		$10,000		**WSC**	Catchment	Yr 1	1 – Keystone
12.2 Determine load and flow changes under a range of development scenarios and assess estuarine processes to determine "tipping point"	This should provide some understanding of how close to tipping point the estuary is.		$500,000	$10,000	**WSC**	Catchment	Yr 2	2 – Efficient planning
12.3 Include as a consideration in population planning	If social, economic and environmental limits are known, they are likely to be included in planning.		$10,000	$2,000	**WSC**, Department of Planning	Catchment	Yr 3 – 5	3 – Less likely to be used

Evaluation and Management
- Calculate catchment load inputs, environmental flow requirements (as part of action 24.2) and investigate estuarine processes that buffer catchment impacts
- Co-ordinate with Department of Planning to determine what is required to inform their plan process
- Ensure sensitivity analysis is completed when setting limits. If there is a big range in results, the datasets may not be that useful

Reporting
- Use this information to represent Council's interests at planning events
- Council Management Plan, Strategic Landuse Plans
- Inform Stormwater Management Plan on appropriateness of treatment targets in new development areas

Funding
- s.94 funds
- H-CRCMA programmes for advanced planning

Supporting Information
- Given current understanding of buffering processes, determine what order of magnitude is likely to tip the estuary back to the status it was in the late 1980's.
- This is a high-risk project that may not reach a useful/implementable conclusion – it could still be ignored during regional planning simply because it doesn't have a place for consideration. This should be resolved in 12.1.
- The information should still be an important focus for Council. If it can establish likely limits, it may be useful in negotiations with State and Federal governments over grant funds for instance.

7.2.4 Maintain creek mouths for navigation and water flow

The dredging of sediments from the mouths of rivers and creeks draining into the estuary is a controversial issue (Figure 34). Such deposits are natural in principle but their volume is exacerbated due to catchment clearing and bank erosion. While creek entrance shoaling can have an adverse impact on water quality in the lower estuarine reaches of affected creeks, the blockage is primarily a navigation problem. As such, it needs to be addressed for both ecological and anthropogenic reasons and the Estuary Management Plan proposes a significant allocation to keep the mouths of tributary creeks open, to both facilitate navigation and the exchange of water and estuarine fauna between the lakes and the creeks.

Generally, dredging is a contentious and very costly responsibility for Council. At present the approval process can cost more than the dredging operation itself and disposal of dredge material can cost more than its extraction. Both the approval and disposal costs can be entirely unreasonable in comparison with the issue they are addressing. In this Action Plan, it is suggested that an overall rolling programme be designed and approved for all the creek mouths including cost effective disposal strategies. Responsibility for making this happen would be Council's with assistance from the Minister for the Central Coast in regard to gaining assistance from the State Government.

Figure 34. The mouth of Tumbi Creek became blocked in 2001.

Maintain creek mouths for navigation and water flow (PP19)

Benefits of meeting the target
Creek mouths remain open for boating and to allow water flow to and from the estuary

Risks of doing nothing
Excess sedimentation can produce an increased flood risk, navigation hazards and reduced flow

EMS Issues Addressed
Main Issues: Risk of flooding (WP3)
· Sedimentation, weirs, drains and river crossings can create migration barriers and affect natural flows (WP2, WF2)

Fixing a symptom/cause or providing an enhancement?
Symptom

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
19.1 Assess all creek entrances and determine the need for dredging and identify causes of sedimentation			$45,000		**WSC**, DNR, Maritime, Lands, DPI (Fisheries)	Saltwater, Tumbi, Ourimbah, Wyong, Wallarah, Spring	Yr 1	1 – Keystone
19.2 Develop remediation plans where sedimentation can be minimised (tie to programmes in PP1)	This is an important part of programme 1 and should be linked to it.		Costed elsewhere		**WSC**	Saltwater, Tumbi, Ourimbah, Wyong, Wallarah, Spring	Yr 2	2 – Keystone
19.3 Develop a rolling plan for dredging creeks that need it.			$30,000	$5,000	**WSC**, DNR, Maritime, Lands, DPI (Fisheries)	Saltwater, Tumbi, Ourimbah, Wyong, Wallarah, Spring	Yr 2	3 – Efficient planning
19.4 Implement the dredge programme and the remediation programme and obtain rolling approvals (NB. remediation is costed in PP1).	The approvals process can be time consuming and costly. If possible, an “all in one” approval should be obtained.	$100,000		$500,000	**WSC**	Saltwater, Tumbi, Ourimbah, Wyong, Wallarah, Spring	Yrs 3 – 5	2 – Implementation
19.5 Review effectiveness of programmes and feed back into management planning.				$10,000	**WSC**, DNR, Maritime, Lands, DPI (Fisheries)	Saltwater, Tumbi, Ourimbah, Wyong, Wallarah, Spring	Yrs 3 – 5	3 - Checking

Evaluation and Management

- Measure a reduction in need for dredging and tie to improved stormwater management and streambank rehabilitation programmes
- Measuring sedimentation would be ideal but it is likely to be difficult (measurement of delta dynamics is more likely)
- Consider the implications of the approvals process and factor it in to planning any dredging works

Reporting

- Agencies would expect oversight of this process and should be involved from inception
- Consider the preparation of an overarching dredging management plan that could control all dredging activity in the lake. It might make it easier to be obtain rolling approvals (especially if tied to ongoing entrance dredging. This could be used to routinely report to Council.
- All dredging activity should be reported in the SOE.

Funding

- Potential for State Agency funding
- H-CRCMA programmes are unlikely to cover this on a rolling basis.

Supporting Information

- The $100,000 start-up cost for the dredging programme is to cover the cost of necessary approvals. This figure could be revised upwards to $200,000 depending on the requirements of the agencies (e.g. if a detailed REF is required for each location).
- The dredging of river mouths was considered to be undertaken on an “as needs” basis and as such no existing annual budget was included.

7.2.5 Maintain flow through the entrance

Unlike Tuggerah Lakes, Lake Illawarra does not have a dredge to maintain an open entrance and it has recently suffered major water quality and depth-related problems as a result of extended periods of closure, thereby reinforcing the potential importance of an effective entrance. As indicated in the Estuary Process Study, ocean water exchange (Figure 35) is equal to the total exchange associated with rainfall (and subsequent polluted stormwater) and groundwater. Council currently expends in the order of $0.34 million per annum on this activity. It is proposed that this investment should continue as a first priority action under the plan with only a small additional allocation proposed. The "new" funds would facilitate an assessment of the impact of dredging on physical, chemical and biological processes in the estuary and in the longer term provide for increasing maintenance costs associated with the dredge.

Figure 35. The entrance to Tuggerah Lakes.

Maintain current flows through the entrance (PP18)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Minimise flood risks, allows exchange of ocean water and provides a tourist attraction.	Potential for loss of tourism, and small potential for an increase in flood risk	Main Issue: Risk of flooding (WP3) Other Issues: WE6	Enhancement

Proposed actions:

Action		Comments	Cost			Responsibility	Implementation		Priority
			Start-up	Implement.	Ongoing		Location	Timeframe	
18.1	Provide funding and resources for the continuation of the dredging programme	Current programme has a flooding and entrance tourism based focus. Been in place for over 10 years.	$10,000		$350,000	**WSC** DNR DPI (Fisheries)	The Entrance	Yr 1 – 5	1 – Efficient planning
18.2	Assess ocean entrance dredging effects on key estuarine/physical processes	Need to understand the positive and negative impacts that the current dredging programme may be having (consider implementing via programme 23).	$10,000	$350,000		**WSC** DNR DPI (Fisheries)	The Entrance	Yr 1 – 5	1 – Checking
18.3	Develop flood, safety and ecological triggers that aid in determining dredging requirements/timing	This will assist in decision-making and timing of actions	$10,000	$5,000		**WSC** DNR DPI (Fisheries)	The Entrance	Yr 2 - 5	3 – Efficient planning
18.4	Review the dredging programme in light of any new information	New information should determine whether changes are needed for the type/location/timing of the dredging			$10,000 (2 yrly)	**WSC**	The Entrance	Yr 2 – 5	2 - Checking

Evaluation and Management

- Series of triggers will help take any subjectiveness out of the decision-making regarding entrance dredging. The process becomes more transparent.
- Entrance management regime may have improved the ecology, but we need to assess this and assess the benefit it provides for flood mitigation.

