

Foreword

The Estuary Management Plan for Gunnamatta Bay was prepared under the direction of the Gunnamatta Bay Working Party (GBWP) and was jointly funded by Sutherland Shire Council (SSC) and the Department of Land and Water Conservation (DLWC), under the State Government's Estuary Management Program. This document was prepared by Nelson Consulting with input from WBM Oceanics.

It follows on from the Estuary Processes Study (WBM 2002), which defines baseline conditions including status and trends for the various physical, chemical and biological estuarine processes and interactions between them and between other land and water uses. The Estuary Management Plan is based on the findings of the Processes Study, other background information and the results of community and stakeholder consultation.

The Estuary Management Plan is the application of the State Government's *Estuary Management Policy* to Gunnamatta Bay. The general goal of this policy is to achieve an integrated, balanced, responsible and ecologically sustainable use of the State's estuaries. Specific objectives of the Policy (NSW Government 1992) are:

- The protection of estuarine habitats and ecosystems in the long-term, including maintenance in each estuary of the necessary hydraulic regime.
- The preparation and implementation of a balanced long-term management plan for the sustainable use of each estuary and its catchment, in which all values and uses are considered, and which defines management strategies for :
 - conservation of aquatic and other wildlife habitats
 - conservation of the aesthetic values of estuaries and wetlands
 - prevention of further estuary degradation
 - repair of damage to the estuarine environment
 - sustainable use of estuarine resources including commercial uses and recreational uses as appropriate.

Summary

The Gunnamatta Bay Management Plan goals are to:

- **Enhance the quality of the Bay's waters, foreshores and aquatic habitats**
- **Enhance the biodiversity of Gunnamatta Bay**
- **Enhance the scenic amenity and natural values of Gunnamatta Bay and its foreshores and conserve cultural heritage features**
- **Provide a safe and pleasant environment and access for a range of recreational pursuits which reflect the maritime character and natural values of the Bay**

A summary of Management Plan actions to achieve these goals is provided below.

- Design and implement a coordinated, statistically valid water quality monitoring and detection program to:
 - identify sources of pollution;
 - assess suitability of waters for public recreation and ecosystem health; and
 - assess performance of stormwater quality improvement devices/programs.
- Address identified sources of pollution, eg undertake sewer pipe remediation as required, and encourage a reduction in other possible pollution sources, eg provision of a public boat pumpout facility and adequate/appropriate bins for recycling etc.
- Manage activities to minimise the risk of spreading the invasive algae, *Caulerpa taxifolia*, and further research into control/eradication methods.
- Encourage active bushland management on private properties and review development controls to further protect and augment remnant bushland, enhance scenic amenity and conserve cultural heritage.
- Carry out investigations and prepare a Landscape Master Plan for the eastern foreshore/head of Gunnamatta Bay to:
 - improve pedestrian access around Hungry Point, along the eastern foreshore and within the foreshore parks;
 - address dune/beach erosion from coastal processes, stormwater discharges and informal dinghy and outrigger canoe storage;
 - investigate removal of accumulated silt/sand at the head of the bay (including investigation of contaminants levels and control of *Caulerpa taxifolia*) to improve navigation and visual amenity;
 - coordinate/upgrade signage, park furniture and foreshore facilities including the public wharf, public boat ramp, parking and commercial/club buildings at the head of the bay; and
 - improve park vegetation through weed control, dune stabilisation, replacement of mature remnant trees and selected shade and landscape planting.
- Undertaken navigation channel dredging at the entrance to the bay and reuse sand for beach nourishment (pending effective control measures for *Caulerpa taxifolia*).

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1 Introduction

1.1 Background

Gunnamatta Bay is located on the northern side of the Port Hacking estuary in the southern Sydney metropolitan area. It is the eastern most of the Port Hacking northern bays and is surrounded by the Sutherland Shire suburbs of Cronulla, Woolooware and Burraneer.

Land use within the catchment of Gunnamatta Bay is predominantly residential, with commercial development concentrated at the head of the bay adjacent to the Cronulla centre and railway station.

Much of the eastern shore of the bay is public open space and includes Tonkin Park (which was formed by reclamation works in the 1940s), Gunnamatta Park and baths and Darook Park.

Boating facilities include the Gunnamatta Bay boatramp, Cronulla Marina, Cronulla public wharf and Cronulla Sailing Club at the head of the bay and two public wharves and the Royal Motor Yacht Club (RMYC) on the western foreshores. See **Figure 1.1**, which shows the catchment area and features of the bay.

Typical water depths in Gunnamatta Bay are 9 to 12 m, reducing to about 1 m over the large marine sand shoal at the mouth of the bay. The bay has a waterway area of approximately 117 ha and relatively small catchment area (about 198 ha). Flushing times are relatively short, estimated at less than 10 days (WBM 2002).

