

BALLINA SHIRE COUNCIL

**SHAWS BAY, EAST BALLINA
ESTUARY MANAGEMENT PLAN**

**Volume 2
ESTUARY MANAGEMENT STUDY AND PLAN REPORT**

**Issue No. 4
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BALLINA SHIRE COUNCIL

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1 INTRODUCTION

Shaws Bay is a small tidal embayment located adjacent to the mouth of the Richmond River at Ballina. Shaws Bay has been utilised by the local community for a long time, as the enclosed nature of the bay offers an environment which is protected from large waves, boating traffic and most marine stingers. Good sandy access into the water along the majority of the Bay's foreshore, and a wide variety of fish life enclosed within the bay, have contributed to its popularity as one of Ballina's most utilised water-based recreational areas.

In recent years, seagrasses have begun to establish along much of the Bay's shoreline. Although seagrasses have been present in the East Arm of the Bay for many years, their encroachment onto the foreshores is seen by the general community as a major concern. In 1998, Ballina Shire Council formed the Shaws Bay Estuary Management Committee to address all future management issues concerning Shaws Bay, including the recent appearance of seagrasses.

This report (*Volume 2 of the Estuary Management Plan*) documents the management needs of Shaws Bay, and the proposed activities which will address these needs. This report follows on from a previous study (*Volume 1 of the Estuary Management Plan*), which documents the details of various estuarine processes that are active in Shaws Bay. *Volume 1* essentially gives a 'position statement' on the overall health and diversity of the Shaws Bay estuary.

This report, the *Shaws Bay Estuary Management Study and Plan* report, provides a Summary of Estuary Processes outlined in the *Volume 1* report (*Chapter 2*), develops a list of Management Objectives for Shaws Bay (*Chapter 3*), discusses and assesses a range of different Management Options to address these Objectives (*Chapter 4*), before presenting an actual Management Plan, which can be adopted and implemented by Council (*Chapter 5*). The proposed implementation of the Plan is outlined in *Chapter 6*.

This Management Plan has been developed for the Shaws Bay Estuary Management Committee using the principles of the NSW Government's Estuary Management Program, as outlined in its Estuary Management Manual (*NSW Government, 1992*).

2 SUMMARY OF ESTUARY PROCESSES

Volume 1 of the Shaws Bay Estuary Management Plan (*PBP, 1999*) provides a basic understanding of the estuary processes that are active within Shaws Bay. These processes are summarised below. Detailed discussion of the estuary processes, is contained in *Volume 1* of the Shaws Bay Estuary Management Plan, titled *Estuary Processes Study Report*.

2.1 HYDRODYNAMICS

2.1.1 Tidal Hydraulics

Shaws Bay is tidal, with water moving into and out of the Bay through the porous northern breakwater (*rock wall*) of the Richmond River entrance. A comparison of tidal levels at locations inside and immediately outside Shaws Bay shows that the training wall, which separates Shaws Bay from the Richmond River prevents low tide in Shaws Bay from reaching levels as low as that in the adjacent river. Low tide in Shaws Bay is permanently perched at a level of approximately -0.1m AHD . High tide in Shaws Bay, however, is very similar to the river, which indicates good passage of tidal waters through the wall during mid and high tide.

Sediment build-up and the establishment of mangroves inhibits flow through the western half of the wall. Therefore, the passage of water through the wall is nearly entirely restricted to the eastern half of the wall. This results in significant tidal flows (*and associated velocities*) through the channels in the East Arm of Shaws Bay.

During the larger (*spring*) tides, approximately $130,000\text{m}^3$, or 130 million litres of water passes through the northern training wall into and out of Shaws Bay every tide. During neap tides, this volume reduces to about $90,000\text{m}^3$, or 90 million litres.

2.1.2 Freshwater Inflows

Freshwater is discharged into Shaws Bay by constant groundwater seepage from the adjacent escarpment, and from flooding of the local catchment, as well as flooding from the Richmond River. The groundwater seepage flow can be up to about 2 litres/second, depending on antecedent rainfall, but would typically be much less than this rate.

17 stormwater drains discharge into Shaws Bay. These drains service the entire Shaws Bay residential area, as well as developed and undeveloped areas to the west of Shaws Bay, up to and including Hill Street. The total catchment area is approximately $700,000\text{m}^2$, or 70 hectares, of which approximately 52% is urban, 20% is native vegetation and 28% is open space and public reserve. For a 1 in 10 year Average Recurrence Interval (*ARI*) event, approximately $44,000\text{m}^3$ of freshwater would be discharged into Shaws Bay. This is equivalent to approximately 10% of the total volume of water held in Shaws Bay at high tide, and is only about one third of the total volume of water exchanged with the river every spring tide. The majority of the local runoff entering Shaws Bay comes from the urban areas to the east of Shaws Bay, and from the creek at the head of the Bay.

2.1.3 Flushing

A computer model was developed to help assess the flushing potential of Shaws Bay. Flushing in Shaws Bay varies from 1 day in the East Arm, to approximately 5 days in the northern bay. This takes into account the mixing of the water due to wind driven circulation currents, and the groundwater seepage along the north-western foreshore.

2.1.4 Dilution and Dispersion

Shaws Bay has a large potential to dilute and disperse pollutants discharged into the waterway due to the relatively large volume of resident water in comparison to catchment runoff volumes. The computer model was used to show that the Bay returns to background conditions within about 12 hours after a significant catchment runoff event (ie a 1 in 10 year ARI event).

A summary of the hydrodynamic processes of Shaws Bay is presented in **Figure 2.1**.

2.2 SEDIMENTS

2.2.1 Physical and Geochemical Analyses

Sediment samples were taken from the bed of the Bay, and from below the bed via three (3) cores, to assess physical and geochemical characteristics. The sediments within Shaws Bay are either fine, or coarse. Fine sediments (*silts and clays*) are transported into Shaws Bay via local catchment runoff and flooding of the Richmond River. Fine sediment generally settles out in the deeper, less mobile, parts of the Bay. The coarser sediment, which mostly comprises sand, is generally found along the Bay foreshores, and is slowly working its way into the deeper sections of the Bay. The coarse sand is generally derived from marine sources, however, significant reworking of the material has occurred within and around Shaws Bay.

A chemical analysis was carried out on selected surface and subsurface samples. The analysis showed that there were no significant pollutants within the sediments which may cause future management problems.

2.2.2 Sediment Dynamics

Air photos were used to help distinguish past and present sediment dynamic conditions. Prior to the breakwater construction, Shaws Bay was part of the greater Richmond River entrance. During the first half of the 20th Century, marine sand moved into Shaws Bay from the ocean during storm conditions, and from aeolian (wind) transport. During the 1960s, the low lying sand dunes located to the east of Shaws Bay were filled and compacted, ready for residential development. The construction of access roads and dredging from Shaws Bay dramatically changed the sediment dynamics of the waterway. In the 1970s, 1980s, and early 1990s, sediment was removed from the centre of the Bay (*via dredger or long reach excavator*), and was placed on the Bay's foreshores to establish and maintain sandy beaches.

At present, coarse sand is transported along the Bay foreshores from south to north due to the dominant SE winds. The quantity of sand presently being transported along the foreshores would be less than what has typically occurred over the past 20 years or so. This longshore sand transport has formed numerous lobes along the shoreline, and has prograded the point which separated the main body of the Bay from the northern bay. The coarse sand is slowly infilling a small section of the bay just inside the northern bay at a rate in the order of about 0.1 metres per year (averaged over the last 10 years or so).

There has been a progressive build-up of fine sediment on the bed of the Eastern Arm. The source of the sediment is the gradual (*and ongoing*) erosion of the fine silts and clays contained in the upper shoreface escarpment of the adjacent shoreline. The fine sediment is trapped by and is building up amongst the seagrass beds.

2.2.3 Bank Erosion

A small section of the Shaws Bay foreshore, located on the northern bank of the East Arm, is presently eroding. This erosion is likely to be the combined result of poor subsoil drainage, wind effects, long period ocean swell, and tidal currents. Localised gully erosion is also occurring at a number of locations within and around Pop Denison Park, primarily due to poor surface drainage and the relative impermeability of the surface soil.

A summary of the sediment processes of Shaws Bay is presented in **Figure 2.2**.

2.3 WATER QUALITY

2.3.1 Bacteria

Council has measured bacteria levels in Shaws Bay since the late 1960s, however, a formal bacteria monitoring program has only been in place since 1991. The results of this monitoring indicate that bacteria levels in Shaws Bay are generally low. Some higher values have been recorded, however, it is likely that these records coincided with rainfall, or other unfavourable conditions.

Field experiments by Council indicate that bacteria in Shaws Bay die-off rapidly once in the waterway. Thus, periods of high bacteria levels are likely to last for only a day or two. This is confirmed by the results of the computer modelling which shows that pollutants, such as bacteria, are diluted and dispersed rapidly within the waterbody (*refer Volume 1 for details*).

2.3.2 Other Water Quality Parameters

A permanent water quality probe has recently been installed in Shaws Bay to assess temporal variations in water quality. Field sampling was also carried out to assess spatial variability of water quality around the bay, as well as variations with water depth.

In general, the water quality of Shaws Bay is typical of a healthy estuarine environment. Of particular note is the variation of water temperature and salinity with depth at the northern end of the bay. This is likely to be related to the significant amount of rainfall in the weeks and months prior to the analysis. Dissolved oxygen was also slightly depressed near the bed of the Bay, which is most likely due to the decay of organic matter (*such as*

leaves and seagrass fronds) on the bed surface. The large beds of seagrass in the East Arm can also modify the local water quality (*mostly oxygen concentrations*) through photosynthesis and respiration.

2.3.3 Impacts of Catchment Runoff

On average, local catchment runoff will generate approximately 45,000 kg/year of Suspended Solids, 160 kg/year of Total Phosphorus, 970 kg/year of Total Nitrogen, and 13×10^9 E. Coli organisms/year. These loads are considered to be small in comparison to the oceanic flushing potential of the Bay.

The computer model was used to predict likely pollutant concentrations in the Bay following a major stormwater runoff event (*say a 1 in 10 year ARI event*). One hour after the end of the storm event, the model predicted notable increases in pollutants, however, apart from E. Coli, these pollutant levels were still below recommended ANZECC guideline values. E. Coli levels were predicted to fall below ANZECC guidelines in less than 12 hours after the end of the storm event.

The northern bay of Shaws Bay receives a large amount of catchment runoff relative to its smaller resident volume. As such, this section of the Bay is more susceptible to poorer water quality, however, it is not considered to be a significant problem, providing primary contact with the water (*ie swimming and snorkelling*) is avoided for the first 12 hours or so after rainfall.