Reporting

- Entrance management operations should be reported back to the agencies (especially DNR and DPI (Fisheries))
- Expenditure and outcomes should be reported back to any technical advisory board and the Estuary Management Committee
- Given its importance, the programme should also be covered in Council's Management Plan and in the SOE.

Funding

- DNR Estuary Programme
- Research funds via university partnerships/research grants (link to programmes 13 and 23)

Supporting Information

- A second entrance is not recommended
- A permanent entrance is unlikely to provide a good cost/benefit outcome and would have unknown effects on the lake system.
- The development of the triggers should link to the amplitude model that is already in use.

Figure 36. Map showing locations of Socio-Economic Programmes

7.3 Implementing this action plan

7.3.1 Budget

The current Council expenditure on social/economic activities is approximately $1.24 million p.a. This Action Plan identifies approximately $3.42 million of annual social/economic improvement funds, which means approximately **$2.18 million p.a. of new funds** are required.

7.3.2 Assigning Priorities

The priority programmes under this action plan are all important. Their relative priority is very difficult to judge and will change depending on current knowledge, available budget etc. As such, an assumption has been made that their relative priority should be equal. However, priorities have been assigned within each priority programme to guide Council as to which action should be implemented first and why. These are ranked from 1 (most important/urgent) to 3 (least important/urgent).

7.3.3 Agreeing to responsibilities

An important part of working with stakeholders is reaching agreement on which organisation has responsibility for implementing the various actions. Council retains care and control of most foreshore areas of Tuggerah Lakes and as such will be responsible for implementing most of the actions on the ground (such as new facilities). However, this responsibility should be balanced by partnerships with business and user groups to ensure funds are being distributed appropriately. As much of the foreshore is Crown Lands, liaison with the Department of Lands will be important in site planning and granting any approvals.

7.3.4 Liasing with affected residents/stakeholders

When works are proposed as part of this action plan, affected residents, businesses and stakeholders should be involved at the earliest opportunity. This will ensure that local knowledge is made available to the design process, and that affected parties have every opportunity to provide comment on actions that impact on them.

7.4 Reviewing and adapting

7.4.1 Review

This action plan should be reviewed in time for the budget planning process that precedes each financial year. The review should focus on:

- Management targets met
- How much of the budget was spent
- Whether projects succeeded or failed and the lessons learnt

- Community and business support
- Prioritising and budgeting next years work

7.4.2 Reporting

It is important that the success of these programmes be reported back to Council, appropriate agencies, organisations part funding the programmes, and most importantly the community. In terms of linking with key documents, it is recommended that Council's Management Plan reflect these Action Plans as the primary vehicles for delivering estuarine management outcomes on a year-by-year basis, guided by the 5-yr Estuary Management Plan.

8 Knowledge and Management Action Plan

8.1 Outline

8.1.1 Why is knowledge and management important for the estuary?

Knowledge and understanding are an absolute necessity for effective management of the estuary. Whilst the estuary processes and management studies provided a good synthesis of current knowledge, they also highlighted the extent of uncertainties. It is therefore necessary to always focus a section of the budget on filling such gaps in understanding of natural and physical processes.

The main objective of this Action Plan is to continue to learn about how the estuary “works” so that management of the estuary continues to target the right issues and use the most appropriate responses. This plan involves providing the estuarine manager, Council staff and the community with a better understanding of the estuary, and applying that understanding to managing its long-term health. A better understanding will specifically involve developing and implementing a system for identifying and understanding other key estuarine questions. It also means passing on current information to the community about the estuary and its health as well as obtaining ideas from the community and utilising university partnerships.

Whilst this action plan proposes that on-going management absorbs only 5% of funds, it is regarded as a first priority matter for consideration by the Estuary Management Committee and subsequent recommendation to Council. Experiences by other Councils with major estuarine responsibilities suggests that an identified estuary management entity with on-going estuarine health as its prime focus, is a prerequisite to effective delivery of the Estuary Management Plan.

To discharge these functions effectively, it is envisaged that 2 or 3 new positions would need to be created as was the case for Lake Macquarie and Lake Illawarra. Funding of such positions would form the main component of "new" funds allocated to the associated priority programme.

8.1.2 Who should be involved and what should they be trying to achieve?

The Action Plans are an annual document that will help meet the Estuary Management Plan goals for Water Quality, Ecology, Social and Economic Opportunities, and Knowledge and Management for the next 5 years. Every financial year, each Action Plan should be reviewed to see if targets have been met, and this review should influence planning the actions for the following year. The Action Plan will need to be implemented by a number of stakeholders, who could form a “Knowledge and Management Action Team” and should be involved in guiding the actions, priorities and budgets each year. It is expected that the estuarine management entity/manager will be ultimately responsible for delivering the action plan.

The Knowledge and Management Action Team should be relatively small, focussed and involve the following stakeholders (Table 16).

Table 16. Stakeholders for the Knowledge & Management Action Plan

Stakeholder	Why are they important for knowledge & mgt actions?
NSW Department of Natural Resources	Responsible for State Estuary Management - Review proposed actions and provide funding opportunities. Where beneficial consult with other agencies for expert guidance and approvals such as: • DEC • DPI (Fisheries) • Department of Lands The guidance of State Agencies will be very important in establishing and creating the charter for an estuary management body.
Hunter-Central Rivers Catchment Management Authority	Provide advice on linking to the Hunter-Central Rivers CAP programmes to access grant funding.
Council Staff	Representatives from Natural Resources, Engineering, Strategic Planning and Education should be involved to provide expert review/guidance on the actions that they are expected to implement. Human Resources will also be important to involve in actions related to staff development and training.
Community Groups (as required)	*Rehabilitation* A significant amount of rehabilitation and management of catchment habitat is undertaken by community groups like Landcare. They should be consulted and where appropriate guided on projects they could be involved in. Community groups can often access special grants that could be used to reduce the funds required by Council. *School Groups* Indigenous groups (e.g. Darkinjung) should be consulted to ensure that proposed actions do not impact on significant sites or cultural activities. In some cases it may be possible for traditional land management practices to be reinstated as part of ecological management. *Oversight* In the establishment of any new estuary management body (especially those using special levy funds) it is important that the community have an appropriate level of oversight. Representatives should be included as part of such a body.
Committee/Advisory Board	Once it has been established, it will be important for review of the proposed actions (especially the new research goals) to ensure they relate strongly to Estuary Management Plan goals and objectives.

Stakeholder	Why are they important for knowledge & mgt actions?
Local residents	Any actions that involve on-ground works near to, or affecting local residents, must involve robust consultation with the residents. This allows for local knowledge to be incorporated into the design process and gives residents an opportunity to comment on the proposal.

Action plans are the primary tool for implementing estuarine management "on the ground". They describe how to meet estuarine objectives and address priority estuarine issues within budget and time constraints. It is important to identify the overarching objectives that the action plan needs to satisfy, so that subsequent revisions remain consistent (Table 17).

Table 17. Relevant Estuary Management Study Components

Principles (Catchment Blueprint)	• Improve knowledge of catchment and estuarine systems
Objectives (EMS)	• Identify extent of information gaps and where appropriate undertake studies to improve understanding • Ensure community is pro-actively involved in estuarine health and management
Priority Issues - Why can't the objectives be met? (EMS)	• Limited funding for works to rehabilitate and manage land (LS4) • Insufficient environmental impact modelling or pre-development ecological assessments (SC2) • Community scepticism about available estuarine knowledge, management intentions and management approach (KC2) • Funding and resourcing further studies into estuarine processes, health trends and key management questions (KG1) • Understanding of key estuarine processes is not complete (KG3) • Existing community perceptions about estuarine health (KC1) • General public are not actively informed through the most effective media channels (KC4)

8.1.3 How will these actions help?

The Estuary Management Study identified 27 programmes to address priority issues. Of these, 5 relate to improving knowledge of the estuary and provide for its long-term management. The proposed programmes (called Priority Programmes and designated with a prefix of "PP") have been grouped according to estuarine management goals for knowledge and management over the next 5 years:

- Establish an estuary management body
- Learn more about key processes in the estuary
- Develop partnerships with universities

- Provide the community with current information on the estuary

These goals are aimed at creating a platform for transparent, sustainable well-funded management of the estuary for future generations.

