



Manly Cove

Coastline Management Study



FINAL REPORT

December 2009



MANLY COVE COASTLINE MANAGEMENT STUDY

Harbour Foreshores & Coastline Management Committee

After the Local Government election in September 2008, Manly Council established the Manly Harbour Foreshores & Coastline Management Committee in early 2009 to guide the preparation of a number of plans including the Manly Cove Coastline Management Plan. The first meeting of the Committee was held on 14 April 2009. Members of the Committee are:

Group	Representing Organisation	Name
Councillors	Manly Council	Dr. Peter Macdonald (Chair)
	Manly Council	Adele Heasman
	Manly Council	Jean Hay, AM (Mayor) ex-officio
Community		Katie Harris
		Sylvia Bell
		Lyn Green
		Ross Thymin
		Richard Hewitt
		Ray Mathieson
Surf Clubs	Queenscliff SLSC	Carlo Bongarzone
	North Steyne SLSC	Kingsley Aves
	Manly SLSC	Geoff Cooper
State Government		Ben Wotton
	Dept of Environment & Climate Change	Mark Moratti
	Dept of Environment & Climate Change	Gus Pelosi
	Dept of Environment & Climate Change	Tracey Macdonald
	Dept of Primary Industries	Paul Schuettrumpf
Council Staff	NSW Maritime	Nicholas Richards
	Manly Council	Rafiquel Islam

Coastal Focus Group

In order to support the Committee and to obtain expert contribution in the formulation of the CMP, an *informal in-house Coastal Focus Group consisting of relevant key staff* was also formed. Members of this Group are:

Name	Position	Name	Position
Eduard McPeake	Manager, Community & Environmental Partnership Branch	Judy Reizes	Community Projects Officer, Manly Environmental Centre
Ted Williams	Manager, Civic Services	Zoran Popovic	Heritage Planner
Terry Jones	Manager, Ranger Services	Anna Nikolov	Social Planner
Tony Goninon	Manager, Urban Services	Nilushi Disanayake	Waste Minimization & Education Officer
Tony Pavlovic	Manager Environmental Health	Dalene Amm	Team Leader, Sustainability
Jennie Minifie	Manager, Planning & Strategy	Lee Lau	Water Cycle Management Team Leader
Fenton Beatty	Parks Coordinator	Michael Galloway	Catchments Project Officer
Chris Kraus	Bushland Management Coordinator	Monique Needham	Environmental Planner
Paul Christmas	Planning & Strategy Coordinator	Rafiquel Islam	Estuary Management Officer
Michael Biddulph	Architect		

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Contributions of the Harbour Foreshore and Coastline Management Committee and internal 'Coastal Focus Group' are highly acknowledged.

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i EXECUTIVE SUMMARY

Manly Cove Coastline Management Study presents 'baseline condition' of Manly Cove study area in relation to institutional & policy environment, land use and land tenure, significance and values of the area, coastal processes, coastline hazards, climate change and adaptations, ecological and socio-economic environment. This study identifies indicative management options to address relevant key issues.

To support this study, a Coastline Hazard Definition Study for the area was completed in April 2004. Also, comprehensive community consultation was conducted during 2005.

Manly Cove Coastline Management Plan will be developed utilising baseline findings and management options proposed in this study

Study Area

The Manly Cove study area lies immediately to the north-west of the entrance to Sydney Harbour, bounded to the west by Federation Point and to the southeast by Manly Point. The study area covers 50.9 hectares and takes in the suburbs of Manly and Fairlight and also the local Precinct Community Forum areas of Fairlight, The Corso and Little Manly.

It extends both seaward and landward from the shoreline and includes rocky intertidal platforms, sandy beaches, grassed recreational areas, a netted swimming enclosure, bushland as well as commercial, retail and residential areas. The study area covers twelve sub-catchments. The entire study area is covered within the Sydney Harbour Foreshores and Waterways Area and Sydney Metropolitan Catchment Management Area.

The study area includes Manly Cove West Beach and Manly Cove East Beach, the seawalls backing these beaches, sandstone cliff faces and wave cut intertidal platforms as well as a number of water based development including Manly Wharf and various boating facilities lining the eastern foreshore. The study area consists primarily of semi-natural, landscaped and built areas. It is characterized by natural and cut sandstone cliffs and escarpments with fringing native bushland pockets and landscaped areas along the Esplanade Reserves.

Institutional & Policy Environment

The Manly Cove Coastline Management Study has been prepared in line with the NSW Government's Coastal Management Program. The Program is designed to fulfil the requirements of the NSW Coastal Policy 1997. However, as the Manly Cove study area comes under the purview of Sydney Harbour catchment, the most important guiding document is the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 under the *Environmental Planning & Assessment Act 1979*. A number of commonwealth, state and local legislations and regional planning frameworks are relevant to the study area.

Commonwealth Government's Coastal Policy 1995, Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Framework for Integrated Coastal Zone Management 2006 are relevant.

State Government has developed and promulgated a number of statutory controls, documents and policies which are relevant to the scope of the Manly Cove study area. These include:

- *NSW National Parks and Wildlife Act 1974*
- *NSW Environmental Planning and Assessment Act 1979*
- *NSW Coastal Protection Act 1979 (amended 2002)*
- *NSW Local Government Act 1993*
- *NSW Fisheries Management Act 1994*
- *NSW Threatened Species Conservation Act 1995*
- *NSW Heritage Act 1997*
- *NSW Coastal Policy 1997*



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- NSW Fisheries Policy & Guidelines: Aquatic Management & Fish Conservation 1998/1999
- *NSW Water Management Act 2000*
- *NSW Catchment Management Authorities Act 2003*
- *NSW Sea Level Rise Policy Statement 2009*

The study area, being located within Sydney Region, is also guided by the following *regional plans*:

- Sydney Regional Environmental Plan - Sydney Harbour Catchments 2005: the Harbour REP
- Sydney Harbour Foreshores and Waterways Area – Development Control Plan 2005
- Sydney Harbour Boat Storage Policy 2004
- Sydney Regional Coastal Management Strategy 1998
- Sydney Metropolitan Strategy 2005
- Sydney Metropolitan Catchment Management Action Plan 2008

As identified within the *Local Government Act*, Manly Council has developed a range of locally focussed plans and strategies. The following plans & policies are relevant to Manly Cove study area:

- Manly Local Environment Plan 1988 (being updated & revised)
- Plan of Management for Community Land 1996
- Manly Social Plan 2004-2009
- Surfing the Future 2006
- Manly Sustainability Strategy 2006
- Annual Manly Management Plan

A number of **institutional stakeholders** share responsibility in development and implementation of the Manly Cove Coastline Management Plan. Manly Council remains the lead institution. Other agencies are:

• Department of Environment, Climate Change & Water (DECCW)	• Land and Property Management Authority
• Industry & Investment NSW	• NSW Maritime
• Department of Planning	• Natural Resources Commission
• Sydney Water	• Sydney Coastal Council Group
• Sydney Metropolitan Catchment Management Authority	• State Emergency Service (SES)
• Aboriginal Heritage Office	

Land Use, Tenure & Management

The current land uses within the Manly Cove study area are predominantly residential development (55.1%), followed by road surfaces (28.97%), open space and parkland (8.11%), commercial (7.26%) and special uses (0.67%). Long stretches of parkland (Esplanade Park) separate residential and commercial blocks from Manly Cove beaches, except the area from Stuart Street south to Manly Point where residential properties border shoreline. Manly Scenic Walkway runs through the study area.

There are 3 parcels of community land within the study area all being zoned as 'open space'. Plans of Management (PoM) covering these community lands are covered by the Plan of Management for Community Lands (1996) and the Manly Peace Park Plan of Management (2004).

The Manly LEP establishes land use zones within the study area as zone 2 – Residential, 3 – Business Zone, 5 – Special Uses Zone and 6 - Open Space. The foreshores and waterways of the study area are designated as W2 (Environment Protection) zone under the Sydney Harbour Regional Environmental Plan.

Significance and Values of Manly Cove

The Manly Cove study area is locally significant providing a range of important uses, services and linkages for the Manly LGA. Manly Wharf, the beaches, harbour and East Esplanade Park are central to many activities.



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The numerous festivals, markets, sporting and social events held in the Manly CBD as well as commercial tourism operations within the study area are popular for both tourists and locals alike. It is this popularity which highlights the need to effectively manage Manly Cove to ensure environmental protection while enhancing opportunities for recreation.

The attraction of Manly Cove is enhanced by its generally good water quality. This results in numerous primary and secondary contact recreational pursuits, including swimming, sailing, kayaking, diving, sail boarding, and boat and shore fishing, which are immense value to locals and visitors alike. For these reasons, recreational visitation and use of the waterway is extremely high with significant “flow on” effects for the local and regional economies.

The Manly Cove study area houses a number of key waterside facilities which provide for water based recreation, particularly sailing activities. The Boating Precinct located on the eastern foreshore of Manly Cove was first established by early European settlers during the 1870s, growing with Manly's popularity as a seaside resort. Today the club precinct remains relatively unchanged and creates distinct characteristics which the community has recognised as being important to retain into the future.

Manly Cove houses a diverse marine environment which ranges from rocky intertidal zone to the seagrass beds of North Sydney Harbour. A number of populations of protected, endangered and vulnerable marine fauna species are found in the vicinity of the Manly Cove study area. Several threatened terrestrial and marine floras and fauna species are known to frequent the study area.

The study area is rich in Aboriginal cultural heritage giving it significance at the regional and state level. The AHO has recorded a number of significant sites within the study area. European cultural heritage is also an important feature of the study area with numerous heritage listed sites and buildings.

Coastal Processes, Water Quality & Foreshore Structures

Coastal lands are exposed to never ending attack by the sea, the atmosphere and coastal rivers. The waves, increased water levels and winds associated with storms, together with coastal currents and rivers debouching into coastal waters, reshape beaches and shift beach sediments offshore and onshore.

The study area is characterized by natural and cut sandstone cliffs and escarpments with fringing native bushland pockets and landscaped areas along the Esplanade Reserves. The study area has gradual rise to an altitude of 36m with a rapid rise between 20m to 26m.

Storms play an important role in determining the rate and magnitude of shoreline change. The most devastating storms to strike the NSW coastline since records began, in terms of erosion damage, is likely to be the May - June 1974 storms.

The wave climates at Manly Cove East and West beaches are composed of a combination of wind and boat generated waves and swell penetrating from the ocean. Manly Cove is generally fairly exposed to wind generated waves from the south-south west with the length of water measured at 6.5kms. Average annual wave height is established at 1m, 1.3m with 1 in 10 yr return period and 1.5m with 1 in 50 yr return period.

Boat wakes are generated by vessels sailing or steaming across the harbour and bay. The predominant vessel wave action experienced along the Manly Cove foreshore is considered to be derived from the Manly JetCats, recently replaced by privately operated, FastFerry. At its closest point, the JetCats route is approximately 200m from the Manly Cove beaches. The vessel generated wave height would not be expected to exceed 0.8m.

A 4 knot speed limit zone is in place north from Manly Point.

Stakeholders and community have identified the regular movement of Sydney Ferries and JetCats as having significant impact on the day-to-day activities conducted on the eastern foreshores. The wake generated by



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these vessels is found to create considerable wave heights resulting in increased noise and wash and unsafe conditions for passive recreational users, particularly during high tidal conditions.

In addition, the wash created by vessels berthing and leaving the western side of Manly Wharf has been found to increase strain on the south-eastern portion of the netted swimming enclosure which has the potential to result in structural damage to this structure.

Longer term sand movements at Manly Cove East and West beaches have been examined using the results of the Profile Area Volume (PAV) analysis, by considering the changes in volume of sand above AHD on the beaches over time. The measurements of Manly Cove West Beach identify erosion in 1974, followed by a phase of beach recovery until 1978. Further erosion then occurred until 1993 when gradual beach recovery began and continued until 2001. In overall terms, for the period 1951 to 2001, Manly Cove West Beach underwent slight erosion with a total sand loss of approximately 5.4 m³/m.

Manly Cove East Beach shows beach recovery from 1974 until 1996, after which erosion occurred until 2001. In overall terms, for the period 1951 to 2001 this area of beach underwent slight accretion. The total gain of sand between 1974 and 2001 was approximately 3.3 m³/m. The overall accretion in to the eastern end of Manly Cove East Beach can be accounted for by the artificial beach nourishment that also occurred during this period. Natural beach realignment resulted in erosion adjacent to Manly Wharf.

Water quality is crucial in overall coastal processes and to protect the health of the Manly Cove embayment. The total load of pollutants in stormwater, based on the modelling exercise undertaken for a normal rainfall year, is estimated to be 769.5 kg/year of total Nitrogen; 105 kg/year of total Phosphorus; 54.2 kg/year of Copper, 70.2 kg/year of Lead, 154.4 kg/year of Zinc, and 41,054.2 kg/year of sediment. Roads and residential land-uses deliver the highest loads of almost all pollutants.

NSW DECCW routinely measures the two major indicators of bacterial contamination in coastal water, *faecal coliforms* and *enterococci*, adjacent to the Manly Cove netted swimming enclosure. Faecal coliform levels complied with swimming guidelines 100% of the time over the years between 2003/04 and 2006-07. With the exception of one season, enterococci levels complied 100% of the time over the same period. There are 4 known sewer overflow locations and 2 sewage pumping stations within the study area.

Industry & Investment NSW placed a ban on all commercial fishing within Sydney Harbour, stating the presence of elevated levels of dioxins in fish and crustaceans. Recreational fishing is still permitted, although dietary advice has been issued, stating that limits should be placed on the amount of Harbour caught fish that are consumed.

There are numerous foreshore structures within the study area including Manly Wharf development, the eastern boating precinct and a number of seawalls. The seawall along the back of Manly Cove West Beach, constructed around 1900, runs for approximately 230 m between Oceanworld to the west and Manly Wharf to the east. The seawall along the beach of Manly Cove East Beach, constructed during the late 1800's is approximately 270 m in length.

A number of boating facilities exist within a "Boat Club Precinct" located between the eastern end of Esplanade Reserve and Stuart Street including the Manly Yacht Club, Manly Rowing and Sailing Club, the Manly 16 Foot Skiff Club and the Manly Cove Launch Club.

Manly Cove is a popular boating area with 96 existing moorings, 9 of which are for commercial use. All moorings in Manly Cove are positioned within 150 metres of the mean high water mark and are consequently located within important seagrass beds.

The newly renovated Manly Wharf, currently leased to private operators by NSW Maritime, encompasses a range of diverse uses providing waterfront restaurants, shopping and entertainment for the enjoyment of tourists and local day-trippers as well as Manly locals. However, this popularity has resulted in a range of management issues which must be addressed through collaboration between NSW Maritime, Wharf Management and Council.

Coastline Hazards

Beach erosion (or storm demand) is measured in terms of the volume of sand transported offshore and is usually expressed in terms of cubic metres per metre run of beach (m^3/m), as measured above Mean Sea Level (MSL) or Australian Height Datum (AHD). Beach erosion hazard value of $20 m^3/m$ and 20 to $30 m^3/m$ for a 100 year Average Recurrence Interval (ARI) storm event is considered reasonable for both Manly Cove East Beach and Manly Cove West Beach respectively.

Excluding the effects of sea level rise, the total loss of sand from Manly Cove West Beach between 1951 and 2001 was $5.4 m^3/m$. Therefore, a total volume of some $920 m^3$ of sand was eroded from Manly Cove West Beach over the 50 year period or about $0.11 m^3/m$ per year. If the average height of sand on the back beach is taken to be about 2.0 AHD (based on photogrammetric data) this would correspond to a landward shoreline movement of about 0.05 m/year (volume/(height x length x no. years)). In summary Manly Cove West Beach has undergone relatively minor longer term sand loss.

Manly Cove East Beach underwent accretion over the period 1974 to 2001. The total gain of sand on Manly Cove East Beach was $3.3 m^3/m$ between 1974 and 2001 or $1.9 m^3/m$ between 1986 and 2001 (based on profiles 1 to 10 total length of beach 180m). Therefore, there was a total sand volume gain of some $342 m^3$ between 1986 and 2001. This overall accretion can generally be accounted for by artificial beach nourishment that took place after in 1989, 1991 and 1992.

A review of hydrographic surveys dating back to 1895 suggests that the beach profile has not changed significantly over the past 100 years. It is considered reasonable to adopt a low rate of shoreline recession for future planning purposes equal to 0.05 m/year.

For Manly Cove East Beach the predicted loss of beach width over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 5 to 10 metres. The current width of the beach, measured at mean sea level, is zero to approximately 15 metres.

At present, the hazard posed by drifting sand is not considered significant for Manly Cove Beaches due to the presence of artificial seawalls which prevent the loss of any significant volumes of sand by aeolian processes.

Debris on the foreshore west of Manly Wharf following the 1974 storms showed that wave overtopping of the Manly Cove West seawall occurs in extreme events. The Manly Cove West seawall crest level varies between 3.4 and 3.7 AHD and is below the limit of wave run-up in severe storms

This overtopping in combination with scour effects at the toe of the seawall could potentially act to destabilise the seawall in an extreme event. Any raise to the seawall is, however, considered both impractical and undesirable from an aesthetic point of view. The potential for wave overtopping does need to be taken into consideration in the design of drainage systems behind the seawall.

During major stormwater runoff events, stormwater collected from back beach areas and discharging into coastal waters can cause significant erosion to the beach berm. There are three stormwater which discharge through the seawall onto Manly Cove East Beach. These outlets scour channels through the beach sand as the stormwater flows across the beach into the harbour. In particular, the eastern two outlets currently create significant channels due to the high beach sand levels relative to the outlet level at this end of the beach.

The discharge velocities associated with these stormwater flows are insufficient to entrain and transport this sand-sized material any significant distance offshore. The delta formed by these sand deposits is redistributed along the beach by wave action and currents.

During high intensity rainfall events, significant overland flows occur across the paved area between Manly Art Gallery and Oceanworld. Investigations highlight that the drainage system is under capacity in this location with the grate regularly blown open during high intensity rainfall events. This flow contributes to regular scouring of the beach sand to the far west of Manly Cove West beach.

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A total of 17 sites with potential cliff and slope instability hazards have been identified. Remediation works at two sites have already been completed. The slope and cliff instability hazards relating to private properties may restrict future development of the site. The remediation of hazards identified on public land is the responsibility of Council who has gained external funding to conduct further geotechnical assessments as recommended within the original CHDS. Once completed the additional geotechnical assessments will enable Council to prioritise remediation based on the level of risk posed to both life and property by individual hazards.

Climate Change & Adaptations

Sydney Metropolitan Catchments has relatively warm summer, with average maximum January temperatures of approximately 26°C. However, the catchments do experience approximately 3 days above 35°C each year. Winters are cool to mild, with average maximum July temperatures of 17°C. Temperatures rarely fall below 0°C. The catchments receive approximately 1,100 mm of rainfall each year.

Due to impacts of climate change, temperature is projected to rise +0.2 - +1.6°C in 2030 and +0.7 - +4.8°C in 2070. Number of days above 35°C is to increase from 3 to 4-6 days in 2030 and 4-18 days in 2070.

Although changes in average temperature, rainfall and evaporation will have long-term consequences, the impacts of climate change are more likely to be felt through extreme weather events. Changes in rainfall and higher evaporation rates are likely to lead to less water for streams and rivers, which will have downstream consequences for storages. Lower flows and higher temperatures may also reduce water quality within the catchments. For example, low flows, higher temperatures and elevated nutrients create a more favourable environment for potentially harmful algal blooms. Salinity problems in the catchments may be exacerbated by changes in rainfall, temperature and stream flows. In addition, the quality of coastal groundwater aquifers may be adversely affected by rising sea levels and salt-water infiltration.

Climate change is likely to drive changes in the distribution of some plant and animal species, driving some species out of the catchments or enabling invaders to move in. Reductions in stream flows are likely to have a negative impact on aquatic biodiversity and wetland ecosystems.

Manly Council has undertaken several greenhouse projects including education programs, energy efficient lighting and retrofits of public amenities (including the beachfront and several sports fields), installation of a solar hot water at Swim Centre and energy efficient equipment in offices. Through these and other actions Manly Council to date has achieved over 1,600 tonnes of greenhouse gas abatement in the corporate sector and over 26,600 tonnes of greenhouse gas abatement in the community sector.

The Sydney Coastal Councils Group has assessed the vulnerability of the SCCG region and its' member Councils to climate change. Manly Council possesses a moderate degree of vulnerability to climate change relative to other Councils. However, due to its coastlines and coastal development, vulnerability to sea-level rise and coastal hazards was assessed to be particularly high. In addition, stormwater management may become a challenge in the future due to development and projected increases in future rainfall. The vulnerability of the coastline and the paucity of natural landscapes suggest the Councils' natural ecosystems have a low resilience to the effects of climate change.

Ecological Environment

The Manly Cove marine environment exhibits a diversity of habitat with a wide range of substrata, vegetation, depths, exposures and their combinations with aquatic plant communities being among the most abundant and conspicuous habitats of sub-tidal reefs in Sydney Harbour.

Sydney Harbour is subject to a variety of stresses from human activities that have the potential to decrease species diversity and abundance. The marine environment within the study area ranges from rocky intertidal zone to seagrass beds. Three predominant aquatic communities along the foreshore of the study area are 'mixed rocky intertidal & sand', 'sandy beaches' and 'seagrass beds'. The conservation status of these three ecological units is 'high', 'medium' and 'high', respectively.



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Seagrass beds within the study area provide important foraging grounds for Manly's endangered population of Little Penguins (*Eudyptula minor*). In 2003 *Caulerpa taxifolia* was identified in the waters of Sydney Harbour including a number of locations within North Harbour. While this noxious species has not yet been recorded in Manly Cove, it has the potential to grow rapidly degrading marine ecosystems and threatening biodiversity.

The intertidal area within the study area has a range of habitats including rocky reefs and platforms, sandy beaches and artificial habitat including seawalls, jetties, pontoons and a netted swimming enclosure. Significant habitat value is exhibited by the existence of the west Manly Cove netted-swimming enclosure. The enclosure is popular with divers and snorkelers wanting to observe the large colony of protected seahorses known to live amongst the marine growth which grows on the net.

North Harbour Aquatic Reserve lies between an imaginary line from the headlands at North Head and Grotto Point and another line joining Little Manly Point, Manly Point and Forty Baskets Beach. The reserve extends from the seabed at these outer boundaries up to the mean high water mark between them and covers an area of approximately 260 hectares. There is a proposal to extend this Aquatic Reserve to include total water area of the Manly Cove study area.

The study area houses a high diversity of marine species due to the close proximity to the ocean and resultant mixing of warm tropical waters from the north and cooler temperate waters from the south meet. A number of populations of protected, endangered and vulnerable marine fauna species are found in the vicinity of the Manly Cove study area

There is an endangered colony of Little Penguins known to utilise the study area for nesting and foraging. Critical habitat has been declared in the south eastern foreshore of Manly Cove and a Wildlife Protected Area at Federation Point. Little Penguins are often sighted adjacent to Manly Wharf.

The terrestrial environment within the study area has seen the largest change. Bushland reserves are scattered throughout the study area with Gilbert Park, Tower Hill Park, West Esplanade Park and East Esplanade Park being the largest in area. Smaller patches of bushland on both public and private land do exist throughout, and in some places provide corridors between the reserves. There are four specific vegetation communities present within and/or adjacent to the study area.

Fragmentation, clearance and degradation of native vegetation in the Manly Cove study area have reduced habitat value for native fauna. Small pockets of remnant bushland do exist between Oceanworld and Federation Point and on Manly Point, providing important habitat for the endangered colony of little penguins (*Eudyptula minor*). Grassed areas within the study area are also known to provide nesting and foraging habitat for the endangered North Head population of long-nosed bandicoots (*Perameles nasuta*).

While fauna surveys of natural bushland did not extend to these pockets a total of 22 bird species (2 introduced), 9 mammals (5 introduced) and 4 species of native reptiles were recorded in adjacent bushland reserves. Grey-headed Flying Fox (*Pteropus poliocephalus*) is the only threatened species recorded.

Socio-Economic Environment

Population of the Manly Cove study area, according to 2001 census, is approximately 3,672. Manly LGA has a population where 48.7% are males and 51.3% females. Manly population is ageing with 30.7% of residents (or 11,375 people) over the age of 50. The number of people who identified themselves as Indigenous was 93 or 0.3% of the population.

Manly LGA receives approximately six million visitors annually, of which 75-88% are day visitors attracted to beaches, marine activities and the ferry ride. These visitors mostly are focussed on the Corso and nearby beaches. Manly Scenic Walkway attracts many tourists and takes them between Manly Cove and ther Spit and North Head.

Social infrastructure has a direct impact on living conditions, health and potential for economic development. East and West Esplanade Reserves provide key social infrastructure in the study area providing many facilities



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such as picnic facilities, and playground, walking paths, toilets, shelters etc. Manly Scenic Walkway is highly used for many activities. There are 2 Council managed toilet blocks located within the study area as well as various amenities in the Manly Wharf development. Much of the recreational activity is based on the promenade and beaches of Manly Cove.

The study area is rich in heritage sites including a number of recorded Aboriginal sites. A number of architectural and archaeological items exist in the study area, built during European settlement period and listed in Manly LEP, Sydney Regional Environmental Plan and Energy Australia Heritage Registrar.

Community Consultation: Key Issues & Their Management

Prior to the commencement of the Coastline Management Study, Council undertook a variety of community consultation events. Open days, which formed the base for community consultation, were widely publicised through the Precinct Community Forums, letter box drops, local media and advertising material.

Consultation commenced during September 2005 with structured community surveys distributed to residents attending Councils regular Hill to Headland walking tour. A display was also set up in Manly Cove in conjunction with Manly Councils Marine Environment Expo with the community requested to complete surveys and identify issues to be included in the CMP.

Consultation with the Little Manly, Fairlight, The Corso and Balgowlah Heights Precincts was undertaken through those representatives on the Manly Harbour Foreshores & Coastline Management Committee, through written correspondence and advertisements in local media.

The responses obtained from the first survey totalled 89 submissions were returned throughout the consultation process. Community perceptions on key values, issues and their management were assessed through this survey. These are grouped in 14 broad based management issues:

- Aquatic/Inter-tidal Habitat Conservation & Management
- Boating, Maritime Operations & Facilities
- Enhancement of Public Facilities, Infrastructure & Signage
- Marine Sediment & Water Quality
- Air Quality & Noise
- Terrestrial Ecology
- Hazards & Climate Change
- Waste Management
- Access & Traffic Management
- Crime Prevention & Safety
- Aesthetic & Landscape Character
- Recreational Activities & User Groups
- Geodiversity
- Heritage Conservation & Management

Community perceptions of managing each of these issues were recorded. These perceptions are the basis for establishing goals, objectives and management options.

Framing Vision, Goals & Objectives

Visioning is an important element in any planning process. Setting the future vision ensures strategic long term thinking and is based on the priority areas under the NSW State Plan, targets set by the Natural Resources Commission (NRC) and vision adopted by the Sydney Metropolitan Catchment Management Authority (SMCMA). At local level, the program 'Surfing the Future' provides a direction to aim towards for the year 2025 for Manly Local Government Area.



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The vision statement, adopted for 'Surfing the Future', has been used in preparation of the Manly Cove Coastline Management Planning process.

"A thriving community where residents and visitors enjoy a clean, safe and unique natural environment enhanced by heritage and lifestyle"

The vision aims to provide a general statement about the future desired state of the study area. This vision statement, from the onset, establishes importance of visitors, heritage and living in harmony with natural environment and influences setting up of management objectives.

For each management issue, a goal has been defined, along with a range of management objectives that were further partitioned into management options. The basis for setting management objectives was Ecologically Sustainable Development (ESD).

The vision statement has been followed by 14 separate issue based goals, further elaborated in 33 management objectives.

In general, set goals and objectives relate to the general goal of the NSW Coastal Policy 1997, Coastal protection Act 1979, Water Management Act 2000 and management principles described in relevant regional plans (Sydney Regional Environmental Plan – Sydney Harbour Catchment 2005, Draft Subregional Strategy: North East Subregion, July 2007), Sydney Metropolitan Catchment Management Action Plan 2008 and also Manly Local Environmental Plans and different strategy documents.

Strategic Management Options

Thirty-three management objectives were translated into indicative and strategic management options. Many of these options have been proposed by community during consultation meetings. Some of the proposed options, before implementation, will be subjected to further consultations with relevant agencies, Precincts and community. A total of 98 indicative management options are presented (Table below).

Key Issues, Goals, Objectives & Indicative Management Options

Objectives	Indicative Management Options
1.0 Aquatic / Intertidal Habitat Conservation & Management <i>Goal: Restore and maintain a healthy and diverse mix of aquatic and intertidal habitats that will maintain and improve biodiversity and ecological functions of Manly Cove</i>	
1.1 To achieve community awareness of and involvement in the conservation of marine ecology through education and participation	1.1.1 Continue to work with other stakeholders in the provision of marine focussed educational events
	1.1.2 Encourage the establishment of a community-based seagrass monitoring program to provide reliable data on any change to the distribution or health of seagrass in Manly Cove.
	1.1.3 Involve the community and user groups in the management planning process to ensure outcomes build public knowledge and meet community expectations
1.2 Ensure all areas of ecological significance are managed in an integrated and sustainable manner	1.2.1 Pursue a submitted proposal to DECCW seeking the extension of the boundary of North Harbour Aquatic Reserve to include Manly Cove (Little Manly and North Harbour).
	1.2.2 Continue work with DECCW to manage Little Penguin Critical Habitat, the Wildlife Protection Area at Federation Point and known nesting sites in line with the Recovery Plan.



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Objectives	Indicative Management Options
	1.2.3 Protect and enhance marine/intertidal habitats within and adjacent to Manly Cove
1.3 To ensure the activities within Manly Cove are carried out in a manner that maintains or improves the ecological condition of marine habitats and species	1.3.1 Minimise the impact that recreational fishing activities have on the intertidal and marine ecology, through education and regulation 1.3.2 Minimise the impact of diver/snorkeler activities and routine maintenance upon the colony of seahorses known to colonise the Manly Cove netted swimming enclosure.
2.0 Boating, Maritime Operations & Facilities <i>Goal: To achieve the highest level of environmental protection and safety for maritime operations within Manly Cove</i>	
2.1 To improve the sustainability of boating activities in Manly Cove	2.1.1 To encourage boat user groups to play a role in educating the boating community on best practice 2.1.2 Encourage the boating community to report marine pest sightings 2.1.3 Ensure Manly Council Rangers are aware of Spill Response Procedures for both on-water and off-water incidents
2.2 To ensure boating activities are conducted through positive interactions with other user groups	2.2.1 Encourage compliance with NSW Maritime boating regulations 2.2.2 Sustainably manage the extent to which commercial operators access and use the Manly Cove embayment 2.2.3 Investigate the feasibility for the installation of a 'ferry underway' warning system for passive waterway users 2.2.4 Ensure skiff rigging and storage activity does not negatively impact other users of East Esplanade Reserve
2.3 To support recreational (and commercial) boating activity through the provision of safe, user friendly facilities	2.3.1 Work with NSW Maritime and organisations in the boating precinct to investigate the feasibility of providing public wharf facilities in Manly Cove 2.3.2 Encourage NSW Maritime, I&I NSW and mooring users to install seagrass friendly moorings throughout Manly Cove 2.3.3 Encourage and support the provision of safe, accessible boating facilities in Manly Cove
3.0 Enhancement of Public Facilities, Infrastructure & Signage <i>Goal: Public facilities, infrastructure and signage are upgraded and maintained to facilitate improved social amenity</i>	
3.1 To provide well maintained and safe facilities and infrastructure on Manly Council owned and/or managed public lands	3.1.1 Investigate the feasibility of installing water conservation measures in the West Esplanade toilet facility 3.1.2 Investigate the upgrading of seating and picnicking facilities within East and West Esplanade Reserves 3.1.3 Ensure the netted swimming enclosure is maintained to ensure protection to users and in line with legislative requirements 3.1.4 Investigate the feasibility of providing additional freshwater bubblers within East and West Esplanade Reserves.