A summary of the water quality processes of Shaws Bay is presented in **Figure 2.3**.

2.4 ECOLOGY (FLORA AND FAUNA)

Shaws Bay and its surrounds is a valuable sanctuary, breeding area and feeding station to a wide variety of flora and fauna. The NSW National Parks and Wildlife Service (NPWS) database was reviewed for significant species located in and around Shaws Bay. This assessment determined that 1 species of endangered flora, 2 species of vulnerable flora and 4 species of unprotected flora have been recorded in the database. Also, 6 species of endangered fauna, 29 species of vulnerable fauna, 144 species of protected fauna, and 3 species of unprotected fauna have been recorded within the Shaws Bay area.

2.4.1 Terrestrial Vegetation

Remnant rainforest exists on the hillside surrounding the western and northern sides of Shaws Bay, however, this particular forest is not recognised or protected by a SEPP 26 zoning. In general, the rainforest appears to be healthy, with a well developed canopy and understorey. However, particular areas of the forest appear to be under threat from weed invasion, including Green Cestrum, Lantana and Madeira Vine.

Other terrestrial vegetation closer to Shaws Bay primarily consists of casuarinas, acacias, banksias and eucalypts, with the majority of these being planted approximately 20 - 30 years ago, when the area was developed for residential living.

2.4.2 Riparian Vegetation

A number of different foreshore and semi-aquatic vegetation species were identified around the edges of Shaws Bay. Salt Couch is present along most of the sandy beaches, often reaching below the high tide mark. The presence of Saltwort and *Juncus spp* indicates an active salt marsh community, particularly at the head of the Bay. Both River Mangroves and Grey Mangroves have established at selected locations within Shaws Bay, however, a large number of seedlings around the foreshores indicates that these locations may expand rapidly in the near future.

2.4.3 Aquatic Vegetation

Seagrasses are a fundamental component of any healthy estuarine environment. They provide food resources, increase habitat diversity, and improve water quality by assimilating excess nutrients and increasing dissolved oxygen. Seagrasses also provide excellent shelter for breeding fish and invertebrates, as well as being an effective nursery for the young once hatched.

Dense seagrass beds (*Zostera spp*) are located within the East Arm of Shaws Bay, with an area of approximately 20,000m². *Zostera* beds have also established in narrow banks around some sections of the foreshore of the Bay. *Halophila spp* was also identified fringing many of the *Zostera* beds. *Zostera* growing in the intertidal area has developed as a genetic dwarf mutant, with fronds approximately 0.1 metres long, compared to the regular approximate 0.5 metre lengths in sub-tidal beds.

An assessment of historical air photos has shown that seagrasses have been present in Shaws Bay, to varying extents, since at least 1947. However, rapid growth around the foreshores of the main and northern sections of the Bay has only occurred within the last few years. It is possible that previous establishment of seagrasses along the foreshores was inhibited by the regular deposition of sediment on the beaches which had been dredged from the deeper sections of the bay.

Sea lettuce (*Ulva lactuca*) has also established within Shaws Bay. It appears to have increased significantly since the previous flora and fauna study carried out in 1993 by SCU student, Graham Johnson.

2.4.4 Terrestrial Fauna and Avifauna

Terrestrial fauna is not expected to be in abundance around Shaws Bay due primarily to the surrounding highly populated and urbanised environment, and the resulting human activity.

A wide variety of avifauna (birds) was observed utilising Shaws Bay and its surrounding areas. The birds using Shaws Bay, particularly those feeding on fish and invertebrates in the Bay itself, are indicative of a healthy estuarine environment.

Birds observed around Shaws Bay included Raptors, such as Brahminy Kites and Osprey, Seabirds, such as Terns, Pelicans and Cormorants, Wading Birds, such as Herons, Ibis, Egrets and Godwits, and Land-based Birds, such as Masked Lapwing, Pigeons, Galahs, Kookaburras and Rainbow Lorikeets.

2.4.5 Aquatic Fauna

A variety of intertidal and aquatic fauna was observed, and has also been recorded by others. The intertidal communities are active, with extensive bioturbation from worms and gastropods (snails). The soldier crab community also appeared to be quite healthy with many thousands of juvenile crabs inhabiting the intertidal and supratidal beaches along the foreshores of the East Arm of Shaws Bay.

In general, the benthic communities of Shaws Bay are quite active, with large numbers of polychaete worms, gastropods, amphipods and bivalves (*molluscs*) being observed. Fish species lists were obtained from others (*refer to Volume 1 for details*). There are over 25 different species of fish observed in Shaws Bay, covering several tropical and sub-tropical species, as well as estuarine and ocean species. It is likely that the fish enter Shaws Bay through the wall during larval stages, and remain for the duration of their life. As such, Shaws Bay has become an excellent location for snorkelling and observing a wide range of fish species, all within a protected environment.

2.4.6 Biological Irritants

Like most coastal embayments, Biting Midge is a problem in Shaws Bay. The main Biting Midge breeding area is along the sandy beach directly adjacent to the Lakeside Holiday Park, with measured larval populations higher than those found in the canal estates of the Tweed River and Gold Coast.

‘Bathers Itch’ has also been noted in Shaws Bay. This irritant is the result of a trematode worm, which can burrow into human skin resulting in a severely itchy, bumpy rash. Although an intermediate host for the larval stages of the worm (the Small Whelk snail) exists within Shaws Bay, it is not certain that this irritant is, or will become, a significant management issue.

2.4.7 Overall Habitat Values

Table 2.1 summarises the various habitats around Shaws Bay and provides some insight into why these habitats are important to the survival of the organisms inhabiting them. A summary of these habitats is shown in **Figure 2.4**.

Habitat type	Value	Potential concerns
Rainforest	<ul style="list-style-type: none"> habitat for native flora / fauna, often protected species source of food for native fauna improvement to runoff water quality by acting as filter 	<ul style="list-style-type: none"> needs protection from weed infestation prevent removal by future development
Other native vegetation	<ul style="list-style-type: none"> habitat for native flora / fauna source of food for native fauna improvement to runoff water quality by acting as filter 	<ul style="list-style-type: none"> prevent removal by future development casuarina encroachment on salt marsh
Open grassy areas	<ul style="list-style-type: none"> breeding habitat for native fauna source of food for native fauna improvement to runoff water quality by acting as filter 	<ul style="list-style-type: none"> lack of adequate drainage in some areas creates boggy situation, suitable for mosquito breeding
Couch grass	<ul style="list-style-type: none"> effectively stabilises sediment to reduce / prevent erosion habitat for native flora / fauna, including various salt marsh species 	<ul style="list-style-type: none"> growth can be out of control and can be classified as a weed
Sandy beach	<ul style="list-style-type: none"> habitat for native fauna food source and breeding habitat for native fauna 	<ul style="list-style-type: none"> suitable habitat for breeding populations of biting midge actively addressing the biting midge issue would have significant adverse implications for other resident fauna
Salt marsh	<ul style="list-style-type: none"> habitat for native flora / fauna improvement to runoff water quality by acting as a filter 	<ul style="list-style-type: none"> exists in very small area of the Bay, and is therefore fragile / vulnerable potential encroachment by mangroves and casuarina
Mangrove	<ul style="list-style-type: none"> habitat for native flora / fauna improvement to runoff water quality by acting as a filter food source and breeding area for many organisms improves stability of muddy, potentially erodible sediments 	<ul style="list-style-type: none"> illegal removal of seedlings and destruction of adult trees permit must be obtained from Fisheries to reduce the growth / spread of mangroves
Seagrass	<ul style="list-style-type: none"> habitat for native flora / fauna food source and breeding area for many organisms improvement to water quality backbone of the health of the Bay 	<ul style="list-style-type: none"> potential competitive exclusion by <i>Ulva lactuca</i> (sea lettuce) in northern arm of Bay human impacts such as trampling or mechanical removal (eg. excavating) permit must be obtained from Fisheries to reduce the growth/spread of seagrass

Table 2.1 Habitat Values and Concerns

2.5 HUMAN IMPACTS ON ESTUARY PROCESSES

Shaws Bay was created through human activities at the turn of this century (*ie training of the Richmond River entrance*). Despite its ‘unnatural’ origins, the Bay has developed, and is continuing to develop, into a healthy estuarine environment.

Various human activities over the past 100 years, however, have had significant impacts on the estuarine processes of Shaws Bay. Such activities include dredging from the Bay and placing spoil either on adjacent land or on foreshore beaches, infilling of the Bay to provide access around the waterway, and removal / harvesting of seagrasses in the East Arm of Shaws Bay. All these activities have had deleterious impacts on the habitats of Shaws Bay, and the organisms that depend on these habitats, as outlined in **Table 2.1**, above.

3 OBJECTIVES FOR FUTURE MANAGEMENT

3.1 DEVELOPMENT OF MANAGEMENT ISSUES

3.1.1 EMC Management Issues

Prior to the commissioning of this project, the Shaws Bay Estuary Management Committee (EMC) compiled a list of issues which was considered to be relevant to the health, attractiveness and amenity of Shaws Bay. These issues were:

- * Tidal exchange between Shaws Bay and the lower Richmond River estuary;
- * Sedimentation in the Bay, primarily from fine sediment (*sludge*) and its impact on recreational amenity, and tidal exchange between the Bay and the lower Richmond River estuary;
- * Proliferation of seagrass growth and its affect on recreational amenity;
- * Poor water quality caused by stormwater runoff and discharges over Compton Drive;
- * Stormwater management. There are 17 stormwater outlets presently discharging into Shaws Bay;
- * Improvements and management of foreshore access to the Bay;
- * Fish passage between Shaws Bay and the lower Richmond River estuary;
- * Foreshore vegetation management, including protection of important areas of mangroves and saltmarsh;
- * Conflict between the use of the Bay for recreational activities and interaction with the natural environment;
- * Opportunities for improvements to recreational public reserves around the Bay foreshores;
- * Development of the Shaws Bay Caravan Park and the need to ensure that such developments are consistent with the management objectives of the Shaws Bay study area; and
- * The need to ensure the long-term conservation of important natural values of the Bay, including scenic quality, vegetation communities and marine and riparian habitats.

3.1.2 Community Issues

As part of a program of Community Consultation carried out at the beginning of this project, a questionnaire was distributed to the wider community of Shaws Bay. As well as asking for specific data relating to the general health of the Bay, the questionnaire asked the community what they thought were the main management issues or problems facing Shaws Bay. A good response to this question was received, with over 20 separate issues

identified by the Community. **Table 3.1**, below, presents these community issues, along with the number of questionnaire respondents who identified the issue.