1.2 Planning Context

The *Port Hacking Management Plan* (SSC 1992) provides an overall framework for the management of Port Hacking, the Hacking River and its entire catchment. The Estuary Management Study and Plan follows on from this and the preceding Estuary Processes Study (WBM 2002), to set the direction for management of Gunnamatta Bay.

A number of other plans will also influence development around Gunnamatta Bay and management of the waterway. These include the Port Hacking Boating Plan of Management (the draft plan is currently under review by the Waterways Authority) and local environmental planning controls. Sutherland Shire Council (SSC) is currently reviewing principles relating to environmental planning controls for the development of a new Local Environmental Plan ("the People's LEP").

Specific principles and controls for part of Gunnamatta Bay will be contained in the Head of Gunnamatta Bay Development Control Plan (the draft plan will be reviewed to ensure consistency with this Management Plan).

2 Values of Gunnamatta Bay

The following values of Gunnamatta Bay are based primarily on information contained in existing reports, plus feed back from the community through a user questionnaire survey (on 6 October 2001) and the results of a residents and stakeholders questionnaire (see **Appendix A**). Areas of natural and cultural heritage value are shown in **Figure 2.1**.

2.1 Ecological Values

Aquatic/Foreshore Habitats

Mapping by NSW Fisheries (Williams and Meehan 2002) identified three broad seagrass community types in Gunnamatta Bay:

- a mixed community of Eelgrass (*Zostera* spp.), Paddleweed (*Halophila* spp.) and Strapweed (*Posidonia australis*) covering 8.9 ha;
- *Posidonia australis* covering 3.05 ha, and located in the north-western part of the bay; and
- *Zostera* spp. covering 0.35 ha.

The seagrass meadows of Gunnamatta Bay are among the largest in Port Hacking (Williams and Meehan in prep. cited in WBM 2002). Seagrasses are recognised as important fish habitat and fish nursery areas.

At the end of Shell Road is a narrow band of saltmarsh (dominated by *Sarcocornia* spp.) adjoining a small (less than 20 trees) mangrove stand comprising Grey Mangroves (*Avicennia marina*) and River mangroves (*Aegiceras corniculatum*). The saltmarsh and mangrove system is special, as it is the only place within the bay that saltmarsh and River Mangroves occur (WBM 2002, SSC undated).

Fisheries

A checklist of fish for Port Hacking/Hacking River compiled by Pease and Herbert (2002) revealed a total of 252 species. Most of these are considered primarily marine or estuarine, with approximately 20% being transient tropical species.

This diverse range of fish species is attributed to:

- geographic location – Port Hacking is located between subtropical and cooler temperate regions with a variable, annual supply of tropical transients from the East Australian Current; and
- estuary type - drowned river valley estuaries (such as Port Hacking) provide relatively open mouths, large areas with marine salinities and a diverse array of habitat types.

Accordingly, many productive fishing spots are located within the Port Hacking estuary. A 1987 recreational fishing survey, by the Fisheries Research Institute, found the area around the mouth of Port Hacking to be the most popular for fishing with the greatest fish catch obtained there (SSC 1992).

Terrestrial Vegetation

The vegetation around Gunnamatta Bay is quite significant. In protected pockets there are remnants of Sutherland Shire Littoral Rainforest (eg Gonyah Gully in Darook Park and scattered remnants around Burraneer Point), which is listed as an Endangered Ecological Community under the *Threatened Species Conservation (TSC) Act*. Remnants (larger canopy-forming species) of Sydney Coastal Riverflat

Forest (also listed in the TSC Act) are present in Gunnamatta Park (Brendon Graham SSC, WBM 2002).

In other areas where there are rich alluvial soils, locally significant species such as Rough-barked Apple (*Angophora floribunda*), Forest Red Gum (*Eucalyptus tereticornis*) and Swamp Mahogany (*Eucalyptus robusta*) can be found (Brendon Graham SSC).

2.2 Scenic Values

PPK and Clouston (2001) undertook a scenic assessment of the Sutherland Shire foreshores. Based on a number of criteria, scenic quality was rated as either high, high-medium, medium, medium-low or low in relation to a range of settings (eg semi-natural, suburban, semi-urban, urban). The overall scenic rating for Gunnamatta Bay was medium.

However, some aspects of Gunnamatta Bay rated highly such as views and vistas. *These offer an interesting urban panorama, demonstrating a balance between built urban form and natural features which is most prominent in the headland areas.* There is also a high level of scenic accessibility for the public, residents and boat users, *facilitated by the public recreation strip (including Gunnamatta Park and Darook Park) along the eastern shore of the bay, and headland walk around Bass and Flinders, and Hungry Point.*

The views, beauty and picturesque nature of Gunnamatta Bay are also highly valued by the community (see **Appendix A**).