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Objectives	Indicative Management Options
3.2 Provide up-to-date regulation and interpretive signage appropriate for the locality and which meets Councils legislative requirements	3.2.1 Undertake review of existing compliance signage which meets Councils legislative requirements
	3.2.2 Replace damaged and/or missing signage in line with findings of signage audit
	3.2.3 To reduce negative impacts upon visual character of Manly Cove through signage consolidation
	3.2.4 Upgrade signage and protective measures in relation to Little Penguin activity and compliance issues
4.0 Marine Sediment & Water Quality <i>Goal: To ensure water and marine sediment quality meets the community's expectations and falls within acceptable standards suitable for fishing and swimming</i>	
4.1 Reduce sediment volume and associated pollution entering the marine environment	4.1.1 Identify point sources of pollution within the study area and assess feasibility of installing suitable treatment measures
	4.1.2 Evaluate the effectiveness of stormwater improvement actions undertaken within Manly Cove
	4.1.3 Identify and implement opportunities for stormwater treatment, harvesting and reuse within Manly Cove
	4.1.4 Develop a greater understanding of sediment quality and processes to guide future management responses with regard to the impact on the marine environment
	4.1.5 Formulate a comprehensive Stormwater Management Plan for Manly LGA encompassing the study area
4.2 Encourage a reduction of effluent discharge/ exfiltration from sewerage infrastructure in the Manly Cove study area	4.2.1 Continue to liaise with Sydney Water to ensure that all sewage overflows (and pumping stations) operate within established licensing requirements
	4.2.2 Continue to liaise with Sydney Water to ensure that sewage infrastructure operates within design capacity
	4.2.3 Encourage property owners to undertake CCTV inspections of their properties sewerage systems and ensure they are adequately maintained.
	4.2.4 Identify and promptly repair sewage leaks from Council facilities
4.3 Ensure sustainable groundwater extraction practices to avoid negatively impacting upon aquifer recharge and quality	4.3.1 Undertake a comprehensive study on the Manly Cove aquifer to identify recharge volumes and to ensure sustainable extraction rates
	4.3.2 Monitor council bores for salinity and other parameters to ensure extraction does not lead to contamination
	4.3.3 Ensure Council staff working with or assessing groundwater issues are familiar with the SCCG Groundwater Management Handbook 2006.
	4.3.4 Develop fact sheets outlining the typical occurrence, behaviour and characteristics of groundwater for distribution to community and building/ construction operators
5.0 Air Quality & Noise <i>Goal: To ensure air quality and noise levels meet community expectations and fall within acceptable standards</i>	
5.1 Reduce localised air	5.1.1 Encourage residents to report incinerator use and illegal backyard burning



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Objectives	Indicative Management Options
pollution	activity in the study area
	5.1.2 Encourage Sydney Water to find a solution to alleviate problems associated with odours created by the sludge truck movements from North Head Sewage Treatment Plant.
5.2 To maintain an acceptable level of noise generation within the community and regulate noise sources	5.2.1 Encourage local residents, through the Community Precinct system, to report all excessive or unreasonable noise pollution to either Manly Council or Police
6.0 Terrestrial Ecology <i>Goal: To conserve and enhance the integrity and diversity of indigenous terrestrial flora and fauna, and their ecosystems</i>	
6.1 To ensure the activities within Manly Cove are carried out in a manner that maintains or improves the ecological condition of terrestrial habitats and species	6.1.1 Maintain remnant vegetation on Manly Point to enhance Critical Habitat for the Little penguin population
	6.1.2 Encourage planting of low dense clumping native flora species on private and public lands to provide improved potential foraging and nesting habitat for the Long-nosed bandicoot
	6.1.3 Encourage the planting of native flora species which provide habitat for the vulnerable Grey-headed flying fox
	6.1.4 Ensure that Council's Street Tree Planting Program results in the planting of appropriate native species
	6.1.5 Facilitate the construction of retractable barriers and appropriate signage to protect Little penguins adjacent to Manly Wharf
6.2 To achieve community awareness of and involvement in the conservation of terrestrial ecology through education and participation	6.2.1 Continue to provide community education in line with actions identified in the Manly Little Penguin Recovery Plan and Draft Long-nosed bandicoot Recovery Plan.
	6.2.2 Encourage community participation in Bush care activities within the study area
7.0 Coastal Hazards & Climate Change <i>Goal: Assess, monitor and mitigate risks from coastline hazards and climate change</i>	
7.1 Reduce to an acceptable level, the risk of damage as a result of beach erosion and shoreline recession	7.1.1 Develop and implement a natural shoreline and shoreline structure monitoring program for Manly Cove East and West Beaches
	7.1.2 Revise the assessment of coastline hazards based on the findings of the monitoring program
	7.1.3 Should the risk of damage to the existing seawall due to the effects of beach erosion and recession in the future become unacceptable, evaluate and implement the available management options
7.2 To ensure the effects of shoreline recession do not adversely impact on beach amenity	7.2.1 Review the results of the beach profile surveys and assess implications for recreational beach amenity
	7.2.2 Should the impact of shoreline recession on beach amenity become unacceptable investigate options to reinstate the beach to the western end of Manly Cove East Beach
7.3 To ensure future development is compatible with	7.3.1 Control new development so that it is appropriately sited and is not adversely affected by the erosion and recession hazard over a suitable planning timeframe (<i>minimum 50 years</i>)



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Objectives	Indicative Management Options
the erosion and recession hazard	7.3.2 Ensure any redevelopment and public facilities are compatible with the erosion and recession hazard and do not adversely affect coastal processes
	7.3.3 Develop guidelines for the construction and maintenance of structures located within areas subjected to coastal hazards.
7.4 To ensure any protective works minimise impact on beach amenity and access, and where practical improve amenity and access	7.4.1 Design any future stabilisation works to minimise impact on coastal processes, and where practical improve existing amenity and access.
7.5 To reduce to an acceptable level, the risk to property and risk to life as a result of slope and cliff instability	7.5.1 Continue the staged mitigation of cliff and slope instability on public lands based upon the level of risk posed to life and /or property and in line with recommendations of the Davis Marina to Manly Point CHDS
	7.5.2 Reissue notifications to private property owners of identified coastal hazards potentially affecting their land and a reminder the information has been recorded on the properties S.149 Certificate
7.6 To reduce to an acceptable level, the risk to property and infrastructure resulting from Sea Level Rise	7.6.1 Adopt an adaptive risk-based approach to managing sea level rise impacts
	7.6.2 Work with regional, state and federal bodies to ensure consistent adaptation planning
	7.6.3 Encourage appropriate development on land projected to be at risk from sea level rise.
	7.6.4 Work within the emergency management frameworks identified in Local Emergency Management systems during times of floods and storms
7.7 Promote understanding of the likely environmental, social and economic impacts of climate change on Manly Cove	7.7.1 Continue to provide updated information to the public about climate change including sea level rise and their impacts
	7.7.2 Incorporate latest climate change information into management decisions
	7.7.3 Promote climate change partnerships through co-operative approaches by Government, individuals, industry, business and community groups
7.8 Limit and reduce the greenhouse gas emissions in the Manly LGA	7.8.1 Encourage the use of passive and local transport within and from the study area.
	7.8.2 Ensure public facilities are fitted with energy efficient lighting and energy fittings and devices
	7.8.3 Encourage the use of energy efficient devices in commercial and residential buildings
7.9 Reduce water consumption within the study area	7.9.1 Ensure public toilet, shower, bubbler and tap facilities within Manly Cove are fitted with water efficient systems
	7.9.2 Repair damaged or malfunctioning public water systems, including leaks, within the study area
	7.9.3 Investigate opportunities for stormwater harvesting and reuse to supplement water use
8.0 Waste Management	



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Objectives	Indicative Management Options
Goal: Promote and facilitate sustainable waste management in Manly Cove	
8.1 To reduce waste while maximising re-use and recycling in the Manly Cove study area	8.1.1 Continue to conduct and support community and business education programs to avoid litter production at source
	8.1.2 Ensure adequate recycling facilities are provided in public areas and encourage responsible disposal of litter within the study area
	8.1.3 Carry out a litter survey of Manly Cove to assess litter types, sources and volumes entering Manly Cove
8.2 To minimise risk to beach users and marine fauna from beach and marine waste while maintaining natural ecosystems	8.2.1 Continue to operate the existing beach raking regime and remove gross pollutants from Manly Cove beaches
	8.2.2 Conduct litter audit to determine sources of rubbish to inform treatment and education programs
	8.2.3 Encourage NSW Maritime to improve its water-based litter and debris cleaning regime
9.0 Access & Traffic Management	
Goal: To provide an environment at Manly Cove that is accessible to all people	
9.1 To improve and control access for pedestrians, cyclists, water based recreation and servicing vehicles, minimising conflicts and negative impacts	9.1.1 Encourage NSW Maritime lessees to improve beach access and public amenity immediately east of the Manly Wharf development
	9.1.2 Raise awareness and understanding of disability issues through research, information, consultation and education programmes involving the community, professionals, Council members and Council staff.
	9.1.3 Investigate the feasibility of constructing an underground pedestrian pathway to link Manly Wharf with The Corso
10.0 Crime Prevention & Safety	
Goal: To provide public areas in which patrons feel and are safe	
10.1 To control and minimise crime and inappropriate behaviour in the study area	10.1.1 Control and minimise the impacts of human and companion animal activity upon Little penguin and seahorse populations of Manly Cove
	10.1.2 Address issues associated with antisocial behaviour adjacent to Manly Wharf and in Manly Cove east.
	10.1.3 Encourage the community to report crime or antisocial behaviour to Police or Council Rangers.
	10.1.4 Ensure public access within Manly Cove is appropriately lit.
11.0 Aesthetic & Landscape Character	
Goal: To maintain and enhance the aesthetic appeal of Manly Cove	
11.1 To reduce the adverse impacts of features that detract from the visual quality of Manly Cove	11.1.1 Ensure all new development complies with the landscape provisions of Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 and the Sydney Harbour Foreshores and Waterways Area Development Control Plan 2005
	11.1.2 Ensure signage is appropriately designed, positioned and sized to ensure minimal impact on visual character of Manly Cove



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Objectives	Indicative Management Options
12.0 Recreational Activities & User Groups <i>Goal: To provide for the continuing, enjoyable and sustainable use of Manly Cove for a range of user groups</i>	
12.1 To minimise conflicts between differing recreational and commercial activities within Manly Cove	12.1.1 Ensure all passive recreational activities are able to continue within Manly Cove in a sustainable and harmonious manner
	12.1.2 Work with Sydney Ferries and NSW Maritime to minimise conflicts between ferries and water based recreational activities
	12.1.3 Support and promote environmentally friendly recreationally sustainable activities
	12.1.4 Support and promote sustainable recreational fishing
	12.1.5 Continue to educate boat users and organization on their potential impact upon the marine environment
13.0 Geodiversity <i>Goal: Conserve the significant geodiversity elements of the area's coastline</i>	
13.1 To protect and conserve the important elements of Manly's geodiversity through raising awareness, considering its values in all planning and management and integrating with biodiversity and cultural heritage management	13.1.1 Undertake a comprehensive assessment of geoheritage values of Manly LGA
	13.1.2 Ensure that geoheritage issues are considered during development assessment processes
14.0 Heritage Conservation & Management <i>Goal: Ensure that all Aboriginal and European (cultural and natural) heritage sites within the study area are preserved and protected</i>	
14.1 Ensure that sites of Aboriginal heritage are protected and appropriately maintained	14.1.1 Continue to undertake consultation with the Aboriginal Heritage Office, Metropolitan Local Aboriginal Land Council, DECCW and other local Aboriginal groups in regard to the management of cultural heritage site management.
	14.1.2 Undertake a Heritage Impact Assessment prior to proceeding with works that may impact on any heritage items within the study area.
14.2 Ensure that all sites of non-indigenous heritage are protected under the relevant legislation and in Council planning instruments	14.2.1 Prepare a Heritage Management Plan to identify detailed management measures to protect and maintain built heritage.
	14.2.2 Undertake a Heritage Impact Assessment prior to proceeding with works that may impact on any heritage items within the study area.

ii ABBREVIATIONS

ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
AHO	Aboriginal Heritage Office
CAP	Catchment Action Plan
CCM	Care, Control & Management
CCP	Cities for Climate Protection
CMA	Catchment Management Authority
CMP	Coastline Management Plan
CSIRO	Australia's Commonwealth Scientific and Industrial Research Organisation
DCP	Development Control Plan
DEC	The former NSW Department of Environment and Conservation (at present, DECC)
DECC	NSW Department of Environment and Climate Change
DLWC	The former NSW Department of Land & Water Conservation
DNR	The former NSW Department of Natural Resources (at present, DECC)
DPI	NSW Department of Primary Industries
DWE	NSW Department of Water & Energy
EPBC	Environment Protection & Biodiversity Conservation (Act)
EPI	Environmental Planning Instrument (includes LEP, REP and SEPP)
ESD	Ecologically Sustainable Development
GIS	Geographic Information System
GPT	Gross pollution Trap
GSE	Graduate School of Environment, Macquarie University
ICZM	Integrated Coastal Zone Management
IPA	Intertidal Protected Area
IPCC	Inter-Governmental Panel for Climate Change
LEP	Local Environmental Plan
LG	Local Government
LGA	Local Government Area
MC	Manly Council
MEC	Manly Environment Centre
MLALC	Metropolitan Local Aboriginal Land Council
MSL	Mean Sea Level
MSW	Manly Scenic Walkway
MSS	Manly Sustainability Strategy
NH	North Harbour
NHR	North Harbour Reserve
NRC	Natural Resources Commission
NSW	New South Wales
PoM	Plan of Management
REP	Regional Environmental Plan
SAP	Scientific Advisory Panel (of the Manly Council)
SCCG	Sydney Coastal Council Group
SEPP	State Environmental Planning Policy
SES	State Emergency Services
SHOROC	Shore Regional Organisation of Councils
SMCMA	Sydney Metropolitan Catchment Management Authority
SREP	Sydney Regional Environmental Plan
TSC	Threatened Species Conservation (Act)
UWS	University of Western Sydney
WPA	Wetlands Protection Area

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1. INTRODUCTION

1.1 COASTLINE MANAGEMENT IN NSW

The NSW coastline is one of the state's greatest assets. Beautiful beaches, dunes, estuaries, lakes, lagoons and wetlands attract tourists, support various industries and provide recreation for everyone. However, the coastline is under constant attack from natural forces, and is therefore dynamic and ever-changing. Beaches erode in response to storms, sand dunes migrate inland in response to strong winds, and many sections of the coast are receding due to long-term coastal processes. Climate change is only likely to exacerbate these effects in the future.

Human activities are also causing a host of further problems along the coast. Around 80 per cent of the NSW population lives on the state's coast, with rapid growth projected for the future, generating constant pressure for development.

The Department of Environment, Climate Change & Water (DECCW) works closely with Catchment Management Authorities (CMAs), local councils and communities to reduce threats from coastal hazards and flooding, and ensure the long term protection, conservation and restoration of coastal and estuarine environments.

DECCW manages the NSW Government's Coastal Management Program, which aims to reduce the impact of coastal hazards while accommodating population growth and protecting the coastal environment. Under the program, the NSW Government provides a 50% subsidy, on a dollar-for dollar-basis, to local councils for:

- preparing coastal studies and coastal zone management plans for long-term management of the coastline
- measures to conserve or improve beaches
- investigating, designing and implementing measures to reduce the risk of damage from coastal hazards

During 2007–08, 36 grants totalling \$2.89 million were approved under the Coastal Management Program in 17 local government areas for projects such as hazard mitigation works, dune restoration and enhancement of coastal facilities (DECC 2008).

1.2 COASTLINE MANAGEMENT IN MANLY

Manly is known distinctively for its beaches and foreshore areas. For this reason it is vitally important that waters and natural features around these beaches and foreshores are nurtured and protected. The majority of the Manly Local Government Area is bordered by water. Foreshore areas are under constant attack from natural elements such as wind and waves. Manly's coastal and harbour foreshores respond naturally to these processes, however human activities also contribute to modify them.

In line with efforts of NSW State Government, Manly Council has also embarked on planning and management of coastal and estuarine areas. The importance of coastal and estuarine management has been significantly highlighted in all key policy, vision & strategy documents adopted by Manly Council. One of the key theme areas of the Manly Sustainability Strategy (MC, 2006) is 'A Natural, Sustainable Manly'. The theme adopts the principle '*Recognise the intrinsic value of Manly's geodiversity, biodiversity and natural ecosystems, and protect and restore them*' and includes the 'Coastline and Estuary Management Program'.

Hence, Manly Council has adopted a staged approach to cover the entire Manly lagoons & foreshores under estuary/coastal management plans (**Table 1.2**). The State Government has provided funding to assist Manly Council to prepare and implement these plans. Environment Levy of the Council is mainly instrumental in funding these plans.



MANLY COVE COASTLINE MANAGEMENT STUDY

Development of the Manly Cove Coastline Management Plan (CMP) is on the principles reflected in the NSW Coastal Policy 1997, ongoing advances in coastal management and amendments made in 2002 to the *Coastal Protection Act 1979*. This is an integrated planning approach that incorporates the management of coastal hazards and risk with social economic, aesthetic, recreational and ecological factors. Development of the Manly Cove CMP is also undertaken to meet requirements for community land management under the *Local Government Act 1993*, and resultantly the CMP addresses legislative requirements with respect to community land within the study area.

Table 1.2 Formulation statuses of Coastline & Estuary Management Plans

Plans	Status	Remarks
Manly Lagoon Estuary Management Plan	Adopted, August 1988	Being implemented
Cabbage Tree Bay Management Plan	Adopted, October 2000	Being implemented
Manly Lagoon and Catchment Integrated Catchment Management Strategy and Evaluation	Adopted, March 2004	Being implemented
Forty Baskets Coastline Management Plan	Adopted, May 2004	Being implemented
Little Manly Coastline Management Plan	Adopted, May 2004	Being implemented
Manly Ocean Beach Coastline Management Plan	Adopted, February 2008	Being implemented
Clontarf/Bantry Bay Estuary Management Plan	Adopted, May 2008	Being implemented
North Harbour Coastline Management Plan	Under development	Coastline Management Study completed. The Plan is on public exhibition
Manly Cove Coastline Management Plan	Under development	

1.3 COASTLINE MANAGEMENT SYSTEM

The coastline management system (**Fig 1.3**) involves a series of steps to establish a committee, identify various coastal processes and hazards, identify land tenure and existing planning controls, environmental features, sensitivity to climate change, assess management options having regard to social, economic, aesthetic, recreational and ecological issues, recommend the best combinations of options and developing a strategy to implement the plan.

The Manly Cove Coastline Management Plan is being developed following these steps through the formulation of three key documents as follows:

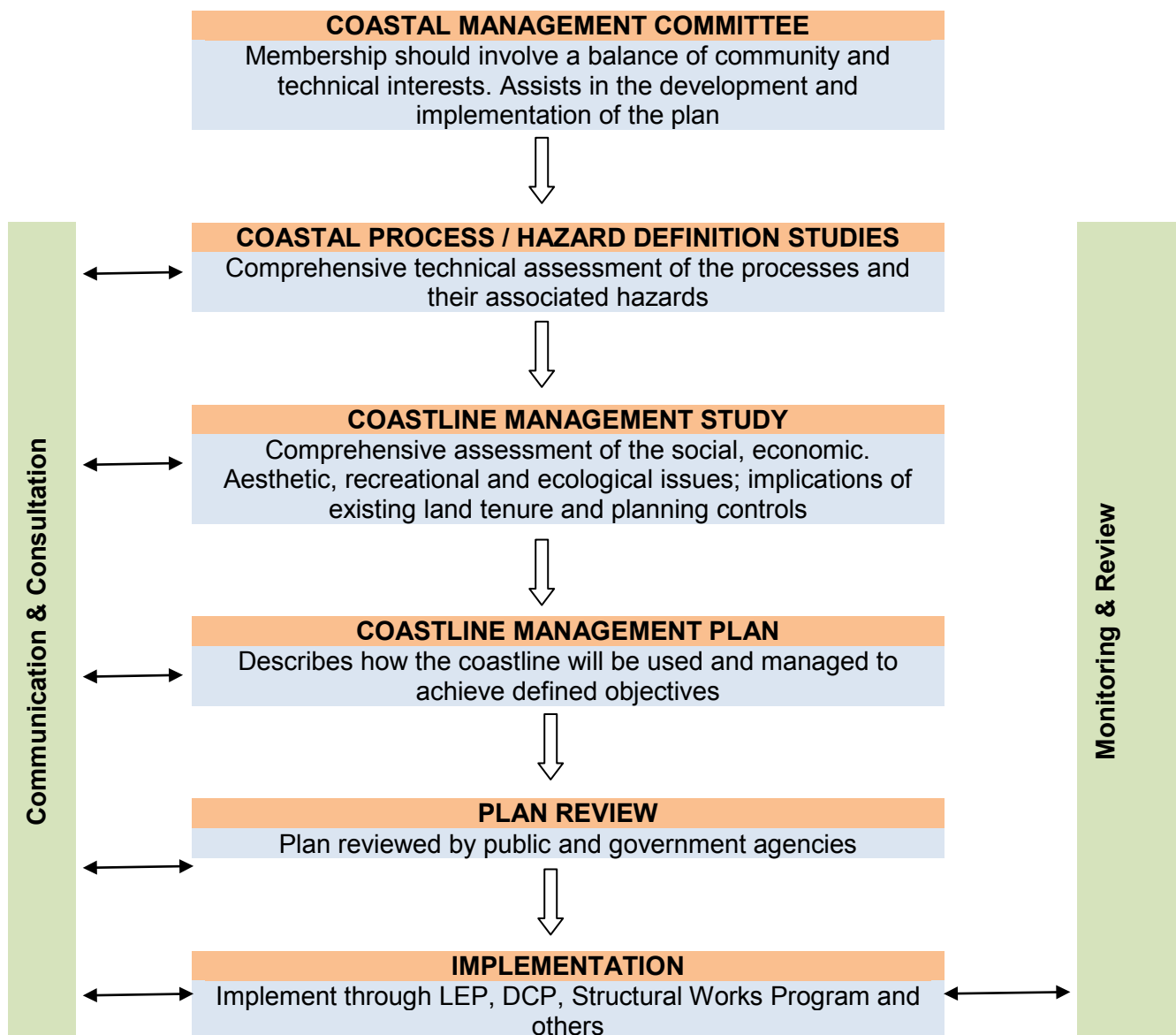
The formulation of the **Coastline Hazard Definition Study**, completed in April 2004, provided a sufficient understanding of the coastal processes and their associated hazards. This study has specifically identified hazards threatening the area and quantified these hazards and their effects. Patterson Britton & Partners (2004) has prepared this study for North Harbour and Manly Cove covering the section of shoreline from the Davis Marina to Manly Point including North Harbour Reserve, Fairlight Beach, Delwood Beach and Manly Cove. The report assessed beach erosion, shoreline recession, sand drift, coastal inundation, stormwater erosion, slope and cliff instability, climate change including an assessment of the existing seawalls.

A **Coastline Management Study** assesses the social, economic, aesthetic, recreational and ecological issues associated with land use along the coastline, in addition to coastline hazards, implications of existing land

MANLY COVE COASTLINE MANAGEMENT STUDY

tenure and planning controls. It identifies options relevant to environmental planning and management. The study considers all feasible management options. The study also defines specifically climate change impacts.

Figure 1.3 Elements of the Coastline Management System



Based on information contained in two documents, a **Coastline Management Plan** describes how the coastline will be used and managed to achieve defined objectives. The plan may include:

- a description of the objectives of the plan
- a discussion of issues, problems, special features and values
- a schedule of specific management measures aimed at achieving the objectives
- a description of the means and timing of implementation of these measures.

Coastline management is a multifaceted process that crosses many different disciplines and, to be successful must incorporate a diverse range of skills and expertise. The Coastline Management Plans are intended to be strategic plans with a long-term time frame of 10-20 years (with appropriate revisions). Implementation of the



MANLY COVE COASTLINE MANAGEMENT STUDY

Plan will involve considerable expenditure and therefore implementation must have regard to resource availability and the priorities of Council and other agencies identified in the Action Plan.

Manly Council is not responsible for all the areas and issues identified in the Coastline Management Plans. As a consequence, implementation of the recommendations contained in the Plans will rely heavily on an integrated approach by the relevant key stakeholder agencies, which have been, and will continue to be, involved in the development of the plans. While some of the recommendations may identify other agencies as responsible for implementation, Manly Council will be responsible for encouraging and facilitating the Plans implementation and will oversee the implementation.

Community consultation and involvement in decision making are an integral component of the coastline management process. Strong community and stakeholder representation on a coastline management committee will assist to promote the widest possible consultation with the community at all stages of the process.

1.4 MANLY HARBOUR FORESHORE & COASTLINE MANAGEMENT COMMITTEE

The Manly Harbour Foreshores & Coastline Management Committee, under the stewardship of Manly Council was established in early 2009 to guide the preparation of a number of plans including the Manly Cove Coastline Management Plan.

The Committee has representations from Manly Council, Community Precincts, State Government Agencies and community. The relevant government departments include:

- Department of Environment, Climate Change and Water (DECCW);
- NSW Maritime; and
- Industry & Investment NSW (I&I NSW).

The first meeting of the Committee was held on 14 April 2009. The Committee meets on a bi-monthly basis.

In order to support the Committee and to obtain expert contribution in the CMP, an internal 'Coastal Focus group' consisting of 20 key staff members from a range of fields was also formed. The Group formally met two times but individuals were extensively consulted throughout the CMP development process.

The present membership of both these groups is presented in the inner cover page of this report.

1.5 COASTLINE MANAGEMENT STUDY

Having defined the type, nature and significance of coastline hazards, this **Coastline Management Study** is undertaken, following Coastline Management Manual (NSW 1990), to identify options relevant to the environmental planning and management of the coastal areas. This study is based on a comprehensive assessment of the social, economic, aesthetic, recreational and ecological issues associated with land use along the coastline. The study analyses implications of existing land tenure and planning controls. It identifies options relevant to environmental planning and management and considers all feasible management options. The study defines specifically climate change impacts.

The study is designed to incorporate the principles of Total Catchment Management, and also aims to include issues across the Triple Bottom Line. The Coastline Management Plan (as follow-up of this study) will use the outcomes from this document to adopt a set of agreed management options.

This study has been developed in-house with contribution from the 'Coastal Focus Group' under the guidance of the 'Manly Harbour Foreshore & Coastline Management Committee'.

1.6 STUDY AREA



MANLY COVE COASTLINE MANAGEMENT STUDY

The Manly Cove study area lies immediately to the north-west of the entrance to Sydney Harbour, bounded to the west by Federation Point and to the southeast by Manly Point (See **Figure 1.6**). The study area covers 50.9 hectares and takes in the suburbs of Manly and Fairlight and also the local Precinct Community Forum areas of Fairlight, The Corso and Little Manly.

It extends both seaward and landward from the shoreline and includes rocky intertidal platforms, sandy beaches, grassed recreational areas, a netted swimming enclosure, bushland as well as commercial, retail and residential areas. The study area covers twelve sub-catchments.

The study area includes Manly Cove West Beach and Manly Cove East Beach, the seawalls backing these beaches, sandstone cliff faces and wave cut intertidal platforms as well as a number of water based development including Manly Wharf and various boating facilities lining the eastern foreshore.

The study area consists primarily of semi-natural, landscaped and built areas. It is characterized by natural and cut sandstone cliffs and escarpments with fringing native bushland pockets and landscaped areas along the Esplanade Reserves.

Manly Cove is a popular location for both visitors and locals alike. The Manly Scenic Walkway, a 10km scenic harbour walking track extending from the Spit Bridge to Manly, directs large numbers of walkers along the length of the study area. Manly Wharf also forms a vital transport link between the Northern Beaches and Sydney CBD.

Land and aquatic areas outside the study area boundaries, which impact on the biophysical or social environment within the boundary, have also been considered in development of the CMP in order to establish holistic management strategies.

North Harbour Aquatic Reserve lies very close to the study area. A new proposal to extend the North Harbour Aquatic Reserve includes entire water side of the study area and is now being considered at the Department of Environment & Climate Change.

The study area of Manly Cove extends to areas beyond the care and control of Manly Council. This is to provide a comprehensive approach to the identification and resolution of issues affecting the study area, including those that relate to the land-water interface. It will also provide an opportunity to bring together the various government agencies involved and through a whole of government approach identify strategies and actions for the future management of the area.

Whilst Manly Council is not responsible for all the areas identified in the study, implementation of the recommendations contained within the CMP will rely largely upon an integrated approach by the relevant key stakeholder agencies. It should be noted however, that Council is the main authority so the majority of the recommendations identified within the Plan will be the responsibility of Council.

The study area borders areas covered by Little Manly and North Harbour Coastline Management Plans.

The entire study area is covered within the Sydney Harbour Foreshores and Waterways Area and Sydney Metropolitan Catchment Management Area. The area, being within the Sydney Harbour, is excluded from the legally defined NSW coastal zone. These have implications on administrative and legal management of the study area.



Figure 1.6 Aerial view of the Manly Cove study area.

2. COASTLINE MANAGEMENT FRAMEWORK - INSTITUTIONAL & POLICY ENVIRONMENT

The Manly Cove Coastline Management Study has been prepared under the NSW Government's Coastal Management Program notwithstanding that the study area does not fall within the Coastal Zone. The Program is designed to fulfil the requirements of the NSW Coastal Policy 1997. However, as the Manly Cove study area comes under the purview of Sydney Harbour catchment, the most important guiding document is the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 under the *Environmental Planning & Assessment Act 1979*.

The following section identifies relevant commonwealth, state and local legislations and regional planning frameworks and provides a brief outline of applicability of each piece of legislation.

2.1 RELEVANT COMMONWEALTH POLICIES & ACTS

Commonwealth Government Coastal Policy 1995

The aim of the Commonwealth Coastal Policy is to promote the ecologically sustainable use of Australia's coastal zone, which houses a diverse and interacting mixture of terrestrial, estuarine and marine ecosystems. It presents the Commonwealth's vision for a co-operative, integrated approach to coastal management. While this Policy only applies to those activities for which the Commonwealth has responsibility, the document provides some direction in terms of coastal management standards. The Commonwealth Government has no direct responsibility for the management of Manly Cove; however, many of the guiding principles (which are mirrored in the NSW Coastal Policy) are being incorporated into the development of the Manly Cove CMP.

- The ecological and physical links between terrestrial and marine systems must be taken into consideration in the use and management of coastal zone resources.
- The economic, environmental, social and cultural values of coastal zone resources should be identified.
- Coastal zone resource uses should be monitored to ensure that impact assessments are accurate.
- If there is a high risk of serious or irreversible adverse impacts resulting from the use of a coastal resource, that use should be permitted only if those impacts can be mitigated.
- Natural physical processes should be safeguarded. Development should take account of natural processes.
- Biological diversity and the biological processes on which it relies should be maintained.
- Sites of ecological, cultural, archaeological, historic and scientific significance should be identified and maintained.
- Waste disposal into coastal waters should be a last resort after all avenues for re-use and recycling have been exhausted.

Environment Protection & Biodiversity Conservation Act 1999

Under the assessment and approval provisions of the *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, any action that is likely to have a significant impact on a matter of national environmental significance are subject to an assessment and approval process. Such actions include a project, development, activity or series of activities. The Act applies to the Manly Cove study area through listed threatened species and ecological communities and potentially through listed migratory species known to inhabit the study area.

Actions that are likely to have a significant impact on the environment of Commonwealth land, and actions taken by the Commonwealth that are likely to have a significant impact on the environment may also require approval under the *EPBC Act*.

National Strategy for the Management of Coastal Acid Sulphate Soils 2000

Acid sulphate soils underlie large areas of Australia's coastline. The impacts of coastal acid sulphate soil runoff come at a significant environmental, economic and social cost to coastal communities. Besides the obvious impact on the environment such as fish kills, acid runoff has been attributed to the decline or failure of fishery and aquaculture industries. The National Strategy for the Management of Coastal Acid Sulphate Soils 2000 proposes a holistic and comprehensive approach to define the problem, prevent it from increasing and encourage remedial actions to reduce existing acid water runoff.

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Framework for Integrated Coastal Zone Management 2006

National Cooperative Approach to Integrated Coastal Zone Management (ICZM): Framework & Implementation (DoEH 2006) provides forward thinking to initiate a nationally cooperative focus on achieving ecologically sustainable development. This sets the scene for national cooperation and provides a strategic tool for guiding national, state, regional and local coastal zone outcomes and adds value to existing initiatives. The major outcomes expected are:

- a) managing coastal issues that are of national scale and scope
- b) managing coastal issues where complimentary arrangements will work better

The Implementation Plan for the Framework sets out, under strategic priority area, implementation objectives and actions.

Table 2.1 - Framework for Integrated Coastal Zone Management 2006 - Priorities

Priority Areas	Actions
1. Integration Across the Catchment-Coast-Ocean Continuum	1.1 Research Priorities 1.2 Freshwater Flows 1.3 Communication 1.4 National networks 1.5 State of the Environment Reporting
2. Land and marine-based sources of pollution	2.1 Coastal & estuarine water quality 2.2 Coastal acid sulphate soils 2.3 Marine debris 2.4 Ocean-going commercial vessels waste 2.5 Small commercial and recreational vessel waste 2.6 Dredging
3. Climate Change	3.1 Understanding of climate change 3.2 Managing and adapting to impacts and opportunities
4. Pest plants and animals	4.1 Weeds & feral animals 4.2 Introduced marine pests
5. Planning for population change	5.1 Planning & population
6. Capacity building	6.1 Information 6.2 Education & training 6.3 Incentive measures
7. Monitoring & Evaluation	

Source: DoEH (2006)

2.2 NSW STATE GOVERNMENT POLICIES & ACTS

A number of statutory controls, documents and policies have been developed by the State Government which is relevant to the scope of the Manly Cove study area. These are discussed in the following section.

NSW National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* establishes that the Director-General of DECCW is responsible for the care, control and management of all every national park, historic site, state conservation area, regional park, nature reserve, karst conservation reserve and Aboriginal area

MANLY COVE COASTLINE MANAGEMENT STUDY

The Act provides statutory protection for all Aboriginal objects and places in NSW. Areas are gazetted as Aboriginal places if the Minister is satisfied that there is enough evidence to show the area is, or was, of special significance to Aboriginal culture.

There are a number of key sections in the *NP&W Act*, which are relevant to Aboriginal heritage. These sections deal with the specific protection of:

- particularly significant Aboriginal sites by the Minister for the Environment (s.84),
- the regulation of archaeological activity around Aboriginal sites (s.86-87),
- the legal protection provided to all Aboriginal objects generally (s.90),
- the requirement to notify the Director General when finding a new site (s.91),
- and the Director General's right to issue a stop-work order for actions likely to significantly affect an Aboriginal object or place (s.91AA).

NSW Heritage Act 1977

The *NSW Heritage Act 1977* provides for heritage management by government agencies. Section 170 of the *Heritage Act* outlines the special obligations of government agencies.

The *Heritage Act* protects the State's natural and cultural heritage. Aboriginal and non-indigenous places or objects that are recognized as having high cultural value are listed on the State Heritage Register.

Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (*EP&A Act*) sets out the framework for local planning in NSW. The Act, administered by the Department of Planning, establishes the framework under which development is assessed and determined by the relevant consent authority for:

- The proper management, development and conservation of natural and artificial resources;
- The planning and co-ordination of development on land and water;
- The sharing of the responsibility for environmental planning between the different levels of government in the state; and
- Achieving ecologically sustainable development on land and water, while promoting orderly and economic development and use on land and water.

To consider the range of possibilities and constraints relating to any proposed development or a particular site, under the *EP&A Act*, a range of planning policies need to be considered. These include the following:

- State Environmental Planning Policies (SEPPs);
- Regional Environmental Plans (REPs)¹;
- Local Environmental Plans (LEPs);
- Development Control Plans (DCPs); and
- Council codes and policies.

SEPPs, REPs and LEPs are collectively referred to as Environmental Planning Instruments (EPIs). The State Government puts SEPPs and REPs in place whereas LEPs are primarily the responsibility of Local Government, although they require the approval of the Minister for Planning.

Under the provisions of the *EP&A Act*, all proposed developments are classified as either:

- Exempt development
- Complying Development
- Local Development
- State Significant Development

The Minister for Planning outlined a planning reform agenda in 2007 and shortly after released a draft Environmental Planning Assessment Amendment Bill on 3 April 2008. The extent of the reform to the planning

¹ REPs' should be referred to as a 'deemed SEPP'. Recent legislative amendments have done away with REP's as a type of environmental planning instrument

MANLY COVE COASTLINE MANAGEMENT STUDY

system are wide ranging and include (but not limited to) the plan making processes, standardisation of Local Environmental Plans and creating independent assessment regimes for large projects.

The *Environmental Planning and Assessment Act* provides protection by considering impacts on Aboriginal heritage in land use and planning decisions. The three main areas are:

- planning instruments allow particular uses for land and specify constraints. Aboriginal heritage is a value which should be assessed when determining land use;
- section 90 of the Act lists impacts which must be considered before development approval is granted. Aboriginal heritage is one of these possible impacts;
- State government agencies act as the determining authority on the environmental impacts of proposed activities and must consider a variety of community and cultural factors, including Aboriginal heritage, in their decisions.

There are a number of State Environmental Planning Policies (SEPPs) which operate under the EP&A Act, only a few of which are relevant directly or indirectly to the Manly Cove CMP study area. These are detailed below:

SEPP No. 4 - Development Without Consent and Miscellaneous Complying Development

This policy is designed to permit development for a certain purpose which is of minor environmental significance, development for certain purposes by public utility undertakings and development on certain land reserved or dedicated under the *National Parks and Wildlife Act 1974* without the necessity for development consent being obtained.

SEPP 71 – Coastal Protection

The policy has been made under the *Environmental Planning and Assessment Act 1979* to ensure that development in the NSW coastal zone is appropriate and suitably located, to ensure that there is a consistent and strategic approach to coastal planning and management and to ensure there is a clear development assessment framework for the coastal zone.

State Environmental Planning Policy (Major Projects) 2005

This newly created SEPP identifies development that requires consent under the newly created Part 3A of the *EP&A Act*. Development that is considered under Part 3A of the Act is subject to the consent of the Minister for Planning rather than Council. Such development was formerly referred to as *State Significant Development*, however, under the new planning reforms is referred to as *Major Projects* and is subject to a different assessment and consent process to development assessed under Part 4 of the *EP&A Act*.

State Environmental Planning Policy (Infrastructure) 2007

Provides a consistent planning regime for infrastructure and the provision of services across NSW, along with providing for consultation with relevant public authorities during the assessment process. The SEPP supports greater flexibility in the location of infrastructure and service facilities along with improved regulatory certainty and efficiency.

Other SEPP's of relevance include SEPP19 (Urban Bushland), SEPP64, SEPP (BASIX), SEPP (POPE's).

Coastal Protection Act 1979

The *NSW Coastal Protection Act 1979* (as amended, 2002) defines the State's 'Coastal Zone'. Under the *Coastal Protection Amendment Act 2002*, the Manly Cove CMP study area is not included in the coastal zone.

The *Coastal Protection Act 1979* (as amended, 2002) facilitates the carrying out of certain coastal protection works and makes provision to the use and occupation of the coastal zone.