<i>ISSUE / PROBLEM</i>	<i># OF RESPONDENTS MENTIONING ISSUE (total = 49)</i>
Stormwater drains / runoff	22
Siltation / shoaling	17
Too much seagrass	14
Reduced tidal flow / stagnant northern end	11
Weed growth	7
Erosion (general)	6
Overfishing	6
Public access (disabled also)	6
Need of facilities within bay area	5
Protection of aquatic life / habitat	4
Protection of terrestrial flora /fauna	4
Need for sand on beaches	4
Rubbish	3
Need for shade	3
Lack of beautification	3
Restriction of dogs swimming	3
Too many mangroves	3
Pollutant input	2
Tropical fish removal / catching	1
Sand flies	1
Decline of people using bay	1
Misuse of Pop Denison Park at night	1
Public health issues	1

Table 3.1 Issues Affecting Shaws Bay as Identified by the Community

As can be seen in **Table 3.1**, many of the concerns identified by the EMC were reinforced by the community. Also, there were a number of additional community issues which were not previously identified by the EMC.

The number of community respondents mentioning the particular management issues gives a good indication of the perceived magnitude of the various problems. Clearly, there is a major perception that stormwater drains and local runoff are having detrimental affects on the environmental and recreational values of the Bay. Also, siltation of the Bay is a major

concern, as is the recent proliferation of seagrasses along the Bay foreshores. Many members of the community were also concerned that the northern end of the Bay was poorly flushed.

3.1.3 Outcomes of the Estuary Processes Study

As described previously, an Estuary Processes Study of Shaws Bay was carried out to assess and understand the various estuarine processes that are active within the Bay (*refer Volume 1 of Estuary Management Plan*). A better understanding of the physical, chemical and biological processes within Shaws Bay has enabled the abovementioned management issues to be prioritised, based on their actual impact on the environmental and recreational values of the Bay.

As an example, the Estuary Processes Study determined that discharge into Shaws Bay from the 17 stormwater outlets does not have a significant detrimental impact on the water quality of the Bay, due primarily to the Bay's large resident volume, and effective tidal flushing through the wall. Similarly, the northern end of the Shaws Bay is not stagnant, but rather, is relatively well flushed with flushing times in the order of 5 days (*refer Volume 1 for details*).

With a better understanding of the estuary processes of Shaws Bay, the previously identified management issues have been re-defined as clear management objectives which aim to meet the central goal of the Government's Estuary Management Policy:

“to achieve an integrated, balanced, responsible and ecologically sustainable use of the State's estuaries”.

These management objectives are presented in **Section 3.2**.

3.2 ADOPTED MANAGEMENT OBJECTIVES

The objectives outlined below represent a balanced cross-section of community concerns regarding management issues which need to be addressed by an Estuary Management Plan. The objectives have been compiled in close consultation with the EMC, and are based on the Committee's initial list of issues, as well as the list of issues provided by the community via questionnaire responses and subsequent drop-in sessions and community workshops.

3.2.1 Overall Goal for Shaws Bay Estuary Management

The overall goal for estuary management of Shaws Bay has been resolved by the EMC as:

“to improve the recreational amenity of Shaws Bay and to ensure that the habitat and ecological values of the Bay are maintained within an acceptable range”.

This goal clearly defined the two most significant, and sometimes conflicting, values of the Bay: Recreation, and Ecology. Objectives have been developed for the majority of issues previously identified. These objectives have been itemised under a number of different headings, representing the primary management concerns, viz: Pollution; Siltation; Recreation; and Ecology.

3.2.2 Pollution Objectives

Objective 1: TO REDUCE THE AMOUNT OF ORGANIC LITTER ENTERING SHAWS BAY

During storm events, organic litter finds its way into stormwater drains, which eventually ends up in Shaws Bay. The organic material generally consists of fallen leaves, tree branches, lawn clippings etc. The larger pieces of litter would tend to accumulate on the shallow beaches and deltas leading out from the stormwater outlets. Smaller material would tend to be advected into the deeper parts of the Bay, where it would settle to the bed.

Decomposition of the organic litter, both on the foreshore and on the bed of the Bay takes time, and in doing so, can cause local effects, such as depletion of oxygen in surrounding water, or foul smells if exposed to the air. The interception of organic litter before it enters Shaws Bay should be addressed by the Shaws Bay Estuary Management Plan.

Objective 2: TO MINIMISE THE AMOUNT OF NUTRIENTS AND BACTERIA ENTERING SHAWS BAY

Nutrients and Bacteria can enter Shaws Bay from a number of sources, including catchment runoff from gardens and lawns, petro-chemical spills along adjacent roadways, and natural faunal and avifaunal inputs, such as the flying-fox colony located in the fringing rainforest, and the congregation of wading birds along the shoreline.

Excess nutrients, which are mostly *dissolved* pollutants, can lead to algae blooms, both within the water body of Shaws Bay, and along its foreshores, which would have deleterious effects on both the recreational and ecological values of the Bay. High levels of bacteria can pose serious health risks to people who come in contact with the water. The amount of nutrients and bacteria entering Shaws Bay should be minimised.

Objective 3: TO REDUCE THE AMOUNT OF RUBBISH AROUND THE FORESHORES OF SHAWS BAY AND GENERALLY IMPROVE AESTHETICS

General rubbish, such as papers, drink bottles and plastic containers, is a common sight in any urbanised area. However, rubbish around the foreshores of Shaws Bay can significantly affect the aesthetic appeal of the waterway, and is a constant reminder of the influence that humans have on such estuarine environments. Rubbish can also have detrimental effects on the flora and fauna of Shaws Bay through entanglements, artificial shading, or by being mistaken as food.

Numerous features of the existing foreshore, such as broken stormwater pipes and bare, non landscaped car parking areas along Compton Drive, detract from the otherwise ‘natural’ environment of the Bay.

The Shaws Bay Estuary Management Plan should address the need to reduce the amount of rubbish which finds its way into Shaws Bay.

3.2.3 Siltation Objectives

Objective 4: TO MONITOR THE AMOUNT OF SILTATION OCCURRING IN SHAWS BAY

Fine sediment, which originates from the local catchment and from within the Richmond River, is accumulating in Shaws Bay at a rate which is in the order of about 5mm per year, and as such, is not considered to be a major concern. Coarse sediment (*sand*), however, may be accumulating in a small section of the Bay, in the vicinity of the point which separates the main part of the Bay from the northern bay at a rate in the order of 100mm per year. The source of this sand is longshore transport along the eastern and western foreshores. Long-term accumulation of sediment at this location may eventually impact on the physical and chemical processes of the Bay, with reduced tidal flushing and potential stratification of the northern bay.

The localised build-up of fine sediment on the bed of the Eastern Arm is coupled to the erosion of the adjacent foreshore. The rate of build-up is unknown but resident’s observations point to a significant build-up over the years. Continued foreshore erosion will worsen the siltation and there is concern that tidal flows through the channel could be restricted.

The Shaws Bay Estuary Management Plan should acknowledge this process of longshore transport and accumulation of mud on the bed of the Eastern Arm, and have facilities in place to remediate the siltation should it become obvious that it is having detrimental impacts on the estuarine processes of the Bay.

Objective 5: TO STOP EROSION OF THE FORESHORES OF SHAWS BAY

Bank erosion has been identified along the northern foreshore of the East Arm. As well as being unsightly and a hazard to the public, this bank erosion is supplying coarse sediment to the eastern foreshore, which is then being transported northward, eventually contributing to the shoaling of the Bay at the entrance to the northern bay (*refer Objective 4*).

In addition, gully erosion is occurring at specific locations in Pop Denison Park, which is also supplying coarse and fine sediment to the Bay.

Erosion of the foreshores should be addressed in the Shaws Bay Estuary Management Plan.

3.2.4 Recreation Objectives

Objective 6: MAINTAIN SEAGRASS-FREE ACCESS INTO AND OUT OF SHAWS BAY

Shaws Bay is utilised by the local community for numerous primary contact activities, including, swimming, snorkelling, wind surfing and paddle boating. As well as personal use, the Bay sometimes serves as a training facility for many sports clubs, including triathlon clubs, surf clubs, and the local High Schools. As such, the retention of a clean sandy substrate, free of seagrass, in areas of community access to the water, is an important community issue.

The Shaws Bay Estuary Management Plan should provide for seagrass-free access areas to be maintained in perpetuity.

At the same time, the intrinsic value of seagrass beds to the ecology of the Bay, should be reinforced through community education (*refer Objectives 10 & 12*).

Objective 7: TO ENHANCE PUBLIC ACCESS (INCLUDING DISABLED ACCESS) AROUND THE FORESHORES OF SHAWS BAY

Foreshore access (*particularly disabled access*) around Shaws Bay is somewhat limited. In response to increasing recreational demands, and to be consistent with Council's Shaws Bay Caravan Park Management Plan, additional foreshore access should be addressed by the Shaws Bay Estuary Management Plan.

Objective 8: TO ENHANCE PUBLIC FACILITIES AROUND SHAWS BAY

As well as public access (*refer Objective 7*), public facilities around Shaws Bay are limited, with high demand on existing facilities, particularly during summer weekends. The Shaws Bay Estuary Management Plan should address the need for additional public facilities, which would cater for all aspects of recreation carried out around Shaws Bay, such as picnicking, walking / running, swimming / snorkelling, and fishing.

3.2.5 Ecology Objectives

Objective 9: TO REDUCE THE AMOUNT OF WEED GROWTH AROUND SHAWS BAY

Some sections of the Shaws Bay foreshore, particularly around Pop Denison Park, and in front of the Shaws Bay Hotel, have been reported to contain various weed species, including Bitou Bush and Burr Grass.

The removal of weeds, and the restoration of more natural foreshore species should be addressed in the Shaws Bay Estuary Management Plan.

Objective 10: PROTECTION OF AQUATIC LIFE AND HABITATS WITHIN AND AROUND SHAWS BAY

As the rock wall forms a barrier to adult fish which have entered Shaws Bay in larval stages, the Bay is in essence ‘a natural fishbowl’ which has developed in response to its aquatic habitat. As Shaws Bay is only relatively small in comparison to the natural habitat of the marine life in the Bay, the diversity of the habitat of the Bay, such as the seagrass beds, mangrove colonies and saltmarshes, becomes very important.