2.3 Heritage Values

Non-indigenous Heritage

Gunnamatta Bay contains a number of sites of heritage and landscape value. Of key importance are the larger sites and parks around the bay, as well as the dramatic rock formations around Burraneer Point. There are also a number of smaller sites including early waterfront structures (predominantly boatsheds), stone retaining walls, rock steps, small jetties and the remains of baths which all contribute to the character of the waterfront (Davies 1998).

A number of parks, institutions and other features around Gunnamatta Bay are recognised for their natural, built and landscape heritage values by listing in the *Sutherland Local Environmental Plan (LEP) 2000*, eg:

- Gunnamatta Park, conserving indigenous forest, sandy beach and period shelter.
- Tonkin Park, conserving traditional cricket oval and picket fence.
- NSW Fisheries Research Institute, conserving natural topography and indigenous vegetation.
- Cronulla Primary School main building (1920s). The grounds contain plantings of Norfolk Island Pines dating from the 1930s and 1940s and plantings of Brush Box and Port Jackson Figs dating from the 1950s.
- Cronulla wharf stone steps at the end of Waratah Street.
- Sandstone steps from street to waterfront at the end of the lane way off Taloombi Street.
- Wharf, boardwalk and steps at the end of Gunnamatta Road and remains of bath walls.
- Waratah Street electrical substation (see **Figure 2.1** for locations).

Indigenous Heritage

A study by Dallas (2002) identified 217 Aboriginal sites within Kurnell Peninsula and the northern bays of Port Hacking. Recorded sites within Gunnamatta Bay (approximately 24 sites) are concentrated around the entrance and include shelters with art, rock engravings, and middens.

An area approximately 100 m around the foreshore of the bay has been identified as being of high archaeological sensitivity (ie it is likely that further surveys would reveal as yet unrecorded Aboriginal sites). Significant sandstone features, plateau edges and creek lines, in particular, have high Aboriginal archaeological potential.

2.4 Recreation Values

Environment and Atmosphere

Gunnamatta Bay residents and visitors alike value the area for its peaceful, relaxed, "family friendly" atmosphere; safe, shallow waters; protected beaches; and treed public parkland (see **Appendix A** questionnaire results). Several respondents also commented on the clean water and relatively uncrowded nature of the area when compared to the Cronulla ocean beaches.

Diversity of Settings and Activities

Gunnamatta Bay is arguably the most popular of the northern bays in Port Hacking as there are a plethora of facilities and amenities located on its shores, each valued by different sectors of the community (Waterways Authority 2001). As one respondent put it - it is the...convenience of water, sand, grass, shade, sun, café and playground all in one area, and as another wrote, it is being able to do all the activities (listed in the questionnaire).

Gunnamatta Bay provides opportunities for:

- passive recreational activities (eg sunbaking, swimming);
- active recreational pursuits (eg water skiing, kayaking);
- sport and training activities (eg surf boat rowing, competitive sailing); and
- socialising and community events (eg picnics, "Shakespeare in the Park").

2.5 Economic Values

Within the Port Hacking estuary, Gunnamatta Bay is the focus for water-related commuter/service/tourism and commercial leisure activities and facilities. Due to its proximity to the Cronulla Centre (and the Cronulla railway station), Bundeena (and Royal National Park) and foreshore infrastructure and access (along the eastern edge) the bay supports a number of businesses providing local employment. Commercial activities/services include:

- the Cronulla – Bundeena ferry
- cruises, fishing charters, party pontoon and houseboat hire
- slipping facilities, boat repairs and maintenance, chandlery and brokerage
- café.

3 Issues Affecting Gunnamatta Bay

Following is a summary of the main issues or problems currently affecting, or potentially affecting, Gunnamatta Bay (see also, **Figure 3.1**). Refer to **Appendix B** and **Appendix C** for further information.

3.1 Water quality

The community regards poor water quality as the most significant problem affecting the bay. Since Sydney Water re-lined sewer pipes around Gunnamatta Bay, monitoring has shown a reduction in bacterial contamination (faecal coliforms and enterococci) (WBM 2002). Gunnamatta Baths and other areas may also be locally affected by illegal discharge of sewage from boats; litter and dog faeces that wash into the bay; and stormwater pollution (SSC undated).

Discharge from a major stormwater drain at the beach to the north of the baths results in scouring and water ponding in this area. Sewage from cracked or partially blocked private house service lines is also likely to be contributing to pollution of the bay.

Water quality within the bay generally meets national guidelines for human and ecosystem health. The exception to this is during and immediately following periods of wet weather, when elevated levels of bacteria and nutrients have been recorded. Guideline values for the bacteria, enterococci, are typically exceeded at Gunnamatta Baths for about 17% of the time (WBM, 2002).

3.2 Sedimentation

Sedimentation is a problem in the northeastern corner of the bay due to the variety of waterway uses, the presence of stormwater outlets and the slow movement of the marine shoal (from the entrance of the bay) into this area.