8.2 Goals for 2006-2011

8.2.1 Establish an estuary management body

Management of the Tuggerah Lakes system is a defacto responsibility of Wyong Shire Council because the lakes and their catchment fall within the confines of the shire and the public expect such a local icon to be looked after at a local level. The Department of Lands is the owner of the estuary however DPI (Fisheries), Waterways or National Parks or some other government agencies are often cited as potential estuarine managers. All have defined responsibilities, that on their own, do not cover the broad spectrum of managerial issues that need to be considered for the estuary.

This was considered to be the highest priority action in the Estuary Management Plan. A robust estuarine management entity is needed to guide the delivery of the actions in the Plan, allocate funding and liaise with key stakeholders. During the development of both the Estuary Management Study and the Estuary Management Plan, community groups consistently voiced their concerns about Council continuing to manage public funds for estuarine management. These concerns were primarily related to a perceived lack of transparency and actions by staff on-the-ground. While it is not being suggested that Council warrants this criticism, there is a strong need to overcome these perceptions. Given the need for a body to manage the increase in funding, responsibility and effort in estuarine management, it is an appropriate time to create a body that will help break these perceptions.

There are a number of estuarine management models in existence in NSW. It is not the place of the Estuary Management Plan to impose a particular model, rather to recognise the need, make recommendations and establish budgets and guidelines so that a model can be chosen and implemented. The characteristics that are recommended for an estuarine management body include:

- Transparent and accessible to the community
- Accountable for preparation and implementation of annual action plans
- Report all relevant current information to the community and other stakeholders

There are two potential models for such a body. The first model could involve establishing a body within Council as a new unit, or within an existing unit. An estuarine management body within Wyong Shire Council would need its own administrative structure with a public face designed to accept accountability for estuarine management and funds. It would also require powers sufficient to steer other areas of Council's administration towards estuarine friendly activities. Council would need to conduct an internal review with the intent of establishing an estuarine management unit within its administration structure as soon as practical. This new unit would be fully funded using both existing

resources and additional funds raised to address overall estuarine health. In this regard it is suggested that internal management costs be capped at no more than 5-10% of total Council expenditure.

The second model could be a specially created and independent “Tuggerah Lakes Authority” which would require its own administration and funding. There are existing models for such authorities, including the Lake Illawarra Authority and the Office of the Lake Macquarie and Catchment Coordinator.

Whichever model is selected, appropriate levels of management and funding oversight will be required of an independent body comprising representatives from relevant community groups, technical experts, business groups and State Agencies.

Once the body has been established its main priority will be to implement the Estuary Management Plan and allocate funding to priority actions. Council is implementing a stormwater levy to raise revenue for some components of the Estuary Management Plan, however there is likely to be a funding shortfall, and as such it will be important to secure additional ongoing funds. It is understood that Council already expends a very credible sum of circa $2.5 million per annum for estuarine management activities. However, it falls short of the total need identified in this Management Plan and it is therefore strongly recommended that Council seek further long-term sources of revenue raised and applied directly to benefit the long-term management of the estuary.

Identify and assist the organisation who will manage and implement the estuary management plan (PP15)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Single independent entity responsible for implementing the EMP and creating more transparency/accountability	Estuary funds could be redistributed to other Council needs. Projects may not be as targeted to estuarine outcomes, or subject to rigorous evaluation.	Main Issue: (KC2) Community scepticism about estuarine knowledge, management intentions and management approach. Other Issues: KG2, KG1	Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
15.1 Develop an organisational model for implementing the estuary management plan, educating staff and the public, liaising with users etc.	This is one of the most critical components of the plan. Focus groups revealed a desire for Council not to be the controlling estuarine management authority.	$1,000	$30,000		**WSC**		Yr 1	1 – Keystone
15.2 Establish the estuary management body based on the management model.	Ensure adaptive management and independent peer/technical review be built into the charter or position.	$250,000		$290,000	**WSC**		Yr 1	1 – Keystone
15.3 Review the effectiveness of the team	This should be an independent assessment				**WSC**		Yrs 2 – 5	2 – Checking
15.4 Consult with the community to determine satisfaction with the administration of estuarine programmes. Revise administration if required.	This is important for building and retaining community confidence in the estuary management approach.				**WSC**		Yrs 2 – 5	3 - Checking

Evaluation and Management

- Management decisions must be transparent and public
- The estuary management entity must be seen as accessible and independent and in control of estuarine funds
- Effectiveness could be measured by resource allocation/ projects completed/stakeholder satisfaction

Reporting

- Estuarine management logic, plans, projects, budgets and current information should be made available in various forms for public scrutiny
- The estuarine management entity should be accountable to an independent technical advisory board (representing all stakeholders and agencies) and the Estuary Management Committee
- The operations, management and achievements of this entity should be reported back through Council's Management Plan and the SOE.

Funding

- Unlikely to be fundable under the stormwater levy
- Consider directing stormwater levy funds to existing stormwater management programmes within Council and directing their existing budget to estuary management activities such as this mgt entity.

Supporting Information

- A number of models could be used, and would need to be discussed with the community (Lake Macquarie Catchment Co-ordinator, Lake Illawarra Authority and Hornsby's Estuary Manager, are all possible models).
- The estuarine manager must be overseen by an independent technical advisory group comprising all stakeholders. It's meetings should be open to the public and published for viewing.
- These costs assume that the unit is established within Council but requires its own resources. If after a period of time the community felt that the unit was not sufficiently independent, its structure and association with Council may be revised.
- The $290,000 cost assumes $50,000 of office space and $120,000 per staff member to cover costs of salaries, equipment (cars, boats etc).
- The calculations assume two full time staff members.

Develop strategies for securing ongoing catchment and estuary management funding (PP16)

Benefits of meeting the target	Risks of doing nothing	EMS Issues Addressed	Fixing a symptom/cause or providing an enhancement?
Catchment and estuarine management can provide ongoing outcomes.	Many of the important catchment management projects will never be funded or undertaken	Main Issue: (KG1) Lack of funding and resourcing for further work on key management questions Other Issues: LS4	Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
16.1 Review spending and effectiveness of any environmental levy	This is important for the community and should be made transparent.			$20,000	**WSC**		Yrs 2 – 3	3 – Efficient planning
16.2 Evaluate additional funding strategies (grant funds)	Grant and partnership opportunities change rapidly and the estuarine management entity will need to keep pace.		$50,000		**WSC**		Yr 1	2 – Efficient planning
16.3 Link to management reporting (especially Council's Management Plan)	Council and the community should be able to see where the funds are being spent and why.			$5,000	**WSC**		Yr 1	3 – Checking

Evaluation and Management

- Consider using business partnerships (sponsorships) to access small funding opportunities
- Spending efficiencies can be reviewed by looking at effort and how things have improved
- Great care should be taken in selecting performance indicators than can be demonstrated.

Reporting

- Councils Management Plan
- Funding sponsors (including State Agencies)

Funding

- There may be some conflicts if Council levy's are applied along with any future H-CRCMA levy.

Supporting Information

- This programme was identified in the Estuary Management Study. It represented the historical difficulty in getting money to do programmes. The raising of a levy will aid this process to an extent (depending on $ raised).
- The objective of this programme is to identify and secure ongoing funding and make any expenditure explicit and transparent.
- The actions that have been listed are designed to review the levy and its ability to achieve estuarine and associated catchment management objectives.

8.2.2 Learn more about key processes in the estuary

There will always be new issues and questions that arise and need to be understood and managed over the long-term future of any management of the estuary. With this in mind, it will always be necessary for estuarine managers to assign resources to investigate issues either on their own or in combination with others be they agency, NGO, private sector or other public bodies.

This goal is a very important one for future management of the estuary and is also an essential part of the adaptive management approach. It is important to be clear that this is not about research for research sake. It is about identifying the key data gaps that make it difficult to apply good management. Once these gaps have been filled, more targeted managerial actions can be applied, resulting in more efficient use of public funds and less disturbance to an already highly pressured system. It is worth noting that the most successful information technology companies in the world (XEROX, Kodak, IBM and AT&T) recognise the importance of research and development, typically reinvesting about 10% of corporate earnings back into research and development (Gill, 1997). This plan proposes spending approximately 4% on answering key questions into the future.