Due to what is termed ‘the edge effect’, the smaller the habitat area, the more critical the diversity of that habitat becomes. This means that in a small area, such as Shaws Bay, a small change to the habitat is likely to have significant impacts on the organisms that inhabit it.

The organisms within Shaws Bay are valuable both to the overall ecological environment, and to the general community. Snorkelling is a popular activity for many community members, as well as for students of local high schools learning about the environment. The Shaws Bay Estuary Management Plan should address the protection of the aquatic habitats of Shaws Bay, and the organisms contained within.

Objective 11: PROTECTION OF TERRESTRIAL FLORA AND FAUNA AROUND SHAWS BAY

In a similar fashion to aquatic habitats, the protection of terrestrial habitats surrounding Shaws Bay should be addressed in the Shaws Bay Estuary Management Plan. These habitats include the remnant littoral rainforest areas along the escarpment to the west and north of Shaws Bay, as well as vegetation linkages between the rainforest and the native species around the Bay foreshores.

Protection of terrestrial fauna should also include avifauna (birds). Many protected species of birds, as well as some vulnerable species of birds, such as the Osprey, frequent Shaws Bay and its surrounds, and rely on its surrounding habitat for feeding and nesting.

Objective 12: TO GAIN A BETTER APPRECIATION FOR THE BIODIVERSITY AND ECOLOGY OF SHAWS BAY

The aquatic and terrestrial ecology of Shaws Bay and its surrounds is widely varied. It represents a good example of the biodiversity offered by estuaries which fringe coastal regions. Visitors to the area, as well as local residents, should be educated about the natural ecology of Shaws Bay, and why it is important in the context of the greater Ballina area.

Appreciation of the ecological value of the Bay will promote greater interest in, and caring for, the Bay.

4 MANAGEMENT OPTIONS

A variety of options have been developed which address the Management Objectives set out in the previous Chapter. These options encompass a range of structural and non-structural measures. Many of these options were suggested by community members during the community consultation period for this project.

The management options are outlined below:

4.1 OBJECTIVE 1: REDUCTION OF ORGANIC LITTER

Option 1.1: INSTALL ORGANIC LITTER COLLECTION DEVICES WITHIN THE DRAINAGE SYSTEM

Physical structures within the watercourses can be reasonably effective at capturing floatable litter, including organic debris, associated with stormwater flow. Structures such as trash racks and Gross Pollutant Traps (*GPTs*) have been used successfully in other catchments to reduce the amount of litter entering the receiving waters.

Structures likely to be suitable for use in the Shaws Bay catchment include custom designed minor (*pit*) GPTs, inlet pit wire baskets, or more ‘off-the-shelf’ interception devices, such as CDS Units and Humeceptors. The efficiency of all floatable systems depends on the regularity of cleaning. It is expected that litter collection devices would need to be cleaned after every significant rainfall event. Consideration would also need to be given to overtopping of the structure, and ensuring that captured litter is retained within the device during overtopping.

The adoption of structural methods for stormwater pollution control in Shaws Bay should be consistent with that adopted throughout the Ballina Shire. Council is presently carrying out a Stormwater Management Plan which will address such issues. Council would need to devote considerable resources to the regular cleaning and maintenance of any litter interception system.

Option 1.2: COMMUNITY EDUCATION AND ENCOURAGEMENT OF NATIVE GARDENS

A large amount of organic debris within the stormwater system would be the result of residential households. Therefore, community education on the most correct disposal methods of garden refuse would be the most effective means of reducing the organic debris into Shaws Bay.

Council could also encourage residents to plant evergreens, particularly native trees and shrubs, in preference to deciduous species, or species subject to defoliation, which subsequently requiring collection and disposal of leaves. General community brochures could be developed, which outline Council initiatives in this

regard. The brochures could also include information on composting of garden and organic household refuse.

Future tree plantings carried out by Council in the Shaws Bay catchment could also utilise native species which produce relatively small amounts of organic litter, such as Tuckeroo, and some Banksia and Melaleuca species.

Option 1.3: PROVISION OF GARDEN REFUSE COLLECTION SERVICE

Like many Councils in the Sydney metropolitan area, Ballina Shire Council could introduce a regular service for the collection of garden refuse from the households within the Shaws Bay catchment. Residents could be encouraged to use this method for disposal of organic material, such as lawn clippings and fallen leaves, rather than dumping in the drains, or nearby bushland.

The 'green waste' could be utilised by commercial compost services or local horticultural interests, subject to adequate safeguards to prevent the propagation of exotic weeds. Council has a green waste disposal group who would develop appropriate safeguards and procedures.

Option 1.4: PLACE GRAVEL APRON AT DRAIN OUTLETS TO PREVENT SCOUR HOLES WHICH CREATE ANAEROBIC CONDITIONS AND BAD SMELLS

Although this option does not specifically reduce the amount of organics entering Shaws Bay, it does address the community's perception of an organics problem. Shallow scour holes can form in the sand at the outlets of stormwater drains. These scour holes are filled with water and organic detritus during rainfall events, however, they are infrequently, or poorly, flushed during dry periods. The organic material within the pools decays, which reduced the amount of oxygen in the water and underlying sediments, and results in foul odours, particularly if the pool sediments are disturbed.

The placement of gravel aprons below the stormwater outlets would prevent scour holes from forming, and as such, small pools of anaerobic water and sediment would not occur along the Bay foreshores. Proper maintenance should prevent the establishment of weeds in the gravel interstices.

4.2 OBJECTIVE 2: MINIMISE NUTRIENTS AND BACTERIA

Option 2.1: COMMUNITY EDUCATION REGARDING NUTRIENT REDUCTION

Nutrients are generally in a dissolved state. As such, they cannot be readily trapped or intercepted within the drainage system. In an urban environment, nutrients can get into stormwater from fertilising of lawns and gardens, washing of cars, boats etc using detergent based cleaning agents, and from pet faeces.

A community education program regarding the reduction of nutrients into Shaws Bay would be the only cost-effective method of reducing the amount of dissolved

nutrients entering the waterway. Similar programs, such as the 'Phosphorus-Reduction' campaigns have been successfully implemented in other areas.

Option 2.2: DISCOURAGE DOMESTIC ANIMAL USE OF SHAWS BAY AND IMMEDIATE SURROUNDS

Bacteria in Shaws Bay would usually be the result of natural inputs, such as excreta from birds, flying foxes etc. However, other inputs from non-native origins could be minimised. A dog exercise area is located to the immediate north of Shaws Bay. Although bags and bins are provided for owners to collect and dispose of faeces, regular patrols could be carried out to ensure that the faeces are being removed from the area. Under the recent Companion Animals Act (1998), pet owners face fines of up to \$200 for not removing faeces from any public area.

The exercising of dogs and other domesticated animals should be discouraged from the other parkland surrounding Shaws Bay, as amenities for removing and disposing of faeces are only provided in the nearby designated dog exercise area.

Option 2.3: CARRY OUT ROUTINE WATER QUALITY MONITORING

Very little data on water quality in Shaws Bay is available. Due to the ecological sensitivity of the area (*refer Objective 10*), routine water quality monitoring should be carried out in the Bay. By regularly assessing the water quality of Shaws Bay, any changes to physical or chemical characteristics of the Bay could be addressed before they have detrimental effects on the aquatic and fringing terrestrial habitats of the Bay.

It is expected that monthly sampling for nutrients, oxygen, algae and bacteria, at selected locations around the Bay would serve as a minimum to better appreciate the water quality of the Bay in the future. Bacterial sampling during the summer months could be more frequent, and could be used as an indicator for the suitability of Shaws Bay for swimming and snorkelling, particularly for the days following rainfall, and subsequent catchment runoff.

It would be possible for Council to devise a programme of routine water quality measurements in conjunction with Ballina High School. This would increase community understanding of water quality processes and increase community commitment to protection of the Bay's aquatic environment.

Option 2.4: REDIRECT STORMWATER TO RIVER

An option that was strongly supported by the community was the re-direction of all stormwater outlets into the adjacent Richmond River. This way, no nutrient-rich or sediment-laden stormwater would discharge into Shaws Bay. Although feasible, the implementation of this option would be difficult and costly. The *Estuary Processes Study* report demonstrated that the existing discharge of stormwater is not having a significant detrimental impact on the Bay, and as such, the cost of expensive solutions, such as the diversion of stormwater into the River, cannot be justified (*refer Section 4.13*).

Option 2.5: DETAIN STORMWATER AND LET FILTER THROUGH GROUNDWATER

Another option put forward by the community was to collect the stormwater before it discharged into Shaws Bay. The water would then be able to filter through the surface soil and subsoil into the groundwater aquifer, where it would then slowly discharge to Shaws Bay and the Richmond River. Although some nutrients can be taken up by algae and other organisms living within the soil, the filtering process is only likely to reduce bacteria concentrations by any substantial amount. The storage of stormwater would also require a very large area, which is not readily available around Shaws Bay.

4.3 OBJECTIVE 3: REDUCE RUBBISH AND IMPROVE GENERAL AESTHETICS**Option 3.1: INCREASE COMMUNITY AWARENESS OF IMPACTS OF LITTERING**

Simple, yet informative signage could be erected at strategic locations around the Bay to educate the public about the implications of littering, particularly in areas where people congregate, such as in Pop Denison Park, near the Shaws Bay Hotel, and near the restaurant on Compton Drive. Education brochures could be prepared and distributed to households in the vicinity of Shaws Bay.

Option 3.2: INSTALL MORE RUBBISH BINS

Council could consider installing more rubbish bins in selected areas around the Bay. These areas would target places where people congregate, such as Pop Denison Park, and near the picnic tables along Compton Drive.

People tend to be less diligent with regard to placing litter in bins if discarded litter is present in the local vicinity. Therefore, considerable effort should be made to keep the foreshores clear of litter.

Option 3.3: IMPROVE GENERAL AESTHETICS OF BAY FORESHORES

There are a number of ways in which the general aesthetics of the foreshores of Shaws Bay could be improved. These include:

- Removing the broken pipes which extend from existing stormwater drains;
- Possibly removing the stumps of dead (sawn) mangrove trees on the western foreshore, pending consultation with NSW Fisheries. Removal would be restricted to those stumps which are considered to be creating a public nuisance;
- Formalise carparking using simple landscaping along Compton Drive to beautify the western foreshore.

4.4 OBJECTIVE 4: MONITOR SILTATION**Option 4.1: CARRY OUT ROUTINE SURVEYS OF SHAWS BAY**

Although the majority of Shaws Bay is slowly infilling, at a rate that is typical of most estuaries along the NSW coast, coarse sediment is likely to be accumulating

in a small section of the Bay in the vicinity of the point which separates the main section of the Bay from the northern bay at a rate which may pose a management problem at some time in the future. There is a localised build up of muds in the Eastern Arm which may also pose a management problem in the future.