Sediments can smother seagrass beds, which are valuable habitat for faunal communities in the bay. The continued movement of sand along the eastern foreshore would eventually interfere with swimming in Gunnamatta Baths and other activities at the head of the bay.

Preliminary analysis of sediments around the head of the bay has shown some heavy metal and Poly Aromatic Hydrocarbon (PAH) contamination. Other areas in the bay affected by sedimentation are near Kurramatta Place and the embayment adjacent to De La Salle College.

The navigation channel along the western edge of the marine shoal has been periodically dredged since 1915. It can infill rapidly following dredging by reworking of material off the entrance shoal by tides and wave action.

3.3 Waterway related facilities and foreshore access

At the head of Gunnamatta Bay, many separate activities require navigation access and foreshore support facilities. These include the public wharf (which is in poor repair), ferry and charter vessels, the boatramp (which is only one lane wide and inadequate during peak periods), Cronulla Marina, Cronulla Sailing Club and the Gunnamatta Baths. Many of these facilities are in need of upgrading and measures to improve their appearance (this also applies to park furniture and amenities in adjacent areas).

Parking is a problem at the boatramp, particularly for cars with boat trailers. Pedestrian and service access to businesses at the head of the bay also needs to be

improved, as do pedestrian links between parks (and from adjacent streets) and around Hungry Point.

There are about 350 registered moorings in the bay which significantly reduce open water expanses for other uses, as well as open water views. The proliferation of private jetties, boatsheds, boat pens, retaining walls, stairs, pools etc have also affected the scenic qualities of the bay (PPK and Clouston 2001).

Opportunities to expand facilities to meet demands are limited due to the lack of available foreshore land (SSC undated). The Waterways Authority has also indicated that no new swing moorings will be allocated.

3.4 Water-based recreational activities

Congestion on the bay can arise due to the number of moored vessels and the transiting of commercial and recreational craft during peak usage times.

As the bay caters for a variety of uses, conflicts may arise between powered and unpowered craft; passive use and powered craft; and between watercraft and swimmers. Note that boating is controlled by an 8 knot speed limit through the entrance channel, 4 knot speed limit at the head of the bay and off Darook Park, together with a designated "no personal watercraft area" adjacent to Darook Park.

Although Waterways have recorded few complaints, many questionnaire respondents raised noise from jetskis and 'tinnies' as an issue. The proximity of jetskis to swimmers was also raised as a potential safety concern.

3.5 Aquatic and foreshore vegetation

The invasive algae species, *Caulerpa taxifolia* (often used in aquariums), has been found in Gunnamatta Bay and is a threat to seagrasses. It can spread via fishing equipment, ropes, chains, anchors and diving gear.

The green algal *Ulva* is abundant within and adjacent to stormwater pipes at the public wharf south of the YMYC, and along the rock wall directly adjacent to a stormwater drain in the northern part of the bay. The presence of *Ulva* at these locations may be indicative of elevated nutrients within the stormwater discharges (WBM, 2002). Seagrasses may be affected by high nutrient loads, shading from jetties and damage from moorings. Disturbance from severe storms has also been a factor in reducing the cover of seagrasses at the entrance to the bay.

Remnant vegetation around the bay foreshores has been degraded:

- by weed invasion (which, in particular, affects bushland at Burraneer Point, saltmarsh near Shell Road and areas of remnant vegetation in Darook Park).
- through illegal tree removal and poisoning of larger trees within bushland at Burraneer Point (WBM 2002).

Also, in areas along the eastern foreshore, dune and park vegetation has been affected by erosion (due to wind and wave action, stormwater discharges and use of informal tracks), wind blown sand, trampling and informal dinghy and outrigger canoe storage.

4 Action Plan

Goals and objectives for the management of Gunnamatta Bay are set out in the following pages. They flow from the goals and objectives contained in broader planning documents, such as Sutherland Shire's *Blueprint for Action* (2002) and the *Port Hacking Management Plan* (SSC 1992).

The associated strategies and actions have been formulated to protect the identified values of Gunnamatta Bay (as set out in **Section 2**) and to address issues and problems (summarised in **Section 3**). Several of these actions have been identified in past studies, see **Appendix B**.

A summary of Management Plan Actions is shown in **Figure 4.1** and information on further studies is provided in **Section 5**.

The authority or organisation primarily responsible for implementing individual actions is shown in bold. The following abbreviations have been used.