Carrying out of development generally requires the concurrence of the relevant Minister and Complying Development is not permitted.

Crown Lands Act 1989 and Coastal Crown Lands Policy 1991

The *NSW Crown Lands Act 1989* governs the planning, management and use of Crown land, including reservation or dedication for a public purpose, and leasing and licensing.

MANLY COVE COASTLINE MANAGEMENT STUDY

The *Crown Lands Act 1989* provides for the reservation and dedication of Crown land for a range of public purposes. When land is reserved or dedicated, management of the reserve is mostly undertaken either by:

- Lands & Property Management Authority
- A Reserve Trust
- Local Government Councils, by devolvement under the *Local Government Act 1993*.

In the case that Council is appointed as Trustee, Council has the ongoing responsibility to provide care, control and management of Crown land in accordance with the *Crown Lands Act 1989*.

To ensure that Crown Land is managed for the benefit of the people of New South Wales, Council as trustee is required to have regard for the principles of Crown land management. Crown land must be used and managed in accordance those principles under Section 11 of the *Crown Lands Act 1989*. The principles of Crown land management include:

- that environmental protection principles be observed in relation to the management and administration of Crown land,
- that the natural resources of Crown land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible,
- that public use and enjoyment of appropriate Crown land be encouraged,
- that, where appropriate, multiple use of Crown land be encouraged,
- that, where appropriate, Crown land should be used and managed in such a way that both the land and its resources are sustained in perpetuity, and
- that Crown land be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles.

A Plan of Management will satisfy the *Crown Lands Act 1989* if the following points are addressed:

- The Plan of Management and its outcomes must incorporate the principles for Crown land management (listed above).
- In addition to incorporating the requirements of Section 36 of the *Local Government Act, 1993* the Plan of Management must address any matters required by the Minister responsible for the *Crown Lands Act* under Section 112 of the Act.
- Any proposed uses, developments and management practices must conform to the public purpose for the reserve.
- The draft Plan of Management is referred to the Department of Lands for comment prior to the public exhibition.
- The draft Plan of Management must be publicly exhibited, including a public notice in the NSW Government Gazette.
- Public submissions regarding the draft Plan of Management are to be referred to both the Minister for Land and Water Conservation and Manly Council as Trust Manager for consideration by the Minister prior to adoption.
- Any alterations to the Plan of Management by the Minister are made.
- Adoption of the Plan of Management by the Minister for Land.
- The Trust must follow the Plan of Management, with all operations being in accordance with the plan.

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Coastal Crown Lands Policy

The Coastal Crown Lands Policy issued in 1991 applies to all coastal Crown lands within 1km landward and 3 nautical miles seaward from low water mark. Objectives of the Policy are to:

- Conserve and maintain the intrinsic environmental and cultural qualities of coastal Crown land.
- Retain all coastal Crown lands of an environmentally sensitive nature and/or required for public purpose, in public ownership.
- Optimise public access and use of coastal Crown lands.
- Provide Crown lands, as appropriate, for recreation, tourism, residential and commercial coastal development with due regard to the nature and consequences of coastal processes.
- Encourage the rehabilitation of degraded coastal Crown lands.
- Continue to acquire significant coastal lands for future public use.

The Policy identifies the assessment of coastal Crown Land and the dedication of beaches for a range of public purposes as a high priority to facilitate sound land management of the coastal environment. Where estuary and coastline management plans exist they may form the basis for a land assessment waiver (by the minister or delegated authority), requiring no formal assessment under the *Crown Lands Act*.

The Policy provides support for the acquisition of unique or environmentally sensitive coastal lands by the State Government, under the Coastal Lands Protection Scheme. Crown lands are identified in the land ownership (Section 3.2) of this Coastline Management Study.

NSW Local Government Act 1993

Community Land Plans of Management

Under the *NSW Local Government Act 1993*, Councils are required to prepare Plans of Management (PoM) for all community land. Community land is then required to be managed in accordance with the adopted Plan of Management applying to the land. A PoM may apply to one or more areas of community land (i.e.: a 'generic' PoM) or to just one area (i.e.: a 'specific' PoM). Councils may determine which type of PoM they prepare except in the following cases, for which 'specific' PoMs are required:

- Land declared to be "critical habitat" under the *Threatened Species Conservation Act 1995* (TSC Act) or Fisheries Management Act 1994.
- Land directly affected by a recovery plan or threat abatement plan under the TSC Act or FM Act.
- Land declared by Council to contain 'significant natural features'.
- Land declared by Council to contain an 'area of cultural significance'.

There are additional minimum requirements for 'specific' PoMs described in section 36(3A) of the LG Act.

The Coastal Policy 1997 states that where possible joint PoMs will be prepared for foreshore lands where Crown lands and community lands adjoin each other. This Coastline Management Plan includes both Crown and Community Lands where appropriate.

Ecologically Sustainable Development

Under section 7 of the *NSW Local Government Act 1993* Council, Councillors and council employees are required to have regard to the principles of ecologically sustainable development in carrying out their responsibilities.

Section 8 of the *LG Act 1993* defines Council as having the following charter:

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“to properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible, in a manner that is consistent with and promotes the principles of ESD.”

The NSW LG Act states that “ ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the four principles:

- Precautionary Principle;
- Inter-generational Equity;
- Conservation of Diversity; and
- Improved valuation & Pricing.

The integration of ESD principles into Council’s planning and activities is also required by a number of state and regional policies, strategies and plans. For example ESD is an integral part of the Sydney Regional Coastal Management Strategy, the Sydney Harbour Catchment Blueprint and is required under the NSW Coastal Policy 1997.

Council has sought to integrate ESD into the management decisions and actions identified in this Coastline Management Plan in order to meet its responsibilities under the LG Act.

Fisheries Management Act 1994

The *Fisheries Management (FM) Act 1994* and the *Fisheries Management Amendment Acts 1997 and 2001* are developed to conserve, develop and share the fisheries resources of the state for the benefit of present and future generations.

Habitat and species conservation

The Act establishes provisions for NSW Fisheries to conserve fish habitat such as the development of Habitat Protection Plans, the designation of aquatic reserves, regulation of damage to or removal of marine vegetation and the protection of fish spawning areas. Under the *FM Act* approvals are required to dredge and reclaim, harm marine vegetation, and restrict the passage of fish. Seagrass, mangroves and other types of marine plants are included in the definition of marine vegetation. Penalties apply for cutting, removing, damaging or destroying these species without a permit for such activities issued by NSW DPI.

Threatened Species

The *Fisheries Management Amendment Act 2001* includes new threatened aquatic species provisions including fish and marine vegetation. It also amends the *EP&A Act 1979* and a range of other legislation including the *Threatened Species Conservation Act 1995*.

Marine Protected Areas

The NSW Government is developing a representative system of marine protected areas for NSW Waters in collaboration with the Commonwealth Government’s national representative system.

The major aim of NSW protected areas is to manage and conserve marine biodiversity on coastal, estuarine or oceanic areas. Marine protected areas generally fall into the categories of marine parks, aquatic reserves and intertidal protected areas.

The planning process for managing marine protected areas is designed to be flexible to suit local needs and conditions. NSW Fisheries prepare management plans for marine protected areas, which provide a framework for the development of work programs that meet the objectives of the marine protected area. This is undertaken in consultation with stakeholders and the community.

Aquatic Reserves

The *FM Act* provides for the creation and management of Aquatic Reserves in NSW Waters to conserve the biodiversity of fish and marine vegetation in the area. Any works within this area will require prior approval from NSW Department of Primary Industries.

Intertidal Protected Areas (IPAs)

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Intertidal protected areas (IPAs) have been established in nine areas around Sydney to protect selected rocky habitats and intertidal species. The aim is to:

- protect intertidal community biodiversity and structure;
- provide biological reservoirs of breeding stock so exploited areas nearby can be recolonised or sustained; and
- help ensure harvesting of intertidal invertebrates is undertaken at sustainable levels.

All IPAs extend from the mean high water mark to 10 meters seaward from the mean low water mark. Collecting seashore animals is strictly prohibited in these closures. This includes crabs, snails, cunjevoi, octopus, sea urchins, anemones, pipis, cockles, mussels, oysters, and nippers (saltwater yabbies).

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) protects all threatened plants and animals native to NSW (with the exception of fish and marine plants, which are covered by the *Fisheries Management Act 1995*). It provides for the identification, conservation and recovery of threatened species, populations and communities. It also aims to reduce the threats faced by those species.

Recovery plans are prepared by the NSW Department of Environment & Climate Change for each threatened species, population and ecological community listed under the TSC Act. The Act specifies that Council must not undertake actions that are inconsistent with a recovery plan and must manage the threatened species, population or ecological community in accordance with the relevant recovery plan.

The TSC Act also requires government planners to take account of threatened species before they make environmental plans and policies at a state-wide, regional and local level. The TSC Act (and the EP&A Act), require that a determining authority cannot carry out or approve an activity that is likely to significantly affect threatened species, populations or ecological communities, or their habitats, unless a Species Impact Statement (SIS), or an EIS has been prepared.

NSW Coastal Policy 1997

The NSW Coastal Policy applies to the NSW Coastal Zone as defined in the *NSW Coastal Protection Act 1979*. As a result this Policy does not apply to areas of Sydney Harbour including the Manly Cove CMP study area. However, its principles provide for best practice in minimising the impact of natural coastal forces upon private and public assets.

The NSW Coastal Policy sets a direction for coastal zone management, planning and conservation in NSW. It provides a framework for the balanced and coordinated management of the coast's unique physical, ecological, cultural and economic attributes. The Policy draws into a single document the State's various management policies, programs, standards and plans in order to co-ordinate our approach to coastal management.

All NSW State Government agencies and local councils are obliged to take account of the 1997 Coastal Policy in the preparation of their own specific policies and programs. The Policy recommends that councils address their implementation of the Policy through the Management Plans, councils are required to prepare under the *NSW Local Government Act 1993*.

NSW Fisheries Policy & Guidelines: Aquatic Management & Fish Conservation 1998/1999

The Policy and Guidelines apply to all planning and development proposals that affect freshwater, estuarine and marine ecosystems. Any development within or adjacent to coastal or river waters will be assessed by these guidelines. These documents aim to assist councils and other government agencies in their assessment of proposals and documents such as licenses, development applications and Environment Impact Statements in order to ensure that they are sensitive to, and mitigate impact on, the aquatic environment.

The Policy identifies a number of general Policies for the conservation of fish, marine vegetation and aquatic habitats, which have been considered in the preparation of this Management Plan.

Fish Habitat Protection Plans



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To assist in the protection of key fish habitats, the *Fisheries Management Act 1994* enables the creation of Fish Habitat Protection Plans for the protection of any fish habitat. This document presently has two Fish Habitat Protection Plans:

Plan No 1

The Plan applies to the following habitats and features; the quantity and quality of waters, mangroves, seagrass, salt marshes, wetlands (3), mudflats, sand and gravel substrates, rocky reefs, snags (primarily fallen trees and rocks), reed beds and other aquatic plants. This Plan also applies to the following activities: dredging and reclamation, damaging marine vegetation, de-snagging and impeding fish passage.

Plan No 2

This Plan is specific to the protection of seagrass and as a result its primary objective is to “*ensure there is no net loss of seagrass within the coastal and estuarine waters of NSW*”. The Protection Plan identifies a number of broad strategies for achieving this objective.

The *Fisheries Management Act 1994* states that “*A person must not cut, remove, damage or destroy marine vegetation on public water land or an aquaculture lease, or on the foreshore of any land or lease....*” Seagrass is included in the definition of marine vegetation. Therefore penalties apply for cutting, removing, damaging or destroying seagrass.

This Plan covers all of NSW’s coastal and estuarine waters. Activities to which this Plan applies include: collection or ‘trimming’ of live seagrass, collection of seagrass from oceanic or estuarine beaches, dredging, reclamation, construction of groynes and breakwaters, construction of jetties, wharves, bridges, ramps and pontoons, moorings, boating and anchoring, fishing, construction and operation of aquaculture facilities, bait digging and collecting and point source pollution. Guidelines for the management of each of these activities are provided in the Plan.

NSW Water Management Act 2000

The *Water Management Act 2000* was passed by the NSW Parliament in December 2000 establishing a complete new statutory framework for managing water in NSW. The object of the *Water Management Act 2000* is the sustainable and integrated management of the State’s water for the benefit of both present and future generations. The Act is based on the concept of ecologically sustainable development. The Act recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water. The key parts of the legislation are the new arrangements for licensing water and the statutory water sharing plans. Since 1 July 2004 the new licensing and approvals system has been in effect in those areas of NSW covered by operational water sharing plans – these areas cover most of the State’s major regulated river systems and therefore the largest areas of water extraction.

The NSW Catchment Management Authorities Act 2003

The *NSW Catchment Management Authorities Act 2003 (CMA Act)* provides for the establishment of statutory Catchment Management Authorities, each with a responsible and accountable board. The Act repeals the *Catchment Management Act 1989*.

Catchment Management Authorities were established in January 2004. The functions of a Catchment Management Authority include the following:

- Develop Catchment Action Plans in consultation with Councils and the catchment’s communities. These plans will integrate and build on the current Catchment Blueprints.
- Implement Catchment Action Plans through Annual Implementation Programs.
- Provide loans, grants, subsidies or other financial assistance for the purposes of catchment activities and to assist implementation of Catchment Action Plans.
- Provide educational and training courses and materials on natural resource management within the catchment.



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A Catchment Action Plan must have regard to the provisions of any environmental planning instrument, other existing natural resource management plans such as Catchment Blueprints, and the need to comply with and promote any State-wide natural resource management standards. These standards are to be developed by the Natural Resources Commission, established under the *Natural Resources Commission Act 2003*.

A Catchment Management Authority must 'consult widely' during the preparation of a Catchment Action Plan, including with local governments, the catchment's communities and the previous Catchment Management Boards. Public notice of the preparation of a plan must be given and the plan must be placed on public exhibition. In reviewing a draft plan for approval, the Minister must seek the advice of the Natural Resources Commission and must take into account any such advice provided. The Minister may seek and take into account the advice of any other person or body (including Council) in reviewing a draft plan.

Manly Cove coastal management area lies within the Sydney Metropolitan Catchment Area. The catchment has an area of 1860 sq.km. and involves 39 LGAs including Manly.

NSW Sea Level Rise Policy Statement 2009

This policy statement outlines the Government's objectives and commitments in regards to sea level rise adaptation. It outlines the support that the Government will provide to coastal communities and local councils to prepare and adapt to rising sea levels.

The NSW Government has adopted sea level rise planning benchmarks: an increase above 1990 mean sea levels of 40cm by 2050 and 90cm by 2100. The primary purpose of the benchmarks is to provide guidance supporting consistent considerations of sea level rise impacts, within applicable decision-making frameworks. This includes strategic planning and development assessment under the EP&A Act and infrastructure planning and renewal.

The use of the benchmarks is required when undertaking coastal and flood hazard assessments in accordance with the Coastline Management and Floodplain Development Manuals. It is already a statutory requirement that the preparation of Local Environmental Plans gives effect to and be consistent with these manuals.

The sea level rise planning benchmarks can be used for purposes such as:

- incorporating the projected impacts of sea level rise on predicted flood risks and coastal hazards
- designing and upgrading of public and private assets in low-lying coastal areas where appropriate, taking into account the design life of the asset and the projected sea level rise over this period
- assessing the influence of sea level rise on new development
- considering the impact of sea level rise on coastal and estuarine habitats (such as salt marshes) and identifying valuable habitats at most risk from sea level rise
- assessing the impact of changed salinity levels in estuaries, including implications for access to fresh water.

To support the Policy Statement, NSW Government has released (in November 2009) of the following documents for consultation:

- *Draft NSW Coastal Planning Guideline – Adapting to Sea Level Rise*
- *Draft Coastal Risk Management Guide: Incorporating sea level rise benchmarks in coastal risk assessments*
- *Draft Flood Risk Management Guide: Incorporating sea level rise benchmarks in flood risk assessments*

2.3 REGIONAL PLANS, POLICIES AND STRATEGIES

Sydney Regional Environmental Plan - Sydney Harbour Catchments 2005: the Harbour REP

This is the most important planning document relevant for the Manly Cove CMP study area. The plan consolidates and replaces the following instruments: - Sydney Regional Environmental Plan No. 22 -



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Parramatta River (SREP 22); - Sydney Regional Environmental Plan No. 23 - Sydney and Middle Harbours (SREP 23); and amends State Environmental Planning Policy No. 56 Sydney Harbour Foreshores and Tributaries (SEPP 56).

The Harbour REP covers the area of Sydney Harbour and aims to establish a balance between promoting a prosperous working Harbour, maintaining a healthy and sustainable waterway environment and promoting recreational access to the foreshore and waterways. It establishes planning principles and controls for the catchment as a whole as follows:

- All waterways are classified into one of nine zonings as a mean of identifying appropriate location for a wide variety of uses;
- The working Harbour is preserved by retaining a prosperous working waterfront and an effective transport corridor, including port and maintenance facilities, naval and aviation uses, commercial and marinas and boatsheds.
- The zoning plan aims to improve water safety and amenity by better locating and consolidating certain uses in specific locations. It identifies potential locations for marinas and limits private facilities for residential developments. With these new controls now in place, along with NSW Maritime's new *Landowners Consent Manual*, the NSW Government has lifted the four year ban on large (chiefly commercial) marinas;
- Public access to the foreshore is enhanced, providing for public boat launching ramps, recreational and club facilities and appropriate development controls.

The study area is located in one of the nine zones covered in Harbour REP: W2 (Environment Protection).

Sydney Harbour Foreshores and Waterways Area – Development Control Plan 2005

A Development Control Plan (DCP) has also been prepared to compliment the Harbour Regional Environmental Plan. The DCP provides detailed design guidelines for development and criteria for natural resource protection for the locations identified as Foreshores and Waterways Area. Council will need to consider the Foreshores & Waterways Area DCP in decisions for new developments proposed along the waterfront (up to one street back from the foreshore).

In this DCP, different landscape character types in and around Sydney Harbour are recognised. These landscape character types provide a statement of character and intent and sets out performance criteria that are to meet for development within each landscape character types. Landscape character type 8 exists in the Manly Cove CMP study area.

Further, and as part of the DCP of this Harbour REP, the Department of Environment & Climate Change has mapped Ecological Communities and Landscape Characteristics. Within the foreshores and waterways area boundary a number of aquatic and terrestrial ecological communities have been identified within the Manly Cove CMP study area including seagrass beds, mixed rocky intertidal and sand, urban development with scattered trees, grass bed and sandy beaches.

Sydney Harbour Boat Storage Policy 2004

The Department of Planning, together with the NSW Maritime, has prepared the Boat Storage Policy for the Sydney Harbour. The policy provides a more strategic and certain approach to regulating boat storage facilities on the harbour. It outlines the NSW Government's policy for achieving a balance between promoting a prosperous working harbour, maintaining a healthy waterway and promoting recreational uses of the foreshores and waterways.

The policy:

- permits the development of commercial marinas in appropriate locations in order to promote working harbour and recreational use of the foreshores and waterways
- supports the conversion of swing moorings to fixed berths in appropriate locations

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- discourages the proliferation of private storage facilities in order to free up navigable water space and limit privatisation of the foreshore and waterway
- simplifies and improves the planning framework.

Sydney Regional Coastal Management Strategy 1998

This strategy was prepared by the Sydney Coastal Councils Group, represented by 15 Local Councils including Manly, to coordinate and integrate relevant coastal planning and management activities, and the responsible organisations, to improve coastal management in Sydney. This strategy applies to the coastal areas between Pittwater local government area and Sutherland local government area, including all areas that were previously excluded from the NSW Coastal Zone.

The primary aim of the present strategy is “to protect and conserve terrestrial and marine ecosystems in the study zone, and to manage the social and economic conditions to achieve this, through the implementation of identified, sustainable coastal planning and management practices.”

At present, the Group is guided by a three-year ‘Strategic Plan 2005-2008’ and a further three-year strategy being drafted.

Sydney Metropolitan Strategy 2005

The Metropolitan Strategy is a broad framework to secure Sydney's place in the global economy by promoting and managing growth. It is a strategic document that outlines a vision for Sydney over the next 25 years. It is also the start of a process to bring the State Government, local government, stakeholders and the community together to discuss, review and then make decisions to guide the future of Sydney's economy, environment and communities. More detailed planning follows via regional strategies and subregional strategies.

A key objective of the Metropolitan Strategy is to protect Sydney's natural environment from the impacts of growth for dual benefit: our waterways, biodiversity, clean air and heritage are protected; and development processes are streamlined with greater certainty.

This Strategy will contribute to the many initiatives underway to improve the health of Sydney's waterways, by ensuring new development is located and designed to meet the community's aspirations for our rivers, coasts and estuaries.

There will be 10 sub-regional plans, to support Sydney Metropolitan Strategy. The LGAs of Manly Council, along with Pittwater and Warringah constitute under North East Sub-region.

Draft Sub-Regional Strategy: North East Subregion, July 2007. The North East Subregion is well known for its natural environment including coastline, waterways and national parks. Growing sustainability requires managing the environmental impact of development and reducing consumption of natural resources as well as safeguarding assets from natural hazards, which are expected to increase over time with climate change. The strategy includes, among others, actions to: improve the health of waterways, coasts and estuaries; protect the loss of biodiversity; conserve and manage Aboriginal and other cultural heritage; and respond to the risk of climate change and sea level rise. The draft Strategy was on public exhibition till 18 September 2008.

The Northern Sydney Aboriginal Social Plan (NSASP) 2007-2011

The Northern Sydney Aboriginal Social Plan is a document compiled by ten Councils in Northern Sydney Region, including Manly, to address the needs of Aboriginal and Torres Strait Islander people in the area. The aims of the Social Plan are to:

- Improve outcomes for the Aboriginal community living in Northern Sydney
- Improve coordination and relationships with government on Aboriginal issues
- Increase sharing and co-operation between individuals, groups, and agencies across Northern Sydney

The NSASP identifies 6 key areas of need; collaboration and cooperation, health and wellbeing, education and training, housing, employment and culture and heritage. The first Aboriginal Social Plan (a five year plan) was adopted in 2000.



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Sydney Metropolitan Catchment Management Action Plan 2008

The Sydney Metropolitan Catchment Management Authority (SMCMA) is a NSW Government agency responsible for the coordination and management of Sydney's natural resources. In Sydney, natural resources include land, rivers, estuaries and coastal systems. The catchment has an area 1860 square sq. km. (the area extends offshore to include state waters to the three nautical mile limit) accommodating 39 Local Government Areas including Manly. The catchment is divided into eight sub-catchments including Manly Cove. Activities of catchment management relates to four themes including 'Water & Coast'.

The Estuary, Coast and Marine theme focuses on a whole of catchment approach to managing impacts on the coastal zone. The unique nature of impacts in estuarine and coastal areas necessitates that the SMCMA encourage partnerships with the community, industry and recreational users in addressing issues of concern.

The SMCMA is currently (2009) working on many projects, some of the relevant ones are:

- Bitou bush (Biodiversity - Coastal - Marine)
- Boat Pump Out Facilities (Water - Marine)
- Botany Bay Coastal Catchment Initiative (BBCCI) (Water - Marine)
- Dune Restoration Stages 1 & 2 (Biodiversity - Revegetation)
- From Tide to Table (Biodiversity - Water - Estuarine)
- Improving Estuaries and Coastal Lakes (Water)
- Integrated Weed Management Program - Stage 2 (Biodiversity)
- Marine Pests - Stage 1 - Risk Assessment and Boat Survey (Water)
- Marine Pests - Stage 2 - Education of the boating and recreational fishing communities (Water)
- Rapid Fauna Habitat Assessment (Biodiversity)
- Sydney Harbour Seagrass and other Estuarine Vegetation - Stages 1 & 2 (Water)
- Vegetation Mapping (Biodiversity)
- Waterways Health Strategy (Water - Rivers - Streams)
- Wetland Management Program - Stage 1 & Stage 2 (Water)

The SMCMA drafted a Catchment Action Plan (CAP) in August 2006. The Natural Resources Commission (NRC) has revised the draft CAP and recommended its approval to the NSW Government (June 2008).

The target for the 'Water & Coast &' sub-theme is 'By 2016, there is improvement in the condition of coastal and marine ecosystems'. This target has further been translated into management targets as:

- By 2016 institutional and technical processes are in place to achieve environmentally sustainable management of beach environs.
- By 2016 active management will protect or improve key estuarine and marine habitat areas in partnership with relevant authorities and user groups.
- By 2016 there is an increase in the extent of Marine Protected areas.
- By 2016, the Sydney coastline is covered by a Coastline Management Plan.

2.4 MANLY COUNCIL PLANS & POLICIES

Council is responsible for the overall management of the Local Government Area (LGA) and enforcing the requirements of the *NSW Local Government Act 1993*, *Environmental Planning and Assessment Act 1979* and the *Crown Lands Act 1989* (where Council has care and control). The *NSW Local Government Act 1993* requires that Council follows the principles of Ecologically Sustainable Development (ESD) in carrying out its responsibilities. Council is responsible for the preparation and implementation of Plans of Management for community lands (under the *Local Government Act 1993*). Council plays a role in controlling development within the Local Government Area boundary under the *Environmental Planning and Assessment Act 1979*. Council is the consent authority for most land-based developments and activities.



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Manly Local Environment Plan 1988

The Manly Local Environment Plan (LEP) establishes Council as the consent authority for all purposes of the LEP and is the main statutory control on development within Manly Local Government Area.

The LEP details the zoning of land within the Manly Council area. It enables Council to make particular Development Control Plans regulating development in any zone and to make provisions for exempt and complying development within Manly.

The LEP also identifies Items of Environmental Heritage, Environmentally Sensitive Areas, Foreshore Scenic Protection Areas and Potential Acid Sulphate Soils and provides planning controls for the ongoing appropriate management of each of these items and areas.

This LEP is now being reviewed and updated in accordance with the NSW Planning Reforms and amended Planning legislation to meet the State government requirement of a new Standardised LEP.

Plan of Management for Community Land 1996

Under Part 2, Division 2 of the *Local Government Act 1993* as amended; Council is required to prepare Plans of Management for Community Land.

Council has adopted an overarching Plan of Management for Community Lands (1996). The document sets out objectives under four areas.

Natural Environment

- Manage our open spaces on a sustainable basis by addressing ecological systems and biodiversity in conjunction with user needs and demands.
- Integrate local drainage needs into park design and bushland management.

Cultural Environment

- Include heritage conservation and cultural identity matters in design criteria when designing and maintaining our reserves.

Recreation

- Manage all open space land in a flexible manner, and ensure that local needs are met.
- Provide a major open space connection between harbour and ocean foreshores, creek and lagoon edges, and the National Parks.
- Maintain our active sporting areas and manage them to maximize choice.

Open Spaces

- Recognise the role of each open space within the wider community and in relation to other objectives.
- Encourage local participation in design, development and management.
- Provide for user health, safety and enjoyment.
- Retain opportunities to use open space land for special events or projects and for future activities or structures if need becomes apparent.
- Improve management of open space in Manly in order to achieve the objectives of this plan.

Manly Social Plan 2004-2009

The Manly Social Plan 2004-2009 was adopted by Council in November 2004. The Social Plan was developed on the basis of consultation with the community and service providers, to identify issues affecting the wellbeing of the people in Manly. Needs assessments were conducted targeting women, men, older people, youth, people with a disability, children and families, gay and lesbian communities, culturally and linguistically diverse



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people and precincts. This consultation generated a series of priority issues. Action plans to address the priority issues are being implemented as ongoing across Manly Council divisions and in collaboration with external agencies such as the Manly Community Centre, and state level government.

The core objectives of the Manly Social Plan are to assist Council, community groups and health and community service agencies to:

- Understand the local community and the needs of individuals and groups within the community;
- Identify gaps in current service provision;
- Plan for current and future needs;
- Allocate resources in the most effective and equitable way;
- Address the needs of social and cultural diversity in Manly;
- Take a leadership role in community development and the provision of services;
- Establish a framework and process to engage with special needs groups, the wider community and other agencies; and,
- Integrate social and environmental sustainability considerations.

Manly Council's strategic directions, including a focus on social and environmental sustainability provide the context for the Manly Social Plan. The Manly Cove Coastline Management Plan considers issues and actions addressed in the plan

The Manly, Warringah and Pittwater Councils Local Disaster Plan (DISPLAN) 2005

This Plan has been prepared by the Manly - Warringah - Pittwater Local Emergency Management Committee in accordance with the *State Emergency and Rescue Management Act, 1989* Section 29 (1). The aim is to ensure coordinated and efficient management of the prevention, preparation, response and recovery arrangements for emergencies within Manly, Warringah and Pittwater Local Government Areas. The objectives of this Plan are to:-

- detail responsibilities for the identification, development and implementation of prevention and mitigation strategies;
- define Agency and Functional Area roles and responsibilities in preparation for, response to and recovery from emergencies;
- set out the control, coordination and liaison arrangements at the local level;
- detail activation and alerting arrangements for involved agencies;
- detail arrangements for the acquisition and coordination of resources;
- detail public warning systems and responsibility for implementation;
- detail public information arrangements and public education responsibilities;
- detail arrangements for review, testing, evaluation and maintenance of this plan; and
- detail reporting and information flow arrangements.

Surfing the Future 2006

It is a 'Vision document' for the Manly Local Government Area for 2025. Surfing the Future is a 'road map' for a journey from 2005 to 2025. The six opportunities and challenges to achieve this vision are:

- A Living Manly– inclusive society and culture
- An Affordable Manly – accommodation for our future
- A Well Governed Manly – the role of local government
- A Natural Manly – a sustainable environment
- A Visitor Friendly Manly – a place to stop and stay awhile
- A Moving Manly – transport, access and getting around



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Manly Sustainability Strategy 2006

The Manly Sustainability Strategy (MSS) 2006 is a living and evolving document and builds on MSS 2002. It is a 10 year plan with the following priorities:

- Contributing to the global climate change response
- Securing Manly's waterways and water use
- Reducing our waste
- Maintaining and improving wellbeing and quality of life in Manly
- Protecting and restoring the diversity of species and their habitats in Manly Council

The strategy addresses the vision through the six principles and 10 broad programmes.

The Manly Cove Coastline Management Plan contributes to the MSS program: Coastline and Estuary Management Program to achieve the principle C: A Natural and Sustainable Manly'. The objective of the Coastline and Estuary Management Program is to manage the terrestrial and marine environment interface to balance environmental conservation and the enjoyment of the areas by user groups and ensure that Manly's coastlines are recognised for their important natural and cultural heritage.

Manly Management Plan 2009-2012

The Manly Plan 2009-2012, is the key planning document driving the operations of the Council. It is a rolling three year plan that identifies a range of objectives and strategies that Council will implement in providing programs, services and facilities to the community made up of those who live, work and visit Manly.

Manly's Sustainable Heritage Conservation Plan (under preparation)

Manly Council is currently undertaking a comprehensive heritage review for the local government area. This review will include the assessment of approximately 200 potential additional heritage items of the built and natural environment for possible listing on the Manly LEP. The study involves a review of Council's strategic policy-making and management for Manly's heritage through a three-staged public consultation process.

Manly LGA Climate Change Risk & Adaptation Action Plan

(under preparation)

Council has received funding from the Department of Climate Change (DCC) as part of the DCC's Local Adaptation Pathways Program for the development of a Climate Change Risk and Adaptation Strategy. This will provide a strategic approach to climate change risk management and adaptation for Manly council and community. Elements of the Cardno report will apply.

2.5 INSTITUTIONAL STAKEHOLDERS

MANLY COUNCIL

Manly Council was incorporated as a local government body on 6th January, 1877. Manly Council is a statutory body deriving authority from the Local Government Act 1993 and other Acts enacted by the Parliament of New South Wales. The Council does not have the power to make decisions outside the legislation by which it derives its authority.

Council is responsible for the overall management of the Local Government Area (LGA) and enforcing the requirements of the *NSW Local Government Act 1993*, *Environmental Planning and Assessment Act 1979* and the *Crown Lands Act 1989* (where Council has care and control).

Manly Council is run by 12-member elected Councillors headed by the Mayor. The Council is supported by the executive General Manager and staff. Councillors are elected to Council at local government elections, which



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are held every four years. In the Manly local government area, there are no wards, and each councilor represents the entire Council area. The Mayor is also directly elected by the Community for a term of 4 years. The role of the Councilors is, as a member of the governing body of the Council to:

- direct and control the affairs of the Council in accordance with the Local Government Act
- participate in the optimum allocation of the Council's resources for the benefit of the area
- play a key role in the creation and review of the Council's policies and objectives and criteria relating to the exercise of the Council's regulatory functions
- review the performance of the Council and its delivery of services, and the management plans and revenue policies of the Council.

The role of Councilors is, as an elected person to:

- represent the interests of the residents and ratepayers
- provide leadership and guidance to the community
- facilitate communication between the community and the Council.

The Ordinary meetings of Council and meetings of the principal committees are held on a four (4) weekly cycle on a Monday evenings. Agendas & minutes may be access via the Business Paper Viewing System, or are available for perusal at the Manly Library on the Friday prior to the meetings. Extracts of the agendas and minutes are available from the Customer Service Centre at the Council Offices.

In all Committee and Council meetings, any member of the public can apply to address Council through the Public Address provision. At Ordinary Meetings, any member of the public can address Council on any matter NOT on the agenda through the Public Forum.

Manly Council is further committed to community consultation, a key component of which is the committee-based **Precinct Community Forums** system. The forum approach was introduced in 1990 to extend the involvement of the community through coordinated consultation and participation. The aim is to involve all property owners, residents and workers in the decisions which affect their local area. Precinct Community Forums are groups of people who live, work or own property in a Precinct area. There are 12 Precinct Community Forums in the Manly Council area and Precinct meetings are held monthly. The meetings discuss matters referred by Council for community consultation, and matters of local importance and interest to the community. The decisions of the Precincts are advisory. Their comments are responded to and considered by Council in its statutory decision making role. The Community Forums are organised by the residents. They play a vital role in ensuring that future changes in the local area are taken into account, and are sympathetic to the amenity of the local residents.

Another operational arm of the Council is various issue or topic based Committees and Working Group. They meet as scheduled usually bi-monthly. Manly Harbour Foreshore & Coastline Management Committee is one of these committees, which oversees development of the Manly Cove Coastline Management Plan.

DEPARTMENT OF ENVIRONMENT, CLIMATE CHANGE & WATER (DECCW)

The Department of Environment, Climate Change and Water was established effective 1 July 2009. The Department is one of the agencies that form the new Environment, Climate Change and Water super agency cluster, along with Sydney Catchment Authority, Zoological Parks Board, Royal Botanic Gardens, Jenolan Caves Reserve Trust & Lord Howe Island Board and the Catchment Management Authorities which are separate statutory authorities.

The Government has changed the name of the Department of Environment and Climate Change and combined its responsibilities with the water management responsibilities of the former Department of Water and Energy.

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Under this Departmental arrangement, we report to two Ministers: the Minister for Climate Change and the Environment and the Minister for Water.