Routine (*eg biannual*) surveys of these sections of the Bay would serve to inform Council on the rate of sediment accumulation, and could act as an indicator to carry out remediation activities, as required (*refer Option 4.2*).

Option 4.2: DREDGE AREAS OF ACCUMULATED SEDIMENT

Coarse sediment is slowly working its way northward along the sandy beaches of Shaws Bay. Eventually, this sediment is deposited into the middle of the Bay in the vicinity of the point which separates the main part of the Bay and the northern bay. Over time, this area of the Bay may shoal to a level whereby the physical, chemical and biological processes within the Bay are affected. Before this happens, it would be advantageous to remove the coarse sediments which would have accumulated over time.

Fine sediment is accumulating on the bed of the Eastern Arm as a result of the erosion of clays and silts contained in the adjacent, eroding foreshore. If the siltation continues, it could reduce tidal flushing. If monitoring indicates that the build-up of fine sediment is likely to reduce tidal flows into and out of the Bay, it would be desirable to remove the mud build-up by appropriate dredging.

As indicated by the level of shoaling (*as determined by routine hydro surveys – refer Option 4.1*), or an associated degradation of the water quality (*as determined by regular water quality monitoring – refer Option 2.4*), the sediment in either or both of these areas could be removed by mechanical (*ie long reach excavator or drag-line*) or hydraulic (*ie dredger*) methods. Based on the estimated rate of accumulation over the past 8 years, dredging of this section of the Bay may be required in another 10 years or so.

4.5 OBJECTIVE 5: STOP FORESHORE EROSION

Option 5.1: CREATE STABLE SANDY BEACH IN EAST ARM

The erosion of the northern bank of the East Arm is supplying sand to the coarse sediment pathway (*which is slowly accumulating in the northern section of the Bay*). The erosion is also unsightly, particularly when viewed from the northern breakwater walking and cycling track, and it may be a public hazard (*particularly at night*). This bank erosion can be easily addressed by developing a sandy beach at this location. The long term stability of the beach would require some soft engineering structures.

The provision of a stable sandy beach at this location would enhance the recreational amenity of the Bay, as it is understood that this area is popular for wading, particularly with younger children. A permit would be required from

NSW Fisheries and the design of the sandy beach would be carried out in close consultation with Fisheries.

Option 5.2: REMEDIATE GULLY EROSION AREAS

The gully erosion areas within Pop Denison Park and adjacent parkland can be detrimental to the overall health of the Bay. As well as being unsightly, and a public hazard, the erosion delivers coarse and fine sediment to the Bay which can smother benthic habitats, and increase turbidity.

To be in keeping with the environmental qualities of the area, the gully erosion sites should be remediated using gravel filters, and replanted.

4.6 OBJECTIVE 6: PROVIDE ACCESS THROUGH SEAGRASSES

Option 6.1: MAINTAIN SEAGRASS-FREE ACCESS AREAS

Seagrasses along the foreshores of Shaws Bay can pose difficulties for the public accessing the water. As well as being uncomfortable and difficult to walk through, pedestrian traffic through the seagrass beds would damage the seagrasses and would affect the organisms which live within them.

To facilitate the public recreational amenity of the Bay, particular sections of the foreshore could be maintained as seagrass-free. At present, there are numerous sections of the foreshore where seagrasses have not established. Maintaining such areas as seagrass-free would involve the discouragement of future seagrass establishment (*which may naturally occur if pedestrian access was concentrated at these specific locations*), and/or removal of juvenile plants (*and possible re-planting elsewhere*) under the close supervision of NSW Fisheries. It would not be necessary for large beds of existing seagrasses to be removed, as there are sufficient seagrass-free sections of the foreshore to establish access locations.

The removal of any seagrass will require a permit from NSW Fisheries. It will be essential to establish the specific location and size of the areas to be kept free of seagrass, through close consultation with NSW Fisheries.

Option 6.2: REGULAR REPLENISHMENT OF SAND ON BEACHES

It is expected that seagrasses have recently established around the foreshores of Shaws Bay because dredged sand has not been placed on the beaches for about 8 years. Re-initiating this former practice of replenishing sand on the beaches via dredging of the deeper parts of the Bay would smother and kill-off existing peripheral seagrass beds, and would inhibit the establishment of new beds. Regular replenishment of sand on the foreshore beaches would, however, ensure safe and comfortable access into and out of Shaws Bay.

Note that for ecological reasons, replenishment of sand on the beaches is discarded in the Management Plan (*refer Section 4.13*).

4.7 OBJECTIVE 7: ENHANCE PUBLIC ACCESS

Option 7.1: CREATE WALKING / CYCLING TRACK BETWEEN COMPTON DRIVE AND THE NORTHERN BREAKWATER

Shared cycleways / pedestrianways traverse many parts of Ballina, including areas around Shaws Bay. It has been suggested by many members of the community that the cycleway / pedestrianway along Compton Drive be extended along the Shaws Bay foreshore, in front of the Shaws Bay Hotel and Fenwick House, to connect to the cycleway / pedestrianway on the northern Richmond River breakwater (*part of Ballina Shire Council's integrated cycleway network*).

The development of this foreshore access would also mean that pedestrians and cyclists would not be required to use the steep, narrow and dangerous section of Compton Drive, where it intersects with Hill Street. A new cycleway / pedestrianway along the western foreshore of Shaws Bay would also be consistent with the objectives of the Management Plan for the adjacent Shaws Bay Caravan Park. This Plan proposes to upgrade the existing access through the Caravan Park to a formal cycleway / pedestrianway along the southern foreshore of the Park.

Option 7.2: DEVELOP DISABLED ACCESS AROUND POP DENISON PARK AND OTHER BAY FORESHORE AREAS

At present, access to the foreshores of Shaws Bay is generally over soft and/or uneven terrain, which can be difficult to negotiate for many disabled or less mobile members of the community. Designated tracks, constructed from material suitable for wheelchair access (*other than concrete and bitumen*) could be established through the bushland of Pop Denison Park, and other foreshore reserves, to viewing platforms or hard-stand areas, which look out over the waterway.

4.8 OBJECTIVE 8: ENHANCE PUBLIC FACILITIES

Option 8.1: INSTALL MORE PICNIC FACILITIES IN POP DENISON PARK

Two shelter sheds and one wood barbecue are the only picnic facilities in Pop Denison Park at present. To cater for the relatively high numbers of people utilising the Park, particularly on summer weekends, additional picnic facilities, such as exposed and covered picnic tables, and electric or gas barbecues could be installed within the Park. Some of these facilities could be located toward the centre of the Park to encourage use of this, presently disused, area.

To complement the establishment of new picnic facilities, additional shade trees should also be planted (*refer Option 8.2*).

Option 8.2: PLANT MORE SHADE TREES

To enhance the useability of Pop Denison Park as a recreational amenity, it was considered by many members of the community that more shade trees first needed to be established. These shade trees should be thoughtfully positioned to maximise

the useability of the Park, as well as provide habitat for terrestrial fauna and avifauna (*refer Option 11.1*).

Option 8.3: INSTALL WASH-DOWN SHOWER ON WESTERN FORESHORE OF SHAWS BAY

Many community members who utilise Shaws Bay for swimming and bathing do so by accessing the Bay from the western foreshore (*ie adjacent to the informal car parking bays off Compton Drive*). Although a wash-down shower is located on the eastern foreshore, in Pop Denison Park, it was suggested that an additional shower be installed on the western foreshore to service those members of the community who access the Bay from the west.

In installing a wash-down shower, careful consideration would need to be given to its location, particularly with respect to the drainage of the shower water, and its subsequent discharge to Shaws Bay.

Option 8.4: INSTALL BENCH SEATING AROUND THE BAY

Many people are attracted to Shaws Bay to simply relax and observe nature. The provision of discretely located bench seating around the bay would increase the comfort of many members of the community, particularly the older members.

Seating at a couple of locations along the northern breakwater, with views over Shaws Bay would significantly enhance the recreational amenity of the area.

4.9 OBJECTIVE 9: REDUCE WEED GROWTH

Option 9.1: REGULAR REMOVAL OF WEEDS AROUND FORESHORES

Within the public reserves around the foreshores of Shaws Bay, weeds such as Bitou Bush and Burr Grass can be a problem. Such weeds could be removed on an 'as needed' basis.

Consideration could also be given to controlling the couch grass which spreads rapidly over the supra-tidal sections of foreshore sandy beaches. However, it should be recognised that the couch grass is contributing to foreshore stabilisation.

Option 9.2: SELECTIVE REMOVAL OF MANGROVE SEEDLINGS

Mangrove seedlings have become established at numerous locations along the eastern and western foreshores of Shaws Bay, particularly around outlets of stormwater drains where deeper scour channels have formed. As highlighted by NSW Fisheries (*pers comm. Rob Williams*), the development of adult mangroves at these locations may not necessarily benefit the waterway environment, as they may compete for space against existing saltmarsh and seagrass communities, and may clash with existing recreational uses of the foreshores.

The removal or relocation of mangrove seedlings is not uncommon, particularly in controlled environments, such as Shaws Bay. The removal of mangrove seedlings

would first require the permission of NSW Fisheries, and it is essential that their advice regarding the removal be sought prior to implementation of this option.

4.10 OBJECTIVE 10: PROTECT AQUATIC ENVIRONMENT

Option 10.1: RESTRICTION OF FISHING IN SHAWS BAY

At present, the only permitted methods of fishing in Shaws Bay are rod and line and dip or scoop nets by recreational fishers. Commercial fishing is not permitted in Shaws Bay. Spear fishing is not permitted in any waters of the Richmond River downstream of the Burns Point ferry.

Being a relatively small habitat, it is possible that a small change in the fish population in Shaws Bay can have significant follow-on effects. For example, if one or more of the main predatory fish are removed, more smaller fish will survive, which means that there will be a greater demand on lower food sources, and so on. NSW Fisheries has advised that there have been no studies or assessments of the impacts of recreational fishing on the ecosystem of Shaws Bay. Hence no conclusion can be made as to whether it is having a deleterious effect or not.

Some members of the community have presented options for restrictions on fishing in Shaws Bay, ranging from novice fishing only, through to a complete ban on fishing in the Bay. Consideration could be given to restricting fishing to designated areas which do not conflict with other recreational activities in the Bay, such as swimming, snorkelling and sunbaking.