There are a number of processes that are not well understood, however the highest priority question is about how the freshwater inflows (stormwater and flow from the creeks) interact with the shallow nearshore waters of the estuary. The current model assumes that stormwater continues to have a negative effect on these nearshore areas, however it may be the case that under flood conditions the scale of impact from the rivers may far outweigh the impact of the stormwater pollutant load. This question is highly significant as it may result in a change to the amount of funds that are allocated to stormwater over upper catchment management.

The other significant questions that should be considered in the next 5 years include the scale and health of the fishery, development of bio-indicators to help identify shifts in estuarine ecology, groundwater pollutant flows and the impact of sea level rise. Of these issues, sea level rise associated with climate change has the potential to be the most significant and impacts requiring research may include:

- Flooding of low-lying properties.
- Scouring of entrance channel and surrounding edges.
- Increased need for erosion protection will probably take precedence over environmental protection (i.e. seawalls built to protect property rather than allow inundation and ecological response).
- Loss of seagrass habitat with increased depth (decreasing light penetration).
- Ecological reactions to changed environmental conditions (fisheries suffer as seagrass habitats change).
- Loss of freshwater wetlands close to the estuary.

Continue to learn about how key parts of the lakes work so that they can be managed better (PP23)

Benefits of meeting the target
Estuary will always be managed using the best available information and therefore funds will be spent wisely

Risks of doing nothing
Expensive options/actions may be misdirected or have no effect

EMS Issues Addressed
Main Issue: Understanding of key estuarine processes is not complete (KG3)
Other Issue: KG3, WH1

Fixing a symptom/cause or providing an enhancement?
Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
23.1 Resolve outstanding high priority management questions	The mixing question must be answered as soon as possible. Other high priority questions are listed below.	$10,000	$500,000		**WSC**		Yr 1	1 – Urgent, Keystone
23.2 Develop a process for identifying new management questions	This should be linked to the renewal of these action plans and other key operational documents		$2,000		**WSC**		Yr 2	2 – Efficient planning
23.3 Develop a protocol for undertaking the research including QA/QC procedures such as peer review	Have these procedures reviewed/overseen by a technical advisory board		$5,000		**WSC**		Yr 2	2 – Checking
23.4 Undertake data collection and assessment	This could be done in-house with appropriate oversight or use universities.			$220,000	**WSC**		Yr 1 (for known)	1 – Implementation
23.5 Develop a process for incorporating new knowledge into management planning and programmes	This should link to relevant Council plans and also be reflected in the education material.		$100,000		**WSC**		Yr 2	2 - Checking

Evaluation and Management

- These questions are not “research for interest”, they are important questions that must be answered to help direct funds and management efforts.
- This work should be done under close supervision from an independent technical/scientific advisory board to ensure programmes are robust and defensible

Reporting

- New knowledge should inform key management planning documents like the estuary management plan, the stormwater management plan etc.

Funding

- For the mixing question, the levy could be used as it will have a strong influence on stormwater management
- H-CRCMA programmes may be used if the research is linked to rehabilitation programmes
- University partnerships will be very important for funding and ensuring best available information is used.

Supporting Information

- The existing questions include the “mixing” question, sustainable fisheries, development of bio-indicators, groundwater contributions and the impact of sea level rise.
- This is a critical component of adaptive management and necessary for helping to manage the estuary effectively.
- Sources of faecal coliforms, importance of environmental flows and the impact of the ocean entrance programme are dealt with in their respective priority programs.
- The $220K as an annual cost is $200,000 per year for the research programmes and $20,000 for contract preparation, briefs and project management.

8.2.3 Develop partnerships with universities

This is a programme that is already in place in an informal way, with for example Sydney University and the University of Newcastle. The goal is to formalise these relationships so that the best academic expertise can be brought to bear to solve difficult estuarine management problems. It also provides the community with confidence that the measures being employed are likely to be best practice, and therefore that their funds are being used efficiently. This is a third order priority area that requires an initiative and minor funding to support significant work effort by universities.

Universities should be actively sought that can assist in answering and reviewing key estuarine management issues, particularly those being investigated as part of the “answering key questions” goal above. The main cost of this goal is in providing funding support for students to assist in key estuarine programmes. Funds should therefore be put aside to cover contributions to universities for joint ARC Linkage grants and other joint partnerships as appropriate. The overall cost of this programme is relatively small, particularly considering the importance of effective use of public funds.

Develop partnerships with universities to get innovative approaches to catchment and estuary management (PP13)

Benefits of meeting the target
Cost-effective way of accessing high quality, best practice information on new ways of managing the catchment and estuary.

Risks of doing nothing
Application of incorrect or inappropriate technology that creates problems and wastes funds.

EMS Issues Addressed
Main Issue: Difficult to fund and resourcing further studies into estuarine processes, health trends, and key management questions (KG1)
Other Issue: (KG3)

Fixing a symptom/cause or providing an enhancement?
Enhancement

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
13.1 Identify academic institutions and researchers with expertise to review existing catchment management practices	Review literature to determine experts in respective fields		$1000		**WSC**	Catchment & estuary	Yr 1	2 – Efficient planning
13.2 Develop memoranda of understanding between Council and the universities	Important to understand and reach agreement on intellectual property and the universities commercial consulting structure		$5000		**WSC**	Catchment & estuary	Yrs 2 – 5	3 – Efficient planning
13.3 Sponsor research programmes that answer management questions (see PP23)	Supports programme 23.	$1000	$1000	$50,000	**WSC** University	Catchment & estuary	Yrs 1 – 5	2 – Implementation
13.4 Feed this information back into management plans (see PP23).	Supports programme 23.		$2000		**WSC**	Catchment & estuary	Yrs 1 – 5	2 - Checking

Evaluation and Management
- This arrangement should be used particularly where the response might cause a major shift in approach (especially in answering the key mgt. questions in programme 23). It will add weight to any findings.
- Care should be taken to avoid using junior students who would have less oversight.

Reporting
- Results should be published in relevant literature with estuarine management staff encouraged to make contributions so that the organisation becomes recognised for its estuarine management efforts.
- SOE, Councils Management Plan (especially where information cause a change in management approach)
- Appropriate Council documents (e.g. DCP's and operational plans)

Funding
- There are opportunities for research grants for projects involving the universities
- H-CRCMA funding is more likely if the grants are part of an overall rehabilitation plan

Supporting Information
- This programme is in place informally, with the University of Sydney and the University of Newcastle being involved in a number of projects over the last 10 years.
- The $50,000 annual sponsorship programme was anticipated to sponsor student projects.

8.2.4 Provide the community with current information on the estuary

This is a Council responsibility that can be addressed at many levels from on ground signage through local schools, through publications and in many other ways. It is another second order priority that needs to be encouraged by an estuarine management unit using the extensive public education resources available to Council, which already expends up to $0.15 million in this area annually.

One of the key difficulties in engaging with the community is the lack of information made available on the current state of the estuary. During the development of the Estuary Management Study it became apparent that a number of myths about the health and condition of the lakes still persist. The estuary is a highly valuable community resource and as such, the community must be kept informed of its condition, issues and management approach. Given the implementation of a stormwater levy, it will become even more important to report back to the community so that they are aware of how their money is being spent. Thought should be given to creating an “estuary brand” that allows the community and stakeholders to immediately identify estuarine information/programmes.

Another issue raised by community focus groups was the perceived lack of estuarine knowledge and responsible practices by Council. There is no suggestion that this a widespread problem, however isolated incidents can tarnish the efforts of many, and there is a need for the major estuarine manager to have a consistent approach to estuarine management across all its business areas. It is recommended that Council staff be provided with appropriate levels of training in estuarine condition and management to address this risk.