DLWC	Department of Land and Water Conservation
EPA	Environment Protection Authority
Fisheries	NSW Fisheries
GBWP	Gunnamatta Bay Working Party
NPWS	National Parks and Wildlife Service
SCCG	Sydney Coastal Councils Group
SCMB	Southern Catchment Management Board
SSC	Sutherland Shire Council
SST	Sutherland Shire Tourism
Waterways	Waterways Authority

Priorities for actions have been listed as:

- high implementation within one to two years
- medium implementation within three to five years
- low implementation within six to 10 years

4.1 Goal: To enhance the quality of the Bay's waters, foreshores and aquatic habitats

4.1.1 Objective: To identify pollution sources (and associated public health risks) and trends in ecosystem health

Strategy	Action	Priority	Responsibility
Coordinate and expand existing water quality monitoring programs	<p>Design and implement a statistically valid water quality monitoring and detection program with the potential to identify sources of pollution (see Section 5.1 for more information).</p> <p>As a number of authorities are likely to be involved in monitoring, ensure sampling and analysis is coordinated and procedures are in place for the exchange of information.</p> <p>Water quality detection and monitoring program to include:</p> <ul style="list-style-type: none"> - new Harbourwatch site off Darook Park - establishment of Streamwatch sites (as support for detection and monitoring program) - short-term monitoring of stormwater outlets and associated sites in the catchment to identify pollution sources (as needed) - long-term monitoring to assess changes in ecosystem health. 	high	SSC , Sydney Water, EPA, DLWC

4.1.2 Objective: To achieve a standard of water quality that protects aquatic ecosystem diversity and allows for recreational and aesthetic enjoyment of the bay

Strategy	Action	Priority	Responsibility
Reduce/eliminate sources of sewage pollution	Based on monitoring results, rehabilitate foreshore sewer pipes as required under Sewerfix Program.	as need arises	Sydney Water
	Support 'Pipecheck' initiatives, eg inspection and repair/replacement of damaged house service lines at time of sale and as condition of consent for dwelling alterations/renovations.	medium	SSC , SCCG
	Provide public boat sewage pumpout facility (accessible after hours) on Cronulla public wharf.	high	SSC , Waterways, DLWC
Manage other possible pollutant sources	Ensure construction site erosion and runoff controls are effectively designed and maintained.	ongoing	SSC
	Stabilise areas of erosion in public parks in conjunction with park improvements.	medium	SSC
	Provide adequate and suitable bins in Gunnamatta Park and other high use areas (eg for used heat beads, dog droppings, recyclables).	low	SSC
	Install "no fish cleaning" sign at Gunnamatta boatramp.	high	SSC , Fisheries
Improve response times to pollution incidents	Patrol foreshore parks during peak times to enforce littering laws.	ongoing	SSC
	Provide information to residents and Council staff on agency responsibilities and appropriate contact numbers for different types of pollution events.	high	SSC , EPA, Sydney Water, Waterways

Strategy	Action	Priority	Responsibility
Investigate/ implement measures to improve the quality of stormwater runoff to the bay	Review Stormwater Management Plan and design of Net-Tech (litter socks) to prevent theft.	high	SSC
	Review frequency of Council programs/prepare formal maintenance plans for street sweeping in the Cronulla Centre, maintenance of the Tonkin Park GPT and other SQIDs, and rubbish removal in Gunnamatta Park during peak periods.	medium	SSC
	Monitor siltation near Kurramatta Place and De La Salle College and investigate measures to reduce this if rates of siltation potentially threaten seagrasses or boating access.	low	SSC
	Undertake periodical 'clean-ups' of the bay's foreshores. Promote the head of Gunnamatta Bay and eastern foreshores for Clean-up Australia Day.	medium	SSC

4.2 Goal: To enhance the biodiversity of Gunnamatta Bay

4.2.1 Objective: To manage threats to ecological communities

Strategy	Action	Priority	Responsibility
Contain the spread of <i>Caulerpa taxifolia</i>	Undertake further research to determine factors controlling populations elsewhere.	high	Fisheries
	Based on further research, investigate measures to control/eradicate <i>Caulerpa taxifolia</i> .	high	Fisheries
	Encourage reporting of new outbreaks of <i>Caulerpa taxifolia</i> .	ongoing	Fisheries, Waterways, SSC
	Continue boater education to avoid infested areas and minimise the likelihood of transport of <i>Caulerpa taxifolia</i> on trailers and boating gear.	ongoing	Fisheries, Waterways
	Continue delineation and enforcement of restriction zones.	ongoing	Fisheries, Waterways
Ensure boating activity does not impact on sensitive seagrass areas	Revise boating maps to incorporate the results of the latest seagrass mapping so that boaters are aware of these. Also consider signage of sensitive areas.	medium	Waterways, NSW Fisheries
	Review mooring locations in light of sensitive areas identified through seagrass mapping.	medium	Waterways
	Where appropriate, replace conventional moorings with 'seagrass friendly' type moorings.	low	Waterways
	Incorporate more environment-related information in Safe Boating Handbook and environment related questions in boat licence tests.	medium	Waterways
Improve compliance with Fisheries regulations	Install regulatory/educational signage at key fishing spots to assist in enforcement.	in hand	Fisheries
	Continue periodical patrols to police illegal bait collection, netting and the taking of undersized fish.	ongoing	Fisheries, SSC