Option 10.2: MONITOR THE GROWTH OF ULVA IN THE BAY

Sea Lettuce (*Ulva Lactuca*) is a species of macro-algae which has spread rapidly within Shaws Bay over the past 6 years or so. The *Ulva*, which looks like thin green plastic sheets, tends to grow around the edges of existing seagrass beds, and as such, may be restricting further development of the seagrasses. Dense *Ulva* within sparse seagrass beds also suggests that the algae may be taking over seagrass beds also.

NSW Fisheries advise that because *ulva* is a naturally occurring, pioneering algae species, the agency favours a non-interventionist approach to its management.

In view of the community concern over the emergence of *ulva*, it is considered that the extent of *ulva* should be monitored so that the significance of its relative abundance can be reviewed with Fisheries in the future.

Option 10.3: MONITOR THE POSSIBLE INVASION OF MANGROVES INTO VALUABLE SALT MARSH AREAS

Under the right conditions, mangroves can spread rapidly, and overrun other fringing aquatic habitats. At the northern end of Shaws Bay, a small colony of mangroves (*mostly grey species*) has established. Recent ideal conditions for seeding has resulted in numerous mangrove seedlings becoming established in

fringing areas, including the adjacent saltmarsh area, which is the only significant area of saltmarsh in Shaws Bay.

The area of saltmarsh habitat should be monitored so that any significant decline can be arrested by selective removal of mangrove seedlings within and around the saltmarsh area or compensated by the establishment of additional saltmarsh by localised contouring or reshaping of tidal lands. Fisheries has indicated they would support the latter which could be incorporated into an eco-tourism, education program for the Bay.

4.11 OBJECTIVE 11: PROTECT TERRESTRIAL ENVIRONMENT

Option 11.1: ESTABLISH VEGETATION CORRIDOR LINKING THE RAINFOREST TO THE BAY

At present, the vegetation communities of the rainforest are separated from vegetation communities around the foreshores of Shaws Bay by large expanses of grassed open land, and roadway. While larger birds and some mammals can traverse these opens areas, they act as barriers for many smaller birds, as well as terrestrial fauna, such as native rodents, reptiles and amphibians.

To expand the available habitat of the smaller animals, and to increase the biodiversity of the foreshores of Shaws Bay, a corridor of vegetation could be planted which links the rainforest communities with those vegetation communities surrounding the waterway. Specific types of trees would need to be planted at relatively close spacing to give the timid animals the security they require when moving around their habitat. Linkages between existing stands of vegetation along the entire eastern foreshore of Shaws Bay would greatly increase habitat diversity for many smaller animals.

Vegetative riparian corridors, to link areas of core habitat, have been planted along the banks of the Tweed River. This has been well received by local communities and there has been considerable volunteer support for the planting programmes (*J. Lofthouse, pers. comm.*).

Option 11.2: ERECT OSPREY POLE

Osprey are birds of prey that rely on clean and healthy environments to supply a ready supply of their staple diet; fish. The value of man-made Osprey nests to overall Osprey populations is unquestioned. It is understood that Ballina, alone, has 5 Osprey poles, however, not all are occupied, possibly due to poor siting.

The southern foreshores of Shaws Bay is an ideal location for an Osprey pole, as there are no tall trees, and it offers commanding views over large expanses of water, including both Shaws Bay and the Richmond River. The encouragement of Osprey into the Shaws Bay environment would significantly add to the overall ecological appreciation of the Bay, and could form a significant component of an eco-educational trail around the Bay.

Option 11.3: REMOVE WEEDS FROM RAINFOREST

A remnant littoral rainforest is located to the north and the west of Shaws Bay. This relatively small stand of vegetation is all that remains of the forest which would have formerly occupied the whole Ballina area prior to European settlement. The rainforest is a small, but highly valued habitat for many species of fauna, many of which are threatened.

The remnant rainforest is currently under threat from weed invasion. Weed species in abundance include Green Cestrum, Lantana, Madeira Vine and Coastal Morning Glory. The invasion of these weeds would be limiting the growth and establishment of native rainforest vegetation, which is important to the native species of fauna occupying the rainforest. Removal of weeds from the rainforest would be beneficial to both the flora and fauna rainforest communities.

4.12 OBJECTIVE 12: APPRECIATE BIODIVERSITY AND ECOLOGY**Option 12.1: MANGROVE BOARDWALK AND WALKING TRAILS THROUGH THE RAINFOREST**

The Shaws Bay environment is well suited for eco-educational purposes. Not only does the estuary contain mangroves, seagrasses and abundant fish, but the estuary is fringed with a stand of littoral rainforest, remnant of pre-European times. Shaws Bay is presently used by Ballina High School and Southern Cross University when teaching about the marine environment, however, there is potential to expand this to include the terrestrial environment as well. With well positioned walking tracks through the remnant rainforest, as well as possible timber boardwalks through a small mangrove colony (*on the northern side of Compton Drive*), students could continue their educational visit to the area to incorporate terrestrial flora and fauna communities.

Option 12.2: INTERPRETIVE ECO-EDUCATIONAL SIGNAGE AROUND THE BAY

Often, the ecological values of particular environments and habitats are not understood by the general community, and as such, these values are frequently under-estimated, or even overlooked. Awareness of these ecological values can be heightened through the placement of selected signs, which provide important, but succinct information pertaining to the environment. Such signs have been successfully installed throughout many areas around Australia, and serve to educate the general resident community, as well as visitors to the area, about the significant features of the site. Depending on the variety of signs to be installed, consideration could be given to the creation of a self-guided eco-tourism walk.

As examples, eco-educational signs could be installed along the northern breakwater cycleway / pedestrianway, near possible bench seating (*refer Option 8.4*). Providing the seating is appropriately positioned, one sign may relate to the seagrass beds in the East Arm of Shaws Bay, while another sign may relate to the mangrove colony on the northern side of the wall. Signage could also be established for the Osprey pole (*refer Option 11.2*), and the remnant littoral rainforest.

Option 12.3: DEVELOPMENT OF SCHOOL PROJECT KITS AND GUIDED TOURS OF THE AREA

Once an informal educational walking trail has been established around the bay, and through the adjacent littoral rainforest, Council could develop school project kits on the ecology of the area. This could be further complemented by the provision of guided tours by local authorities, who could point out significant features of Shaws Bay and the aquatic and terrestrial flora and fauna which inhabits it.

Option 12.4: COMMUNITY PARTICIPATION IN MANAGEMENT WORKS

Community participation should be encouraged when carrying out the significant measures within the Management Plan framework, such as building walking trails and boardwalks, planting trees, relocating mangroves and seagrasses, and removing litter from the foreshore reserves and sand flat areas of the Bay. Actual participation in the works would increase appreciation of the natural attributes of the Bay.

4.13 ASSESSMENT OF MANAGEMENT OPTIONS

While the vast majority of the above management options were endorsed by the community and the Estuary Management Committee, there were a few options which were discarded based on financial, practical or legislative grounds, as discussed below.

- ❑ Discouraging domestic animals from the reserves around Shaws Bay (*Option 2.2*) would be very difficult to enforce unless a Park Ranger was employed full-time. As such, the practicality of this option prohibits it from being adopted in the Shaws Bay Estuary Management Plan.
- ❑ The redirection of stormwater to the Richmond River (*Option 2.4*) would also be very costly, and would require major construction works in and around the Bay. The Estuary Processes Study has shown that the Bay has the capacity to accommodate existing stormwater discharges, and as such, more harm to the environment than good may result in the implementation of this option.
- ❑ Likewise, detention of stormwater (*Option 2.5*) would be very expensive for little apparent gain to the environment of the Bay. Stormwater detention would also require a significant land area, which is not available around the foreshores of Shaws Bay, and as such, this option has not been incorporated into the Management Plan.
- ❑ The regular replenishment of sand on the beaches (*Option 6.2*) has been identified as the likely cause for seagrasses not establishing along the Bay foreshores over the past 20 years. With renewed sand replenishment, the existing beds, which provide valuable habitat to many marine species, would be smothered with likely detrimental ecological implications. This affect is inconsistent with the overall goal of Estuary Management, and as such, has not been further considered.
- ❑ The development of a cycleway / pedestrianway linking Compton Drive with the northern breakwater (*Option 7.1*) may depend on the availability of public land along the foreshore. If

public land is not available, an easement may need to be purchased from existing private foreshore owners at market value. Depending on the value of the land, this option may prove to be too costly, and as such should be pursued at this stage, in an investigation manner only.

- Any restriction of recreational fishing in Shaws Bay (*Option 10.1*) would be very difficult to enforce, particularly with a large itinerant fishing community associated with the two adjacent Caravan Parks. As there is no scientific evidence to suggest that the present level of fishing in Shaws Bay is having any deleterious effect, the restriction of fishing in the Bay was not incorporated into the Plan. It may be advisable, however, to readdress the issue of a sustainable fish population in Shaws Bay some time into the future, say 5 – 10 years or so.

The remaining management options have been developed into Management Tasks, and are incorporated into the Shaws Bay Estuary Management Plan, which is discussed in the next Chapter.

5 SHAWS BAY MANAGEMENT PLAN

5.1 PURPOSE OF THE PLAN

Shaws Bay has been determined to be healthy, with adequate tidal flushing, consequential good water quality, and a wide variety of terrestrial and aquatic flora and fauna. However, there are a number of issues which may threaten the long term sustainability of Shaws Bay in the future.

This Plan is a concise, stand alone document, which addresses the perceived needs of the Shaws Bay estuary. It is to be used as a planning guide by Council and other planning authorities to address the long term management issues associated with Shaws Bay.

5.2 OBJECTIVES OF THE PLAN

The overall goal of the Shaws Bay Estuary Management Plan, as resolved by the Shaws Bay Estuary Management Committee is:

“to improve the recreational amenity of Shaws Bay and to ensure that the habitat and ecological values of the Bay are maintained within an acceptable range”.

The Estuary Management Plan outlines the tasks which have been identified through the Estuary Management Study to address a range of issues aimed at achieving the overall management goal, as outlined above. These issues were developed into specific management objectives, as part of the Estuary Management Study.

The objectives of the Estuary Management Plan are outlined below, ranked in order of priority:

1. Reduction of organic litter input;
2. Minimise nutrients and bacteria input;
3. Provide access through seagrasses;
4. Protect aquatic environment;
5. Protect terrestrial environment;
6. Appreciate biodiversity & ecology;
7. Reduce rubbish and improve aesthetics;
8. Monitor siltation;
9. Stop foreshore erosion;
10. Enhance public facilities;
11. Enhance public access;
12. Reduce weed growth;

These objectives were prioritised based on consultation with the community and the Estuary Management Committee, as well as the findings of the Shaws Bay Estuary Processes Study.