Broadly, the Department of Environment, Climate Change and Water:

- works towards a healthy environment cared for and enjoyed by the whole NSW community
- manages the state's natural resources, including biodiversity, soils and natural vegetation
- provides the cornerstone of conservation, along with linked community efforts, through the management of national parks and reserves, and marine parks and aquatic reserves to protect nature and cultural heritage
- manages natural and cultural heritage across the state's land and waters
- acts to minimise the impacts of climate change
- promotes sustainable consumption, resource use and waste management
- regulates activities to protect the environment
- conducts biodiversity, plant, environmental and cultural heritage science and research to improve decision making
- delivers the Government's policy, programs, regulation and and reform agenda for the water sector in NSW
- conserves, propagates and studies plants in botanic gardens and their associated collections

DECCW's wide-ranging responsibilities include:

- climate change and greenhouse issues, including the climate change fund
- sustainability programs, including environmental education, energy efficiency and water conservation programs and renewable energy policy
- policy and regulation for air and water quality, noise control, chemicals, radiation and forestry
- programs to reduce the amount and toxicity of waste, litter and illegal dumping
- management of national parks and reserves, and marine parks
- biodiversity, threatened species and native vegetation policy and programs
- protection of soils and land and policies for catchment management
- environmental water management and coastal lakes and estuaries
- reliable water supply for critical human and industry needs and the secure and sustainable allocation of water between communities, industry, farmers and the environment
- Aboriginal cultural heritage and historic sites
- botanic gardens - Sydney's Royal Botanic Gardens and Domain, Mount Annan and Mount Tomah Botanic Gardens

DECCW operates under a number of well-recognised 'brands' and legislative authorities. The National Parks and Wildlife Service logo remains associated with our national parks. In regulatory matters for environment protection, DECCW acts under the powers of the statutory Environment Protection Authority (EPA). Staff of the Botanic Gardens Trust (BGT) are part of DECCW, although BGT and its Board of Trustees are responsible separately to the Minister for Climate Change and Environment. DECCW also administers programs on behalf of the statutory Environmental Trust and supports the Marine Parks Authority and Catchment Management Authorities. The Office of Water is responsible for the water management functions (including legal, policy and regulation) undertaken by the former Department of Water and Energy reporting to the Minister for Water.

DECCW provides financial and technical assistance to councils to help develop and implement sustainable coastline management plans through the Coastal Management Program. Under the program, the NSW Government provides a 50% subsidy to local government for:

- Preparation of coastal studies and coastline management plans aimed at ensuring balanced long term management of the coastline;
- Construction of works for the conservation and/or improvement of beaches and public reserves; and
- Investigation, design and implementation of management measures and works to reduce potential damage from coastal processes in existing developed areas.

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DECCW has responsibilities and powers under many NSW environmental legislation. Only relevant ones are mentioned here:

- *Soil Conservation Act 1938*
- *National Parks and Wildlife Act 1974*
- *Coastal Protection Act 1979*
- *Fisheries Management Act 1994* - Note: DECC only administers Part 7 Division 2 of this Act and s227 so far as it relates to that Division and ss 243 & 245 so far as is required in relation to this Division.
- *National Environment Protection Council (New South Wales) Act 1995*
- *Threatened Species Conservation Act 1995*
- *Contaminated Land Management Act 1997*
- *Marine Parks Act 1997*
- *Environmental Trust Act 1998*
- *Forestry and National Park Estate Act 1998*
- *Nature Conservation Trust Act 2001*
- *Catchment Management Authorities Act 2003*

LAND AND PROPERTY MANAGEMENT AUTHORITY (LPMA)

A new agency, the Land and Property Management Authority, was established under the NSW Government restructure that commenced on 1 July 2009. The LPMA comprises the staff and functions of the Department of Lands, the State Property Authority, the Lake Illawarra Authority, the Hunter Development Corporation, the Office of Rural Affairs and the Office of Biofuels.

It is the primary Government agency responsible for managing state-owned land. It is the guardians of all land information in NSW. It operates through a number of Divisions, only relevant ones are described below:

- Services of the Land and Property Information (LPI) Division include land title registration, property information, valuation, surveying and mapping.
- Crown Lands Division practices sustainable management of state-owned lands for the benefit of the people of NSW managing a total area of approximately 12.7 million hectares. In a number of cases however, Council manages Crown Land in accordance with the *Crown Lands Act 1989*
- Soil Conservation Service is established as the authority in planning, design and construction of soil conservation earthworks, rehabilitation and revegetation, and training in conservation earthmoving, urban erosion and sediment control.

Department of Lands has responsibilities and powers under much NSW environmental legislation. Only relevant ones are mentioned here:

- *Valuation of Land Act 1916 No 2*
- *Transfer of Records Act 1923 No 14*
- *Land Sales Act 1964 No 12*
- *Crown Lands (Validation of Revocations) Act 1983 No 55*
- *Community Land Development Act 1989 No 201*
- *Crown Lands Act 1989 No 6 (except parts, Minister for the Environment)*
- *Crown Lands (Continued Tenures) Act 1989 No 7*

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- *Roads Act 1993 No 33, (part)*
- *Surveying Act 2002 No 83*

INDUSTRY & INVESTMENT NSW

Industry & Investment NSW has been established to assist in building a diversified state economy that creates jobs. Formed in July 2009, the Department of Industry & Investment, trading as Industry & Investment NSW, has over 4000 staff in approximately 170 locations across NSW, and several staff overseas.

In keeping with the NSW Government's reforms to provide better services to the people of the state through more integrated services and less red tape, Industry & Investment NSW brings together a number of former NSW Government departments and authorities. These partner agencies are:

- Department of Primary Industries (including Forests NSW)
- Department of State and Regional Development (including Tourism NSW)
- Department of Water and Energy (Energy)
- NSW Film & Television Office (Screen NSW)
- Rural Assistance Authority
- Mine Subsidence Board
- Coal Compensation Board
- Game Council
- NSW Food Authority.

The establishment of our department builds on the strengths and organisational capabilities of each of these agencies.

One of the Divisions, 'Fisheries, Compliance and Regional Relations', manages and promotes sustainable, commercial and recreational use of NSW fisheries' resources, and the protection of the aquatic environment.

The Division has jurisdiction over all fish and marine vegetation in all waters of the state (including all private and public waters and permanent and intermittent waters) extending to 3 nautical miles offshore (and to 80Nm offshore in those fisheries for which it has jurisdiction under the Offshore Constitutional Settlement). This means that it has management responsibility for all aquatic animals (with the exception of aquatic mammals, reptiles, amphibians and birds, which are managed by the NSW Department of Environment, Climate Change & Water) and responsibility for all marine vegetation and key aquatic habitats including seagrass, mangroves, gravel beds and snags. It has also management and research responsibilities related to threatened fish species, populations and ecological communities.

While I&I NSW is responsible for the management of all aquatic animals, the department is a state government authority with limited on-the-ground staff to effectively regulate the management of aquatic environments. As a result Manly Council's rangers are presently licensed as I&I NSW (Fisheries) officers to assist Fisheries with some of their on-the-ground 'localised' regulation functions.

Relevant to estuary management, the I&I NSW administers the following acts:

- *Fisheries Act 1935*
- *Noxious Weeds Act 1993*
- *Fisheries Management Act 1994 - Except Part 7 (Divisions 1 and 2) and Part 7A, jointly the Minister for Climate Change, Environment and Water and the Minister Assisting the Minister for Climate Change, Environment and Water (Water).*



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NSW MARITIME

NSW Maritime is a statutory State Government body classified by NSW Treasury as a non-budget dependent general government agency. NSW Maritime is a self-funding entity.

NSW Maritime is responsible for the on-water management of all NSW navigable waters, including coastal areas, estuaries, rivers, lakes and dams to three nautical miles offshore. On-water management responsibilities include the management of safety, the protection of the marine environment from degradation by vessels, the provision of waterways infrastructure for vessels, the licensing of vessel operators, commercial vessels, on-water events, and mooring management.

NSW Maritime the government body which owns the seabed of Sydney Harbour, North Harbour and Middle Harbour and all related tidal bays, rivers and their tributaries. Under the *Ports Corporatisation and Waterways Management Act 1995* (PC&WM Act 1995) the Waterways Authority is the landowner of Sydney Harbour and its tributaries and therefore controls Sydney Harbour.

NSW Maritime is therefore responsible for management of waterways and the sea bed from mean high water mark (MHWM) seaward. As owner of the bed of Sydney Harbour, Waterways is the consent and determining authority for a variety of water-based developments and activities. Waterways are now also responsible for the investigation of on-water pollution incidents and issuing clean-up and prevention notices in relation to vessels (in navigable waters that are not required to have a pilot).

NSW Maritime is the State's maritime regulator and administers a number of Acts of Parliament and the Regulations made there under. Only relevant ones are mentioned here:

- *Navigation Act 1901*
- *Maritime Services Act 1935*
- *Marine Pollution Act 1987*
- *Ports and Maritime Administration Act 1995*
- *Marine Safety Act 1998*

NSW Maritime also has responsibilities relating to the marine environment under:

- *Environmental Planning and Assessment Act 1979*
- *Protection of the Environment Operations Act 1997*

New requirements for DAs for water based development

From Monday 4 February 2008 most DAs lodged with NSW Maritime seeking consent for water based development under Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 are likely to be 'integrated development applications' because the development is likely to require a controlled activity approval under the Water Management Act 2000.

The change in the DA requirements is a result of the repeal of the *River and Foreshores Improvement Act 1948* and commencement of the controlled activity provisions of the *Water Management Act 2000*.

Under the *Water Management Act 2000*, controlled activities include the erection of a building or the carrying out of a work or the removal or deposition of material and approval and approval is required where the work is carried out in, on or over the bed of any river, lake or estuary.

Once lodged with NSW Maritime, special advertising and notification procedures apply to these DAs under the *Environmental Planning and Assessment Act 1979*. These require a minimum public display period of 30 days, a public notice in a local newspaper and notifications to relevant public authorities and neighbours.



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NSW Maritime's DA form has been updated so that the integrated referral(s) requirement can be identified. If relevant, other integrated approvals may also continue to be required, for instance, approvals required under the *Fisheries Management Act 1994*.

DEPARTMENT OF PLANNING

The Department of Planning was established in August 2005, following the de-amalgamation of the former Department of Infrastructure, Planning and Natural Resources. In March 2006, the NSW Heritage Office was incorporated into the department. The functionality of the Department is run under the following seven Executive Directors:

- Corporate Governance & Policy
- Strategy & Infrastructure Planning
- Land Release
- Planning Operations
- Urban Renewal & Major Sites
- Major DA Assessment
- Assessments Systems, General Counsel

In developing its roles and responsibilities, the Department identifies the following priorities:

- Promoting and facilitating sustainable growth
- Supporting affordable and appropriately-serviced housing and employment land
- Assessing major projects and infrastructure in a timely and efficient way, while ensuring appropriate planning outcomes
- Planning to help mitigate against climate change
- Improving service delivery to our communities and our stakeholders
- Implementing reforms to create a more efficient, transparent and accountable planning system and importantly, the communication of these reforms.

Planning and development is carried out under:

- *Heritage Act 1977*
- *Environmental Planning and Assessment Act 1979*
- *Environmental Planning and Assessment Regulation 2000*
- *Coastal Protection Act 1979 (as amended 2002)*.

Environmental planning instruments (State environmental planning policies, regional environmental plans and local environmental plans) are legal documents that regulate land use and development. Local environmental plans prepared by councils guide planning decisions for local government areas. Through zoning and development controls, they allow councils to supervise the ways in which land is used. Development control plans, prepared in accordance with the *Environmental Planning and Assessment Act*, are also used to help achieve the objectives of the local plan by providing specific, comprehensive requirements for certain types of development or locations e.g. for urban design, and heritage precincts and properties.

Planning and development within the NSW Coastal Zone (as declared under the *Coastal Protection Act 1979*) is now subject to a Ministerial direction for coastal protection, NSW Coastal Policy, SEPP 71 - Coastal Protection, and the Major Projects SEPP (which identifies coastal development that will need the approval of the Minister for Planning). The NSW Government in June 2001 announced its \$11.7 million Coastal Protection Package to protect the State's beaches, headlands and other coastal features for generations to come.

SYDNEY WATER

Sydney Water, a statutory State owned corporation, wholly owned by the New South Wales Government has three equal, principal objectives:

- to protect public health
- to protect the environment
- to be a successful business.

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Sydney Water provides drinking water, recycled water, wastewater services and some stormwater services to more than four million people in Sydney, Illawarra and the Blue Mountains. Drinking water is sourced from a network of dams managed by the Sydney Catchment Authority, then treated and delivered to customers' homes and businesses by Sydney Water. Sydney Water is governed, among others, by

- *Sydney Water Act 1994*
- *Sydney Water Regulation 2006*

Sydney Water has Memoranda of understanding with

- Memorandum of Understanding with the Department of Environment and Climate Change
- Memorandum of Understanding with NSW Health

NATURAL RESOURCES COMMISSION

The Natural Resources Commission (NRC) was created by the Natural Resources Commission Act 2003. The NRC provides independent advice to the NSW Government on a range of natural resource management issues. The NRC reports to the Premier, reflecting its independent nature. The Government has adopted the NRC recommended Standard for Quality Natural Resource Management and state-wide targets for NRM. The targets now form priority E4 of the NSW Government's State Plan.

The NRC contributes to priority E4 by:

- reporting on progress towards the targets, and advising Government on resolving issues that are restricting progress
- auditing the effectiveness of CMAs' implementation of their Catchment Action Plan in terms of compliance with the Standard and contribution to the targets
- reviewing technical issues to provide a sound scientific basis for decisions on specific NRM issues
- developing and revising the Standard and targets and facilitating their use by natural resource managers across NSW to drive adaptive management towards targets
- conducting reviews on natural resource issues as requested by the Government.

The standard and targets provide a quality assurance framework and clear goals to ensure that the investments of the NSW and Australian Governments and others in the activities of catchment management authorities are cost effective, protect and improve high value natural resource assets, and maximise integrated NRM outcomes from the property scale to the state scale. The standard and targets support flexible and innovative regional planning, investment and decision-making while ensuring consistency, rigour and accountability for NRM in NSW.

The NRC follows, at present, the Strategic Plan 2008-2011.

SYDNEY METROPOLITAN CATCHMENT MANAGEMENT AUTHORITY

The Sydney Metropolitan Catchment Management Authority (SMCMA) is a NSW Government agency responsible for the coordination and management of Sydney's natural resources. In Sydney, natural resources include land, rivers, estuaries and coastal systems. The SMCMA was established under the *Catchment Management Authorities Act 2003*. The SMCMA partners with 39 local councils in the metropolitan catchment as well as State and Federal Government departments.

SYDNEY COASTAL COUNCIL GROUP

The Sydney Coastal Councils Group was established in 1989 to promote co-ordination between member councils on environmental and natural resource management issues relating to the sustainable management of the urban coastal environment.

The Group consists of 15 councils adjacent to Sydney marine and estuarine environments and associated



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waterways (Botany Bay, Hornsby, Leichhardt, Manly, Mosman, North Sydney, Pittwater, Randwick, Rockdale, Sutherland, City of Sydney, Warringah, Waverley, Willoughby and Woollahra). The Group represents over 1.3 million Sydneysiders. This area encompasses the waterways of Broken Bay; Pittwater; Port Jackson, the lower Lane Cove River, Middle and North Harbour; Botany Bay, the Lower Georges and Cooks River; and Port Hacking.

The Sydney Coastal Councils Group provides leadership and encourages a focused and coordinated approach to sustainable coastal management undertaken by and in partnership with the member councils to protect and conserve terrestrial and marine ecosystems, and to manage social and economic conditions to achieve this. The Group facilitates outcomes concerning coastal issues, exceptional to those the member councils could achieve individually.

The Sydney Coastal Councils Group is a Regional Organisation of Councils that provides project facilitation and coordination on environmental and natural resource management issues that relate to the sustainable management of the coastal urban environment. The Group provides strong advocacy and support for its 15 member councils on coastal and NRM issues. Being a member council also allows council elected and professional staff the opportunity to exchange ideas at a regional level through SCCG forums, presentations, meetings and conferences.

ABORIGINAL HERITAGE OFFICE

The Aboriginal Heritage Office is a joint initiative by Lane Cove, North Sydney, Manly, Warringah, Willoughby, Ku-ring-gai and Pittwater councils, in a progressive move to protect Aboriginal Heritage in these areas. Part of the work of the Aboriginal Heritage office is to monitor Aboriginal Sites on a day to day basis and long term management reports are developed to ensure their preservation and protection.

Another key role of the Aboriginal Heritage office is to give the Aboriginal people and non-aboriginal people involved with these council areas an avenue of approach to discuss issues or concerns they may have. The office is in direct contact with the Metropolitan Local Aboriginal Land Council and its many resources.

An important part of the role is to communicate with school and other groups and teach children an ethos of understanding to appreciate the unique culture of the Aboriginal people. In association with the local councils, talks, walks and activities are planned to enhance appreciation of Aboriginal culture in the wider community. A selection of information leaflets on various Aboriginal Heritage topics are available to download.

STATE EMERGENCY SERVICE (SES)

The State Emergency Service is an emergency and rescue service dedicated to assisting the community. It is made up almost entirely of volunteers, with 226 Units located throughout New South Wales. The Units comprise of more than 10,000 volunteer members, who are easily identified by their distinctive orange overalls.

While our major responsibilities are for flood and storm operations, the SES also provides the majority of general rescue effort in the rural parts of the state. This includes road accident rescue, vertical rescue, bush search and rescue, evidence searches (both metropolitan and rural) and other forms of specialist rescue that may be required due to local threats. The Service's trained rescuers also support the full-time emergency services during major disasters.

The SES also assists other emergency services when they are performing major operations. These services include the NSW Police Service, the NSW Rural Fire Service, the NSW Fire Brigade and the Ambulance Service of NSW.

3. LAND USE, TENURE & MANAGEMENT

3.1 PRESENT LAND USES

The current land use within the study area is shown in **Table 3.1** and **Figure 3.1**. Land use is predominantly residential development (55.1%) compared to only 39.5% within Manly LGA. This is followed by road surfaces (28.97%), open spaces and parks (8.11%), commercial (7.26%) and special uses (0.67%).

Long stretches of parkland (Esplanade Park) separate residential and commercial blocks from Manly Cove beaches, except the area from Stuart Street south to Manly Point where residential properties border shoreline. Manly Scenic Walkway runs through the study area.

Table 3.1 Current land use within the Manly Cove study area

Catchment Name	Area (m ²)	Land use Breakdown (%)				
		Residential	Roads	Open Space [^]	Commercial	Special Uses [*]
Study Area	509,000	55.10	28.97	8.11	7.26	0.67
Manly LGA	14,129,000	39.50	15.50	32.70	1.90	9.40

[^] includes both open spaces and national parks; ^{*} includes special use property and unzoned

Note: 0.91% of the total area of Manly LGA is currently unzoned.

3.2 BEACHES

The embayment of Manly Cove includes Manly Cove West Beach and Manly Cove East Beach, the seawalls backing these beaches, sandstone cliff faces and wave cut intertidal platforms as well as a number of water based development including Manly Wharf and various boating facilities lining the eastern foreshore. A smaller, unnamed beach is located between 11 and 19 Addison Road.

The development and ongoing upgrades to Manly Wharf have essentially divided the main beach of Manly Cove into two separate beaches: Manly Cove East and West Beaches. Each of these beaches is popular for a variety of recreational uses.

Manly Cove West Beach provides a relatively wide beach profile 250 m in length and is heavily used by sunbathers and picnickers during warmer weather. A netted swimming enclosure lies in the middle of this beach and provides safe swimming for all ages. Manly Cove East Beach is also 250 m in length but offers a much narrower beach profile for public use. This section of beach is used for sailing access. Both beaches are backed by Esplanade Park which provides a range of user facilities..

The unnamed beach on Manly Point is not publically accessible and lies within the area designated as Critical Habitat for Manly's threatened Little Penguin population.

3.3 LAND TENURE

Ownership and management responsibilities for the land and seabed within the study area are shared by a number of government agencies and Manly Council. In general, land of Manly Cove CMP study area consists of private, crown, Manly Council, NSW Maritime, Sydney Water, Land & Property Management Authority and NSW Land and Housing Corporation owned and administered land, with Crown Land representing by far the major public land holding. As the study area is located with the Sydney Harbour, NSW Maritime is responsible for the management of both seabed and waterways.

The foreshore is zoned Existing Recreation under Manly Local Environmental Plan 1988. In general, Council seeks to maintain the area for public use with a preference for aquatic and recreational activities. Future improvements should maximise scenic qualities and public amenity.



Figure 3.1 Land use within the Manly Cove study area

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There is a mix of land tenure within the study area including:

- Crown Reserve: Council as Trustee
- Crown Land administered by DECCW
- NSW Maritime - Leased Land
- Sydney Water
- NSW Land and Housing Corporation
- Land & Property Management Authority
- Council Owned Land: community classification
- Council Owned Land: operational classification

Crown Reserve: Council as Trustee

Three separate parcels of Crown Land totalling 26,191 m² exist within the study area for which Manly Council are Trustee. They include:

- 13,598 m² which encompasses West Esplanade Park (Parcel No. 1004083 DP 752038)
- 1,994 m² Esplanade Park (Parcel No. 1003903 DP 1074609) immediately to the north of Manly Wharf and is currently utilised for pedestrian access.
- 10,599 m² East Esplanade Park (Parcel No. 1003902 DP 1074608)

A small parcel of this land is leased by Manly Council to Manly Waterworks and Council has approved the subletting of part of this parcel for the use as a Café.

Manly Council also lease a small parcel of East Esplanade Park, identified as Lot 7011, DP1074608 to Manly Yacht Club and Manly 16ft Skiff Sailing Club. The parcel extends from outside No.53 East Esplanade around the South Eastern foreshore of Manly Cove to Stuart Street.

Crown Land administered by DECCW

A 6 m² parcel of Crown Land (Lot 7012, DP1023881) lies on the foreshore immediately below the drainage reserve off Oyama Avenue.

NSW Maritime Leased Land

As Manly Cove is of considerable importance in the provision of water based recreation, a total of 17,786 m² of land is leased by NSW Maritime. **Table 3.3** summarises the lease holders and land information.

Table 3.3 – Summary of NSW Maritime land ownership, Manly Cove

Name	Title	Ownership	Land Use	Area (sqm)	Classification
Parcel on foreshore of 18 Cove Avenue.	Lot 8, DP70187	NSW Maritime	Private	5.4	Leased to private resident
Manly Bathers Pavilion	Lot 2, DP1019352	NSW Maritime	Manly Bathers Pavilion	1,564	Leased
Waterworks	Lot 1, DP1019352	NSW Maritime	Waterworks	178	Leased
Manly Wharf	Lot 1, DP809933	NSW Maritime	Manly Wharf	13,460	Leased
Oceanworld	Lot 1, DP122478	NSW Maritime	Oceanworld	690	Leased
Manly 16ft Skiff Sailing Club	None	NSW Maritime	Manly 16ft Skiff Sailing Club	902	Leased



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Name	Title	Ownership	Land Use	Area (sqm)	Classification
Manly Yacht Club	None	NSW Maritime	Manly Yacht Club	518	Leased
Manly Rowing Club	None	NSW Maritime	Manly Rowing Club	331	Leased
Manly Launch Club	None	NSW Maritime	Manly Launch Club	138	Leased

Sydney Water Owned Land

Sydney Water owns a single 21 m² parcel of land (Parcel No. 40530 DP 533948) within East Esplanade Park which houses a sewerage pumping station.

NSW Land and Housing Corporation Owned Land

A public housing estate accounts for 4,676 m² of land on foreshore to the eastern portion of the study area (DP189998 and DP456719).

Land & Property Management Authority Owned Land

A single parcel of land comprising of 591 m² is owned by the NSW Land & Property Management Authority. This parcel (Lot 2839, 2840 and 2841, DP821305) provides for ramp access to the Manly Wharf underground carpark.

Council Owned Land: community classification

Manly Council owns a total of 1036 m² of land under community classification in three parcels. Further details are in section 3.5.1.

Council Owned Land: operational classification

Manly Council owns a total of 168 m² of land under operational classification in a single parcel (No. 98680 DP 604520) which currently provides drainage easement and public access to the foreshore immediately to the north of 3 Oyama Avenue.

3.4 LAND MANAGEMENT REQUIREMENTS

Crown Land Requirements

The *NSW Crown Lands Act 1989* governs the planning, management and use of crown land, including reservation or dedication for a public purpose, and leasing and licensing.

The Land & Property Management Authority is the principal NSW Government agency responsible for managing state-owned land together with the Reserve Trusts appointed by the Minister. The *Crown Lands Act 1989* provides for the reservation and dedication of crown land for a range of public purposes. When land is reserved or dedicated, management of the Reserve is mostly undertaken either by:

- the Land & Property Management Authority;
- a Reserve Trust; or
- Local Government councils, by devolvement under the *Local Government Act 1993*.

In the case where Council is appointed as Trustee or management is devolved to Council, Council has the ongoing responsibility to provide care, control and management of crown land in accordance with the *Crown Lands Act 1989*.

To ensure that crown land is managed for the benefit of the people of New South Wales, Council is required to have regard for the principles of Crown Land management. Crown land must be used and managed in accordance with those principles under Section 11 of the *Crown Lands Act 1989*.

The principles of crown land management include:

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- that environmental protection principles be observed in relation to the management and administration of crown land;
- that the natural resources of crown land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible;
- that public use and enjoyment of appropriate crown land be encouraged;
- that, where appropriate, multiple use of crown land be encouraged;
- that, where appropriate, crown land should be used and managed in such a way that both the land and its resources are sustained in perpetuity; and
- that crown land be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles;

The Manly Cove CMP will satisfy the *Crown Lands Act 1989* if the following points are addressed:

- The CMP and its outcomes must incorporate the principles for Crown Land management (listed above).
- In addition to incorporating the requirements of Section 36 of the *Local Government Act 1993*, the CMP must address any matters required by the Minister responsible for the *Crown Lands Act 1989* under Section 112 of the Act.
- Any proposed uses, developments and management practices must conform to the public purpose for the Reserve.
- The draft CMP is referred to the Department of Lands for comment prior to the public exhibition of the draft CMP.
- The draft CMP must be publicly exhibited, including a public notice in the NSW Government Gazette.
- Public submissions regarding the draft CMP are to be referred to both the Minister responsible for the *Crown Lands Act 1989* and Manly Council as Trust Manager for consideration by the Minister prior to adoption.
- Any alterations to the CMP by the Minister under Section 114 are made.
- Adoption of the CMP by the Minister responsible for the *Crown Lands Act 1989*.
- The Trust must follow the CMP, with all operations being in accordance with the Plan.

This CMP has been developed to meet these requirements.

Community Land management requirements

Community land cannot be sold, exchanged or otherwise disposed of (except when adding the land to Crown Reserve or to a protected area under the *National Parks & Wildlife Act 1974*). Community land cannot be leased, licensed or any other estate granted over the land for more than 21 years.

Under section 36 of the *Local Government Act 1993*, a plan of management for community land must be prepared for the land and that plan must categorise the land. This Coastline Management Plan serves as generic Plan of Management for community lands within the study area.

For community land that is not owned by Council the *Local Government Act 1993* requires that, where Council controls but does not own the land, the plan of management must:

- identify the owner of the land;
- state whether the land is subject to any trust estate, interest, dedication, condition, restriction or covenant; and
- state whether the use or management of the land is subject to any condition or restriction imposed by the owner.

3.5 COMMUNITY LANDS

3.5.1 Land Identification

There are three separate parcels of community land within the study area (**Fig 3.5.1**). These include:

- A 209 m² parcel of land described as Tower Hill Park (DP 60402). This parcel is currently used as a Public Reserve.
- The 177 m² parcel of land which makes up a portion of the Town Hall forecourt (DP 1121113); and
- The 650 m² parcel of land at the southernmost tip of Manly Point (DP 2/564246) which is designated as Public Reserve

Each of these parcels is zoned as 'open space'. These lands are used either as reserve or pedestrian pathway.

3.5.2 Plans of Management

As mentioned above, under section 36 of the *Local Government Act 1993*, a plan of management for community land must be prepared for the land and that plan must categorise the land. In 1996 Manly Council prepared a generic Plan of Management for all community lands. This Plan sufficiently meets the requirements for Tower Hill Park (DP 60402) and the parcel of land which makes up a portion of the Town Hall forecourt (DP 1121113).

However, due to the designation of Manly Point as Critical Habitat for the Manly Little penguin population, a specific Plan of Management is required for the public space in front of 'Kilburn Towers' on Manly Point. A Plan of Management, known as the *Plan of Management for Manly Peace Park* (2004) was developed as part of the Little Manly Coastline Management Plan. This PoM includes the land identified as DP 2/564246.

3.6 LAND USE PLANNING

The Manly Cove CMP study area consists of land, foreshore and waterways areas. Land use planning of the study area is governed by two documents, the *Manly Local Environment Plan 1988* (Manly LEP) and the *Sydney Regional Environmental Plan - Sydney Harbour Catchments 2005* or simply the Harbour REP, both enacted under the *Environmental Planning and Assessment Act 1979*.

The *Manly Local Environment Plan 1988* (Manly LEP) is the main statutory control over local development within the Manly Local Government Area and applies to all land including the Manly Cove CMP study area. The Clause 9 of the Manly LEP establishes land use zones (presented in section 3.6.1). The LEP also identifies Items of Environmental Heritage, Environmentally Sensitive Areas, Foreshore Scenic Protection Areas and Potential Acid Sulphate Soils.

The *Sydney Regional Environmental Plan - Sydney Harbour Catchments 2005* applies to the hydrological catchment of the harbour. It also defines and contains specific provisions for the 'Foreshores and Waterways Area' (which is generally the area 'one-street back' from the foreshore), strategic foreshore sites, heritage items and wetlands protection areas. The relevant council is the consent authority for land-based development and land-water interface development. The Minister administering the *Ports and Maritime Administration Act 1995* is the consent authority for water-based development. The Minister for Planning is the consent authority only where development is state significant or if any Environmental Planning Instrument nominates the Minister as the consent authority (whether within or outside of a council's Local Government Area (see Clause 5).

The *Sydney Regional Environmental Plan - Sydney Harbour Catchments 2005* contains a set of planning principles relating to land within the Sydney Harbour catchment, land within the Foreshores and Waterways Area and heritage conservation. The planning principles need to be taken into consideration in the preparation of environmental planning instruments and development control plans under Part 3 of the *Environmental*



Figure 3.5.1 Location of community lands within the study area

MANLY COVE COASTLINE MANAGEMENT STUDY

Planning and Assessment Act 1979 (EP&A Act) and the preparation of environmental studies and master plans for the purposes of the Act. This will ensure that all strategic land use decisions with the potential to impact on the harbour are made having regard to such impacts. The catchment planning principles include a number of natural resource management principles that relate to water quality and quantity, implementation of the actions outlined in the Sydney Harbour Catchment Blueprint (Department of Land and Water Conservation, 2003), soil management (salinity and acid sulphate soils) and the protection and rehabilitation of wetlands, remnant native vegetation (including riparian vegetation) and the enhancement of ecological connectivity.

3.6.1 Land Zoning

Land within the study area is zoned under the Manly LEP as zone 2 – Residential, 3 – Business Zone, 5 – Special Uses Zone and 6 - Open Space (including areas to be acquired), as shown in **Figure 3.6.1**. The objectives of each of the zone need to be addressed in any of the proposed management options that represent development under the LEP. Those objectives, described separately for each zone, are as follows:

Zone 2 - Residential

- (a) to set aside land to be used for the purposes of housing and associated facilities;
- (b) to delineate, by means of development control in the supporting material, the nature and intended future of the residential areas within the Municipality;
- (c) to allow a variety of housing types while maintaining the existing character of residential areas throughout the Manly Council area;
- (d) to ensure that building form, including alterations and additions, does not degrade the amenity of surrounding residents or the existing quality of the environment;
- (e) to improve the quality of the residential areas by encouraging landscaping and permitting greater flexibility of design in both new development and renovations;
- (f) to allow development for purposes other than housing within the zone only if it is compatible with the character and amenity of the locality;
- (g) to ensure full and efficient use of existing social and physical infrastructure and the future provisions of services and facilities to meet any increased demand;
- (h) to encourage the revitalisation of residential areas by rehabilitation and suitable redevelopment; and
- (i) to encourage the provision and retention of tourist accommodation that enhances the role of Manly as an international tourist destination, and particularly in relation to the land to which Manly Local Environmental Plan 1988 (Amendment No 57) applies.

Zone 3 - Business

- (a) to provide for and encourage the development and expansion of business activities which will contribute to the economic growth and employment opportunities within the Manly Council area;
- (b) to accommodate retail, commercial and professional services in established locations in the residential neighbourhoods where such development is compatible with the amenity of the surrounding areas;
- (c) to ensure there is adequate provision for car parking in future development in the business areas; and
- (d) to minimise conflicts between pedestrians and vehicular movement systems within the business areas.

Zone 5 - Special Uses Zone

- (a) in the case of land shown unhatched on the map, is now owned or used for public or community purposes;
or
- (b) in the case of land shown hatched on the map, will be acquired by a public authority for the particular public or community purpose shown on the map.



Figure 3.6.1 – Land zoning within the Manly Cove study area

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Zone 6 - Open Space

- a) to ensure there is provision of adequate open space areas to meet the needs of all residents and provide opportunities to enhance the total environmental quality of the Council;
- b) to encourage a diversity of recreation activities suitable for youths and adults;
- c) to identify, protect and preserve land which is environmentally sensitive, visually exposed to the waters of Middle Harbour, North Harbour and the Pacific Ocean and of natural or aesthetic significance at the water edge;
- d) to facilitate access to open areas, particularly along the foreshore, to achieve desired environmental, social and recreational benefits;
- e) to conserve the landscape, particularly at the foreshore and visually exposed locations, while allowing recreational uses for those areas; and'
- f) to identify areas which:
 - i. in the case of areas shown unhatched on the map are now used for open space purposes, and
 - ii. in the case of land shown hatched on the map are proposed for open space purposes.

3.6.2 Foreshore & Waterways Area Zoning

Under the Sydney Regional Environmental Plan - Sydney Harbour Catchments 2005 or simply the Harbour REP, the entire waterways of the harbour and its tributaries are classified into nine zones: W1 (Maritime Waters), W2 (Environment Protection), W3 (Naval Protection), W4 (Aviation), W5 (Water Recreation), W6 (Scenic Waters – Active Use), W7 (Scenic Water Casual Use), W8 (Scenic Waters – Passive Use) and W8a (National Parks). These waterways zones have been specifically tailored to suit the differing environmental characteristics and land uses of the Harbour. This has resulted in a system that provides greater clarity and certainty for applicants and consent authorities in development considerations and applications.

However, foreshores & waterways of the entire Manly Cove study area is classed in W2 - Environment Protection zone (see Figure 3.6.2).

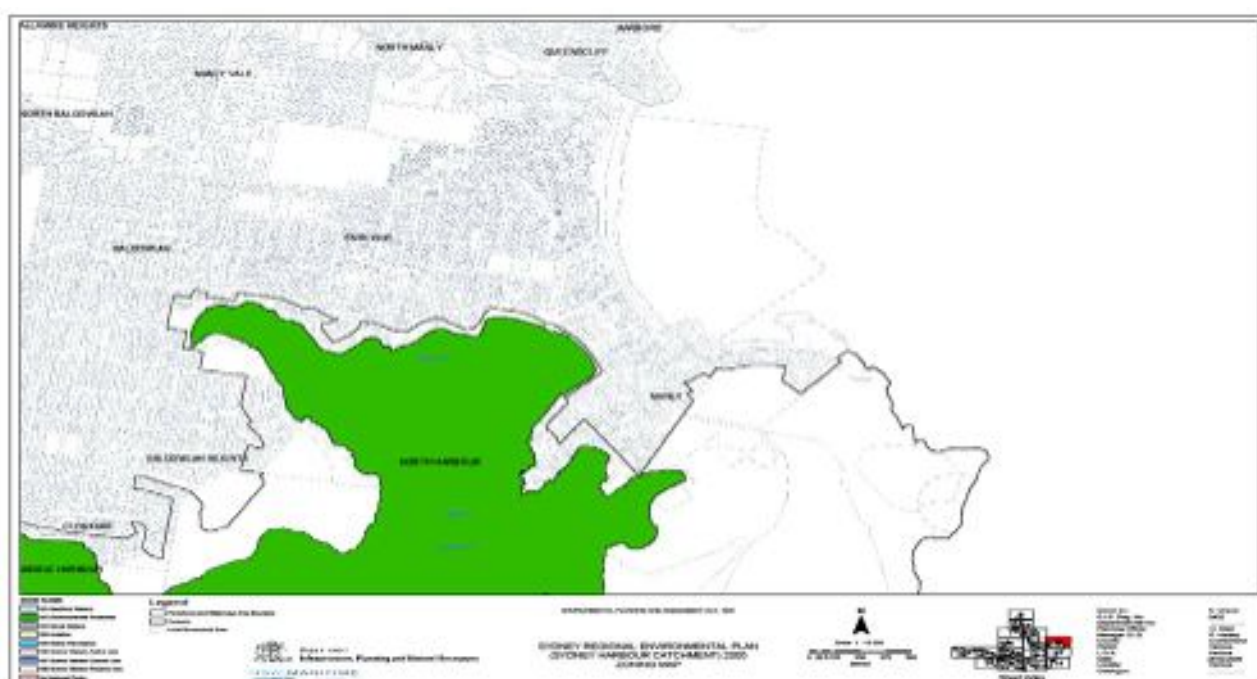


Figure 3.6.2 – Foreshores & Waterways zoning map of the Manly Cove study area

MANLY COVE COASTLINE MANAGEMENT STUDY

Zone W2 – Environment Protection

The zone provides for the protection, rehabilitation and long term management of the natural and cultural values of the waterways and adjoining foreshores.