Strategy	Action	Priority	Responsibility
Protect existing bushland	Continue to investigate and prosecute property owners for illegal tree removal and poisoning of trees, particularly within bushland at Burraneer Point.	ongoing	SSC
	Publicise penalties for illegal tree removal under Council's Tree and Bushland Preservation Order.	high	SSC
Control weed invasion of foreshores	Prepare management plan for saltmarsh near the end of Shell Road. Establish and train Bushcare group to manage bushland at Burraneer Point. Continue to support and train existing Bushcare groups at Shell Road and Darook Park.	high	SSC

4.2.2 Objective: To maintain and enhance foreshore vegetation, habitats and 'green corridors'

Strategy	Action	Priority	Responsibility
Implement recommendations of the Green Web Strategy	Review Urban Tree Policy to augment/restore key habitat areas and existing/proposed linkages within the Green Web.	medium	SSC
	Develop a 'Land for Wildlife' program that supports bushland management on private property.	medium	SSC, NPWS
	Encourage retention and more planting of indigenous canopy trees and shrub species in the catchment and along the foreshores.	medium	SSC
	Continue support for and expand Council's Bushcare program for public lands.	ongoing	SSC

4.3 Goal: To enhance the scenic amenity and natural values of Gunnamatta Bay and its foreshores and conserve cultural heritage features

4.3.1 Objective: To minimise the impact of development and boating facilities on scenic amenity

Strategy	Action	Priority	Responsibility
Review current development controls and foreshore building lines	In accordance with the <i>Blue Print for Action</i> (SSC 2002):	medium	SSC
	- define new 'environmentally-sensitive' zone for residential areas fronting Gunnamatta Bay to protect and enhance landscape features including remnant vegetation and sandstone rock formations; and		
	- introduce new development controls to ensure development along the foreshore respects the natural and built scenic amenity.	in hand	SSC
	Update the Waterfront DCP to reflect government policies for foreshore/waterway structures, ie:		
- DLWC's Crown Land Foreshore Tenures Policy			
- Waterway's Land Owners Consent Manual (currently under revision)			
- NSW Fisheries Jetties Policy (in preparation).			

Strategy	Action	Priority	Responsibility
Encourage rationalisation and a coordinated approach to provision of boating facilities	Carry out initial survey to identify and investigate the removal of unauthorised and/or inappropriate private foreshore structures on Crown land. Undertake follow-up surveys to identify new illegal structures.	high	DLWC, SSC
	Encourage sharing of private foreshore structures (eg jetties, pontoons) between adjoining landholders to minimise the number of structures.	ongoing	SSC, DLWC
	Review boat mooring and berthing provision with regard to: <ul style="list-style-type: none"> - area of waterway alienated by swing moorings (ie number of moorings and size of vessels) and also proximity to seagrass beds - relinquishment of swing moorings where vessels can be accommodated at marina berths. 	medium	SSC, Waterways, DLWC
	Investigate formal storage facilities for dinghies and outrigger canoes to reduce impacts on foreshore areas and park users.	high	SSC

4.3.2 Objective: To increase awareness and appreciation of the natural and cultural heritage features of the bay

Strategy	Action	Priority	Responsibility
Protect known and as yet unrecorded Aboriginal sites of significance	Introduce new development requirements to identify and assess sites based on archaeological sensitivity of the location and the extent/nature of development proposed.	in hand	SSC
	Prepare an Aboriginal Cultural Heritage Management Strategy addressing: <ul style="list-style-type: none"> - conservation of sites and places of significance to Aboriginal people - identification of as yet unrecorded archaeological sites - assessment of development applications affecting Aboriginal sites - consultation with and involvement of the Aboriginal community - means to increase community interest and understanding of the management of Aboriginal sites. 	high	SSC
Make information on natural and Aboriginal/non-Aboriginal cultural heritage values readily available to residents and visitors	Expand on existing interpretive signage along the eastern shore of Gunnamatta Bay to provide more information on natural, cultural and built heritage values.	low	SSC
	Produce brochure showing walking tracks/pedestrian access and features of interest (as appropriate) around Gunnamatta Bay/Cronulla peninsula.	low	SSC, SST

Strategy	Action	Priority	Responsibility
Make information on natural and Aboriginal/non-Aboriginal cultural heritage values readily available to residents and visitors (continued)	Produce brochure that explains how Aboriginal sites are protected and how developments can be planned to minimise impacts on the archaeological resource.	medium	SSC
	Provide information on Council's website for residents and visitors.	low	SSC, SST

4.4 Goal: To provide a safe and pleasant environment and access for a range of recreational pursuits which reflect the maritime character and natural values of the Bay