5.3 DEVELOPMENT OF MANAGEMENT TASKS

A range of structural and non-structural tasks have been identified to address these management objectives. Structural tasks incorporate the construction or formation of physical structures to achieve the desired results. Non-structural tasks generally incorporate a broader community wide participation program and investigation of issues which require further data.

The tasks presented in the Shaws Bay Estuary Management Plan have been drawn from the long list of management options outlined in the Estuary Management Study, which were developed with the assistance of the community through a detailed consultation program. The tasks represent the most practical and achievable means of addressing the management objectives within the context of Council's budgetary constraints and state and local government planning policies.

Management tasks are discussed below, based on the primary management issues, viz:

- Pollution;**
- Siltation;**
- Recreation;** and
- Ecology**

Specific tasks which are to be carried out around Shaws Bay are outlined in **Figure 5.1**, while pictorial representations of selected tasks are presented in **Figures 5.2 to 5.6**.

5.4 POLLUTION RELATED TASKS

A: install litter / organic debris collection devices

The input of litter and organic debris is one of the main threats to the ecological habitats of Shaws Bay. Therefore, Council should give consideration to installing devices within the catchment and at appropriate locations, to intercept litter and organic debris from the stormwater system before discharge into the Bay. Highest priority would be the sub-catchments draining the urban development to the east of Shaws Bay, ie Stormwater Drainage Lines C, B and A (*in that order of priority*).

B: encouragement of native gardens

A considerable amount of organic litter can be generated from the domestic garden, particularly if it contains deciduous trees. Council should encourage the planting of native evergreen tree species, to minimise the potential organic load into the stormwater system. This may include discounted prices for seedlings of native evergreen species.

Any plantings by Council in the Shaws Bay catchment should also be with native species, particularly those species which are less susceptible to defoliation when stressed.

C: garden refuse collection service

The Plan recognises the need to reduce organic material entering the stormwater system. Therefore, Council should investigate the feasibility and cost of implementing a garden refuse collection service within the Shaws Bay area. This service would discourage the community from discarding 'green waste' into drains, vacant lots and reserves. The feasibility assessment should include the possibility of mulching and selling the refuse to help offset the costs of collection as well as adequate safeguards to prevent the propagation of exotic weeds.

D: placement of gravel aprons at stormwater outlets

The Plan recognises that considerable community perception regarding poor water quality in Shaws Bay stems from anaerobic pools of water and sediment at the outlets to stormwater drains. Council should consider

preventing the development of these pools by stopping scour of the sandy beaches during rainfall events. This could be achieved by placing a small gravel apron on the beach at the outlets of the stormwater drain.

The apron should be designed to accommodate the likely scour velocities associated with large rainfall events.

E: community education on pollution

The Plan identifies a need for Council to initiate and maintain a community awareness program to encourage the community to reduce pollution. Specifically, the program should target:

- Reducing excessive fertiliser (*nutrient*) usage on gardens and lawns, as well as in detergents used for vehicle washdown etc;
- Reducing general littering within the catchment, particularly areas frequently used for recreation and sightseeing;
- Reducing the amount of organic waste produced by encouraging composting and mulching – possibly through the sale of discounted composting containers.

F: regular water quality monitoring

Very little water quality data is currently available for Shaws Bay. The Shaws Bay Estuary Management Plan recognises the need for additional data collection, so that Council can make informed decisions regarding the water quality of the Bay.

Council should expand their current bacteriological sampling program to include other water quality parameters which are important to the overall health of the Bay.

As a minimum, this should include dissolved oxygen, nutrients and possibly algae, and should be monitored at least once per month.

G: install more rubbish bins

Litter around the foreshores of Shaws Bay was identified by the community as a particular concern. Council should investigate the feasibility and practicality of installing more rubbish bins, or relocating existing bins, so they target areas primarily used by recreational users of the Bay (*eg Pop Denison Park*), as well as sightseers of the Bay (*eg near picnic tables on western foreshore along Compton Drive*).

H: improve aesthetics of Bay foreshores

The Plan recognises that some of the foreshores of Shaws Bay contain obtrusive structures and are generally unbefitting of the nature of the environment. As such, Council should consider beautifying the foreshores of the Bay, particularly the western foreshore. Specific works that could be carried out include:

- the removal of broken stormwater pipes from the beaches;
 - the possible removal of dead (sawn) mangrove tree stumps and root masses where considered to be a public nuisance; and
 - basic landscaping to formalise and improve appearance of car parking along Compton Drive, using Kopper log fencing and screen shrubbery, for example.
-

5.5 SILTATION RELATED TASKS

I: routine hydro surveys of Shaws Bay

The community has identified siltation within Shaws Bay as a particular concern. While the accumulation of fine sediment in the deeper sections of the Bay would be a relatively slow process, coarse sediment from the beaches may be infilling a small section of the Bay, located around the point which separates the main part of the Bay from the northern bay. Fine sediment is accumulating on the bed of the Eastern Arm due to silts and clays contained in the adjacent, eroding foreshore.

Council should initiate a program to routinely monitor the accumulation of sediments at identified areas of shoaling within the Bay ie. area between main part of the Bay and northern part as well as the Eastern Arm.

Frequency of hydro-surveys of these identified areas should be about 2 years, while surveys of the whole Bay could be more infrequent, ie every 10 years or so. Low altitude aerial photographs would be very useful to show changes in foreshores. Photos could be taken every 2 years.

J: remove accumulated sediment, as required

Pending the results of the regular hydro-surveys (*refer Management Task I*), accumulated sediment may need to be removed before it has any detrimental affects on the water quality and overall ecological health of the Bay.

The Plan recognises the possible need to remove sediments from within the main body

of the Bay as well as the bed of the Eastern Arm at some time in the future. The indicator for action may be a notable change in water quality (*ie sustained stratification of the water in the northern bay*), or may be a minimum water depth (*eg 1 metre at low tide*).

K: create stable sandy beach in East Arm

Bank erosion is occurring along the northern foreshore of the East Arm of Shaws Bay. The Plan recognises the need to address this erosion and to increase the recreational amenity of the area by the creation of a stable sandy beach at the site of the erosion using 'soft' engineering techniques. The design of the beach would be done in close consultation with NSW Fisheries.

L: remediate gully erosion

Gully erosion has occurred in Pop Denison Park, and in front of the Lakeside Holiday Park. The Plan recognises the need to remediate this gully erosion, as it is presently unsightly, and also poses a hazard for the public accidentally stumbling into the gully.

Therefore, Council should remediate the areas of gully erosion using a combination of gravel and/or synthetic filters and fill to ensure that the erosion does not recur.

5.6 RECREATION RELATED TASKS

M: maintain seagrass-free access into water

One of the primary concerns of the community, and the only potential conflicting issue relates to the seagrasses around the edges of the Bay, and access through these seagrasses for recreational users of the Bay. As well as recognising the need to protect aquatic habitats, the Shaws Bay Estuary Management Plan provides for the community need to have amenable access into and out of the water.

Council should therefore encourage the use of designated seagrass-free sections of the foreshore for public access to the waterway. These sections would be maintained free of seagrasses in the future by relocating any plants that become established. The removal of any seagrass will require a permit from NSW Fisheries. The specific locations and size of the seagrass-free areas will be determined through detailed discussion between Council and Fisheries.

N: cycleway / pedestrianway along western foreshore

The Plan recognises the importance of cycle and pedestrian linkages around the Bay foreshore. Consequently, Council should investigate the possibilities for providing a formal cycleway / pedestrianway along the western foreshore of Shaws Bay, in front of the Shaws Bay Hotel and Fenwick House, to link routes along Compton Drive with routes along the northern breakwater.

Investigations to be carried out by Council should include land tenure, zoning and

costing (for construction, maintenance, and land purchase, if required).

O: disabled access to Bay foreshore

At present there is limited access to the Bay foreshores for those members of the community requiring wheel chairs, or who find walking on soft terrain difficult. The Plan recognises the need to provide hardened paths to the foreshore so that the whole community can enjoy the benefits of Shaws Bay. Paths could be constructed from wheelchair-friendly, but environmentally sensitive materials, such as cement stabilised, crushed gravel. Consultation with Council's Access Committee should be carried out in this regard.

P: install more picnic facilities in Pop Denison Park

The Plan recognises that existing picnic facilities in Pop Denison Park are limited, and as such, are in high demand, particularly during summer weekends. To encourage public use of the Park, Council should install more picnic facilities, which would include barbecues (electric or gas burning), tables, and shelter sheds. The need for additional parking in Pop Denison Park may need to be assessed in the future, depending on the perceived future demands on existing facilities.

Q: plant more shade trees in Pop Denison Park and around foreshores

To promote the use of Pop Denison Park as a recreation destination, the Park first needs to

be suitable for picnicking and recreation activities. The Plan recognises this fact, and in response, Council should carry out plantings of stands of trees for the specific purpose of providing shade. To be consistent with Management Task B, these trees should be native, and should be relatively resistant to defoliation under stressed conditions. Possible species include the Tuckeroo, and some Banksia and Melaleuca species.

The plantings should take advantage of established vegetation within the Park, and should consider the recreational need for larger areas which are free of trees (*for ball games, kite flying etc*). The plantings should also consider the needs of the vegetation corridor (*refer Management Task W*).

R: install wash-down shower on western foreshore

The Plan recognises the use of Shaws Bay as a local swimming and bathing facility. Many members of the community, who enjoy the Bay in this regard, access the water from the western foreshore only. Therefore, Council should investigate the feasibility of installing a cold water wash-down shower on the western foreshore to service these members of the community.

The location of this shower should coincide with access locations through the seagrasses (*refer Management Task M*).

S: install bench seating around Bay

Apart from some picnic tables along the western foreshore, there are no seats around Shaws Bay which provide views over the water. The Plan recognises that seating around the Bay, and along the breakwater wall, would be beneficial to the community,

particularly the elderly and less mobile members of the community. Council should investigate the feasibility of installing bench seating at a number of key locations around the Bay, which have good views over waterway. These seats could be incorporated into hard-stand areas which are also accessible by wheelchairs (*refer Management Task O*), and may provide interpretive signage on particular features of the Bay (*refer Management Task AA*).