The objectives of this zone are as follows:

- (a) to protect the natural and cultural values of waters in this zone,
- (b) to prevent damage or the possibility of longer term detrimental impacts to the natural and cultural values of waters in this zone and adjoining foreshores,
- (c) to give preference to enhancing and rehabilitating the natural and cultural values of waters in this zone and adjoining foreshores,
- (d) to provide for the long-term management of the natural and cultural values of waters in this zone and adjoining foreshores.

3.7 DEVELOPMENT CONTROL PLANS

3.7.1 Manly LEP 1988

The *Manly Local Environment Plan 1988* (Manly LEP)² is the main statutory control over local development within the Manly Local Government Area and applies to all land including the Manly Cove CMP study area.

The Manly Local Environment Plan (LEP) establishes Council as the consent authority for all purposes of the LEP and is the main statutory control on development within Manly Local Government Area. Clause 10 of the Manly LEP establishes that in order for consent to be granted for development, the Consent Authority must be of the opinion that the proposed development is consistent with the objectives of the relevant zone. Clause 10 also identifies the types of development that are permissible without development consent (item 2), permissible with development consent (item 3) and development that is prohibited (item 4) within each of the land use zones (**Table 3.7.1a**).

Table 3.7.1a Development controls within 4 land zones in the Manly Cove CMP study area

Zones	Without Development Consent (Item 2)	Only with Development Consent (item 3)	Prohibited (Item 4)
Zone 2 – Residential zone	Bed and breakfast accommodation; home occupations.	Any purpose other than a purpose included in item 2 or 4.	Advertising structures; amusement centres; bulk stores; car repair stations; backpacker accommodation; clubs; hotels; motels; refreshment rooms; service stations and tourist facilities (other than backpacker accommodation; clubs, hotels, motels, refreshment rooms, service stations and tourist facilities in the Tourist Area); commercial premises; gas holders; generating works; heliports; industries other than home industries; institutions; junk yards; liquid fuel depots; mines; motor show rooms; public buildings; retail plant nurseries; roadside stalls; sawmills; service stations; shops other than small shops; transport

² The present version of the Manly LEP 1988 is updated and amended in December 2008. Simultaneously, work is going on to revise the present LEP into a standard LEP template.



MANLY COVE COASTLINE MANAGEMENT STUDY

Zones	Without Development Consent (Item 2)	Only with Development Consent (item 3)	Prohibited (Item 4)
			terminals; warehouses.
Zone 3 - Business zone	Bed and breakfast accommodation, home occupations.	Any purpose other than a purpose included in item 2 or 4.	Bulk stores; bus depots; car repair stations; dwelling-houses ; fuel depots; gas holders; generating works; heliports; purposes specified in Schedule 3; junk yards; liquid fuel depots; mines; road transport terminals; roadside stalls; sawmills; warehouses.
Zone 5 – Special Uses Zone	Nil	The particular purpose indicated by red lettering on the map; child care centres and other child care facilities; drainage; educational establishments; landscaping; roads; telecommunications facilities; utility installations other than generating works or gas holders.	Any purpose other than those included in item 3.
Zone 6 - open space zone	Works for the purpose of landscaping, gardening or bush fire hazard reduction.	Agriculture; boating facilities; car parking ancillary to a use permitted in this item; child care centres; drainage; forestry; golf courses; marinas; parks; public baths; public dressing pavilions; race courses; recreation areas; refreshments rooms; roads; sports clubs; sports grounds; surf life saving clubs; telecommunications facilities; tennis courts; utility installations other than gas holders or generating works or both.	Any purpose other than a purpose included in items 2 or 3.

The LEP also identifies Items of Access land, Foreshore Scenic Protection Areas, Environmental Heritage, vicinity of Aboriginal Relics and Potential Acid Sulphate Soils and provides planning controls for the ongoing appropriate management of each of these items and areas.

Open Space Land Owned by Council or Public Authority

Under Clause 16 of the Manly LEP, Council shall not consent to an application to carry out development on land which is zoned 6 and owned by Council or another public authority unless it has made an assessment of:

- the need for the proposed development on that land;*
- the impact of the proposed development on the existing or likely future use of the land; and*
- the need to retain the land for its existing or likely future use.*

Foreshore Scenic Protection Area

A Foreshore Scenic Protection Area has been established by the Manly LEP.

Manly LEP (Clause 17) establishes that the Council shall not grant consent to the carrying out of development unless it is satisfied that the development will not have a detrimental effect on the amenity of the Foreshore Scenic Protection Area.

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Items of Environmental Heritage

The Manly LEP identifies a number of specific items, including many within the Manly Cove study area, listed as being of Environmental Heritage Value. Clauses 18 and 19 of the Manly LEP identifies the restrictions on development of or adjacent to items of Environmental Heritage. The Council shall not grant consent to a development application to carry out development in the vicinity of an item of the environmental heritage unless it has made an assessment of the effect which the carrying out of that development will have on the historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance of the item of the environmental heritage and its setting.

Development in the vicinity of Aboriginal relics

Clause 20 of the Manly LEP establishes that the Council shall not grant consent to an application to carry out development on land within the vicinity of an Aboriginal relic unless it has notified the Director of National Parks and Wildlife of the proposed development within 14 days of the receipt of the application.

Acid Sulphate Soils

Clause 33 of the Manly LEP relates to the development of land identified on potential Acid Sulphate Soils (ASS). Mapping of ASS has been undertaken across the Manly LGA and areas subsequently placed into 5 separate Classes. The study area is identified on Map 5 of the Manly LEP as Class 4 or Class 5 land. Unless otherwise indicated by Council, consent is required for the carrying out of works as described in **Table 3.7.1b**.

Table 3.7.1b Details of land categorization for potential Acid Sulphate Soils

Class of Land	Works
4	Works beyond 2 metres of the natural ground surface; Works by which the water table is likely to be lowered beyond 2 metres below natural ground surface.
5	Works within 500 metres of adjacent Class 1, 2, 3 or 4 land which are likely to lower the water table below 1 metre AHD on adjacent Class 1, 2, 3 or 4 land.

3.7.2 DCP for Sydney Regional Environmental Plan – Sydney Harbour Catchments (2005)

Council is the responsible authority for land/water interface development under the provisions of the Sydney Regional Environmental Plan -Sydney Harbour Catchments (2005).

Land/water interface development consists of boating industry facilities; boat launching ramps; boardwalks; large marinas; marinas; public water transport facilities; water based restaurants and entertainment facilities; water recreational facilities; development for the purposes of dwellings of any type (inc serviced apartments), commercial premises, tourist facilities, shops and retailing, restaurants, recreation facilities, car parking when carried out wholly or partly in the waterway.

The Development Control Plan (DCP) of the Sydney Regional Environmental Plan - Sydney Harbour Catchments (2005) sets out in detail Council's town planning controls and guidelines on key development factors. As mentioned already, the study area is entirely located in W2 (Environment Protection) zone.

Activities that may be carried out without development consent

Aids to navigation, demolition (other than demolition of a heritage Item), general restoration works, naval activities and single mooring (other than associated with a commercial marina or a boating industry facility).

Activities that may be carried out only with development consent

Boat launching ramps (Public), community facilities, dredging, flora and fauna enclosures, maintenance dredging, private landing steps, public boardwalks, public water recreational facilities, public water transport facilities, recreational or club facilities and telecommunications facilities

Development activities that are prohibited

Advertisements, advertising structures, aviation facilities, boat lifts (other than boat lifts for storage of vessels above water, boat lifts for the storage of vessels above water, boat repair facilities, boat sheds (private), charter and tourism facilities, commercial marinas, commercial port facilities, houseboats, intertidal dredging, mooring



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pens, private landing facilities, private marinas, reclamation works, residential development, skids, slipways, swimming enclosures (private), swimming pools, tourist facilities, water-based restaurants and entertainment facilities and waterfront access stairs.

However, special provision clause 34 applies to existing boat repair facilities called Manly Boatshed whereby development can be carried out only with development consent (Map). Further, special provision clause 37 allows a consent authority may grant development consent to the development of land that is within 20 metres of the boundary of zone no. W2 and another zone for a purpose for which development may be carried out in either Zone No. W2 or the adjoining zone.

In this DCP, different landscape character types in and around Sydney Harbour are recognised. These landscape character types provide a statement of character and intent and sets out performance criteria that are to be met for development within each landscape character types. Landscape character type 8 exists in the Manly Cove CMP study area.

LANDSCAPE CHARACTER TYPE 8

Statement of Character and Intent: These areas have a high level of built form with waterside commercial, industrial and residential uses. The commercial and industrial uses play an important role in terms of tourism and maritime services which support water-based activities. There are special features in these areas that contribute to the visual character of the area that should be maintained.

Performance Criteria: Any development within this landscape is to satisfy the following criteria:

- vegetation is integrated with land-based development to minimise the contrast between natural and built elements;
- design and mitigation measures are provided to minimise noise and amenity impacts between incompatible land uses;
- the maritime uses on the Harbour are preserved. Pressure for these uses to relocate is minimised. New developments adjoining maritime uses are designed and sited to maintain compatibility with existing maritime uses; and
- remaining natural features that are significant along the foreshore are preserved and views of these features are maintained.

3.7.3 DCP for Manly Cove 1996

This Development Control Policy sets out in detail Council's town planning controls and guidelines on key development factors in the harbour front area of Manly Cove. This policy applies to land above and below high water mark between Commonwealth Parade, West Esplanade and East Esplanade and a line drawn from the south western end of East Esplanade Reserve to the southernmost point of Commonwealth Parade. The policy relates to building location and scale, building design, access, loading and parking; drainage/water quality and waste management. According to this DCP, there will be no new building work other than on the location of existing buildings. In order to preserve the visual integrity of Manly Cove in terms of views to and from the water no building will exceed 10.5m AHD.

3.7.4 DCP for Residential Zone 2007 – Amendment 1

This DCP provides controls, considerations and requirements for development in the Residential Zone under Manly LEP 1988. It applies to all forms of residential development in the zone with the objectives of this Plan also applying to residential development in other zones and non-residential development in the Residential Zone. This has established standard for dwelling density, floor space ratio, building height, setbacks, open spaces and landscaping, swimming pools, car parking and access.

MANLY COVE COASTLINE MANAGEMENT STUDY

The residential zone is divided into 7 density sub-zones with the study area designated within sub-zones 2 (with minimum allotment size of 250 m²), 3 (with minimum allotment size of 250 m²), 4 (with minimum allotment size of 300 m²), 5 (with minimum allotment size of 500 m²) and 7 (with minimum allotment size of 750 1150 m² at different slopes)

This DCP establishes following Foreshore setbacks and existing foreshore building lines:

- a) Development on any property having frontage to the foreshore shall be setback a minimum of either 15m from mean high water mark, or the maximum wall height of the proposed building on the foreshore frontage, whichever is the greater.
- b) In residential areas which have been subject to foreshore building lines set by Council at less than 15m from mean high water mark, the setback will be determined individually taking into account the terrain, the adjoining development and the Council's existing and any future foreshore walkway.

3.7.5 DCP for Access 1996

This DCP is pursuant to Section 72 of the *Environmental Planning and Assessment Act* 1979 and applies to the entirety of the Manly Council area. It sets out in detail Councils controls and guidelines to provide for an environment accessible to all people (including those with disabilities) in order to assist in achieving the aims and objectives and the policies and strategies of the LEP.

The DCP incorporates those parts of Manly Council Access Policy relating to development and building. This policy applies to public car parking provision, signage, audible access, footpaths and ramps, paving and public toilet facilities.

3.7.6 DCP for Landslip and Subsidence 2001

This DCP (updated March 2003) is designed to ensure that Council and the Community is aware, and responds appropriately to all identified potential hazards as a result of landslip and subsidence. It is also intended to address the range of major risks to public safety, including risks to life, health, private and public property, the economy and the environment.

The DCP aims to provide a framework for identification, assessment, treatment and monitoring of landslip and subsidence risk and assists Council in the Development Application process. The study area contains land which fall under all four Zones A, B and D. Further details on each zone are provided in **Table 3.7.5**.

Table 3.7.5 Summary of Land Slip and Subsidence in the Manly Cove study area

Zone	Location	Description	Slope Angle	Council requirement
A	Generally areas behind Zone B	Ridge crests, major spur slopes and dissected plateau areas.	< 15°	Geotechnical assessment may be required
B	Generally areas behind Zone C all along the foreshore	Flanking Slopes	15°-25°	Geotechnical assessment may be required
D	North Harbour Reserve & beaches	Beach foredune and alluvial flats	< 5°	Should follow good engineering practice

3.7.7 DCP for Energy Efficiency Buildings 1998

This DCP (updated March 2003) encourages the design and development of energy efficient housing and other development in the Manly Council area. It reflects Council's concern for the conservation of the environment, possible climate changes due to the Greenhouse Effect and Councils support for the ecologically sustainable development of the Sydney Metropolitan Area. The guidelines and specific controls set out in this plan apply to the assessment of residential, commercial and industrial development on Manly.



MANLY COVE COASTLINE MANAGEMENT STUDY

3.7.8 DCP for Waste Minimisation and Management 2000

The DCP (updated March 2003) for Waste Minimisation and Management 2000 encourages development applicants to consider waste management issues during the planning stage.

The DCP reflects Council's emphasis on the principles of ecologically sustainable development and a desire to reduce the amount of waste disposed of at landfill, in recognition of State and Federal Government targets. Waste avoidance is imperative to achieving this goal and is central to the requirements of this DCP.

Key controls in this DCP require developers lodging a development application to:

- Complete a waste management plan prior to the issuing of a construction certificate
- Include waste facilities in the development that support source separation of waste and efficient waste collection.

3.7.9 DCP for Advertising Signs 1993

This plan (updated March 2003) aims to control the use of advertising structures and signs, so as to retain the uniqueness and natural beauty, and the architectural and historic significance of the LGA environment.

3.7.10 Other Council Plans & Policies

Described in detail in Chapter 2

4. SIGNIFICANCE & VALUES OF MANLY COVE

This section summarises the special features and unique qualities of the Manly Cove study area that make it significant from a local, regional, and national level. This is based on the feedback from community consultation, as well as the research and data collection collated for this study.

Council held a number of community consultation events allowing residents (and visitors) of Manly to contribute to the identification of issues and opportunities for improvement which will then be incorporated into the CMP.

Extensive questionnaires were distributed at community events, via the Precincts and internet and through letter box drops. The Harbour Foreshores Management Committee provided significant input into shaping these consultation events to ensure that they are appropriate for Council and stakeholders. Consultation enabled the identification of the values and significance of the Manly Cove study area as a whole and for key features.

4.1 SIGNIFICANCE

The identified characteristics identified within the following section indicate significance of the study area which is of existing and perceived future local or regional significance.

4.1.1 Local Significance

The Manly Cove study area provides a range of important uses, services and linkages within the Manly LGA. Manly Wharf, the beaches, harbour and East Esplanade Park are central to all key activities.

Although highly modified since European arrival, Manly Cove exhibits high visual appeal with its location just to the northwest of the entrance to Sydney Harbour. The original sandy beach has been divided into two distinct sections by Manly Wharf and is backed by an artificial seawall and promenade.

Norfolk Island Pine lined public reserves provide for a transition from the beach through to heavily utilized public transport facilities, East and West Esplanades and the commercial/retail centre of Manly, which itself is centred on Manly Corso. Whilst serving as a tourist focal point, Manly Cove also provides an important recreational resource to locals and residents of the northern beaches.

The numerous festivals, markets and sporting and social events held in the Manly CBD as well as commercial tourism operations within the study area are popular for both tourists and locals alike. It is this popularity which highlights the need to effectively manage Manly Cove to ensure environmental protection while enhancing opportunities for recreation.

The attraction of Manly Cove is enhanced by its generally good water quality. This results in numerous primary and secondary contact recreational pursuits, including swimming, sailing, kayaking, diving, sail boarding, and boat and shore fishing, which are immense value to locals and visitors alike.

The Manly Cove study area houses a number of key waterside facilities which provide for water based recreation, particularly sailing activities. The boating precinct located on the eastern foreshore of Manly Cove was first established by early European settlers during the 1870s, growing with Manly's popularity as a seaside resort. Today the club precinct remains relatively unchanged and creates distinct characteristics which the community has recognised as being important to retain into the future.

Manly Cove houses a diverse marine environment which ranges from rocky intertidal zone to the seagrass beds of North Sydney Harbour. A number of populations of protected, endangered and vulnerable marine fauna species are found in the vicinity of the Manly Cove study area.

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Fragmentation, clearance and degradation of native vegetation in the Manly Cove study area have reduced habitat value for native fauna. Small pockets of remnant bushland do exist between Oceanworld and Federation Point and on Manly Point, providing important habitat for the endangered colony of little penguins (*Eudyptula minor*). Grassed areas within the study area are also known to provide nesting and foraging habitat for the endangered North Head population of long-nosed bandicoots (*Perameles nasuta*).

During community consultation, respondents to the questionnaire were asked to indicate the level of importance that they gave to eleven *activities* undertaken within Manly Cove. The results clearly identified the importance of Manly Cove as an exercise haven with walking, jogging and swimming considered the most popular uses for the area (See Figure 5). Other more passive activities are also seen as important, along with the use of Manly Cove as a commuter transport hub.

Results (**Fig. 4.1.1**) showed that the five most important activities carried out by residents in Manly Cove are walking/jogging (84%), swimming (68%), passive recreation (63%), picnic/BBQ (53%) and commuting (40%).

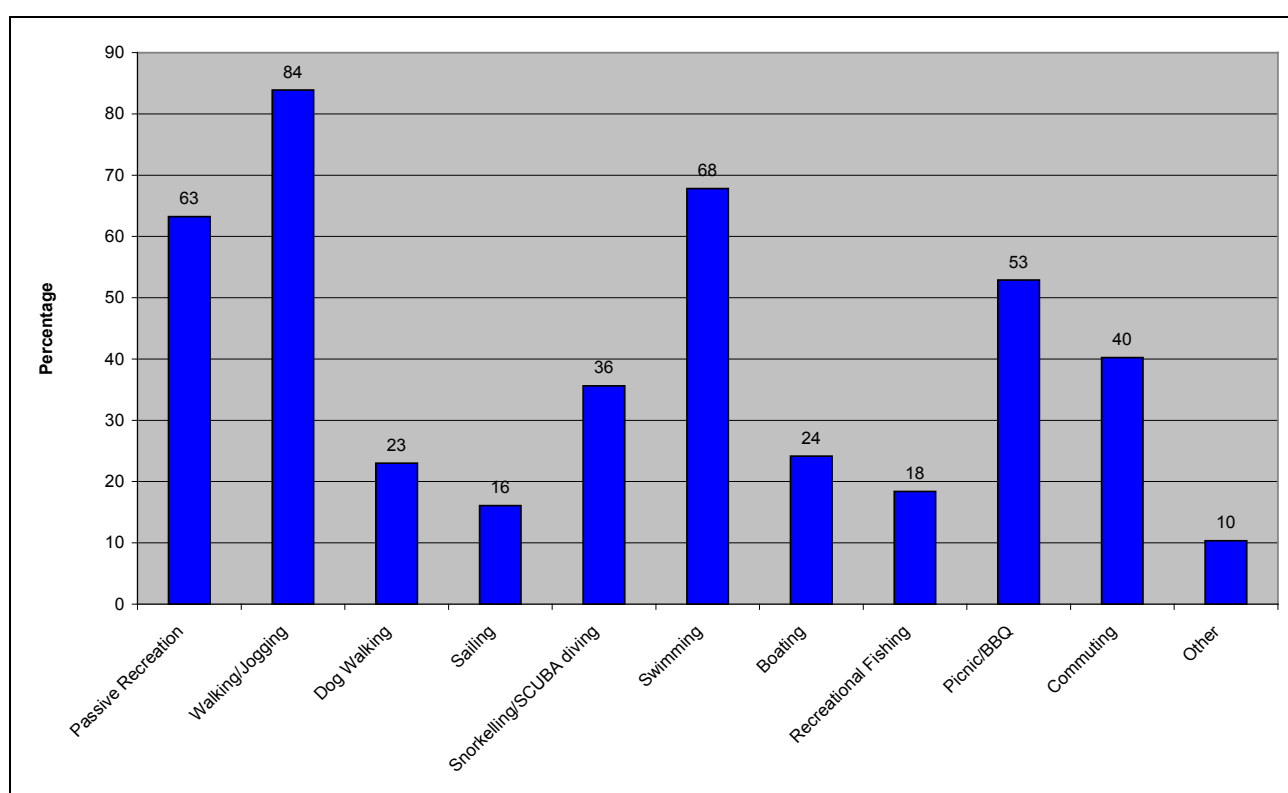


Figure 4.1.1 - Activities of importance identified through community consultation

Given its scenic beauty, Manly Cove is highly attractive and people want to be near it, look at it, or be on it. For these reasons, recreational visitation and use of the waterway is extremely high with significant “flow on” effects for the local and regional economies. Its deep waters are very attractive to the boating community.

Because of its scenic beauty and views, foreshores have already become highly sought after residential area. At present, 55% of the study area foreshore is under residential land use compared to 37% within Manly LGA.

4.1.2 State and Regional Significance

The study area is rich in Aboriginal and European cultural heritage giving it significance at the regional and state level. The AHO has recorded a number of Aboriginal sites within the study area (AHO & MC 2006a) including one rock engraving. European cultural heritage is also an important feature of the study area with numerous heritage listed sites and buildings.



MANLY COVE COASTLINE MANAGEMENT STUDY

At the regional level, the study area acts as a vital transport link between the Northern Beaches and city of Sydney. The Manly Ferries are part of Australia's social history with a large number of visitors taking the return journey across Sydney Harbour by either ferry or the high-speed Fast Ferry to reach Manly Wharf. Bus travel between Manly bus interchange and the Sydney commercial business district across the Harbour Bridge is another alternative.

Manly Cove is rich in its cultural heritage, including Aboriginal heritage, natural heritage, and the built heritage representing the historic development of the Manly Local Government Area (LGA). The community and Council seek to preserve this heritage and encourage sensitive management and conservation of heritage items both within public and private ownership.

Manly Cove's marine environment exhibits a diversity of habitat with a wide range of substrata, vegetation, depths, exposures and their combinations with aquatic plant communities being among the most abundant and conspicuous habitats of sub-tidal reefs in Sydney Harbour. In recognition of the diverse array of habitat types that are still found in Manly Cove, the NSW State Government, under its Sydney Regional Environmental Plan - Sydney Harbour Catchment (NSW DoP 2005), has zoned entire waterways of the study area as Environmental Protection, which aims to "provide for the protection, rehabilitation and long term management of the natural and cultural values of the waterways and adjoining foreshores.

North Harbour Aquatic Reserve lies very close to the study area. Council is preparing a new proposal to extend the North Harbour Aquatic Reserve to include entire water side of the study area for consideration by the Department of Environment, Climate Change & Water.

A number of threatened flora and fauna species have been recorded within Manly Cove, making the study area important from an ecological perspective. Of particular mention are marine species including Whites seahorse, Pot-bellied seahorse and the occasional Green turtle along with Manly's endangered Little Penguin population and the North Head colony of Long-nosed bandicoot.

4.2 VALUES OF THE AREA

It is also important to gain an appreciation of the multiple features and values of the area. The following values reflect attributes, activities and processes that are of importance to the community, and are the qualities on which the study area depends for its attractiveness, desirability, liveability and use. These values were derived from the community consultation that was undertaken during September 2005 and April 2007, to assist in the development of the Manly Cove Coastline Management Plan.

4.2.1 Historical Values

Aboriginal Occupation: For thousands of years prior to the arrival of Europeans, the vast area of land stretching between what is now known as Newcastle through to the southern-most part of present day Sydney was home to the Guringai people. Living primarily along the foreshores of the harbour, they fished and hunted in the waters and hinterlands of the area, and harvested food from the surrounding bush. Self-sufficient and harmonious, the Guringai had no need to travel far from their lands, since the resources about them were so abundant, and trade with other tribal groups was well established.

It is believed that two clans of the Guringai people; the Kay-e-my and the Cannalgal, occupied what is now part of the Manly Municipality Council. In particular the Cannalgal are believed to occupy their clan estate that is known in part as Manly Point. Nearby inner North Head ("Carangel") occupied a significant part of the social and spiritual lives of the peoples of the eastern coast from Broken Bay to near Wollongong. It was within this cultural precinct that healing and other ceremonies were conducted by koradji or senior law men who travelled considerable distances, from south of Wollongong, the lands of the Gundungara and Dharawa and from north of Newcastle, the lands of the Awabakal and Worimi.

The Guringai people lived a self-sufficient and harmonious life, and had a rich and complex culture that included trade with other tribes, and a large amount of leisure time (AHO, 2008). Fishing is an important part of

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Aboriginal culture. Indigenous fishing is undertaken using a variety of methods and equipment, including hand gathering, lines, rods and reels, nets, traps and spears. Indigenous fishing targets a range of species of fish, shellfish, crabs and worms that are used for food, medicine or bait. Target species include (but are not limited to) mullet, flathead, whiting, tailor, bream, blackfish, mud crab, oysters, pipis, prawns, beach worms and river worms. Beach worming and shellfish gathering are recognised as an important part of the Aboriginal fisheries.

Dennis Foley, an Aboriginal descendent of the Gai-marigal Aboriginal people of northern Sydney recently documented his cultural history and explained the social traditions of the Gai-marigal clan – the ‘traditional’ owners of northern Sydney. The following information is derived from his recent publication: ‘Repossession of our Spirit’ (Foley, 2001).

Foley documented the original occupants of the northern Sydney region as the people of the Gai-marigal clan. This clan was comprised of six major indigenous family groups. The Gatlay family group was associated with the Manly LGA and consisted of two smaller groups: the Boregal and Gorualgal people. It is important to note however, that while the Gai-marigal clan occupied the northern Sydney region, the Metropolitan Local Aboriginal Land Council states that there are no known traditional Aboriginal owners of the North Shore peninsular (MLALC, 2003). More recently MLALC has recognised Bob Waterer as a traditional owner of Guringai country following the discovery of birth certificates proving that his great great great grandmother was Motora, the wife of Bungaree.

Many midden sites have been destroyed by European land uses, with substantial destruction in the early years of colonisation when middens were exploited as a source of lime (I&I NSW 2001). Every seaside beach was believed to contain midden areas, as did the populated bays on the harbour foreshore. These bays included that of the North Harbour area, in which middens can be found today, for example the grassed area of Esplanade Reserve.

European Arrival: Lieutenant James Cook arrived in 1770, declared that the land as uninhabited and named as New South Wales, to be the property of Britain's King George III. Captain Arthur Phillip then arrived in January of 1788 with orders to establish a penal colony, and take control of the land for settlement. The first European land ownership was granted only four days after this arrival, when a group of men began clearing land to gain access to fresh water.

Following a rich history of Aboriginal occupation, Manly was visited and named by Captain Arthur Phillip and a small exploratory party between 21st and 23rd January, 1788 after they encountered a group of Aboriginal men. Phillip later reported *"their confidence and manly behaviour made me give the name of Manly to this place"*.

The arrival of the Europeans resulted in numerous armed conflicts with the Guringai people contributing to the demise of the local population. Along with the conflict, the Guringai people also began to suffer from a shortage of food as the much larger white population depleted fish and kangaroo stocks through unsustainable netting and hunting, cleared the land and polluted the water.

Exotic diseases from Europe were introduced with the invasion, for which the isolated Aboriginal people had no immunity. Over half the Aboriginal population of the Sydney basin died from small pox in less than one year. The remaining population was displaced from the land as the Europeans cleared it for farming and settlement. These brought to an end of traditional lifestyles of Aboriginal population in this area. Aboriginal people continue to live in the area, although very little traditional knowledge has survived.

European Settlement: Manly remained isolated for many years due to the 112km long journey by road from Sydney through Parramatta, Hunter's Hill, Lane Cove and Narrabeen. The other route involved crossing the Harbour by punts at North Sydney and The Spit.

Henry Gilbert Smith founded the village in 1853 after acquiring 100 acres of land. Soon a very small population grew which was able to eke out a living from fishing or farming. In June 1855, Smith wrote to his brother in England:

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" the amusement I derive in making my improvements in Manly is, no doubt, the cause of my greater enjoyment, in fact I never feel a dull day while there. I should long ere this have been with you if it had not been for this hobby of mine, in thinking I am doing good in forming a village or watering place for the inhabitant of Sydney".

He purchased large tracts of land with the vision of Manly, with its splendid ocean beach and sheltered sandy coves, becoming 'the favourite resort of the Colonists'. In 1855 Smith built the first pier at Manly Cove and laid out his plans for the Manly Village. He built the first hotel opposite his pier, and lay out and cleared the route of the Corso, thus establishing a growth and recreation pattern for the area. **Table 4.2.1** provides a summary of historical events relevant to the Manly Cove study area post European settlement.

Table 4.2.1 - Summary of historic events within the Manly Cove study area 1788-2008.

Year	Event
1788	Manly visited by Captain Arthur Phillip and small exploratory party
1853	Henry Gilbert Smith buys John Thompson's 100 acres; Smith leases Katherine Darley's 130 acres
1855	Smith's <i>Ellensville</i> Plan drawn up; First Manly Wharf constructed; Pier Hotel constructed Sunday ferry service begins; Corso Widened
1857	Brighton Baths bathing house constructed
1858	Sept - first school opens Sept – Mass held for first time
1860	Brighton Temperance House (later known as Temperance Hotel), cnr Corso & East Esplanade; (Dec)
1868	Ferry wharf extended
1870	Manly Pavilion constructed
1876	First Post and Telegraph Office, Telegraph line extended to Manly; Nov 1 – Port Jackson Steam Boat Co Ltd opens its comes into legal existence in January 1877
1877	Jan 6 – proclamation of Municipal District of Manly Feb 13 – first Council elections May 27 – fire in West Esplanade leads to formation of Manly Fire Brigade
1878	October – ferry <i>Fairlight</i> enters service;
1879	Colonial Government grants £300 for tree planting; Nov - Foreshore reserves dedicated
1880	Men's Baths opened;
1881	July 1 - Port Jackson Steamship Co Ltd formed; October - Smallpox epidemic cases at Quarantine Station
1885	Women's Baths built; Corso Gas lamp;
1886	Aquarium on Corso opened 23 December
1888	Passenger wharf Camera Obscura opened 8 October
1889	Steam punt at the Spit opened
1893	Manly Co-operative Steam Ferry Co formed; Boxing Day, 20,000 visitors;
1899	Feb - Sewerage scheme completed
1900	April/May – Bubonic plague in Manly; Passenger wharf Camera Obscura demolished (due to rat infestation); Nov – Tramway from Mosman to the Spit
1902	July – Steamer <i>Manly</i> goes aground, all saved; William Gocher makes daylight swim (date uncertain);
1903	Feb – Steam tram to Manly Lagoon; 2 Nov – Council changes bathing by-law to permit all-day bathing; Manly wharf remodelled
1905	Ferry <i>Binngarra</i> enters service;
1913	First Venetian Carnival

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Year	Event
1916	14 Oct – War Memorial, Corso, unveiled;
1924	Demolition of Pier Hotel
1926	Construction of Olympic pool at Gentlemen's baths
1927	Jan – crowd of 4000 at Manly Baths to see Takaishi versus Charlton swimming race;
1928	First sand sculptures of John Suchomlin on beach; Nov – maiden voyage of ferry <i>Curl Curl</i>
1929	3 Nov – collision of liner <i>Tahiti</i> with ferry <i>Greycliffe</i> , among fatalities is Dr C W Reid, Chief Quarantine Officer
1930	13 June - Manly Art Gallery & Museum established
1931	Harbour Pool and boardwalk constructed, Manly Cove
1933	Opening of Manly Harbour Swimming Pool Pavilion
1938	1 Sept – ferry <i>South Steyne</i> arrives in Sydney
1939	Aug - Fire at Manly Wharf;
1942	Remodelling of Manly Wharf
1961	Kilburn Towers constructed
1965	Hydrofoil <i>Manly</i> begins operations;
1966	Nov - Hydrofoil <i>Fairlight</i> begins operations
1971	Primary treatment sewage plant completed; Pines on Ocean Beach felled
1972	Brambles Industries Ltd takes over Port Jackson Company
1973	Council establishes Planning department
1974	May - Severe storm damage results in demolition of Harbour baths Revision of Manly Planning Scheme; Ferry service becomes State-owned; Ferry <i>South Steyne</i> burnt out in a fire
1979	Corso pedestrianised
1982	Launch of "Freshwater" (March);
1988	Spit to Manly walkway opened; Sept – Local Environmental Plan gazetted
1989	Redevelopment of Manly Wharf
1990	First precinct committee meetings; JetCats enter service; Manly Wharf upgrade; North Head sewage outfall switched on;
1996	Environmental levy imposed
2005	Corso and Wharf 150 th Anniversary
2006	Start of Corso Upgrade;
2008	Corso Upgrade completed
2009	JetCats ceased; Fast Ferry introduced

4.2.2 Social Values

Social values are linked community's willingness to participate in consultation. More than 89 survey forms were returned with comments, suggestions for the desired management of Manly Cove. People recognise the area as public land for the enjoyment of the local community and visitors and value being able to provide input into the future direction and management of the area.

4.2.3 Cultural Values

Cultural values are associated with the Manly Cove's indigenous and non-indigenous heritage and the identification of significant Aboriginal sites. The entire Manly Cove study area was used extensively by the Aboriginals, known locally as the Gayemal clan of the Guringai tribe, who spent much of their time on the



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foreshores of Sydney Harbour (AHO, 2008). The Aboriginal Heritage Office has recorded a number of Aboriginal sites within the study area.

A list of heritage items of the study area is presented in Section 9.4.

4.2.4 Ecological Values

Ecological values are associated with the protection and improvement of aquatic, inter-tidal and terrestrial environments. These include marine habitat, intertidal habitat, mixed rocky intertidal with sand, sandy beaches, sea grass beds, urban bush lands and reserves and wetlands. The consultation process identified that the community highly values the preservation of natural bushland, seagrass and water quality. The Manly Cove study area supports habitats of regional and state conservation value including species and communities listed under the *Threatened Species Conservation Act 1995*, *Environment Protection and Biodiversity Conservation Act 1999*, *Fisheries Management Act 1994*, and/or State Environmental Planning Policies.