Provide the community with up to date information on the estuary (PP25)

Benefits of meeting the target
Community that is in touch with the estuary and able to offer good feedback on estuarine management actions and priorities

Risks of doing nothing
The community will not be able to hold Council/estuarine manager accountable – their opinions will be less relevant if they are based on outdated or inaccurate information

EMS Issues Addressed
Main Issue: Community are not actively informed through the most effective media channels (KC4)
Other issues: KC1, SP4, KC2, KC3

Fixing a symptom/cause or providing an enhancement?
Cause

Proposed actions:

Action	Comments	Cost			Responsibility	Implementation		Priority
		Start-up	Implement.	Ongoing		Location	Timeframe	
25.1 Preparation and implementation of community education programme focusing on residents, tourists, and school students (as future estuarine managers)	Use as many types of media as necessary to access broadest cross-section of the community. Regular newspaper information pieces should be provided. Establish a Tuggerah Lakes website as an important first step. All current information should be made available in an interactive format. An Estuary Education Centre could be established.	$300,000		$250,000	**WSC**	Shire-wide	Yr 1	1 – Urgent
25.2 Preparation and implementation of capacity building programme for staff	Staff training particularly important and was reinforced by the focus groups. Staff responsible for implementing/maintaining estuarine management projects should receive special training (e.g. stormwater device maintenance/foreshore maintenance)	$20,000		$125,000	**WSC**	Council	Yr 1	1 – Urgent
25.3 Review effectiveness of programmes and revise approach	Delivering these messages to the community and staff can be in a number of formats and the review process must determine which is the most effective.			$20,000	**WSC**		Yrs 2 – 5	3 - Checking

Evaluation and Management

- The education material should support as many of the priority programmes as possible.
- There are a number of ways that the education can be measured including attitude change, behavioural change, use of education materials, change in complaints/reporting.
- For the community, it is recommended that an attitudinal shift be measured (Behavioural change is covered in PP26). Website hits would be a valuable window on the amount of interest in up-to-date estuary info.
- For staff, a behavioural shift is important because they and their actions are highly visible. If the community is receiving one message and staff behave contrary to that, it can damage public faith and Council's credibility.
- Consider including sub-contractors and developers as part of the capacity building programme.

Reporting

- The outcomes from the above evaluations should be reported to Council, appropriate advisory committees and back through the SOE.

Funding

- Limited grant funding opportunities

Supporting Information

- The focus of this programme is to provide the community/staff with information on the state of the estuary, the health of the estuary and issues that affect the estuary (i.e. awareness raising).
- There is an existing education officer operating in Council. This programme could be a sub-set of those programs or alternatively, the funds/resources could be sent to the estuary unit/team/keeper.
- The $149,000 is a combination of single grant funded education programs currently operating. The $300K establishment cost for the community education programme includes costs of education strategy, advertising space, artwork, interpretative signage, web development/hosting. The $250K ongoing cost for community education is based on $100K for materials and $150,000 for the cost of staff and their resources (including cars, field days etc) NB: If staff costs are ignored this would be less than double the current community education effort of $217,000.
- The $125,000 capacity building programme is based on 1000 staff doing a 2hr workshop every 2 years costing $250/session. Use this budget to provide specialised training for some staff.
- The detailed design of a community programme would take a year to get ready. The annual costs are for education every year for 5 years. However it is expressed as an average because there would be no education in Yr 1.

Figure 37. Map showing locations of Knowledge and Management Programmes

8.3 Implementing this action plan

8.3.1 Budget

The current Council expenditure on improving knowledge and management is approximately $199,000 p.a. This Action Plan identifies approximately $1.19 million of annual knowledge and management funds, which means approximately **$0.99 million p.a. of new funds** are required.

8.3.2 Assigning Priorities

The priority programmes under this action plan are all important. Their relative priority is very difficult to judge and will change depending on current knowledge, available budget etc. As such, an assumption has been made that their relative priority should be equal. However, priorities have been assigned within each priority programme to guide the estuarine manager as to which action should be implemented first and why. These are ranked from 1 (most important/urgent) to 3 (least important/urgent).

8.3.3 Agreeing to responsibilities

An important part of working with stakeholders is reaching agreement on which organisation has responsibility for implementing the various actions. Council is advised to consult widely with the community when developing the model for the estuary management body so that the actions it implements will be via a system that the community supports. This is important because the body will be responsible for implementing most of the actions in Strategy Action Plan.

8.3.4 Liasing with affected residents/stakeholders

When works are proposed as part of this action plan, affected residents, businesses and stakeholders should be involved at the earliest opportunity. This will ensure that local knowledge is made available to the design process, and that affected parties have every opportunity to provide comment on actions that impact on them.

8.4 Reviewing and adapting

8.4.1 Review

This action plan should be reviewed in time for the budget planning process that precedes each financial year. The review should focus on:

- Management targets met
- Knowledge targets met
- How much of the budget was spent

- Whether the established processes worked as expected
- Community support
- Prioritising and budgeting next years work

8.4.2 Reporting

It is important that the success of these programmes be reported back to Council, appropriate agencies, organisations part funding the programmes, and most importantly the community. In terms of linking with key documents, it is recommended that Council's Management Plan reflect these Action Plans as the primary vehicles for delivering estuarine management outcomes on a year-by-year basis, guided by the 5-yr Estuary Management Plan.

9 Managing & Reviewing

9.1 Recommended Management Approach

The Tuggerah Lakes Estuary Management Plan has been developed to be an iterative and adaptive process of "learning by doing" across Wyong Shire Council and with the close involvement and support of stakeholders and user groups. Figure 38 illustrates the key components of the Estuary Management Plan.

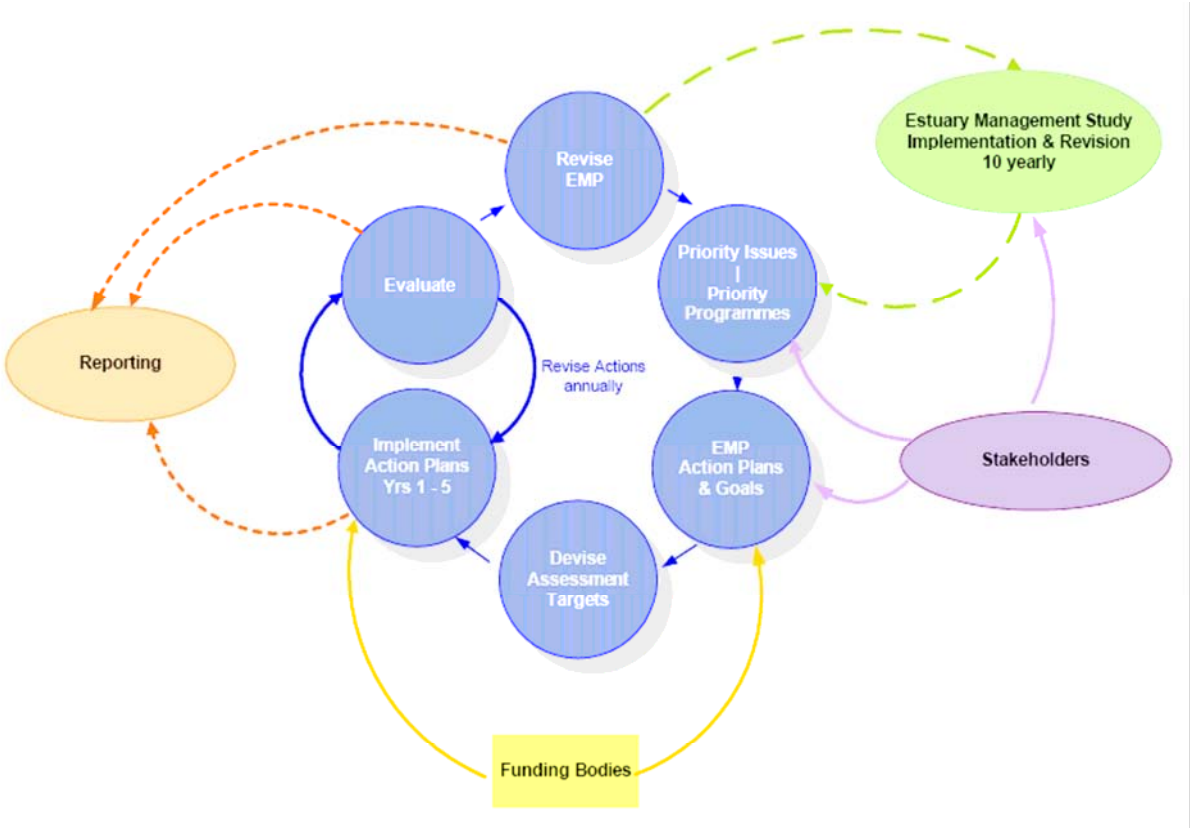

Figure 38. Proposed Framework for the Tuggerah Lakes Estuary Management Plan

9.1.1 Key Documents

The Estuary Management Plan (EMP) should ensure that links to the Estuary Management Study (EMS) are retained. The EMS was developed specifically to be the primary body of knowledge for all current and foreseeable estuarine management issues. When the time comes to revise the EMP, the EMS should be revisited and a reprioritisation of key issues undertaken. From this a new suite of priority programmes can be established and fed into the Action Plans in the EMP.