5.7 ECOLOGY RELATED TASKS

T: remove weeds from around foreshore

The Plan recognises that weed species can become established around the foreshore, particularly Bitou Bush and Burr Grass, which detract from the recreational amenity of the Bay. Council should initiate and maintain a program of regular weed eradication from the foreshores of Shaws Bay, as well as reserves adjacent to the Bay, including Pop Denison Park.

U: selective removal of mangrove seedlings

Mangrove seedlings can take root just about anywhere along the foreshores. To ensure that the ecological, and recreational values of the Bay are not compromised (*refer Goal of Shaws Bay Estuary Management Plan*) by the establishment of mangroves in undesirable locations, seedlings could be removed, and possibly transplanted to more desirable locations in Shaws Bay, or other nearby estuaries.

Council should consult with NSW Fisheries regarding the possible removal of mangrove

seedlings from areas of saltmarsh, located at the northern end of the Bay, as well as areas of high recreational value, such as the beach in front of the Lakeside Holiday Park. The development of mangroves within saltmarsh areas may limit the ecological sustainability of the saltmarshes. Re-establishment and nurturing of mangrove seedlings could be carried out with the assistance of local high school students, and in close liaison with NSW Fisheries.

As an alternative to the removal of mangrove seedlings from areas of saltmarsh, it may be possible to establish additional saltmarsh by localised contouring or reshaping of tidal foreshore land.

V: monitor the spread of Ulva in Shaws Bay

The Plan identifies *Ulva* as a potential threat to the existing aquatic habitats of Shaws Bay. Council should initiate and maintain a program to monitor the spread of *Ulva* through Shaws Bay, and the impacts that it has on seagrass and other benthic habitats. NSW Fisheries should be consulted in this regard, particularly if it is determined that the *Ulva* is having a detrimental impact on the ecology of the Bay. Actual monitoring of *Ulva* in Shaws Bay could be carried out with the assistance of local high school students, and in close liaison with NSW Fisheries.

W: plant vegetation corridor between Bay & rainforest

The Plan recognises the importance of the interaction between different flora and fauna within an ecologically sustainable habitat. As such, Council should carry out selected planting of appropriate native species to encourage the existing fauna of the adjacent littoral rainforest to utilise the terrestrial

vegetation around the fringes of Shaws Bay, and visa versa.

An essential component of the implementation of the Plan will be the careful and informed design of a planting programme which recognises the faunal species which will utilise this vegetation corridor. The programme will include specific plant species and diversity, plant spacings and shading required to provide a viable habitat.

X: erect Osprey pole

The Plan recognises the value of biodiversity with an ecological environment. As such, Council should consider the construction of an Osprey pole on the foreshore of Shaws Bay. NPWS confirm that the southern foreshores of Shaws Bay are ideal for Osprey nesting. NPWS should be consulted in the siting and construction of an Osprey pole.

Y: remove weeds from rainforest

The Plan recognises that the remnant littoral rainforest fringing Shaws Bay is a highly valued area of both local and regional significance. Unfortunately, the rainforest is under threat from weed invasion. Accordingly, Council should initiate and maintain a program for weed eradication from within the fringing littoral rainforest adjacent to Shaws Bay.

Z: mangrove boardwalk and rainforest hiking trails

The Plan recognises the eco-educational values of the Shaws Bay area. To further the existing values, which are focussed on the aquatic environment, Council should investigate the feasibility to develop a terrestrial-based educational program, which may include the construction of hiking trails through the littoral rainforest (*once weeds have been controlled somewhat – refer Management Option Y*), and a timber boardwalk across mangrove swamps located on the north side of Compton Drive.

To enrich the educational experience, consideration could be given to complementing the timber boardwalk with enhancement planting to increase mangrove species diversity.

AA: interpretive eco-educational signage

To help the community better appreciate the ecological values of Shaws Bay, Council should consider the installation of suitable educational signs, which discuss different values of the Bay, such as seagrasses, mangroves, the littoral rainforest, and the Osprey nest (*once a nest has been established*). Signage could also discuss the unusual origins of Shaws Bay, along with some old photos of the area.

BB: development of school project kits and tours

Once an educational platform has been initiated around Shaws Bay, Council should consider developing a series of school project kits to help make children (*and their parents*) more aware of the value of the

Shaws Bay habitats, and estuarine habitats in general, as well as the impacts of humans on these habitats.

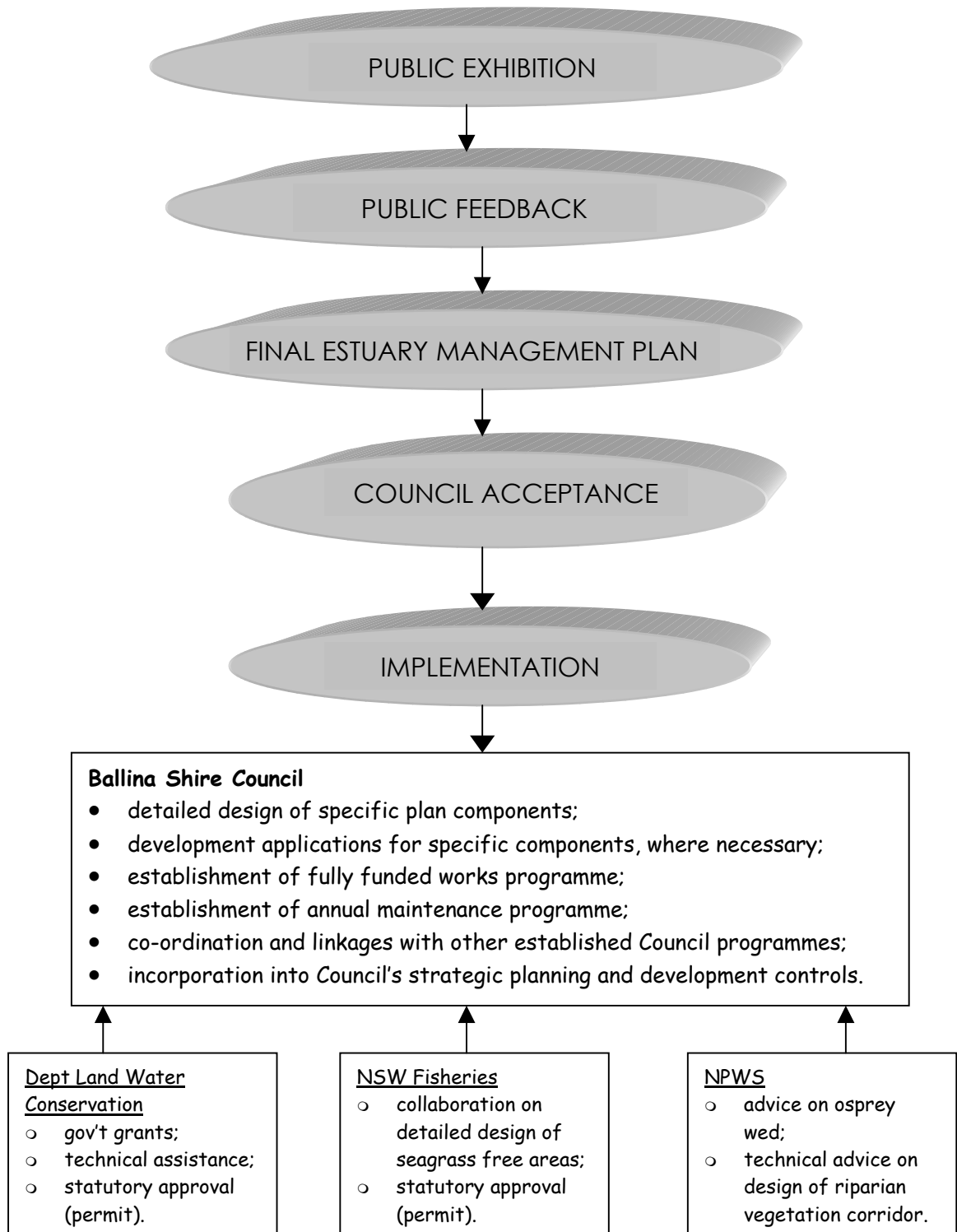
As a further step, Council could consider the feasibility of organising guided tours of the area, conducted by local authorities and providing bus parking in Pop Denison Park. Council could also given consideration to the production (*and sale*) of tourist information maps for self directed eco-educational tours.

CC: community participation in management works

The Plan recognises the importance of community participation in many of the Management Tasks to achieve the overall goals. To develop a strong bond with the community and to establish a commitment by the community to helping Shaws Bay, Council should consider encouraging community participation in the management works that are to be carried out. This may involve organised events, such as ‘working bees’, or may be more passive, where works are carried out on an opportunity basis, such as litter collection.

6 IMPLEMENTATION OF PLAN

The Shaws Bay Estuary Management Plan is a concept plan. The actual steps to implementing the plan are shown below.



The Estuary Process Study (*Vol 1*) has been on public display recently. Once the conceptual scope of the Estuary Management Study and Plan (*ie. this document*) has been accepted by the Community and Council, the actual implementation of the specific plan components will require detailed design and statutory approval, as appropriate.

As shown above, the implementation of the Shaws Bay Estuary Management Plan will be largely the responsibility of Ballina Shire Council, with assistance from various government departments, such as DLWC, NSW Fisheries and NPWS.

Table 6.1, overleaf, outlines the various Management Tasks identified in the Shaws Bay Estuary Management Plan, and provides performance measures, potential costs, possible funding sources, and agencies which should be consulted before carrying out the works.

Table 6.1 Shaws Bay Estuary Management Plan and Tasks can be found under the Tables directory on CD as Table6_1.pdf and Table6_1b.pdf

FIGURES

The following figures can be found under the Figures directory on CD:

[Figure 2.1 Hydrodynamic Processes conceptual model ..\Figures\FigMP2_1.pdf](#)

[Figure 2.2 Conceptual model of sediment processes ..\Figures\FigMP2_2.pdf](#)

[Figure 2.3 Water quality conceptual model ..\Figures\FigMP2_3.pdf](#)

[Figure 2.4 Habitat values ..\Figures\FigMP2_4.pdf](#)

[Figure 5.1 Vegetation ..\Figures\Fig5_1.pdf](#)

[Figure 5.2 Gravel apron at stormwater outlets ..\Figures\Fig5_2.pdf](#)

[Figure 5.3 Stable sandy beach ..\Figures\Fig5_3.pdf](#)

[Figure 5.4 Disables access to foreshore \(typical\) ..\Figures\Fig5_4.pdf](#)

[Figure 5.5 Bench seating \(typical\) ..\Figures\Fig5_5.pdf](#)

[Figure 5.6 Osprey pole ..\Figures\Fig5_6.pdf](#)