4.4.1 Objective: To improve navigation and waterway facilities

Strategy	Action	Priority	Responsibility
Improve boat launching facilities, public wharves and Gunnamatta Baths	Upgrade boatramp (to double width) and investigate improvements to car and trailer parking area.	high	SSC, DLWC, Waterways
	Upgrade/refurbish Cronulla public wharf and wharf at the end of Gunnamatta Road.	high	SSC
Maintain navigation channel into Gunnamatta Bay	As per REF (PBP 2002) carry out maintenance dredging of navigation channel along the entrance shoal (subject to effective containment of <i>Caulerpa taxifolia</i>) and reuse sand for beach nourishment.	high	SSC, DLWC
Improve boating access to existing facilities at the head of the bay and the area's appearance	As part of preliminary investigations for an environmental assessment of remedial dredging at the head of the bay, design a sampling and analysis program to assess the: <ul style="list-style-type: none"> - degree and extent of sediment contamination (in accordance with EPA guidelines); and - acid generating potential of sediments. Also determine the extent of <i>Caulerpa taxifolia</i> at the head of the bay.	high	SSC, DLWC

4.4.2 Objective: To improve public access to the foreshore and the amenity of public open space

Strategy	Action	Priority	Responsibility
Investigate additional public access to the foreshore	Prepare management plan for NSW Fisheries site to pursue and enhance public foreshore access around Hungry Point.	high	SSC Fisheries
	Review the Crown Lands Assessment with regard to effectiveness for protection of the foreshore environment and creation of additional, practical public access elsewhere along the foreshore.	medium	DLWC
	Investigate access/viewing improvements to significant viewpoints identified in the Scenic Assessment Report (PPK and Clouston 2001), ie Hungry Point and Burraneer Point.	low	SSC

Strategy	Action	Priority	Responsibility
Prepare Landscape Master Plan for eastern foreshore	Master Plan to include: <ul style="list-style-type: none"> - improved access and links to and along the eastern foreshore - measures to address dune and foreshore erosion and stormwater improvements to minimise scour and water ponding - improved signage; park furniture; parking; foreshore facilities; shade, landscape and dune stabilisation planting. See Section 5.2 for more details.	high	SCC

4.4.3 Objective: To minimise conflicts between user groups

Strategy	Action	Priority	Responsibility
Increase compliance with boating regulations	Continue boater education and enforcement program to target distance off requirements, personal watercraft exclusion zone off Darook Park, wash, noise and speed.	ongoing	Waterways

5 Further Studies

5.1 Water Quality Monitoring

A framework for a water quality monitoring and detection program is presented in **Table 5.1**. It reflects identified problems within Gunnamatta Bay, regional priorities and available/potential resources for water quality monitoring. Suggested monitoring sites are listed below and shown in **Figure 5.1**.

The information in **Table 5.1** would be used as a base to develop the monitoring and detection program (including implementation costs) in accordance with best practice and statistically valid methods.

Table 5.1 Water Quality Monitoring Framework

Monitoring Objective	Suggested Monitoring Sites	Parameters to be Monitored	Frequency/Longevity/Responsibility
Determine suitability for human uses (ie public health)	Designated / recognised swimming areas ie: - Gunnamatta Baths - Darook Park beach	faecal coliforms enterococci	Every 6 days as part of EPA Harbourwatch Program (Gunnamatta Baths have been part of EPA Harbourwatch program since 1994)
	Selected foreshore areas (particularly at stormwater discharge points) used for primary (eg swimming) and secondary (eg boating) contact recreation) eg: - eastern foreshores - public boatramp - Gunnamatta Rd public wharf - Royal Motor Yacht Club	faecal coliforms enterococci	Periodical wet and dry weather monitoring by Sydney Water/ SCC Routine monitoring of faecal coliforms under Sydney Water's Streamwatch Program (in support role)
Identify pollutant sources within the catchment	Outlets of individual subcatchment drainage lines The outlets of the largest subcatchments should initially be targeted eg: - Kurramatta PI - Tonkin Park - Gunnamatta Park - Combined remainder of eastern foreshores	faecal coliforms enterococci nutrients biological oxygen demand	Limited duration, periodical wet and dry weather monitoring Sydney Water/SCC
	Various locations within the stormwater network, systematically targeting different subcatchment drainage lines based on results of outlet monitoring	faecal coliforms enterococci nutrients biological oxygen demand	Periodical wet and dry weather monitoring by Sydney Water/ SSC Limited duration only, with follow-up monitoring after remediation works have been carried out
Assess effectiveness and performance of SQIDs	- Tonkin Park GPT - Gunnamatta Park Net-Techs	sediment organics litter (as appropriate)	SSC as part of routine maintenance
Assess ecosystem health	Main waterway area at approximately 4 sites evenly distributed along the length of Gunnamatta Bay	based on National Land and Water Resources Audit Index, eg chlorophyll-a, turbidity, nutrients and biological parameters, such as critical habitat loss, invasive species	Infrequent, long-term monitoring under future Southern Catchment Management Board program

5.2 Eastern Foreshore Landscape Master Plan

A number of matters require attention along the eastern foreshore of Gunnamatta Bay (including the area at the head of the bay). See **Appendix B** for further information. These would best be addressed in a coordinated manner through a Landscape Master Plan.