The Action Plans of the EMP are the primary vehicle for undertaking estuarine management actions. These Plans should be developed in consultation with stakeholders, considering opportunities for accessing funding programmes and ensuring that appropriate evaluation and reporting mechanisms are in place.

9.1.2 Stakeholders

The involvement of stakeholders in a meaningful, constructive way is a central element of adaptive co-management. Stakeholders should be involved at any stage where a shift in direction or priority is being considered (e.g. prioritisation of new EMS issues or, evaluating proposed actions in an annual Action Plan). Stakeholders should be informed about current knowledge and the key elements of the estuarine planning process so that their own experiences and expertise can be placed within the management framework, and co-operative outcomes are obtained.

One of the main “hands on” opportunities for stakeholders is their involvement (or representation of their organisation) in the Action Teams which allocate funds and decide on work priorities on an annual basis. These teams are seen as key to building powerful relationships between the estuarine management body and the stakeholders and user groups that will implement and/or be affected by the actions or outcomes.

9.1.3 Implementation

Implementation occurs at two levels, the Action Plan level, and the overarching Estuary Management Planning level. The EMP is implemented on a 5yr cycle, and has expectations of funding associated with it (such as the Stormwater Levy), however available funds in any given year will vary. The priority programmes identified in the Estuary Management Study drive the 5yr EMP. These programmes were developed in response to the priority issues identified by stakeholders during the consultation phase of the Estuary Management Study. In order to be actioned, the priority programmes are placed under goals in each of the Action Plans, where they stay during the 5 year life of the EMP.

The Action Plans (containing the priority programmes) are implemented/evaluated/revised on a 1yr cycle, which allows actual financial budgets to be brought into play in revising the approach in any given year, without the need for revising the entire Estuary Management Plan. While the title of the priority programmes remains, the actions needed in any given year will change as a result of need, budget and success of past years actions.

9.1.4 Assessment

Assessment and evaluation needs to occur at two main levels:

Management Targets

These are relatively easy to develop and tend to relate to the completion of specific measurable targets that are readily measurable by humans (e.g. 100 ha of wetland rehabilitated per year). This is

a statement of managerial effort and does little to inform management of the success of environmental programmes in producing ecological outcomes. Nevertheless, it is important for environmental managers to have these types of targets to report against, especially when substantial and overt expenditure of public money is involved (as with a stormwater levy). Waiting several years for an ecological outcome can be seen as intolerably long in today's management/political timeframes.

Unfortunately, for many of the ecosystems identified in the Estuary Management Plan, there is insufficient information available to determine what an appropriate treatment response would be (e.g. how many Ha of wetland should be rehabilitated each year, and to what standard?). This is where uncertainty of ecological targets collides with the desire for certainty within managerial targets. This situation lends itself to two types of evaluation: forecasting and backcasting.

Forecasting targets is based on making a commitment to achieve a certain outcome. They tend to be set at the start of project planning. This fits with standard management practice and will aid reporting and budgeting. As mentioned above this can be limited by the level of information on what an appropriate target should be. This being the case, targets can be backcast; reporting on what has been achieved this year, and comparing it to previous years. In this sense, the appropriateness of the target is irrelevant, because it has already been achieved. It is really a measure of what was achieved this year against last.

Management targets can be set at three separate levels; actions (priority programmes), action plan or estuary management plan. It is appropriate to consider setting management targets at each of these levels in order to establish relative successes. The EMP contains suggested evaluation measures in each of the priority programmes. These should be developed further by the relevant Action Team prior to embarking on implementation (as they will judged against them). Targets should be in place before implementation begins otherwise the evaluation process is confounded.

Ecological Targets

The setting of specific ecological targets is difficult and is still in its infancy. The difficulties center on the fact that targets by their nature tend to be specific, and ecology by its nature is subject to spatial and temporal variability, the scale of which can make target setting useless. An example of this is committing to reduce turbidity by x%. The variables that influence this outcome include rainfall, wind, entrance condition, local bathymetry and sediment type. Trying to determine what's "normal", requires specialist knowledge and understanding of how to appropriately quantify spatial and temporal variability in the real world.

While there may be some difficulty in setting required targets, they can often be set for "what we don't want". Given the increasing pressures that Tuggerah Lakes faces, such targets are not only more likely to be assessable, they are more likely to be measurable. Suggested larger scale targets for measuring ecological change are:

- No return to eutrophic (nutrient rich) status

- No further loss of seagrass
- No further loss of saltmarsh
- Recreational and commercial fish catch does not become unsustainable

These ecological targets should be evaluated over the lifecycle of the EMP, as more frequent evaluation (e.g. 1yr Action Plans) are inappropriate for ecosystem responses.

9.2 Reporting

Reporting is expected to occur at three areas of the management framework: outlines of Action Plans, evaluation of Action Plan outcomes, and revisions of the Estuary Management Plan. Reporting on the implementation of the plan through time is to be achieved through the three following mechanisms.

9.2.1 Estuary Management Committee

The Estuary Management Committee is the primary group responsible for overseeing the ongoing implementation of the plan. To this end the group/person responsible for estuarine management should be required to produce action plans of projects and works for the Committee prior to the commencement of each financial year. These plans would take into account internal Council budget constraints and include the use of the prioritising process as detailed against each action. Regular meetings of the Committee will be held so that the ongoing actions and any variations to the plan can be reported on. This way all key stakeholders represented on the Committee will be kept abreast of the ongoing implementation of the programmes.

9.2.2 Internal Council Reporting Processes

Reporting of the progress of the EMP should be included in Councils annual management plan and budget process cycles. In addition an annual report to Council is to be produced at the end of each financial year, which will detail all the actions completed or underway as a result of the EMP. A key performance indicator for the production of this report should be developed and included in Councils quarterly management plan process. Council is also required to produce regular State of the Environment reports. Outcomes of the ongoing implementation of the estuary management programme should be reported in the section of the SOE devoted to “Water”.

9.2.3 Reporting to the Community and other Stakeholders

The annual EMP reports to Council should be circulated to members of the estuary management committee and any other relevant state or federal government agencies or authorities, including those agencies/groups responsible for potential grant funding. The report should also be posted on a dedicated web page, which outlines the estuary management programme within Council and supplies staff and Councillor contact details for interested members of the community. The Estuary Management Plan and all supporting documents and programmes should also be posted on this site.

9.3 Revision

The Estuary Management Plan should be reviewed every 5 years beginning with a re-prioritisation of the issues in the Estuary Management Study and a new suite of priority programmes. These programmes should be fed back into and form the revised EMP for the next 5 years. The Action Plans in the EMP should be evaluated annually and success against managerial targets be reported as described above.

10 Glossary

Actions: Specific works or programmes that have been timetabled, costed and resourced. For the Tuggerah Lakes, actions will appear in the Estuary Management Plan as they are a sub-set of the options identified in this report.

AEAM: Adaptive Environmental Assessment and Management

Algae: Aquatic plants with no root systems. Include microscopic phytoplankton and seaweeds.

Algal Bloom: Excessive growth of phytoplankton or macroalgae which may be in response to increased nutrients.

Anoxic sediments: Bottom sediments that no longer have any oxygen within their interstitial spaces.

Anthropogenic Disturbance: Disturbances caused by humans. Includes sewage discharges, dredging, stormwater etc.

Bathymetry: Depth profile of a water body.

Benthic: The sea bottom. Can be comprised of mud, sand or rock. When referring to benthic organisms: those animals or plants that live on the bottom.