4.2.5 Aesthetic Values

Aesthetic values are often associated with a pleasant, appropriate and 'green' landscape character. For example the consultation process identified that the community values the more natural characteristics of the area. Esplanade Park and the Manly Cove boating precinct hold specific scenic value.

4.2.6 Recreational Values

Recreational values rely upon creating an enjoyable environment for all users, visitors and local residents. For example people value being able to undertake various recreational activities in public places, both on land and on/in water. The attraction of Manly Cove is enhanced by the ease of access to the study area and its generally good water quality. This results in numerous primary and secondary contact recreational pursuits, including swimming, sailing, kayaking, diving, sail boarding, and shore fishing. The foreshores around are also used for numerous recreational pursuits, including walking / jogging, dog exercise, bird watching, scenic enjoyment / nature appreciation and picnicking. Esplanade Park and the beaches of Manly Cove are popular recreational areas.

4.2.7 Economic Values

Economic values are associated with a number of economic activities. The area is important to a range of stakeholders, ranging from local retailers to commercial tourism operators, boating services, marinas and support industries.

In 2005 Council engaged the University of Western Sydney (UWS) Tourism for Healthy Futures Research Group to undertake an independent triple bottom line assessment on the effects of tourism in Manly, and the potential for ecotourism in Manly. Whilst the findings were a summation of information across the entire LGA, the information is applicable to the Manly Cove study area. The following information is extracted from the study report (UWS 2005).

Overall, the results suggest tourism is commonly perceived as beneficial to the Manly local economy but, that there are significant social problems and maintenance of the environment with the pressure of high human use comes at a considerable cost to Council and community. The most significant social problems are associated with vehicle use affecting access, traffic, parking and congestion. While some 50% of visitors to Manly arrive by car, and add considerably to congestion, local residents also account for pressure on the town centre as a popular place for recreation and social activity. This is followed by issues associated with health and well being such as security/safety and the effect of noise on local ambience. Late night drinking is singled out as a serious cause of impact on safety and noise levels. However, it is noteworthy that most people believe it is a problem caused by locals from nearby Northern Beach suburbs, and is not specifically a tourism issue. The most significant impact on the environment appeared to be direct damage to aquatic habitat caused by power boating and fishing. Less concern was expressed about other tourist activities on the environment. This may be



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because Council has already committed considerable expenditure in protecting habitats from litter, stormwater pollution and direct damage, though the high cost of achieving this through cleaning streets, beaches and facilities is regarded as a regular drain on local rates.

Analysis of the results suggests that sustainable coastal tourism has considerable potential as an extension of the existing profile of Manly as a tourism destination. However, care should be taken if the focus is extended to rare and endangered species, and some forms of ecotourism could actually increase pressure on certain habitats. It is likely there is very limited buffering capacity in the natural environment with an attendant high risk for breaching thresholds of harm. Many of the current tourism businesses, visitors and the destination profile of Manly do not match the nature-based character of ecotourism. Moving to ecotourism as recommended in the 1993 Tourism Plan of Management, would require a significant market shift in the orientation of business, the psychographic profile of the visitor and their stated preferences, and the iconic nature of Manly as a destination. There is much greater potential and strong business and community support for strategies that deliver environmentally and socially responsible tourism based on the current form of tourism. Therefore, recommendations of this UNSW report focus on sustainable coastal tourism. This will include elements of ecotourism, nature based tourism and cultural/heritage tourism.

There is a strong interest in the cultural heritage of Manly particularly linked to the built heritage, nostalgia and history of the place as a recreational site and to the harbour and ferry transport. While currently relatively unexplored, there is also good potential for elements of Indigenous tourism to be developed given the rich history of the area. A partnership with the Manly Art Gallery could see cultural tourism expand considerably into both Indigenous culture and beach culture. Local Traditional Owners would need to be interested and closely involved to ensure any such development was culturally appropriate. The current strengths of Manly such as walking, sightseeing, swimming /surfing and other beach activities could conceivably be part of an ecotourism profile, and a number of very good ecotourism products already exist. However, the majority of the current market is not ecotourism oriented.

The ferry ride to Manly, the beach and the aesthetic appeal of Manly's natural and built heritage are the key attractions to visitors (more than 90 percent of those surveyed). They are also the key to quality of life for residents who acknowledge that tourism allows them to enjoy a very regular ferry service and a cosmopolitan village atmosphere because of the large number of cafes and restaurants, many of which take advantage of ocean and harbour views.

The recent approval to increase the differential Council rates for businesses in Manly Town Centre will see the business sector making a much more significant contribution to the maintenance and presentation of The Corso and surrounds. Many residents would like to shift the focus of tourism off The Corso and the beach. This however has the potential to increase the social impacts and spread them to non commercial areas, rather than alleviate them.

There is opportunity for a strong environmental education component to be added to the current mix of activities at Manly. The rich natural and cultural heritage has significant potential to add to and extend the range of attractions for visitors.

Focusing on these assets can help to raise the awareness and appreciation of both locals and visitors to the importance of local heritage. Any educational resources are as much a resource to the local community as they are to visitors and local tourism businesses. Achieving this outcome may be possible through Council entities such as the Manly Environment Centre, Manly Art Gallery and the Visitor Information Centre in much more active partnerships

Commercial fishing had been one of the key economic activities of the study area but has remained banned since October 2006. However, recreation fishing is allowed with some restrictions. NSW Fisheries has carried out a recreational fishing survey of NSW (I & I NSW, 2002), which indicates that there are almost half a million recreational anglers in Sydney, many of whom would utilise the area from time to time. Total expenditure of Sydney recreational anglers could be in the order of \$150 - \$250 million per year. Manly is a visitor's destination in Australia and attracts approximately 6 million visitors per year. It has very positive impact on local economy. Recently, attention has been drawn towards ecotourism to market natural, heritage and cultural showcases

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existing in Manly and selling 'Manly – more than a beach'. The Manly Cove area offers many opportunities for touristic visitation.

4.2.8 Physical Values

Physical values associated with coastal foreshore and processes. For example residents and visitors value being able to access and experience the foreshore and associated views. Values associated with effectively maintained infrastructure and services. For example people identify that well maintained facilities and services contribute to the experience of the area.

4.2.9 Sustainable Use Values

Values associated with the sustainable use and management of resources, lands and the marine area. The consultation identified that the community would like to ensure that the area be used and managed in a way that will ensure that these values are preserved in the future.

4.2.10 Accessibility Values

Accessibility values associated with convenient access to all public areas. For example people value the ability for all people to access and enjoy the area.

4.2.11 Lifestyle Values

Lifestyle values associated with a safe environment. For example people value being able to enjoy the area knowing that it is safe and will not affect their health

5. COASTAL PROCESSES

Coastal lands are exposed to never ending attack by the sea, the atmosphere and coastal rivers. The waves, increased water levels and winds associated with storms, together with coastal currents and rivers debouching into coastal waters, reshape beaches and shift beach sediments offshore, onshore and atmosphere. This section looks at various coastal processes along with background information on geological settings.

Patterson Britton and Partners were commissioned to undertake a Coastline Hazard Definition Study for the Manly Cove study area to identify coastal processes and define coastline hazards. The study was undertaken in accordance with the Coastline Management Manual (NSW Government 1990) and the Coastline Hazards Policy (NSW Government 1988).

This section of the CMP is a summary of the technical details of the Coastline Hazard Definition Study. However, this section should not be used in isolation, and should be read with close reference to the Davis Marina to Manly Point Coastline Hazard Definition Study report (Patterson Britton & Partners, 2004).

5.1 GEOLOGICAL SETTING & SOILS

Sydney Harbour is made up of mostly sandstone and shale formed during the Triassic period (about 220 million years ago). These formations were later raised to their present heights by earth movements, starting in the Jurassic period, (200 million years ago). During this time great cracks formed and molten lava rose up through the rocks to form volcanic vents, these then cooled and hardened to form dykes of basalt. Remains of basalt dykes can still be found around North Head.

The Manly Cove area is predominantly Hawkesbury sandstone. Sandstone is a very hard rock that tends to break away in large blocks leaving the boulders and vertical cliffs that characterises the Sydney coastline.

Along some parts of the harbour there are some low lying areas of sand that has been deposited by water (alluvium) running between hills of sandstone. Particularly high areas such as North Head and South Head which were once islands are now joined to the mainland by sand spits such as the Corso area of Manly.

The sandstone and clays of the Sydney Basin were deposited as sediments during Permian and Triassic times, 275 to 180 million years ago. About 90 million years ago (Late Cretaceous), the Sydney Basin was uplifted and erosion of the softer top layers began, exposing the lower beds of sandstones. Sydney Harbour was once a valley, formed by stream erosion and subsequently inundated when sea level rose by about 100 metres at the end of the last Ice Age. Since that time the harbour has been gradually filling with deposits of mud, sand and silt.

The soils of the study Area are a result of weathering of the Hawkesbury and Narrabeen sandstone bedrock marine deposition and Aboriginal shell middens. These landscapes are Hawkesbury Colluvial (ha), Gynea Erosional (gy) and Woy Woy (ww). Mapping of the 1:100 000 map sheet by the Soil Conservation Service of NSW in 1989 identified three basic soil landscapes. These are described below (Skelton & White 2004).

Hawkesbury Colluvial (ha)

These soils cover the majority (approximately 85 %) of the terrestrial part of the study area. These soils are characterised by shallow, discontinuous lithosols/siliceous sands associated with rock outcrops, earthy sands, yellow earths and some yellow podsol soils on inside of rocky benches and along joints and fractures, localised yellow and red podsol soils associated with shale lenses, siliceous sands and secondary yellow earths along drainage lines. These soils are typically vulnerable to extreme soil erosion hazard, mass movement (rock fall) hazard, steep slopes, rock outcrops, shallow, stony, highly permeable soil and low soil fertility (Chapman and Murphy 1989).

Gynea Erosional (gy)

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These soils are characterised by shallow to moderately deep yellow earths and earthy sands on crests and inside of rocky benches, shallow siliceous sands on leading edges of rocky benches, localised gleyed podzolic soils on shale lenses, shallow to moderately deep siliceous sands and leached sands along drainage lines (Chapman and Murphy 1989). These soils are typically vulnerable to localised steep slopes, high soil erosion hazard, rock outcrop, shallow highly permeable soil and very low soil fertility.

Woy Woy (ww)

These soils are characterised by deep Siliceous Sands and occasional Podzols on sandy rises, Humus Podzols in poorly drained areas, Calcareous Sands near beaches (Chapman and Murphy 1989). These soils are typically have permanently high water tables, localised flooding, periodic waterlogging in depressions, very low to low soil fertility, localised areas of high soil erosion hazard.

5.2 ACID SULPHATE SOILS

Marine and estuarine sediments have the potential to contain acid sulphate soils. Planning for acid sulphate soils is addressed by Manly Council's LEP 1988. Map 5 of the LEP categorises Manly's soils from 1 to 5 (with class 5 soils having the least potential to be acid sulphate soils and the least impact if disturbed).

Acid sulphate soils occur when soils containing naturally occurring iron sulphide are dried and exposed to the air, usually as a result of human activity. In air, iron sulphides are oxidised and sulphuric acid is produced. This sulphuric acid has the potential to leach into the surrounding environment, where it can affect the health of waterways, groundwater, aquatic and terrestrial plants and animals, and also causes damage to engineering structures (Willing & Partners, 1999).

The study area is identified on Map 5 of the Manly LEP as exhibiting Class 4 or Class 5 land. Unless otherwise indicated by Council, consent is required for the carrying out of works as described in **Table 5.2**, and depicted in **Figure 5.2**.

Table 5.2 - Detail of land categorization for Potential Acid Sulphate Soils

Class of Land	Works
4	Works beyond 2 metres of the natural ground surface; Works by which the water table is likely to be lowered beyond 2 metres below natural ground surface.
5	Works within 500 metres of adjacent Class 1, 2, 3 or 4 land which are likely to lower the water table below 1 metre AHD on adjacent Class 1, 2, 3 or 4 land.



Figure 5.2 Potential Acid Sulphate Soils within Manly Cove Study Area

5.3 TOPOGRAPHY & BATHYMETRY

The study area is characterized by natural and cut sandstone cliffs and escarpments with fringing native bushland pockets and landscaped areas along the Esplanade Reserves. The study area has gradual rise to an altitude of 36m with areas of considerable slope. This terrain has implications for stormwater management, public access to foreshores, erosion, and the potential for land slip.



Figure 5.3a Topography of the Manly Cove study area

The seabed of Manly Cove is relatively uniform in bathymetry and slopes down to a depth of 6.5 m



Figure 5.3b – Bathymetry of the Manly Cove

5.4 STORMS

Storms play an important role in determining the rate and magnitude of shoreline change. The most devastating storms to strike the NSW coastline since records began, in terms of erosion damage, is likely to be the May - June 1974 storms.

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PWD (1985) provides a history of the storms affecting the NSW coast between 1880 and 1980 and categorises storms in terms of offshore significant wave height³ and damage caused. Two categories of storms result in substantial coastal erosion; these are so-called categories X and A. Category X storms are extreme events that have significant offshore wave heights of greater than 6 m and are characterised by damage to coastal installations, severe erosion and disruption to shipping (PWD, 1985). Category A storms have significant offshore wave heights of between 5 and 6 m and are also characterised by erosion and damage to coastal installations and disruption to shipping (PWD, 1985).

Of particular interest is the occurrence of Category A and Category X storms during the period 1972 to 1975. Analysing the storm history over this period assists in understanding the behaviour of the beach observed from the photogrammetric analysis of available vertical aerial photography dated 28 April 1972 and 6 August 1975, in particular assessment of the storm erosion demand. A summary of the Category X and A storms presented in PWD (1985) over this period for the Central NSW Coast is set out below in **Table 5.4**.

Table 5.4 Category A and X Storms over the period 1972-1975

Date	Category
23 June 1972	A
20-21 February 1974	A
25-26 May 1974	X
8-14 June 1974	A
21-23 June 1975	A

5.5 ELEVATED WATER LEVELS

The still water level that occurs during a storm can be much higher than that experienced during calm weather. Other than astronomical tide, there are three components that can contribute to an elevated still water level during a storm; namely barometric setup, wind setup and wave setup.

Barometric setup is a localised rise in ocean level due to a reduction in atmospheric pressure. Wind setup is a result of strong onshore winds causing water to “pile-up” along the coast. Wave setup is an increase in still water level in the surf zone, i.e. inshore of where the waves break, due to a conversion of some of the kinetic energy of waves to potential energy. Individual waves cause temporary water level increases above the still water level due to the process of wave run up or uprush. The above components of elevated water levels at the times of storms are illustrated in **Figure 5.5**.

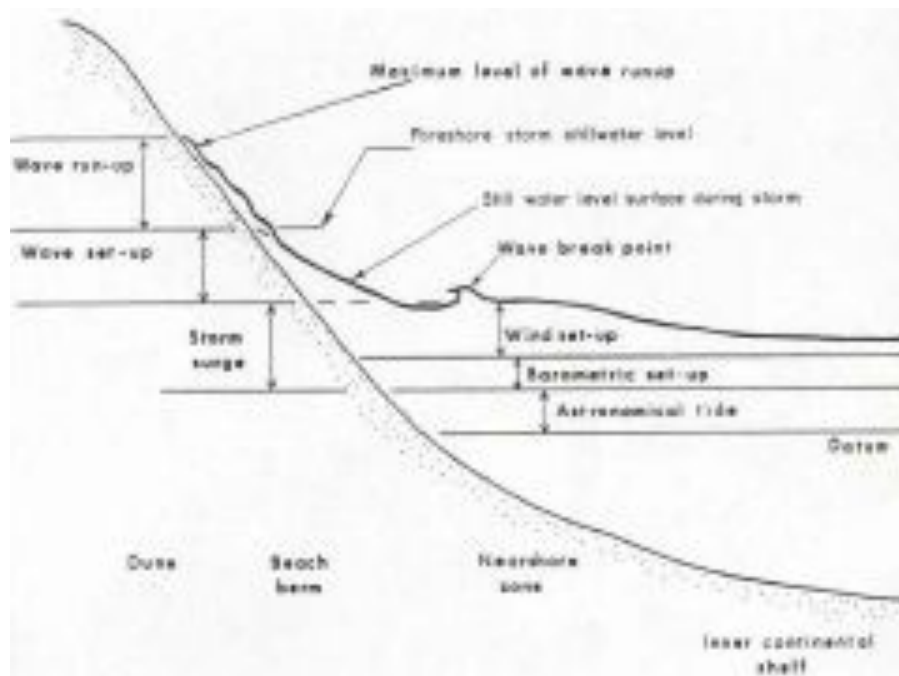


Figure 5.5 Components of elevated still water levels during storms

Source: Public Works Department

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Barometric setup, wind setup and wave setup are interrelated but are all independent of astronomical tide. Whether the peak of the storm coincides with high tide or low tide is a very significant factor in determining the level of erosion damage.

Tidal anomaly exceedances for Sydney for a range of Average Recurrence Intervals (ARIs) as reported in WRL (2003) are set out in **Table 5.5**. Tidal anomaly refers to the difference between the actual recorded water level at a tidal gauge and the predicted astronomical tide. It is a measure of storm surge (*where the tidal gauge is situated such as not to be influenced by wave setup*). In this case the tidal anomalies are based on analysis of 76 to 88 years of data from the Fort Denison tide gauge.

Information on water levels (in the absence of waves) has been recorded at Fort Denison, Sydney Harbour for more than 100 years. The data recorded from 1914 onwards is considered reliable. Based on a joint probability analysis of tide and storm surge (assumed as independently occurring events), for the 1914 to 1991 data set, MHL (1997) predicted that the 100 year, 50 year and 20 year Average Recurrence Interval (ARI) water levels at Fort Denison were 1.49m, 1.46m and 1.41m AHD (i.e. above mean sea level) respectively. The highest recorded water level at Fort Denison was 1.48 AHD in May 1974.

A wave refraction analysis for Manly Cove was undertaken by Lawson and Treloar in 1998 for various water levels between 0.3 and 2.7m above Indian Spring Low Water (ISLW). The analysis, which determined wave coefficients for varying wave periods and directions, showed that a maximum significant wave height at Manly Wharf for an ARI of 100 years and a maximum elevated water level of 2.7 m ISLW was 0.85 m.

This value has been used to determine the wave set up near Manly Wharf and thus the extreme water level. The predicted extreme water level in a 100 ARI event including astronomical tide, storm surge and wave setup is estimated to be approximately 1.8m above Australian Height Datum (AHD). AHD corresponds approximately to Mean Sea Level. As previously state, the wave height and thus the elevated water level would be expected to be slightly higher in Manly Cove West and slightly lower in Manly Cove East.

Table 5.5 Extreme Water Level and Tidal Anomaly Exceedances

ARI (yrs)	Positive Tidal Anomaly (m)	Water Level (m AHD) excluding wave setup	Offshore Hs (m)	Hs at Manly Cove Beaches (m)*	Wave setup based on 15% of Hs (m)	Water Level (m AHD) including 15% wave setup
1	0.48	1.28	5.8	2.03	0.30	1.58
2	0.52	1.31	6.4	2.24	0.34	1.65
5	0.54	1.36	7.2	2.52	0.38	1.74
10	0.56	1.39	7.8	2.73	0.41	1.80
20	0.57	1.43	8.4	2.94	0.44	1.87
50	0.59	1.47	9.3	3.26	0.49	1.96
100	0.61	1.50	9.8	3.43	0.51	2.01

* Based on a refraction coefficient of 0.35

Source: WRL (2003) for tidal anomaly and offshore significant wave height.

5.6 WAVE CLIMATE

The wave climates at Manly Cove East and West beaches are composed of a combination of wind and boat generated waves and swell penetrating from the ocean.

5.6.1 Wind Waves

Wind waves result from wind blowing across the water surface. The height and period are dependant upon the speed, duration and direction of wind, the length of water (or fetch) over which the wind blows and the water depth.

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Manly Cove is generally fairly exposed to wind generated waves from the south-south west. Based on the Shore Protection Manual wave hindcast methods (PBP, 2004), and using an estimated fetch distance to Shark Island, Patterson Britton & Partners established the following wave climate data.

Table 5.6.1 Wind Generated Significant Wave Heights

Direction of Wind	Fetch Length (km)	Significant Wave Height (m)		
		Return Period		
		Annual	1 in 10 yr	1 in 50 yr
South-South west	6.5	1.0	1.3	1.5

5.6.2 Boat Generated Waves

Boat wakes are generated by vessels sailing or steaming across the harbour and bay. The size of the wave generated at the site is a function of the speed of travel of the vessel, displacement and hull shape of the vessel, and the distance of the site from the vessel's sailing line.

Field measurements of boat wakes for various types of vessels have been recorded by the Water Research Laboratory of the University of New South Wales, the Sydney Ports Corporation, and Patterson Britton and Partners (PBP) at various locations in New South Wales. A summary of the maximum wave height and corresponding wave period measured close to the vessels' sailing lines are summarised in **Table 5.6.2**.

Table 5.6.2 Measured Boat Wake Waves for Various Vessel Types

Vessel Type	Maximum Wave Height (m)	Wave Period (sec)
Sydney Ferries (excluding catamaran type)	0.4	2.2
Rivercat	0.3	7.0
Water Taxis	0.5	2.2
15m Motor Cruiser	0.8	3.6
13m Tug	0.8	1.4
Power Boat	0.4	2.0

Although no measurements were taken for JetCats operations Patterson Britton & Partners estimate the maximum wave height expected to be generated by these vessels would not be expected to exceed 0.6m at a distance of 50m from the sailing line.

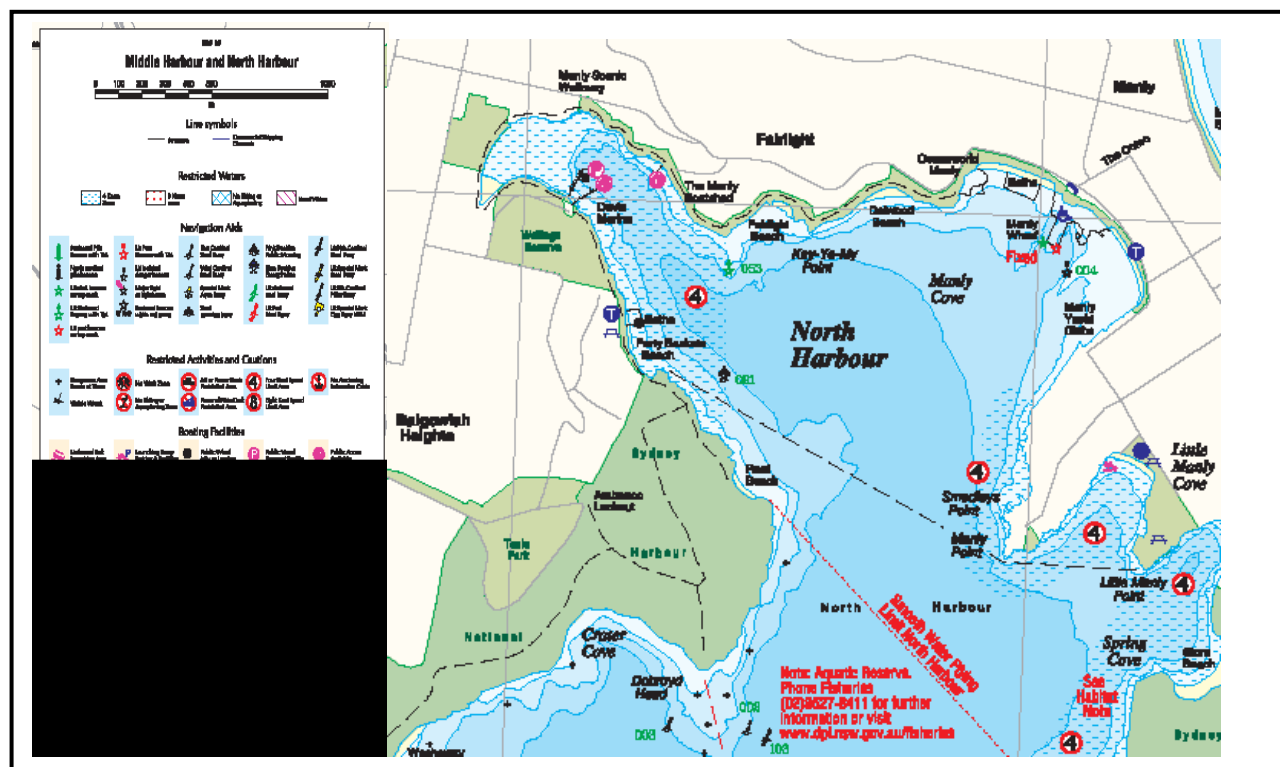
The predominant vessel wave action experienced along the Manly Cove foreshore is considered to be derived from the Manly JetCats. At its closest point, the JetCats route is approximately 200m from the Manly Cove beaches. The vessel generated wave height would not be expected to exceed 0.8m. Recently, JetCats have been replaced by privately run FastFerry.

To manage this large amount of boat traffic, there is boating restrictions in place (**see Figure 5.6.2**) that in theory should minimise the effects of boat generated waves for certain parts of the study area.

Boat wakes are generated by vessels travelling across a water body. The size of the wave generated at the site is a function of the speed of travel of the vessel, displacement and hull shape of the vessel and the distance of the site from the vessels "sailing" line (PBP, 2004). Boat waves are generally highest when a vessel is accelerating or decelerating as ferries do in the waters adjacent to Manly Wharf.

A small portion of the Manly Cove embayment is subject to speed controls for boating. A four (4) knot speed limit exists from the foreshore between Stuart Street south to Manly Point and extending 100 metres offshore from the MHW. This speed zone also lies adjacent to the area designated as Critical Habitat for Manly's Little Penguin Population. Assigned by NSW Maritime the designated 4-knot zones assist with the protection of seagrass beds and address safety concerns of passive foreshore user groups. Figure 10 identifies existing speed zones for the study area.

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Source: NSW Maritime, 2006

Figure 5.6.2 Boating Restrictions within the Study Area

Stakeholders and community have identified the regular movement of Sydney Ferries and JetCats as having significant impact on the day-to-day activities conducted on the eastern foreshores. The wake generated by these vessels is found to create considerable wave heights resulting in increased noise and wash and unsafe conditions for passive recreational users, particularly during high tidal conditions.

In addition, the wash created by vessels berthing and leaving the western side of Manly Wharf has been found to increase strain on the south-eastern portion of the netted swimming enclosure which has the potential to result in structural damage to this structure.

With two commercial kayak operations and various sailing activities operating within the study area, conflict has arisen between passive recreation and ferry/JetCat movements. While operators are aware of the danger posed from regular activity of commuter vessels, it is recommended that Council encourage Sydney Ferries to implement a system which alerts users of Manly Cove prior to any vessel travelling south from Manly Wharf. One option presented during consultation is the erection of a warning beacon which alerts waterway users prior to the departure of ferries/JetCats from Manly Wharf. Conflict has also arisen due the absence of a public wharf facility and the subsequent inability for recreational vessels to pick up and drop off passengers and supplies.

5.6.3 Ocean Swell Waves

Manly Cove East and West Beaches are directly affected by refracted ocean swells through Sydney Heads. During extreme events, elevated ocean levels due to storm surge in combination with wave diffraction (*i.e. bending of waves around an island or headland*) and refraction can result in low height long wave period ocean swells reaching the beaches.

Foster *et. al* (1975) noted that a feature of the May-June 1974 storms was the severe damage experienced within Sydney Harbour at Balmoral and Manly Cove. They argued that the wave climate could not have resulted from short period seas generated within the harbour, yet theoretical analysis (*which at the time did not allow for*

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the combination of refraction and diffraction around a headland) could not predict the conditions that must have occurred. Through analysis of vertical aerial photographs taken during subsequent storms in August 1974 they were able to construct refraction/diffraction diagrams for Sydney Harbour. This analysis showed significantly higher wave heights in the lee of the headlands as a result of wave diffraction and refraction acting together.

In **Table 5.6.3** it was noted that the 100 year ARI significant wave height offshore is 9.8 m (WRL, 2003). A wave refraction analysis for Manly Cove East was undertaken for various water levels between 0.3m to 2.7m above ISLW (Lawson & Treloar 1988). This analysis determined wave coefficients for varying wave periods and directions. The analysis showed that virtually no swell wave energy can reach the site at low water (0.3m ISLW). The wave coefficients determined for long period (10.5 second) swell waves at a water level of 2.7m ISLW were in the order of 0.11. The probability of Exceedances plot prepared from this analysis shows that the maximum significant wave height at Manly Wharf for an ARI of 100 years and maximum elevated water level of 2.7m ISLW was 0.85m. On the basis of this plot Table 5.7.3 identifies the frequency of swell waves heights expected at Manly Cove East and West Beaches.

Table 5.6.3 Frequency of swell wave heights at Manly Cove

Total no. of days/annum wave height exceeded	Significant Wave height (m)
1	0.5
5	0.4
10	0.3
20	0.3
50	0.2

It is expected that Manly Cove West would experience a significant wave height slightly greater than these values and Manly Cove East slightly lower significant wave heights due to the relative exposure of the two beaches.

5.6.4 Overall Wave Climate

Waves in Manly Cove beaches generally occur as a result of a combination of ocean swell entering the harbour during storm events and local wind conditions generating wind waves from the south-south-west direction (PBP 2004).

While no joint probability data exists for the combined occurrence of both wind and swell waves in the harbour, Patterson Britton and Partners estimate that a combined wind wave and swell wave having a return period of about 100 years would have a breaking wave height of approximately 2 m at Manly Cove West and slightly smaller in Manly Cove East. The most severe combination for beach erosion considerations would be the combination of large ocean swell waves and moderate wind waves.

5.7 WAVE INDUCED CURRENTS

The most common forms of wave induced currents are longshore currents and rip currents. Longshore currents occur within the breaker zone and move essentially parallel to the shoreline, they are usually generated by waves breaking at an angle to the shoreline. These currents cause movement of sediment along the shoreline, commonly referred to as littoral drift. Due to the variability in wave approach direction at most open coast beaches, there may be times when the littoral drift is in one direction and at other times when it is in the opposite direction. At harbour beaches subject to ocean swell, such as the Manly Cove Beaches, the degree of filtering of wave approach direction which occurs is such that a wide range of wave approach directions is not possible.

A variety of studies conducted within the study area have concluded that tidal currents in Manly Cove would be expected to be low. Tidal modelling undertaken by Lawson and Treloar (Lawson & Treloar, 1988) for a 1.3m spring tide showed tidal velocities of between 2 and 4 mm/s which are considered negligible.

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Lawson and Treloar also noted that the occurrence of infrequent harbour seiching, the reflection and amplification of long period waves across the harbour, can interfere with ferry operations at Manly Wharf. These long period waves can also potentially influence sediment transport in the Cove due to the higher velocities created in shallow water.

5.8 SEDIMENT BUDGET

A number of investigations have been conducted on sediment budgets within the Manly Cove study area noting that the redevelopment of the Manly Pier in 1988 contributed to the division of Manly Cove into two separate compartments east and west of the wharf, and that there is now no natural sand movement from west to east along the beach, underneath or around the wharf (MHL 1997a & b, 2002).

A sediment budget of Manly Cove East was undertaken using a variety of techniques including an assessment of stormwater flows and sediment loads, hydrographic surveys and PAV analysis (MHL, 1997a & b). The sediment budget analysis showed a slight decrease in total sand volumes since the redevelopment of the wharf in 1988. The following redistribution of sand was noted to have occurred:

- the east and western areas of Manly Cove are discrete compartments with little or no sand traveling between them;
- within East Manly Cove, the sand is generally transported from west to east along the beach;
- artificial beach nourishment has been undertaken on the eastern beach at the following times: 1500m³ in 1989, 1500m³ in 1991 and 500m³ in 1992;
- since 1978 there has been a realignment of East Manly Cove beach with loss of beach width at the western end and a larger increase in the beach width at the eastern end;
- this realignment is the result of a shadow area to the east of the Manly Wharf Jetty that was created when the wharf was redeveloped and the seawall at the back of the promenade was moved seaward when the steps were constructed on the eastern side of the new wharf;
- a review of vertical aerial photography taken between 1930 and 1996 concluded that there was a net gain of 500m³ in volume of beach sand between 1978 and 1996. A gain of 640m³ was apparent at the eastern end and a loss of 140m³ at the western end adjacent to the wharf. The net gain was determined to be solely due to beach nourishment.

Excluding sand nourishment, the assessment concluded that the total net change in volume of sediment in the defined area of the period of analysis was approximately zero, suggesting that the system is a closed system. A later report (MHL, 1997b) reiterates that the overall coastal processes within Manly Cove East are "largely in balance". Manly Cove East Beach and Manly Cove West Beach are largely closed sediment systems based on a number of factors:

- the Manly Cove Beaches are discontinuous at each end due to the existence of Oceanworld, Manly Wharf and the seawall at the far eastern end of the Cove. These features extend a minimum of 50 m out from the beach, and it is unlikely there is any significant littoral sand supply or loss;
- the Manly Cove beaches are truncated by a seawall along their full length and as there are no dune systems there is subsequently no loss or gain of sand across the back beach boundaries;
- the results of photogrammetric analysis of historical vertical aerial photography indicate that there have been generally only minor changes in beach volume over the period of available record.

5.9 SHORT TERM ONSHORE/OFFSHORE SAND MOVEMENT – STORM DEMAND

5.9.1 General

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Onshore/offshore sediment movement is caused by natural variations in the wave climate. The offshore movement of sediment is usually referred to as storm erosion. This movement of sediment results in short term fluctuations in the width of the beach profile. The issue of offshore sediment movement is much more prevalent for open coast beaches than those within Sydney Harbour, however, the Manly Cove study area was severely affected during the May-June 1974 storms.

During storms, the beach is cut by storm waves with beach sand moving offshore to form bars in the surf zone. This process typically occurs over a period of hours to days. When extended periods of calmer waves occur, the material held within these bars migrates back onshore to rebuild the beach berm. Depending upon the magnitude of the preceding storm, this beach building process can occur over a time scale of days to years.

Then depth of the active profile, or closure depth, is the discernable offshore limit of significant bathymetric change. For the beaches of Manly Cove, which are sheltered harbour beaches subject to ocean swell, the closure depth would be approximately -3 m AHD. Significant offshore/onshore movement of sediment is restricted to shallower depths above this contour.

The amount of sediment which can be removed from a beach during a storm event (and transported offshore) is referred to as the "storm demand". This quantity is generally measured above 0m AHD and is usually expressed as a volume per metre length of beach (m^3/m). Knowledge of the storm demand for a beach allows for an estimation of the amount of material required to be held in reserve for a storm in order to protect a given asset. It also allows estimation of the degree to which a beach would be eroded or cut back in a storm for a given pre-storm beach profile.

The reason for storm demand being measured above 0 m AHD reflects the way in which the data to describe storm demand has been obtained, which is generally through survey or photogrammetric techniques where a specific portion of beach above Mean Sea Level is either considered or is visible.

At any location, at any point in time, the storm demand is dependant upon a number of variables including:

- wave height and period as well as the duration of the storm;
- state of the beach before the storm;
- direction of the storm relative to the orientation of the beach;
- magnitude of the storm surge accompanying the event;
- the amount of wave setup and run-up on the beach during and immediately following the storm;
- tidal range at the time of the storm; and
- state of the tide at the peak of the storm.

Because the actual storm demand is a complex function of these variables, it is usual to express the storm demand in terms of an Average Recurrence Interval, i.e. storm demand for a 1 in 50 year event, 1 in 100 year event etc. In the preparation of the Manly Cove CMP consultants were requested to provide estimates of storm demand based on a 1 in 100 year ARI storm event.