As part of the development of the Master Plan the following investigations and improvements are recommended.

Access

- Pursue foreshore access around Hungry Point to link to The Esplanade oceanfront walkway.
- Improve pedestrian links between Darook, Gunnamatta and the head of Gunnamatta Bay/Tonkin Park, including wide pedestrian 'promenade' (with lighting and viewing points) from the Gunnamatta Baths north and around the head of the bay.
- Formalise paths within Darook and Gunnamatta Parks to address erosion/improve circulation.

Dune/Beach Erosion

- Identify suitable location and formalise arrangements for dinghy and outrigger canoe storage.
- Investigate measures to address erosion from coastal processes and stormwater scour, including sand nourishment with material removed from Gunnamatta Bay navigation channels.
- Investigate stormwater improvements to minimise scour and water ponding at discharge points.

Vegetation

- Develop vegetation management strategy covering weed control, dune/foreshore stabilisation, replacement of mature remnant trees as they die, and theme for new shade and landscape planting at the head of the bay.

Signage, Park Furniture and Foreshore Facilities

- Locate directional/information signage at entry points to Darook Park and additional interpretive signage along the eastern foreshore.
- Upgrade/install park furniture using a consistent theme, particularly for Gunnamatta Park/head of Gunnamatta Bay to improve the image and amenity of the area and to cater for high usage. Park furniture should include recycling bins, dog dropping bins and in Gunnamatta Park, bins suitable for disposal of used heat beads.
- Investigate opportunities to increase the number of parking spaces around the head of the bay, particularly for car and trailer parking.
- Coordinate the upgrading/replacement of structures at the head of the bay, including the public wharf and boatramp. Investigate suitable location/design for fish cleaning facility to minimise odour and attraction for seagulls etc.
- Investigate contaminant levels/management of *Caulerpa taxifolia*, with a view to removal of accumulated silt/sand at the head of the bay to improve the appearance of this area and navigation to boating facilities.

6 Assessment and Reporting

The Estuary Management Plan would be periodically reviewed by the GBWP. The role of the GBWP would be to report to the community on the implementation of the Plan. This could be via inclusion of information in Council's State of the Environment Report, website or articles in the local newspaper, *The Leader*.

Measures to assess the effectiveness of actions in meeting objectives include:

- The results of water quality monitoring programs outlined in **Section 5.1**.
- Amount of litter and sediment collected from stormwater quality improvement devices.
- Monitoring of siltation near Kurramatta Place and De La Salle College.
- Monitoring of erosion and undercutting along southern end of eastern foreshore.
- Follow-up surveys to map changes in the condition and extent of seagrasses and the invasive *Caulerpa taxifolia*.
- Surveys/assessments of foreshore vegetation to identify changes in ground cover, canopy cover and extent of weed invasion.
- Follow-up user survey to assess community perceptions about water quality and satisfaction with foreshore facilities.
- Follow-up user survey, or records of complaints, regarding management/control of foreshore and waterway activities.

7 References and Bibliography

- Ashton (1993) *Sutherland Shire Heritage Study Landscape Historical Archaeology*.
- AWT and AACM (2000) *Draft Hacking River Stormwater Management Plan*.
- Davies, Paul (1998) *Sutherland Shire Foreshore Study*.
- Department of Conservation and Land Management (1991) *Assessment of Crown Land at Port Hacking under Part 3 of the Crown Lands Act 1989*, Metropolitan Lands Office, Report No.MN90H454.
- Mary Dallas Consulting Archaeologists (2002) *Sutherland Shire Council Aboriginal Heritage Study*.
- NSW Government (1992) *Estuary Management Manual*.
- Patterson Britton & Partners (2002) *Maintenance Dredging of Port Hacking Navigation Channels including nearshore nourishment of North Cronulla Beach Review of Environmental Factors*.
- Pease B (NSW Fisheries) and Herbert S (2002) Checklist of Fishes from the Hacking River Catchment, including the Port Hacking Estuary, in Central New South Wales in *Wetlands Australia*, Vol.20 No.2 pp66-79.
- PPK and Clouston (2001) *The Shires and Foreshores – Achieving Scenic Quality*.
- Sutherland Shire Council (SSC 2002) *Blue Print for Action – Towards Our New Local Environmental Plan*.
- SSC (undated) *Head of Gunnamatta Bay Draft Development Control Plan*.
- SSC (2000) *Preliminary Draft Green Web Strategy*.
- SSC (1999) *Our Shire Our Future – Our Guide for Shaping the Shire to 2030*.
- SSC (1992) *Port Hacking Management Study*, report of the Port Hacking Planning and Advisory Committee.
- Waterways Authority (2001) *Port Hacking Boating Draft Plan of Management* .
- WBM Oceanics Australian (2002) *Gunnamatta Bay Estuary Processes Study*.