Bio-indicators: Biological organisms used to measure some aspect of environmental condition or health.

Biomass: The mass of living organic material which can include both plants and animals.

Catchment Blueprint: A management document put together for the Central Coast Catchment Management Area by the board. This area takes in Lake Macquarie, Tuggerah Lakes and Brisbane Water.

DEC: NSW Department of Environment and Conservation, formerly the Environment Protection Authority which now manages Parks and Wildlife, the Botanic Gardens Trust, policy, science, environmental protection and regulation.

DEC (Parks & Wildlife): NSW Department of Environment and Conservation's Parks and Wildlife Division, formerly the NSW National Parks and Wildlife Service.

Detritivore: Organisms that feed on detritus, eg. protozoans, worms.

Detritus: Non-living organic material.

DPI (Agriculture): NSW Department of Primary Industries (Agriculture), formerly NSW Agriculture

DPI (Fisheries): NSW Department of Primary Industries (Fisheries), formerly NSW Fisheries

DPI (Forestry): NSW Department of Primary Industries (Forestry), formerly State Forests of NSW

DNR: NSW Department of Natural Resources, formerly the Department of Infrastructure, Planning and Natural Resources (DIPNR).

Ecological health: Generally refers to a measure of whether an ecosystem is in poor or good condition. An attempt to classify ecological functions as analogous to those in measurements of human health.

Ecologically Sustainable Development: Development that does not interfere with the short and long-term well being, health and viability of the ecosystem.

Ephemeral: Changing from one time to another.

Epibenthic: Generally refers to organisms that live on the surface of the seafloor.

Epiphytes: Organisms living attached to the surface of other organisms.

Estuarine Processes: Processes that affect physical, chemical and biological interactions in the estuary.

Estuary: An enclosed or semi-enclosed body of water having an open or intermittently open connection to the sea.

Eutrophic: Water with elevated levels of nutrients and excessive plant growth.

Eutrophication: Enrichment of waters with nutrients resulting in excessive growth of aquatic plants and algae.

Flushing: The process by which water enters and exits an estuary.

GWCWA: Gosford Wyong Councils Water Authority also known as the Joint Water Supply (JWS).

H-CRCMA: The Hunter-Central Rivers Catchment Management Authority. This body takes over from the Central Coast Catchment Management Board and is the state body responsible for catchment management north to Taree, west to near Gulgong and south to the Hawkesbury River.

Hydrodynamics: The various mechanisms by which water moves within an estuary or river; includes circulation, mixing and flushing.

Invertebrates: Animals without backbones.

Issues: Are the things that prevent us from meeting our objectives.

IWCM: Integrated Water Cycle Management refers to using elements of the urban water cycle (e.g. stormwater runoff) to supplement water supply.

Macroalgae: Small to large seaweeds (reds, greens and browns) which grow attached to the seabed or other structures or drift around the estuary (drift algae).

Macrobenthos: Large benthic animals and plants generally visible to the naked eye.

Macrophytes: Aquatic plants with root systems.

Meiobenthos: Group of very small benthic invertebrates less than 0.5mm in size.

Mesotrophic: Medium nutrient levels within a body of water.

Mixing: Process by which one body of water joins with another.

Nekton: Fish and invertebrates that are considered pelagic.

NHT: Natural Heritage Trust is a Commonwealth body that distributes funding to environmental projects in Australia.

Objective: A specific target for managing the catchment or estuary – in this document, objectives help protect the principles.

Oligotrophic: Nutrient-poor body of water.

Options: Actions or programmes that can help us address the issues that prevent objectives from being met.

Pelagic: Organisms that are free living within the water column.

Phytoplankton: Microscopic single celled algae.

Polychaete: A segmented marine worm that lives in the sediments.

Principles: Are the catchment and estuarine characteristics that we are trying to protect.

Riffle zones: Areas within creeks where rocks or other structures constrict flow and cause turbulence.

Salinity: Total mass of dissolved salts per unit of mass of water. Seawater has a salinity of 35 parts per thousand (ppt).

Saltmarsh: A coastal wetland subjected to inundation by the tide and consisting of salt tolerant plants.

SWOT analysis: An analysis of an organisation or person's strengths, weaknesses, opportunities and threats.

Subsidence: Process by which the land drops as a result of mining.

Tidal delta: The build up of shallow shoals and flats in the lower reaches of an estuary due to the accumulation of sand transported in through the entrance.

Tidal prism: The total volume of water moving past a fixed point in an estuary during flood or ebb tide.

Turbidity: A measure of the ability of water to absorb light. The greater the concentration of suspended matter in the water, the higher the turbidity.

WSUD: Water Sensitive Urban Design – a planning and engineering approach to ensuring that development areas are designed in a way that minimises their reliance on water supplies through landscaping, reusing and recycling urban water and rainfall.

Wrack: The floating leaves of seagrasses and drift algae. Also includes flotsam and jetsam.

11 Acknowledgements

The Project Team gratefully acknowledges the support received from Ms Siân Fawcett of Wyong Shire Council, whose commitment and dedication to the Tuggerah Lakes estuary has been a driving force behind this Estuary Management Planning process. Thanks also to Mr Greg White of Wyong Shire Council and Mr Neil Kelleher of the NSW Department of Natural Resources for their continuing support and guidance. The assistance of Dr Ros Muston has been invaluable in guiding the Plan towards a product that the community and business can connect with. Her support and counsel is greatly appreciated.

The Estuary Management Plan was workshopped with representative Technical, Community and Business Focus Groups. Members are sincerely thanked for their interest, their candour, and their feedback during the planning process. Members are listed in Appendix B.

Finally, the team wishes to thank the community of Wyong Shire for taking an interest in this process, visiting shopping centre displays and expressing their views in letters and via the media. It is our hope that this plan provides a solid platform for the community to work with Wyong Council in creating a healthy, sustainable lakes system that the community enjoy.

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13 Index

F

G

H

J

L

M

N

O

P

R

S

T

W

Appendix A - Rewording the Priority Programme titles

PP	Priority Programmes (EMS)	Translated for the EMP
1	Streambank rehabilitation and erosion protection	Stabilise the foreshore banks and streambanks
2	Stormwater management in new urban areas focussing on sediment and nutrient management, water sensitive urban design and producing more natural flows for downstream environments	Maintain natural nutrient and sediment loads after new development
3	Retrofit stormwater interventions in existing urban areas focussing on sediment and nutrient management, contaminants and gross pollutants	Reduce nutrient and sediment loads from existing development
4	Undertake a programme of works to restore degraded or threatened habitat through rehabilitation, strategic land protection and active management of invasive species (e.g. weeds)	Restore degraded habitat in the catchment
5	Foreshore management programme including identification and passive/active rehabilitation of key habitats such as saltmarsh and fringing wetlands, and managing threatening processes on public and private lands	Improve and protect natural foreshore areas
6	Improve facilities in designated recreation areas based on community consultation including additional seating, BBQ's, picnic areas, educational signage, upgraded boat ramps	Provide better facilities in foreshore recreation areas
7	Limit public access to ecologically sensitive areas of the foreshore and estuary where necessary, including saltmarsh (e.g. Tuggerah Bay) and seagrass habitat (e.g. Budgewoi Sandmass)	Control damaging activities in sensitive parts of the estuary
8	Audit sub-catchments for environmental compliance including sediment/erosion and contaminant controls	Help landholders and business to limit pollution at the source
9	Develop a catchment audit process for assessing high risk catchments and prioritising interventions	Develop an assessment tool that helps determine which sub-catchments need priority assistance
10	Continue to monitor faecal coliforms at recreational locations	Ensure beaches meet primary water contact requirements
11	Monitor key wetlands for degradation and changes in condition	Monitor key wetlands for signs they are being damaged
12	Develop a population strategy that is based on what environmental changes the estuary, rivers and catchment can sustain rather than on available land	Ensure development is based on sustainable catchment and estuary management principles
13	Develop partnerships with universities to get innovative approaches to managing the catchment and estuary in a sustainable manner	Develop partnerships with universities to get innovative approaches to catchment and estuary management
14	Develop partnerships with developers and business operators to get innovative approaches to managing the catchment and estuary in a sustainable manner	Develop partnerships with business to solve common problems and improve economic opportunities
15	Explore the development of a central body to oversee programmes and expenditure for estuarine management	Identify and assist the organisation who will manage and implement the estuary management plan