A Profile Area Volume (PAV) analysis of the historical beach profiles established by photogrammetry was undertaken by the then Department of Land & Water conservation and supplied to Patterson Britton and Partners for interpretation as part of the Davis Marina to Manly Point Coastline Hazards Definition Study. A similar assessment of beach behaviour during storms was undertaken by MHL in 1997.

The beach erosion/recovery volumes found for the Manly Cove Beaches are generally low. This is expected due to the protection from direct ocean swell waves afforded to the beaches by North Head and Manly Point. It is recommended that a storm demand value of up to $20 \text{ m}^3/\text{m}$ be adopted for Manly Cove East Beach and a value of 20 to $30 \text{ m}^3/\text{m}$ be adopted for Manly Cove West Beach for a 100 year average recurrence interval event (PBP 2004).

5.9.2 Manly Cove East and West Beaches

A Profile Area Volume (PAV) analysis of the historical beach profiles established by photogrammetry³ was undertaken by the then Department of Land and Water Conservation (DLWC) and supplied to Patterson Britton for interpretation as part of the Davis Marina to Manly Point hazard definition study.

Interpretation of DLWC PAV Analysis

By comparing the sub aerial beach volumes, i.e. volumes above 0 m AHD, before and after the 1974 storms it is possible to make some assessment of the storm demand in extreme events. Variations in storm demand along the beach can also be determined in this manner. It needs to be recognised of course that photography is not always available immediately before and immediately after a storm. Hence some judgement is applied to measure erosion volumes before design values are adopted for storm demand.

The only available date of photography before the 1974 storms for Blocks 1 and 2 was May 1951. This is too far before the storm period to provide a realistic storm demand volume. It is therefore not possible to determine a storm demand for Manly Cove West by comparing sand volumes before and after the 1974 storms. The earliest date of photography after the 1974 storms for Blocks 1 and 2 is 19/06/1974 (directly after the May-June 1974 storm event).

Alternate means have therefore been used to quantify an approximate storm demand for Manly Cove West. The 1978 profile was used to compare with the eroded 1974 profile as 1978 was the most recent date of photography following 1974. It was noted, however, that there was a category 'A' storm between the 28th and 30th January 1978 just prior to the 1978 photograph taken on the 12th February. The recovery values determined are therefore lower than the potential recovery that would have occurred prior to this storm. Between 1974 and 1978 the average recovery was 4.1m³/m in Blocks 1 and 2 combined.

Similarly for Manly Cove East, the earliest photography available in sufficient accuracy for Block 4 is 19/06/1974 (after May-June 1974 storm events). Again, the 1978 profile was used to compare with the eroded 1974 profile. For Manly Cove East it would also be reasonable to assume that the storm demand volume would not exceed that determined for Manly Cove West due to the more sheltered nature of the eastern beach. It should be noted that Block 3 was excluded completely from the Manly Cove East analysis as three of the profiles were located beneath Manly Wharf and sand levels in the remaining three profiles were well below 0 m AHD.

A summary of the post 1974 beach recovery calculated on a block average basis in the PAV analysis is presented below in **Table 5.9.2**. The maximum beach recovery volume calculated at an individual beach profile is also given

Table 5.9.2 1974 Storm Demand Calculated from PAV Photogrammetric Analysis

Location	Block	Dates	Average Storm Demand (m ³ /m)	Maximum Storm Demand (m ³ /m)
MC West Beach	1 & 2	1974-1978	4.1	7.7
MC East Beach	4	1974-1978	0.8	3.1

The beach recovery volumes found for the Manly Cove Beaches are generally low. A slight accretion was actually found for Fairlight Beach based on the available dates of photography. This is expected due to the protection from direct ocean swell waves afforded to the beaches by North Head and Manly Point.

³ The photogrammetric plotting for the Manly Cove Beaches was undertaken by the then Department of Land and Water Conservation using vertical aerial photography dating from 1951 to 2001. At Manly Cove West Beach, cross-shore beach profiles were prepared at six locations (50 m centres). These six profiles are known as Blocks 1 and 2. At Manly Cove East Beach, cross-shore beach profiles were prepared at sixteen locations (20 m centres). These sixteen profiles are known as Blocks 3 and 4.

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In arriving at recommended values for storm demand it is useful to determine the “available beach volume” along Manly Cove Beaches. In certain circumstances, this volume can be used to infer limits on the storm demand, e.g.:

- in situations where a seawall exists which could fail if all the sand was lost but which has not done so in the available historical record (*inclusive of severe storms*). This could suggest the storm demand is less than the available sand volume on the beach determined from the historical record;
- in situations where historical photographs exist showing evidence of all sand being lost from a beach after severe storms, for example underlying bedrock exposed. This could suggest the available sand volume on the beach is less than the storm demand.

There is a seawall which runs along the length of Manly Cove East and West Beaches which is believed to have been constructed around 1900. Since its construction the Manly Cove seawalls have experienced storm damage and have required repair work on a number of occasions. Though some of the seawall damage was limited to capping stones, data indicates that a damaging storm affects Manly Cove Beach on average once every 12 years (PB&P 2004).

It is recommended that a storm demand value of up to 20 m³/m be adopted for Manly Cove East Beach and a value of 20 to 30 m³/m be adopted for Manly Cove West Beach for a 100 year average recurrence interval event (PB&P 2004).

5.10 LONGER TERM SAND MOVEMENT

5.10.1 General

Longer term sand movement at Manly Cove Beaches has been examined using the results of the DLWC Profile Area Volume (PAV) analysis, by considering the changes in volume of sand above AHD on the beaches over time between the first and last dates of photography.

The interpretation of the information is subject to a number of factors; for example, the relatively short period of the historical data (*it is implicitly assumed that coastal processes over this period are representative of the longer term situation*), the frequency and severity of storms over the time span for which the volume changes were measured, the fluctuations in sand volumes due to storms which can often mask longer term trends, and the influence of sea level rise which causes a reduction in the volume of sand above AHD and which has been operative over the period of the photographic record.

5.10.2 Interpretation of PAV Analysis

Longer term sand movement at Manly Cove Beaches has been examined using the results of the DLWC Profile Area Volume (PAV) analysis, by considering the changes in volume of sand above AHD on the beaches over time between the first and last dates of available photography. More detailed information, including beach profile plots can be found in the *Davis Marina to Manly Point Coastline Hazard Definition Study* (PBP, 2004).

As erosion and accretion rates are known to vary across the length of beaches, Manly Cove Beaches were divided into 4 blocks with a number of individual profiles measured within each.

The plot for Blocks 1 and 2 of Manly Cove West Beach identify erosion in 1974, followed by a phase of beach recovery until 1978. Further erosion then occurred until 1993 when gradual beach recovery began and continued until 2001. In overall terms, for the period 1951 to 2001, Manly Cove West Beach underwent slight erosion with a total sand loss of approximately 5.4 m³/m.

The plot for Block 4 of Manly Cove East Beach shows beach recovery from 1974 until 1996, after which erosion occurred until 2001. In overall terms, for the period 1951 to 2001 this area of beach underwent slight accretion. The total gain of sand between 1974 and 2001 was approximately 3.3 m³/m. This overall gain is comprised of a large gain at the eastern end of the beach and a loss at the western end of Block 4. Block 3, which is located

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immediately to the east of Manly Wharf, could not be included in the analysis due to the low sand levels (below 0 m AHD). The overall accretion in Block 4 can be accounted for by the artificial beach nourishment that also occurred during this period.

The following would appear evident for Manly Cove East Beach:

- nourishment sand placed on the sub aerial portion each at the western end of Manly Cove East is redistributed relatively quickly alongshore to the east and offshore to the bed of the Cove as it readjusts to its natural plan form alignment and cross-shore profile. In particular, Profiles 7-10 of Block 4 at the eastern end of the beachfront indicate a large accumulation of nourishment material over the subaqueous portion of the beach profiles, potentially consistent with the measured subaerial loss rates;
- the natural beach alignment and width have undergone relatively little change over a long period of time (MHL, 1997), although there probably has been some realignment associated with the Manly Wharf development;
- any further nourishment sand is likely to respond in a similar way to previous nourishment campaigns unless structures are introduced to restrict movement of the nourishment sand or sufficiently large quantities of sand are placed on the beach to nourish the full cross-shore profile and to build out the beach over its full length (in a similar planform alignment).

5.11 AEOLIAN (WIND) SAND MOVEMENT

Aeolian sand movement occurs when dry sand is entrained by aeolian (wind) processes and transported into the back beach area. The Manly Cove beaches are generally well sheltered from most directions with the exception of winds emanating from the south-western sector. The beach is backed by a high seawall (height above sand varies between 1 to 2.5 m) with the exception of the stepped area at the eastern end of Manly Cove East where the sand has been pushed up towards the steps by the sand raking machine to allow for easy access. There would, therefore, appear to be negligible sand loss from either of these beaches through aeolian sand movement.

5.12 STORMWATER RUNOFF

Stormwater within the study area flows through artificial drainage networks. The hard artificial surfaces that stormwater travels over and through in urban environments greatly increases its velocity. These high velocity concentrated flows are then directed and released into bushland, watercourses or the foreshore. Often the end of the pipe is surrounded by soft surface material such as soil or sand, which is easily eroded by the large volumes of high velocity rainwater during a storm.

Manly Cove is a sheltered harbour beach and embayment which is located to the north of the entrance to Sydney Harbour. The surrounding Manly Cove sub-catchment occupies an area of 50.9 hectares, and has become highly developed since early settlement, with residential property being the predominant land-use.

The sub-catchments are generally small and steep with the exception of the Manly CBD which is relatively uniform in slope. All catchments are densely developed with expanses of open space adjoining the foreshore. Manly Cove has a diversity of natural significant values and includes endangered populations of Long-nosed Bandicoots and Little Penguins, isolated pockets of remnant bushland which provide important habitat for a range of species (much of which is declared as Critical Habitat for Little Penguins).

Evidence of the existence of a number of natural streams prior to human development has been identified in development of this study. More specifically a freshwater stream was known to exist in the North West corner of the study area which at one point ran through the existing Art Gallery Site. Another was thought to run into Manly Cove from the sub catchment in the vicinity of the existing 16 Foot Skiff Club. Anecdotal evidence further suggests that an intermittent stream once flowed along a line where Ashburner Street currently lies which is thought to have linked ocean and harbour receiving waters.

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Stormwater Drainage

The study area encompasses 12 sub catchments with a total of 15 stormwater outlets, each discharging into the receiving waters of Manly Cove (Refer to **Figure 5.12**). While much of the land use is comparable across the study area, the pollutant loads would vary considerably in the sub catchments centred on the commercial centre of Manly Corso and the Manly Wharf area.

Sub-Catchment MA-01 (**Figure 5.12.1**) collects the residential and street stormwater runoff for the area between Bruce Avenue, south along Addison Road to Manly Point. The drainage network commences at a the gully pit outside No. 10a Addison Road, travelling south then north-west to discharge onto the rocky foreshore adjacent to 17 Addison Road. This stormwater line includes two gully pits.

Three private chlorinated swimming pools are located within this sub-catchment, each being positioned on the rocky foreshore immediately bordered by the receiving waters of Manly Cove.

Residential properties are required by law to have their systems connected to the sewerage system due to the chlorine content and the effect on receiving waters. This practice adds considerable pressure on to the sewerage system, however provides the best option for local marine waters.

Land-use within this Sub-catchment MA-01 is predominantly residential which accounts for approximately 69.67 % of the total area. The remainder of this Sub-catchment is made up by Addison Road. There is currently no stormwater treatment devices located within this Sub-catchment.

Sub-catchment MA-02 (**Figure 5.12.2**) includes a small drainage network approximately 70 metres in length starting at the gully pit outside 6 Oyama Ave travelling north west to discharging at an outlet to the western corner of 9 Oyama Ave. This stormwater line includes two gully pits capturing road and residential run off.

This Sub-catchment is dominated by residential development which accounts for more than 92% of total land use. The remainder of usage by area is made up of the road surface of Oyama Avenue. This relatively small Sub-catchment does not have any stormwater treatment devices in place.

Sub-catchment MA-03 (**Figure 5.12.3**) has a stormwater network with two lines running into a single outlet point which is located to the north of 3 Oyama Avenue. The stormwater line splits in two directions with a total length of 115 metres between 2 Oyama Ave and 17 Cove Ave to the foreshore outlet. This stormwater line includes six gully pits capturing road and residential run off, land uses which account for 81% and 19% respectively. Sub-catchment MA-03 is also made up of residential and road land-uses with no gully pit inserts or other physical treatment devices currently in place.

Sub-catchments MA-04 and MA-05 (**Figures 5.12.4 and 5.12.5**) share a drainage network which discharges onto the foreshore adjacent to the south-west corner of the Manly 16 Foot Skiff Club. The stormwater line splits in two directions capturing road (20%) and residential (79%) runoff from the catchment flowing to the western end of Stuart Street and East Esplanade junction. The Sub-catchment has a small proportion of open space land use. This stormwater line includes six gully pits.

Sub-catchment MA-06 (**Figure 5.12.6**) includes a drainage network that collects runoff in the area between Addison Road, Osbourne Road and Wood Street. A majority (64%) of the sub-catchment is made up of residential land with road surfaces accounting for 28% of total area and the remaining 7% incorporates the open space of East Esplanade Reserve. The stormwater drainage network is relatively small and includes 3 gully pits flowing to an outlet on the rocky foreshore immediately to the northeast of the Manly Launch Club.



Figure 5.12 Stormwater Drainage Networks and Outfalls within the Manly Cove study area.

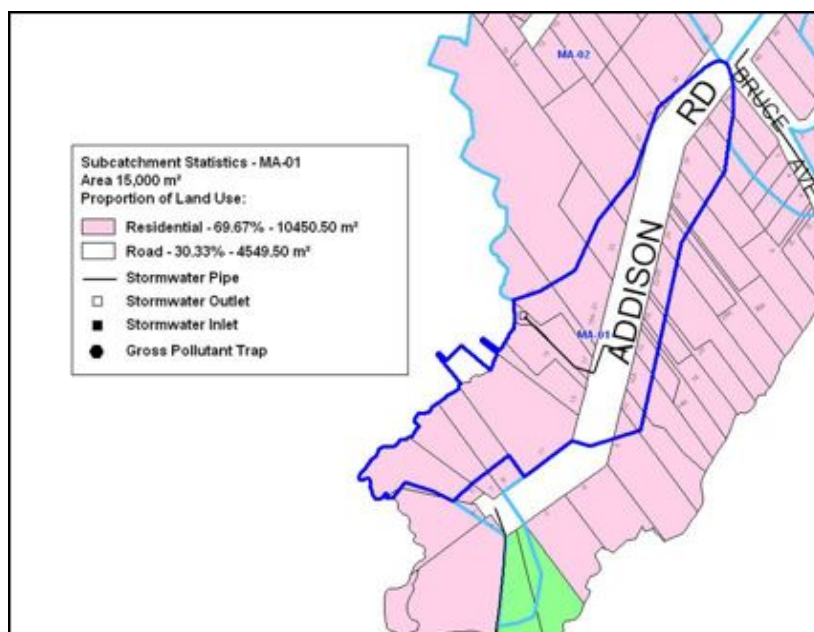


Figure 5.12.1 - Map of land use and stormwater system for Sub-catchment MA-01, Manly Cove.

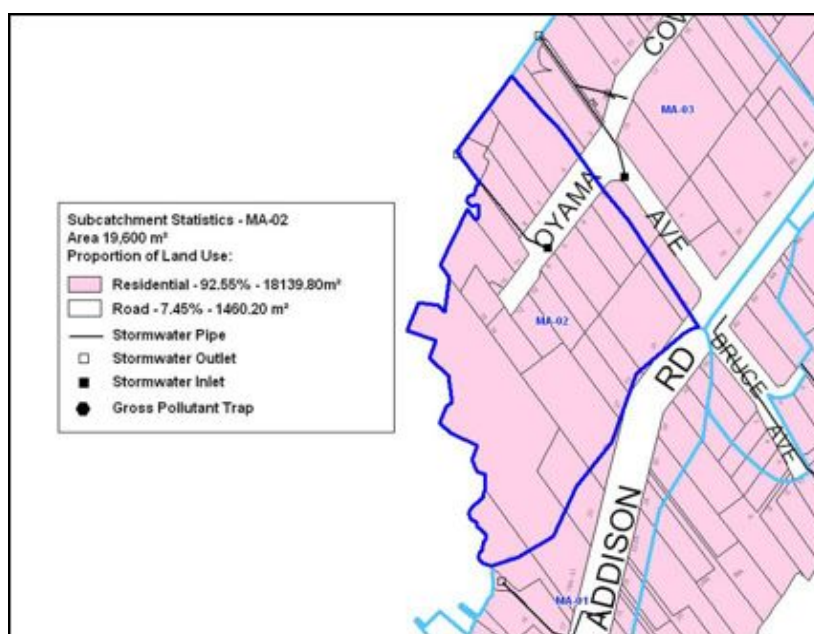


Figure 5.12.2 - Map of land use and stormwater system for Sub-catchment MA-02, Manly Cove

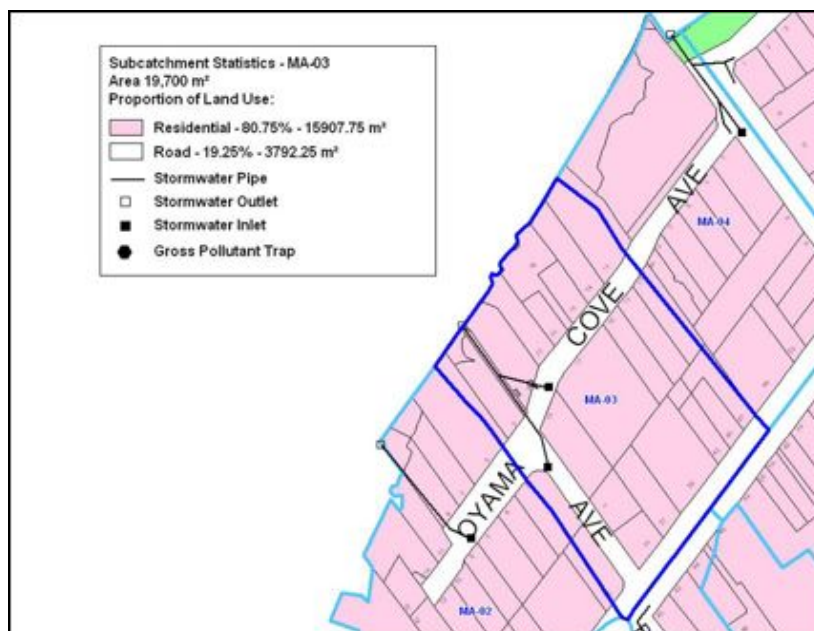


Figure 5.12.3 - Map of land use and stormwater system for Sub-catchment MA-03, Manly Cove

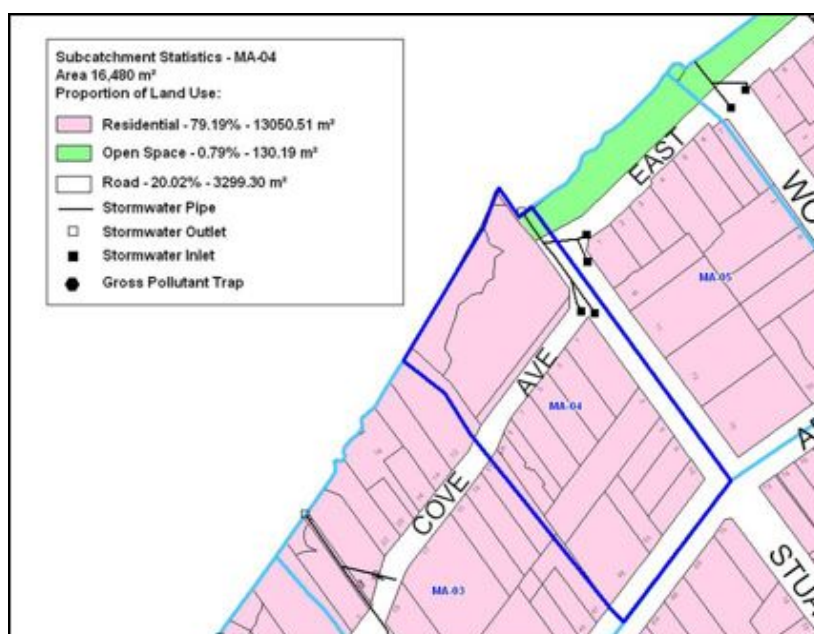


Figure 5.12.4 - Map of land use and stormwater system for Sub-catchment MA-04, Manly Cove



Figure 5.12.5 - Map of land use and stormwater system for Sub-catchment MA-05, Manly Cove

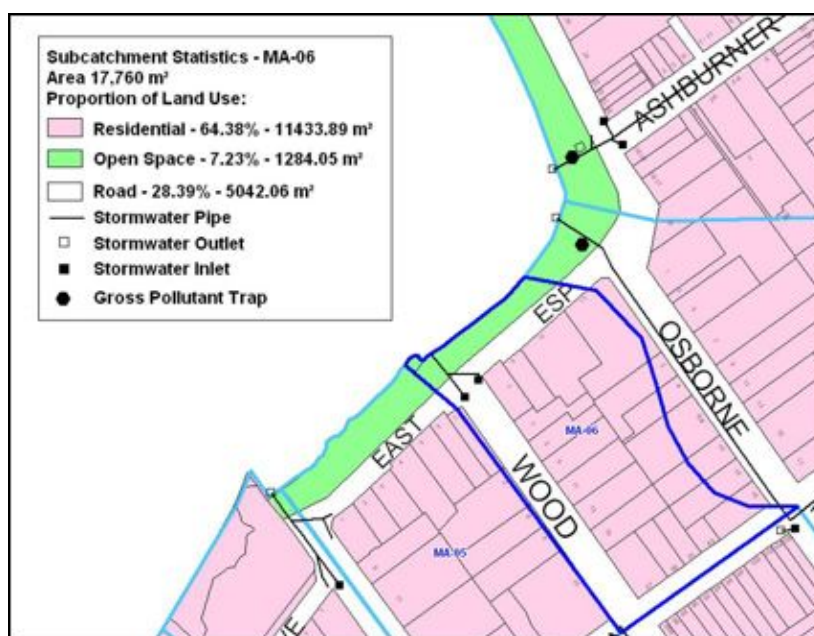


Figure 5.12.6 - Map of land use and stormwater system for Sub-catchment MA-06, Manly Cove

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Sub-catchment MA-07 (**Figure 5.12.7**) has one drainage line which starts at the Addison Road/High Street junction and flows down Osborne Street to an outlet that discharges onto the sandy beach in the eastern corner of Manly Cove beach (east). This stormwater line includes eight gully pits capturing road and residential run off which account for 72% and 25% respectively. The sub-catchment includes a small area of commercial land use and a gully pit set in the open space adjacent to the foreshore.



Figure 5.12.7 - Map of land use and stormwater system for Sub-catchment MA-07, Manly Cove

Sub-catchment MA-08 (**Figure 5.12.8**) houses a larger stormwater network which originates in two separate lines on Vivian Street. One stormwater line travels northwest from Vivian Street down the steep gradient of Darley Road where it turns southwest, along Ashburner Street to the discharge at the seawall in the eastern corner of Manly Cove beach (east). The second line directs flows from Vivian Street northwest along Fairybower Road to Addison Road to a junction on Darley Road. This stormwater network includes 24 gully pits capturing runoff from the road and residential land uses which make up 25% and 72% of total land use in the sub-catchment.



Figure 5.12.8 - Map of land use and stormwater system for Sub-catchment MA-08, Manly Cove

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Sub-catchment MA-09 (**Figure 5.12.9**) has a mix of land use types which include road (39%), commercial (34%), residential (18%) and open space (9%) of total area, capturing flow between Darley Road southwest along Victoria Parade to the outlet which discharges onto the beach at the Manly Cove east seawall. A total of five gully pits capture flows in this sub-catchment, with most located along Victoria Parade.



Figure 5.12.9 - Map of land use and stormwater system for Sub-catchment MA-09, Manly Cove

Sub-catchment MA-10 (**Figure 5.12.10**) encompasses a relatively small area of 3.1 hectares which is comprised of 54% road surfaces and 43% commercial land use. Residential area accounts for 18% of total area. The catchment includes East Esplanade, a portion of the Manly Wharf Forecourt and a commercial service lane. Eleven gully pits are located on this stormwater line discharging at 3 separate outlet points.

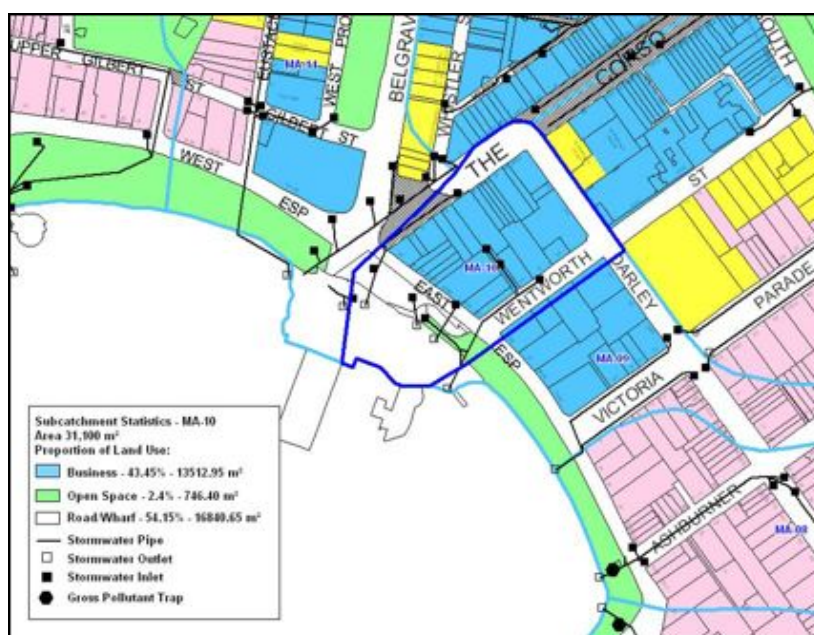
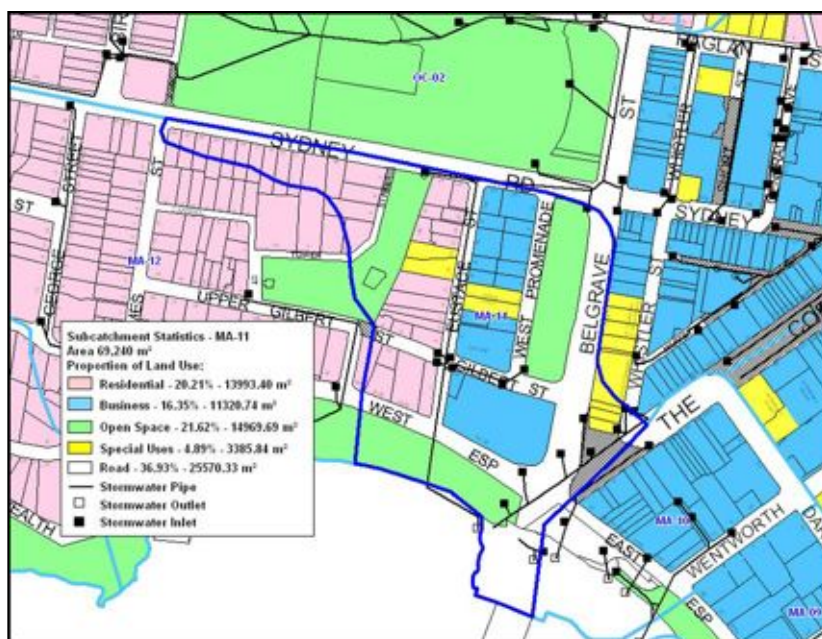


Figure 5.12.10 - Map of land use and stormwater system for Sub-catchment MA-10, Manly Cove

Sub-catchment MA-11 (**Figure 5.12.11**) is a large area that of mixed land use which includes two separate stormwater networks servicing the low lying area of central Manly. The first stormwater line begins at the junction of Whistler Street, The Corso, Belgrave Street and West Esplanade, areas which experience some of the heaviest road and pedestrian activity. From this point, the drainage system continues approximately 165 metres in a southwest direction to the outlet which discharges at the west Manly Cove seawall (opposite Belgrave Street). This stormwater line includes thirteen gully pits capturing road (37%), open space (22%), residential (20%) and commercial (16%) run off.



The second stormwater line within Sub-catchment MA-11 has similar land uses to the first line and transports flows from Eustace Street, Gilbert Street, West Promenade, Sydney Road and East Esplanade. The flows captured in this stormwater line include the steep gradient of Sydney Road to the western Boundary of Ivanhoe Park. There are 14 individual gully pits along the length of this system, which also includes the bus interchange and parking areas.

Sub-catchment MA-12 (**Figure 5.12.12**) is another large stormwater sub-catchment with considerable gradients. The upper limit of the stormwater line is located on Sydney Road, adjacent to 25 George Street and travels south along George Street where it junctions east along Fairlight St to Commonwealth Parade before running underneath Oceanworld and discharging into Manly Cove. This system collects stormwater from a large residential area including all of Griffin Street George Streets and portions of Sydney Road, Fairlight Street and Commonwealth Parade. A smaller line collects stormwater from Upper Gilbert Street, West Esplanade and the pedestrian areas adjacent to Manly Art Gallery and Oceanworld. There are a total of 25 gully pits within this sub-catchment.



Figure 5.12.12 - Map of land use and stormwater system for Sub-catchment MA-12, Manly Cove

5.13 WATER QUALITY

5.13.1 Overview of Water Quality

Stormwater quality varies dramatically not only within different parts of the catchment but also in any given storm event. This high degree of variability makes stormwater treatment a challenge. The physical, chemical and biological processes of stormwater systems and their interactions with pollutants are complex.

A number of pollutants are typically found in stormwater runoff generated from urbanised catchments. These pollutants originate from either point or non-point sources. Point sources are specific and identifiable locations where stormwater pollution can occur such as illegal discharges of trade wastes and sewer overflows. Non-point or diffuse sources are more general, and comparatively difficult to identify and control. Typical examples of non-point source pollutants include oils, heavy metals, litter, suspended solids and nutrients in runoff from road surfaces and runoff. **Table 5.13.1** (below) provides a summary of the common pollutants that are likely to enter Middle Harbour, as well as their likely sources, and impacts on the environment.

Table 5.13.1 Pollutants Likely to Enter Manly Cove

Pollutant Group	Examples	Sources	Impacts
Gross Pollutants	Plastic bags, bottles	Littering, Illegal dumping	Ingestion by marine fauna
Oxygen Demanding Substances	Leaves, twigs	Bushland, roads, residential gardens, stormwater	Reduced dissolved oxygen, marine flora and fauna cannot survive
Oils, greases & hydrocarbons	Car oil, petrol, lubricants	Roads, industrial areas, marinas, boats	Marine fauna smothered and/or poisoned
Nutrients	Fertilisers, detergents, sewage	Residential gardens, sports fields, golf courses, sewage leaks/overflows	Algal blooms
Heavy Metals	Lead, copper, zinc	Industrial areas, roads, marinas, boats	Bioaccumulation of heavy metals through the food chain
Pathogens/Micro organisms	<i>Faecal coliforms, enterococci</i>	Sewage leaks/overflows, animal faeces	Human infection as a result of pathogens
Sediments	Sand, silt	Construction sites, residential gardens	Smothering of marine flora and fauna; reduced light penetration and ability for marine plants to photosynthesise

In such an urbanised area as the Manly Cove Catchment, it is not possible to incorporate sufficient treatment devices in the sub-catchments to achieve the long-term water quality objectives identified in the Northern Beaches Stormwater Management Plan (PBP 1999). The sustainable solution is to direct the community and industry to implement the control of pollutants at their source, before they enter the stormwater system. This can only be achieved through a tiered approach:

1. **Eliminate pollutants** through waste minimisation strategies i.e. reducing or eliminating packaging, returnable bottles, removal of phosphorus based detergents etc;
2. **Change people's habits** through education i.e. making residents and industry responsible for the cleaning of gutters/stormwater pits in front of their properties etc;
3. **Enforcing appropriate actions** through regulation i.e. policies, fines, audits etc.

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However, as it usually takes a number of years for source control strategies to become effective and hence to prevent further degradation of the environment, source controls need to be combined with treatment devices such as gross pollutant traps, oil/grit separators, sediment traps and mini wetlands where suitable.

Anecdotal evidence is important in helping to understand the history of water quality in a catchment, however a detailed understanding is necessary to ensure appropriate management actions can be implemented. There are two methods of estimating water quality in a catchment – modelling and monitoring. Both have been undertaken and are described below. The modelling described in section 5.13.2 provides information on the pollutant loads produced by the terrestrial catchments within the study area, and the monitoring described in section 5.13.3 provides information on measured water quality within the North Harbour itself.

5.13.2 Modelled Pollution

Estimation of annual pollutant loads transported into Manly Cove through the stormwater drainage systems was undertaken for the most common and priority pollutants identified to occur in stormwater. These were identified from local research undertaken in Manly (Smith, P.G., 2006; Galloway, M.J., 2005a), and through literature review of national and international studies (USEPA, 1983; Galloway, M.J., 2005b). Pollutants identified were: Total Nitrogen (TN), Total Phosphorus (TP), Copper (Cu), Lead (Pb), Zinc (Zn), and Sediment.

Modelling was commissioned to estimate the total annual loads (in kg) of these pollutants entering Manly Cove. This desktop study was undertaken through assigning a runoff coefficient to each land-use identified in the nine sub-catchments (a percentage of rainfall that will runoff and enter stormwater), adopting annual recorded rainfall in Manly, and adopting assumed average stormwater pollutant concentrations for stormwater runoff for each land-use. Values were selected to be as site-specific to Manly Cove conditions, or similar conditions, as possible.

This modelling was extended to estimate the contributions from each land-use class (residential, commercial, etc.) within the study area. To facilitate modelling of individual land-use classes, different stormwater pollutant concentrations were incorporated for each land-use type (**Table 5.13.2a**). These values were derived from both previous stormwater monitoring work within the Manly Local Government Area, and common literature concentrations in the Sydney Basin.

Manly Councils Water Cycle Management Team modelled the nine catchments within the study area. For this modelling an alternative comparable system had to be used for stormwater pollutant concentration data, due to a lack of data available for the study area. Stormwater pollutant concentrations were attributed from those measured in adjacent catchments in the Manly LGA with similar identified land-uses, for which detailed sampling and analysis have already been undertaken. Extrapolation of these results through the modelling process for the Manly Cove study area, along with known rainfall figures, then provided modelled total pollutant loads.

Models were produced to estimate both total annual pollutant loads (kg/year) expected within the study area, total annual pollutant input on a per hectare basis (kg/ha/year), and annual pollutant input on a per hectare basis from each land-use class individually within the Manly Cove sub-catchments. Four models were produced for each situation to estimate a range and incorporate variability in two key assumptions:

1. the estimated “percent effective impervious area” of each land-use (the amount of rainfall likely to be exported as stormwater), and
2. The Manly annual rainfall (in mm).

It must be noted that each of these variables was assigned a “low” and a “high” value.

For “percent effective impervious area” the low value was derived from stormwater monitoring work undertaken within the Manly Local Government Area. High values were derived from Northern Beaches Stormwater Management Plan 1999 (**Table 5.13.2b**).

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For Manly annual rainfall the low value was derived from the total rainfall recorded in the dry year of 2002 at the Manly Hydraulics Laboratory (MHL) North Manly rainfall station (871.5mm). The high value was derived from the total recorded at the same rainfall station during the wet year of 2003 (1171.5mm) (Table 5.13.2b).