PP	Priority Programmes (EMS)	Translated for the EMP
16	Develop funding strategies to ensure on-going and dedicated catchment and estuarine management programmes	Develop strategies for securing ongoing catchment and estuary management funding
17	Develop strategies to identify and manage key remaining catchment habitats	Identify and protect important remaining catchment habitats
18	Maintain ocean entrance dredging programme	Maintain current flows through the entrance
19	Maintain river mouth dredging on a rolling 5yr programme for Tumbi, Ourimbah, Wyong, and Wallarah/Spring Creeks	Maintain creek mouths for navigation and water flow
20	Continue to maintain stormwater treatment devices ensuring performance data are collected and analysed	Maintain stormwater traps and collect information on the material removed
21	Designate foreshore recreational areas and manage/encourage maximum recreational use and enjoyment including beach cleaning and wrack management	Maintain foreshore recreation areas and beaches
22	Maintain identified foreshore rehabilitation areas, protect sensitive habitats and educate community about the habitats	Maintain the rehabilitated natural foreshore areas
23	Provide a process for addressing key estuarine process & management questions such as faecal coliform sources, fishery status, bioindicators, groundwater, sea level rise and mixing	Continue to learn about how key parts of the lakes work so that they can be managed better
24	Conduct appropriate research into riverine ecological processes and water quality to support environmental flow management	Learn how the changes to flow in the rivers affects plants and animals in the estuary
25	Prepare and implement an ongoing community information and education programme about estuarine health using websites, newspapers, Council columns and field days	Provide the community with up to date information on the estuary
26	Improve pollution source control through education of community, industry & tourists	Educate people in the catchment (including residents, tourists and industry) about how they can reduce pollution going to the estuary
27	Develop incentives for the community to encourage sustainable use of water and pollutant reduction	Reduce the demand for river water that flows to the lake, by encouraging sustainable use of water in the community.

Appendix B – Membership of Focus Groups

Technical

Ian Rhodes	Manager Open Space & Rec Wyong Shire Council
Tony Wells	DPI (Agriculture)
Gary Casement	Water Authority
John Ferguson	Assistant Manager Open Space & Rec Wyong Shire Council
Kylie Frazer	Social Planner Wyong Shire Council
Greg White	Manager Natural Resources Wyong Shire Council
David Tierney	Environmental Officer Wyong Shire Council
Neil Kelleher	Department of Natural Resources
Dean Chapman	Hunter-Central Rivers Catchment Management Authority
Anthony Signor	Department of Lands
Jodi Cameron	Darkinjung Aboriginal Land Council
Wayne Milner	Delta Electricity
Tom Wallace	Senior Design Engineer (Flooding) Wyong Shire Council
Ken Brookes	Catchment Management Officer Wyong Shire Council
Adam Fawcett	NSW Department of Primary Industries (Forestry)

Community

Mr Frank Borsova	
Mr Bert Sweeney	
Mr Malcolm Poole	Recreational Fishing Alliance
Mr Phil Heaton	Tuggerah Lakes Estuary, Coastline and Floodplain Mgt Committee
Mr Bob Buggy	Tuggerah Lakes Estuary, Coastline and Floodplain Mgt Committee
Mr Richard Byles	Tuggerah Lakes Estuary, Coastline and Floodplain Mgt Committee
Mr W Lupica	Tuggerah Lakes Estuary, Coastline and Floodplain Mgt Committee
Mr N Allan	Tuggerah Lakes Estuary, Coastline and Floodplain Mgt Committee
Ms M Pennings	Tuggerah Lakes Estuary, Coastline and Floodplain Mgt Committee
Mr Peter Fussell	Tuggerah Lakes Estuary, Coastline and Floodplain Mgt Committee

Leigh Dickson	Western Foreshore Alliance
Ken Greenwald	Watanobbi/Warnervale Community Precinct Committee
Mr Ray Rauscher	Lakes Community Precinct Committee
Gerry Pennings	The Entrance North Landcare
Max Cuthbertson	
Tom Ford	The Entrance Community Precinct Committee
Tony Scott	The Entrance Community Precinct Committee
Gordon Silk	Wallarah North Community Precinct Committee
Pat Silk	Wallarah North Community Precinct Committee
Jen Waller	Long Jetty Catamaran and Boat Hire
Toby Scheitel	Wyongah Landcare
Tracey Scheitel	Wyongah Landcare
Lyndsay Scheitel	Wyongah Landcare

Business

Mr Stephen Ball	Masterfoods Australia New Zealand
Mr John Kay	Sanitarium
Mr Duncan Gilchrist	Business Central Coast
Ms Mardi Love	NSW Department of Tourism, Sport and Recreation
Mr Kevin Faulks	Wyong Chamber of Commerce Inc
Mr John Millard	Chairperson, The Entrance Chamber of Commerce
Mr Jason Knott	Tuggerah Regional Business Chamber
Ms Cyd Ross	Andrews Neil On behalf of UDIA
Mr Mark Cleary	Local business owner
Mr Bob Butt	Wyong Shire Council (Business Development)

Appendix C – Suggested Actions for 2006/2007

Water Quality Goals	Suggested Actions for 06/07
Improve quality of stormwater from the catchment	• Implement WSUD and sediment/nutrient control devices for the Wyong Economic Zone and Warnervale Development Areas – focus on maintaining health of downstream aquatic ecosystems • Retrofit nutrient and sediment controls to Tumbi Creek and Saltwater Creek catchments as a matter of priority. Focus on controlling both of these pollutants at the source
Ensure beaches meet primary water contact requirements	• Monitor recreational beaches at existing locations, and add 2 new locations in Lake Munmorah as indicated on the map. • Identify sources of faecal pollution and use this information to improve water quality at swimming beaches
Stabilise foreshore and streambank erosion	• Stabilise the streambanks in Tumbi Creek to minimise sediment deposition at the creek mouth • Other priorities for 06/07 include Ourimbah Creek and Wallarah/Spring Creek as identified on the map.
Encourage sustainable use of water	• Trial best practice water saving devices for i) residential developments, and ii) for industrial development • Should include rainwater tanks, water efficient landscaping, grey water recycling.

Ecological Goals	Suggested Actions for 06/07
Improve foreshore habitat	• Restore saltmarsh habitat in foreshore areas of Berkeley Vale, Long Jetty, Tuggerah Bay, Tuggerawong
Protect and restore catchment habitat	• Undertake restoration of Porters Creek Wetland and Pioneer Dairy Wetland
Protect estuary habitat	• Limit damage and if necessary, access to Tuggerah Bay
Learn how changes to flow in the rivers affect plants and animals in the estuary	• Not a works project

Socio-Economic Goals	Suggested Actions for 06/07
Improve recreational facilities around the lakes and creeks	• Replace Boat Ramp at Saltwater Creek and upgrade facilities (toilets and contained wash-down area) • Provide toilets and fish-cleaning facilities at Wyong River boat ramp • Beach nourishment at Northern Lake Munmorah Baths • Remove wrack accumulation zones in Wallarah Pt (nr bridge), Prawn Beach, Rocky Point • Dredge boat ramps at Tumbi Creek, Kanwal, San Remo, Budgewoi Aquatic Club, Colongra Bay, Elizabeth Bay, Toukley Aquatic Club • Continue wrack harvesting and beach cleaning at Canton Beach, Gorokan, Toukley Sailing Club, Budgewoi, Elizabeth Bay, Long Jetty
Provide estuary positive business opportunities	• Not a works project
Develop sustainable targets for development	• Not a works project
Maintain creek mouths for navigation and water flow	• Dredge Tumbi Creek • Dredge of Budgewoi Channel
Maintain flow through the entrance	• Maintain existing dredging of The Entrance

Knowledge Goals	Suggested Actions for 06/07
Establish an estuary management body	• Decide on a model for estuary management that the community supports • Establish estuary management body
Learn more about key processes in the estuary	• Not a works project
Develop partnerships with universities	• Not a works project
Provide the community with current information on the estuary	• Not a works project