Table 5.13.2a - Adopted pollutant Event Mean Concentrations (EMCs) (mg/L)

	TN	TP	Cu	Pb	Zn	Sediment
Residential & Special Use	2.622*	0.401*	0.03456*	0.04048*	0.18562*	75
Commercial	3.9862*	1.1577*	0.05049*	0.02494*	0.34074*	75
Open Space	0.9	0.22	0.01	0.02	0.01	200
Other (inc. roads)	1.8	0.05	0.3	0.6	0.7	142

Source: NSW EPA (1997), (* = Galloway, 2005)

Table 5.13.2b - Low and high values adopted for “percent effective impervious area” variable

Land Use	Low Value	High Value
Residential & Special Use	11.5%	62%
Commercial	27.20%	90%
Open Space	8%	30%
Other (inc. roads)	70%	80%

Source: NBSMP (1999), (* = Galloway, 2005)

Modelling Results for Sub-catchment Stormwater Pollutant loads

The total estimated load of pollutants in stormwater for all combined land uses within the Manly Cove sub-catchments are shown in Table 5.13.2c and Figure 5.13.2.

Table 5.13.2c Estimated loads of pollutants likely to enter Manly Cove from entire sub-catchments of the study area

Manly Cove		Pollutant loads (kg/year)					
Sub-catchment Id	Sub-catchment Area (M ²)	Total Nitrogen	Total Phosphorus	Copper	Lead	Zinc	Sediment
MA-01	15,000	22.4	2.5	1.7	2.3	4.8	1263.2
MA-02	19,600	26.4	4.1	0.9	1.2	3.5	1204.6
MA-03	19,700	28.0	3.7	1.6	2.1	5.0	1441.9
MA-04	16,480	23.4	3.0	1.4	1.8	4.2	1218.1
MA-05	18,410	24.0	3.1	1.4	1.9	4.3	1319.5
MA-06	17,760	25.0	2.8	2.0	2.5	5.3	1453.6
MA-07	66,140	97.0	12.0	6.6	8.6	19.2	5235.9
MA-08	101,400	145.2	17.3	10.2	13.3	29.2	8020.1
MA-09	28,700	61.5	11.1	4.2	5.2	11.9	2730.4
MA-10	31,100	78.2	13.7	6.0	7.6	16.6	3473.0
MA-11	69,240	113.5	16.5	9.2	11.9	25.0	6297.5
MA-12	95,510	124.9	15.2	9.0	11.8	25.4	7396.4
TOTAL	499,040	769.5	105	54.2	70.2	154.4	41054.2

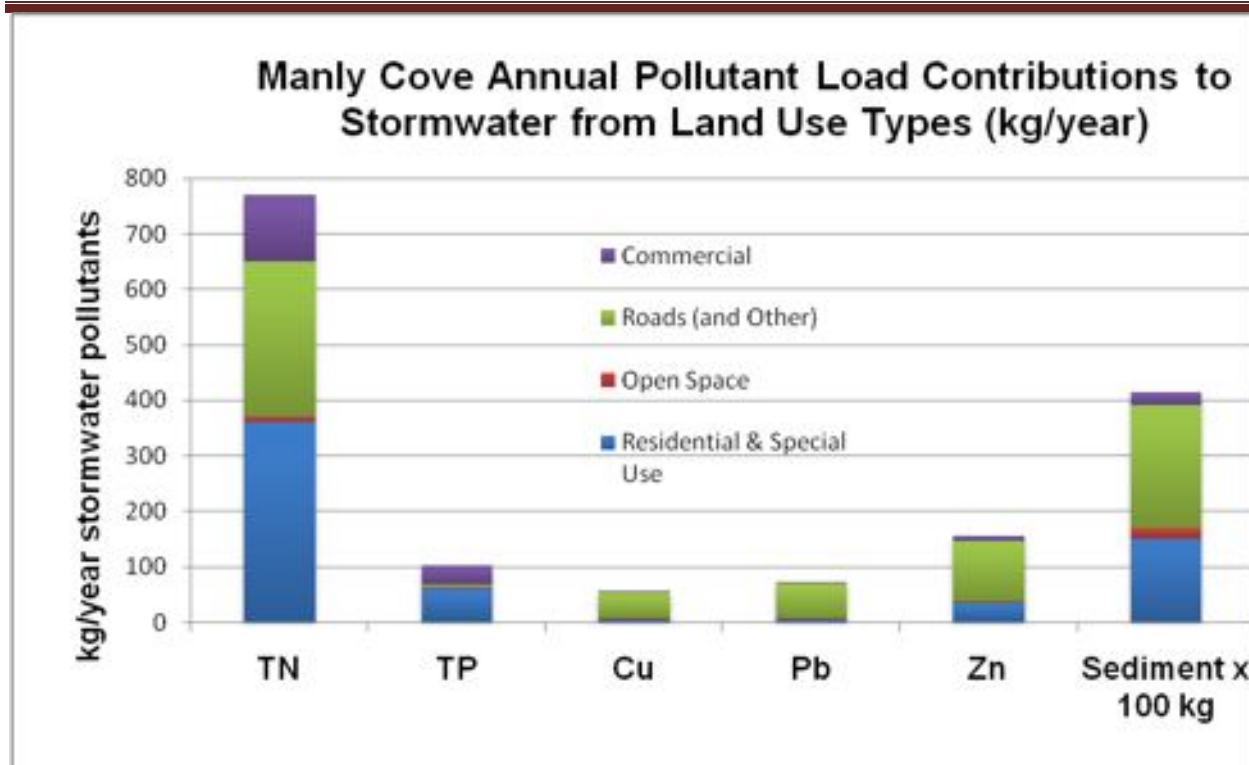


Figure 5.13.2 – Annual pollutant load contributions for Manly Cove

The greatest contributing land-uses emergent from the modelling were roads and residential land-uses. These land-uses delivered the highest loads of all pollutants except Total Phosphorus. Roads were estimated to produce highest loads for Copper, Lead, Zinc and Sediment, with residential the second greatest. However, residential land-uses were estimated to produce the highest loads of nutrients (TN and TP). Suggested sources include vehicle traffic and corrosion of road surfaces (delivering heavy metals, and sediment into stormwater); deciduous trees (delivering nutrients); residential buildings (delivering heavy metals including Cu, Pb, Zn from corrugated roof surfaces into stormwater), construction sites and disturbed sites (delivering high levels of sediment), and residential gardens and vegetative matter through lawn mowing (delivering nutrients and sediment).

5.13.3 Measured Pollution

Measured pollution refers to data that has been obtained through taking water samples and analysing them to estimate pollution within a water body. This method of estimating pollutant loads is clearly more accurate than desktop modelling; however, it still has limitations. Firstly, water sampling is undertaken at discreet locations, and these may not be representative of the greater water body within which each sampling location lies. Secondly, the water sampling is only undertaken at a given point in time, and this may not be representative of the average pollutant loads in the given water body.

The most comprehensive measured water quality data identified was through the Harbourwatch program, run by the Department of Environment, Climate Change and Water (DECCW). The Harbourwatch program's key concern is human health relating to the use of harbour waters, and as a result it focuses primarily on bacterial pollution (DECCW, 2008). Hence, the two major indicators of bacterial contamination, *faecal coliforms* and *enterococci*, are measured at various harbour swimming locations. Faecal coliforms and Enterococci are found naturally in the intestines of humans and therefore also in the sewerage system, so are used to indicate the presence of sewage pollution. Sampling location within the study area is adjacent to the Manly Cove netted swimming enclosure in Manly Cove West.

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The Harbourwatch Program was established in November 1994 to monitor and report on water quality in the Bays and estuarine swimming areas of Sydney Harbour.

The Harbourwatch Program monitors and reports on water quality at over 60 sites within Sydney Harbour including North Harbour and Manly Cove. The Harbourwatch daily reporting program uses rainfall data and sewer overflow information for daily assessment of Harbour beaches and swimming enclosure. The Manly Cove monitoring point is located within the netted swimming enclosure to the west of the study area.

Harbourwatch uses two types of indicator bacteria, faecal coliforms (also known as thermo tolerant coliforms) and enterococci, to measure recreational water quality, as recommended by the National Health & Medical Research Council (NHMRC, 1990). These guidelines also refer to other physical and chemical parameters for the assessment of recreational water quality, such as pH, clarity and temperature. Harbourwatch focuses on the use of faecal coliforms and enterococci as these indicate the possible presence of waterborne pathogens that pose the most significant risks to human health. If these bacteria are present in water at levels above certain limits set down by the National Health and Medical Research Council, then the water is polluted with stormwater and/or sewage and may not be safe for swimming. Monitoring is conducted according to strict NHMRC Guidelines.

Harbourwatch collects water samples for the Sydney Metropolitan area at all sites once every six days as part of the long-term monitoring program. The sampling frequency is in accordance with national health guidelines for recreational use of water. Samples are transported to a commercial laboratory and analysed for the presence of two indicator organisms, faecal coliforms and enterococci, which may indicate that sewage pollution is present in the water.

Faecal coliforms generally survive in marine waters between 24 and 48 hours. When elevated faecal coliform levels are detected in a water sample, this indicates the presence of recent sewage contamination at the swimming site.

Enterococci survive for much longer periods in marine waters than faecal coliforms. Thus, when elevated enterococcal levels are detected, in conjunction with low levels of faecal coliforms, this indicates the presence of aged sewage contamination.

As Harbourwatch collects samples from swimming locations once every six days in accordance with national guidelines, the results more likely to detect aged sewage contamination than fresh sewage contamination. Accordingly, enterococcal compliances at many sites are lower than faecal coliform compliances. As the laboratory analyses take up to 48 hours to complete, results of the water quality monitoring are not available for inclusion in the Harbourwatch daily bulletin.

Harbourwatch considers that waters are unsuitable for swimming if:

- the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100 mL) for five samples taken at regular intervals not exceeding one month, or
- the second highest sample contains equal to or greater than 600 cfu/100 mL for five samples taken at regular intervals not exceeding one month, or
- the median enterococcal density exceeds 35 cfu/100 mL for five samples taken at regular intervals not exceeding one month, or
- The second highest sample contains equal to or greater than 100 cfu/100 mL for five samples taken at regular intervals not exceeding one month.

Harbourwatch uses a rolling median (and rolling second highest sample) to calculate the seasonal compliance estimates for each beach. There is considerable debate in the scientific community on both the absolute and relative usefulness in assessing the public health risk of faecal coliforms and enterococci as indicators of faecal contamination. Many technical issues remain to be resolved. Nevertheless, the DECCW considers that the use of faecal coliforms and enterococci as indicators provides a suitable expression of the disease risks presented

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by contaminated bathing waters and allows for international comparisons to be made. It will, however, maintain a close monitor of scientific developments in this area

The NHMRC endorsed new guidelines for managing risks in recreational waters in June 2005. These guidelines are largely based of the World Health Organization guidelines, published in October 2003. They are not mandatory but provided as a tool for Local and State Governments to develop relevant programs. Results presented in this report are described in terms of faecal coliform and enterococci compliance with Harbourwatch water quality criteria.

Overall, water quality monitoring results within Manly Cove highlight that compliance with enterococci and faecal coliform parameters has improved over the past decade. Much of this improvement can be attributed to improvements to existing sewerage and stormwater infrastructure by both Council and Sydney Water. However, results are also heavily influenced by rainfall as well as the methodology of Harbourwatch monitoring. **Table 5.13.3** provides Harbourwatch data for the Manly Cove monitoring point for the period between 1995/96 and 2007/08.

Table 5.13.3 - Harbourwatch compliance for Manly Cove swimming area 1995-2007

Year	Summer		Winter	
	Faecal coliforms	Enterococci	Faecal coliforms	Enterococci
1995-1996	100	90	100	91
1996-1997	100	94	100	100
1997-1998	100	72	100	95
1998-1999	100	22	95	29
1999-2000	100	90	100	71
2000-2001	100	87	100	100
2001-2002	97	87	100	95
2002-2003	100	100	95	100
2003-2004	100	100	100	100
2004-2005	100	94	100	100
2005-2006	100	100	100	100
2006-2007	100	100	100	100
2007-2008	100	94	100	100

Faecal coliform and enterococci densities generally increased with increasing rainfall. Faecal coliform densities occasionally exceeded the median guideline limit in response to 20 millimetres of rain or more in the previous 24 hours. Enterococci densities occasionally exceeded the median guideline limit in response to light rain in the previous 24 hours.

5.13.4 Stormwater Quality Improvement Measures

Physical Measures for Stormwater Management

Consultation with the community has highlighted concerns over water quality on the receiving waters of Manly Cove and emphasised the need to implement a range of appropriate treatment measures aimed at intercepting pollutants prior to them entering the receiving waters of Manly Cove.

Current treatment of stormwater in Manly Cove involves street sweeping and end of pipe gross pollutant interception. Based on previous analysis of these treatment tools, it is inferred that the pollutant load reduction is in the order of 5– 55% for nutrients and heavy metals. This ratio is highly dependent on sweeping intensity, maintenance frequency, storm frequency and land use activities over time and space.

Street sweeping is conducted throughout the Manly Cove study area. Council operates one Roadway Sweeper, a Footpath Sweeper and two staff in one truck who hand sweep throughout the study area. The larger street sweeping truck has a holding capacity of approximately 3 m³, where as the hand operated sweepers hold up to

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1 m³. The amount of material varies throughout the year and is based largely upon weather conditions experienced between cleans (i.e. rainfall, wind, time of year vs. deciduous species etc).

The area between Federation Point and Manly Point is swept daily collecting approximately 1 cubic meter per day (this includes rubbish from car park area near Ocean world) varying between summer and winter months. The streets in Manly CBD are cleaned on a daily basis including the Corso and Mall areas average between 1 - 3 cubic meters per clean.

Total waste material volumes are calculated on whole of precinct basis and unable to be provided on a study area basis. Each Precinct area is cleaned in its entirety on a 12 week cycle with the following collection rates:

- Little Manly cleaned 12 weekly approx 35 m³
- The Corso cleaned 12 weekly approx 33 m³
- Fairlight cleaned 12 weekly approx 22 m³

Two end-of-pipe GPTs presently exist within the Manly Cove CMP study area. Both of these exist in East Esplanade (see **Figure 5.13.4**).



Figure 5.13.4 – Location of Gross Pollutant Traps in East Esplanade

The northern GPT (1) is a Rocla Cleansall Model 600. This removes approximately 11 cubic metres of gross pollutants per year (14,080 kg), broken down into the ratio of 1.3% litter/trash, 38.6% organic matter/leaves, and 60.1% sediment (by weight). (Source: Council's GPT Contractor). Council contractors have confirmed that extremely high levels of sediment (and associated pollutants) are removed from this treatment system during normal maintenance regimes. According to a local resident, This GPT at Ashburner is not cleaned regularly enough (approx 3 months). Pollutants are jammed into an overfilled pot and the pit does not operate as it should. This is a major problem in a public swimming area and must be addressed.



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The southern GPT (2) is also a Rocla Cleansall Model 600. This removes approximately 7 cubic metres of gross pollutants per year (7,700 kg), broken down into the ratio of 1.5% litter/trash, 54.1% organic matter/leaves, and 44.4% sediment (by weight). (Source: Council's GPT Contractor).

Council maintains the aesthetics, amenity, utility and safety of Manly Cove beaches by raking the upper layer of beach sand on a daily basis. The BeachTech 2000 rake/sieve rakes the upper 200mm surface layer of sand, although sifting depends on the conditions and time available. Raking collects litter and debris (e.g. wrack, bottles, cans, and cigarette butts) while sieving gives a 'combed' finish to the sand.

Council has implemented a number of complementary flow retarding and water saving measures for key sites within the Manly Cove catchment, including:

- A 14,000 litre rainwater harvesting and on-use system has been retrofitted to the Manly Art Gallery with collected rain water used to irrigate the grassed recreation area of West Esplanade. Councils Water Cycle Management Team estimate that the water collected within these tanks is made up of 50% roof water and 50% groundwater. It is estimated that a total of 8,460 L/week is used for irrigation. Irrigation is undertaken overnight to minimise the potential for human contact.
- Installation of water efficient beach showers and drinking fountains throughout the study area.

To further understand existing practices and the need for further interventions it is recommended that an automated stormwater sampling program is established for the main stormwater outlets. The information derived from such a program will allow for the calibration of the modelling undertaken in this report and identification of abnormalities such as sewage ingress into the storm water system.

Stormwater Education Programs

Starboard Right and Green (SR&G) is a community education initiative. The overall purpose of the program is to improve the quality of the marine environment in and around the Manly LGA by:

- reducing the negative impact of recreational boat users, marinas and slipways on the marine environment;
- Improving partnerships between Council, community and Manly's marine operators;
- Increasing recreational boater awareness of marine issues including *Caulerpa taxifolia*, Little Penguins, the importance of seagrass habitats, boating and fishing compliance, waste management and sewage disposal.

Regulatory Action for Stormwater Pollution Prevention

Regulation of specific residential, commercial and industrial premises is a widely used technique to minimise stormwater and groundwater pollution. Some premises are typically licensed by a government agency, with their activities controlled through legally enforceable licence conditions that are regularly checked by enforcement officers who audit the premises.

Control of *point sources* of stormwater pollution is generally easier than controlling diffuse sources (e.g. runoff from roads and open space land uses), and more rewarding on a cost-benefit basis. A well-managed point source regulation program is a priority of Council as it is responsible for managing stormwater and groundwater quality at the local level.

Enforcement is another cost-effective regulatory tool for the management of stormwater and groundwater quality. Council uses enforcement of State legislation the *Protection of the Environment Operations Act 1997* to modify behaviour that has the potential to pollute stormwater or groundwater. Regulatory controls have also been established through Councils LEP to address specific forms of pollution (e.g. cigarette butts).

Smoke Free Zones initially commenced in Manly on 1 December 2004. Since that time further areas have also become smoke-free. Smoking is no longer acceptable in the following areas:

- all harbour and ocean beaches
- within 10 metres of all Council owned children's play areas

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- on and around all Council sporting grounds and playing fields
- within 10 metres of all Council properties
- at all alfresco dining areas on Council land.
- at all Council events.
- in any leases, licences etc on Council owned and managed land or property.
- in Council owned parking stations.
- within bus shelters.

Consequences of enforcement activities to a polluter can include the payment of a fine, the payment of clean-up costs, being unable to legally operate a business, and, in extreme cases, imprisonment. Enforcement is primarily an economic disincentive that is designed to influence people's behaviour.

Analysis of Stormwater Treatment and Management Measures

As identified in the preceding section of this report, Council undertake a range of methods in addressing the issue of stormwater pollution. The minimisation of catchment based pollution can only be achieved through a multifaceted approach, whereby Council aims to:

1. **Eliminate pollutants** through waste minimisation strategies i.e. reducing or eliminating packaging, returnable bottles, removal of phosphorus based detergents etc;
2. **Change people's habits** through education i.e. making residents and industry responsible for the cleaning of gutters/stormwater pits in front of their properties etc;
3. **Enforcing appropriate actions** through regulation i.e. policies, fines, audits etc.

Council Street Sweeping

Street sweeping using sweeper and vacuum trucks is currently carried out 7 days a week within the Manly LGA, with areas and precincts of greater concern swept at the greatest frequency.

Strengths:

1. Sweeping management (sweeping frequency) is flexible and can be modified at a later date subject to further catchment research or demonstrated needs.
2. Roads were estimated to be the highest source of Copper, Lead, Zinc, and sediment in NT-01 and NT-02. Increased frequency of road sweeping would thus likely significantly reduce these loads.

3. Research in other precincts of the Manly area has demonstrated the success of street sweeping. Total annual pollutant loads (kg/year) captured throughout the Manly LGA by street sweeping in 2005/06, based on monitoring research was estimated. This included over 580 tonnes of sediment, and over 4 tonnes of nutrients. Independent research conducted in Manly has also demonstrated street sweeping to capture and prevent 1-50% of total annual pollutant loads of nutrients (Total Nitrogen and Total Phosphorus) and heavy metals (Copper, Lead, Zinc); and between 7-63% of total annual pollutant loads of sediment from entering waterways (variation due to differences between results in different catchments studied, and differences in frequency of street sweeping application in those catchments).

Street Sweeping estimated pollutant prevention in Manly Council (2005/06) (kg)	
TN	4,463.7
TP	847.8
Cu	81.1
Pb	62.1
Zn	232.4
Sediment	580,840.6
Algal growth prevented	25,434.1



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Weaknesses:

1. Street sweeping only captures pollutant loads on road surfaces. Pollutants accumulating on building rooves, driveways, paths, open space, and other premises will not be targeted or prevented by street sweeping, and will continue to be transported into the stormwater system.
2. Street sweeping is restricted by a maximum capture size range of target pollutants. Pollutants below a certain size (depends on sweeping vehicle type) may not be able to be captured from road surfaces.
3. Street sweeping is a relatively time consuming technique when considering catchment area vs. area swept per hour.

Gross Pollutant Traps

Fourteen inline GPTs are currently installed in a range of priority catchments throughout Manly, together with 9 stormwater pollution nets/litter booms. GPTs primarily serve the function of reducing coarse pollutants such as sediment (which also provides some pollutant capture for heavy metals and/or nutrients bound to sediment); and litter. Stormwater pollution control nets primarily serve the function of capturing litter (such as plastic bags, bottles, rubbish) and preventing these from entering waterways.

GPT estimated pollutant prevention in Manly Council (2005/06) (kg)

TN	625.7
TP	80.0
Cu	9.9
Pb	10.4
Zn	54.6
Sediment	108,550.7
Algal growth prevented	2,399.2

Strengths:

1. Because GPTs are installed at the base of sub-catchments at drainage concentration points, pollutants from all sources in the sub-catchment will be directed through them (compared with street sweeping, which only treats pollutants stored on road surfaces).
2. Research in other precincts of the Manly area has demonstrated success of GPTs. Total annual pollutant loads captured within Manly by GPTs in 2005/06 were estimated. This included over 108 tonnes of sediment, and 0.6 tonnes of nutrients. Independent research conducted in Manly has also demonstrated GPTs to capture and prevent 5-35% for nutrients (Total Nitrogen and Total Phosphorus) and heavy metals (Copper, Lead, Zinc), and between 29-74% of sediment loads (variation depending on catchment studied and GPT model design).
3. MA-07, MA-08, MA-11 and MA-12 are estimated to produce a very large volume of sediment. MA-07 and MA-08 already have GPTs constructed under Esplanade Park capturing flows from each sub catchment. If sediment capture rates of between 29-74% were achieved in these subcatchments (similar to other GPTs in Manly), this would result in between many tonnes of sediment a year being prevented from entering Manly Cove, and reduced impact on ecosystem health. Installation of an in line GPT is recommended for catchment MA-12.

Weaknesses:

1. GPTs are fixed in location, capture screen aperture, and storage volume once installed, and can be difficult to modify at a later date.
2. GPT performance is only as good as the maintenance (cleaning) regime which is imposed on them. If not adequately cleaned, pollutants stored within a GPT will undergo biological and chemical reaction (breakdown), become re-suspended in subsequent rainfall events, and be delivered into waterways. Maintenance incurs an increased and ongoing cost.
3. As with street sweeping, GPTs are restricted by a maximum capture size range of target pollutants. GPTs typically do not treat very fine pollutants such as dissolved and fine-sediment suspended heavy metals and nutrients. This maximum size limit is also greater than street sweeping.

Pit Inserts in Stormwater Drains

Pit inserts, consisting of fine mesh, can be installed into existing stormwater pit locations and drains to prevent catchment pollution entering stormwater drains and mixing with stormwater where it will become more difficult and costly to treat.

Strengths:

1. When well researched, gully pit inserts can target pollution at the source (i.e. immediately below developments) or to target specific pollutants (depending upon mesh sizing which can target fine sediments to 4 µm or gross pollutants).
2. The use of pit inserts is a relatively cheap option compared to GPTs.
3. Some pit inserts are designed with no moving parts and are structurally designed not to block stormwater flows or pipe systems. They can also act to retain first flush flows therefore minimising the flow rates at end of pipe outlets.
4. If designed relative to individual pit attributes, maintenance demands are minimal and may only be required 3-4 times per year.

Weaknesses:

1. Not all stormwater pits have the hydraulic capacity to enable installation of gully pit inserts. If constructed in unsuitable locations gully pit inserts may have a negative impact upon hydraulic capacity. This could potentially lead to localised flooding.
2. Maintenance can become an issue if inserts are positioned in unsuitable locations.

Increased residential uptake of rainwater tanks to reduce stormwater flows

Increased community installation of rainwater tanks at an individual residential scale, would greatly reduce the volume of polluted stormwater entering Manly Cove, through disconnecting the large roof areas of residential properties' from the stormwater network. This would decrease the proportion of stormwater swept off-site from residential properties, and the capacity of stormwater to entrain and transport pollution into the Manly Cove embayment. In particular it would also decrease the pollution load from residential land-uses in the catchment through containing nutrient and other pollution on-site. Residential land-uses were estimated to be the greatest source of nutrients and the second-greatest source of heavy metals and sediment in Manly Cove (see Figure 5.14.2). Manly Council would encourage residents to consider installation of residential rainwater tanks as a means to reduce stormwater flows into Manly Cove, and establish an alternate water source for their gardens and/or properties.

Manly Council's Guidelines on the Installation of Rainwater Tanks are available at Council's website: www.manly.nsw.gov.au under "DA Fact Sheets" in the "Planning and Development" menu.

Education Programs

Education campaigns to target behaviour in individual residences have been conducted in the past in many Precincts in Manly. In particular the Sea change education program for residents has targeted residents to achieve behavioural change outcomes, and reduce pollution from individual premises.

Strengths:

1. Aims to reduce the amount of litter and pollution entering our natural drainage lines and stormwater systems at the source.
2. Can be tailored to specific groups (i.e. construction groups, business, school groups etc) and specific pollutant sources.

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Weaknesses:

1. Education must be an ongoing process to ensure that the message is adequately transferred to target audiences. This can become expensive and onerous for Local government.
2. Must be applied in conjunction with regulatory processes.

5.13.5 Known Designed Sewer Outflow Locations

The other likely sources of pollutants entering Manly Cove include sewage exfiltrating into the stormwater. Sewage contains high levels of bacteria and nutrients and can pose significant health risks for human consumption and/or contact. Sewage entering Manly Cove can cause a general increase in nutrient levels in the water column, and is known to increased phytoplankton growth, and enhanced growth of macroscopic and microscopic algae on seagrass. This may result in a decline in the seagrass beds due to competition for space and light (Connell Wagner, 1999).

Sydney Water have identified that sewage overflows and leakages contribute to a relatively large component of the bacterial load to stormwater on an average annual basis. It also has a significant contribution to the nutrient loads exported into the receiving waters (PBP, 1999)

The original sewer collection system for Manly Cove is some 100 years old and previously drained via the MOOS (Manly Ocean Outfall Sewer) to an old outfall at Bluefish Point near Shelly Beach. This system has since been modified with the construction of a major pumping station at Shelly Beach to transfer sewage to the North Head STP and deep ocean outfall.

There are presently four sewerage overflow points within the Manly Cove study area, all of which have the potential to significantly impact upon local water quality and the sensitive marine environs of Manly Cove and the North Harbour Aquatic Reserve (See **Figure 5.13.5**).



Figure 5.13.5 – Location of sewerage overflow points within the Manly Cove study area

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Further, the close proximity of the Manly Cove study area to the North Head Sewage Treatment Plant (STP) has identified community concerns to the odours emanating from this facility, particularly during east/north-east winds.

Sydney Water, with whom the responsibility of safe and efficient operation of the North Head Sewage Treatment Plant lies, currently remove excess grit and biosolids from the STP by trucking the material through Manly to an alternate waste disposal site. The operation of removing and trucking sludge has been identified through community consultation as a source of noise and odour concerns.

Performance objectives are determined through the Environment Protection Licences issued to Sydney Water by the EPA in 2000 as well as the Sewerage Overflow Licensing Project Environmental Impact Statement published by Sydney Water in 1998.

Table 5.13.5 identifies the wet weather performance of the four directed overflows located within the Manly Cove study area. The results are based on a 10 year rainfall time series as identified in Sydney Waters Sewerage Catchment Asset Management Planning (SCAMP) - Needs Assessment Report (2002).

Table 5.13.5 - Wet weather performance of the four directed overflows within Manly Cove study area

Overflow Id	Overflow Location	Overflow frequency (events/10 yrs)
SMAS4OF01	Directed overflow at corner of East Esplanade and Stuart Street	48
SP117OF01	Directed overflow at corner of Cove and Stuart Street	2
SP306OF01	Directed overflow at corner of East Esplanade and Ashburner Street	0
SNAS4OF01	Directed overflow at corner of Cove and Stuart Street	0

Measures are made against both dry and wet weather flows with the report indicating that overflow SMAS4OF01 experienced 48 overflow events and does not meet the performance requirement of < 20 overflow events in a 10 year timeframe.

The Manly SCAMP model was originally built and calibrated in 2001. Following the recommendation from the 2002 Needs Assessment Report and investigation was initiated to confirm reported overflows/spillage prior to options development for the wet weather overflows. Sydney Water adopted the following approach:

- investigate and identify high overflow areas;
- identify pumping station operations associated with problem areas;
- determine inflow into the above pumping stations to determine their performance;
- correlate issues with customer complaints database;
- carry out additional flow monitoring to provide a better representation of the model;
- recalibrate the model with the new gauge data and other pump operational data available (i.e. pumping station data and additional flow monitoring data);
- statistically validate the calibration results;
- reassess system performance; and
- develop options to meet licence target.

This approach altered the results significantly from the 2001 SCAMP with the figure decreasing from 48 overflow events in 10 years to only 17. The new figures highlighted that the overflow in East Esplanade was within licensing parameters.

Two Sewage Pumping Stations exist within the Manly Cove study area, SP0117 located at 3 Oyama Avenue and SP0306 in East Esplanade Park opposite Ashburner Street. Sewerage Pumping Station 306 was identified

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as not providing sufficient emergency dry weather containment of overflow in the event of pumping station failure. In order to retain 6.5 hours of dry weather flow and additional 194m³ of storage area must be created. The existing pump within this SPS was found to have adequate capacity (35L/sec) for ultimate design wet weather flow (6m ARI). The existing 200mm diameter RM is also adequate to convey peak design flow.

Treatments being implemented to reduce sewage pollution

Sewage in storm water represents the largest limitation for swimming criteria compliance. The program will also identify the transportation of pollutants throughout storm events and target the most effective suit of practices in prevention pollution.

Sydney Water is required by DECCW licence conditions to manage sewerage treatment systems efficiently. This is required to protect and minimise harm to the environment and public health from sewage treatment plant effluent and sewage overflows by minimising the frequency and volume of sewage treatment plant bypasses and sewage overflows.

Sydney Water is currently implementing detailed sewerage planning programs across Sydney, through the development of SCAMPs or Sewerage Catchment Asset Management Plans. This integrated sewerage system planning tool aims to enable Sydney Water to programme its capital expenditure to meet existing and future catchment performance standards as defined by the Environmental Protection Licences issued by the DECCW.

The purpose of the SCAMP process is to analyse the performance of the sewer system, primarily to address the public health and environmental risk of sewerage overflows in order to comply with DECCW Licence conditions.

SewerFix is Sydney Water's 20-year program for maintaining and improving the sewer system. Key works include:

- The North side Storage Tunnel has been constructed to capture wet weather overflows from the four major overflow sites at Lane Cove, Quakers Hat Bay, Tunks Park and Scotts Creek. The Tunnel was designed to reduce the number of overflows at the four major wet weather overflow points from more than 150 to less than 20 in an average 10-year period. Since coming on-line the Tunnel has prevented more than 18.6 billion litres of diluted sewage from entering Sydney Harbour (Sydney Water 2006).
- In consultation with DECCW, Sydney Water is targeting sewage overflows that occur in the vicinity of beaches. Where poor performance is identified, works will be conducted to reduce the overflows and improve beach water quality. These works will include amplification, storage and sewer lining to reduce wet weather overflows.
- Sydney Water recently conducted a review of its dry weather overflow abatement strategy. A key component of the new strategy is to inspect and fix problems on small-diameter sewer mains that carry high flows. These small-diameter sewers have been found to cause the majority of the dry weather overflows to waterways. A large proportion of the \$20 million allocated for 2006–2007 to reduce dry weather overflows will address these sewers. Further funding has been allocated out to 2009–2010 to ensure that discharge targets for waterways are met.
- Upgrades have been completed to 250 sewage pumping stations to minimise the risk of dry weather sewage overflows. Telemetry systems have been upgraded at all but two of the 659 operating stations to provide warnings of failure. The improved telemetry reduces response times and the likelihood and severity of overflows to the environment.

Two options have been identified by Sydney Water for further investigation in order to reduce the number of sewage overflows events at the East Esplanade/Stuart Street overflow (No. SMAS4OF01). One option involves amplification of pipes to provide additional online storage. This would involve the existing pipe network being replaced with superior plastic piping, although the joints will still be rubber, as other materials cannot be made to close around the pipes quick enough at these joints. The problem is that bacteria eventually attack the rubber, but attempts to extend the lifespan of these joints has failed.

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The second option would be to rebuild the weir crest level and construct a pumping station to ensure that the low-lying properties nearby are not affected by overflow events. The second option would involve further investigation as it involves private sewer and therefore Sydney Water is not yet sure if this would be feasible.

Groundwater

Groundwater in the broad sense is all water that occurs below the ground surface (ANZECC 2000). It is an integral part of the water cycle and interacts directly with the water present on the earth's surface and provides significant contributions to rivers, lakes, wetlands and swamps, being an ongoing source of water during seasonally dry periods. It also maintains the dynamics of estuarine and near-shore marine water bodies, contributing inflows of fresh water to otherwise saline environments. Because groundwater remains mostly unseen, there is generally little understanding of the potential for it to be used as an alternative water supply (SCCG, 2006).

In New South Wales the volume of groundwater is estimated to be 5 billion megalitres (ML) or more than 200 times the storage capacity of all water supply dams in the state. Approximately 200,000 people in 130 communities rely on groundwater for their drinking supply.

Drought conditions experienced across eastern Australia in the years preceding the development of this report, combined with a greater demand on resources from an increasing population, have seriously depleted the water supplies on which Sydney depends. In response to restrictions placed on the use of mains water, there has been a significant interest amongst the community in accessing and using groundwater.

The use of groundwater in the Manly LGA generally involves the irrigation of public parks, playing fields, gardens and golf courses. Such irrigation requires high yields of good quality groundwater, particularly for golf courses, and therefore these applications are primarily found across the coastal sand aquifers. In areas where porous or fractured rocks occur, the groundwater yields may be too low, and the quality not suitable for such purposes (SCCG, 2006).

Within the Manly Cove study area two types of water supply installations are used by Council: spearpoints and bores. Spearpoints are shallow installations which only partially penetrate the aquifer, usually reaching depths of no more than 6 metres. They comprise small diameter casings and screens of lightweight construction and can only be utilised for water supply in the coastal sand bed aquifers, such as those found with the Manly Cove study area, where groundwater aquifers are often close to the surface. The lowering of the water table during drought periods, the deterioration of airtight seals or the clogging of the well point can all reduce the amount of water that can be pumped.

Bores are more complicated installations than spearpoints because they are designed to maximise the available yield during pumping. They are generally large diameter robust installations that fully penetrate the aquifer (i.e. extend through the entire thickness of the water bearing layer).

Bores typically comprise heavy duty PVC casing and stainless steel screens, and because they are drilled and constructed as two separate processes, they have a wider range of application than spearpoints. They are also considerably more expensive to install and operate.

The extraction of groundwater from bores is the most commonly accomplished by the use of electro-submersible pumps, which are suspended in the bore at a depth below the water table, allowing the motor to be cooled by the flow of groundwater during pumping. Because the pump does not operate by suction, but drives groundwater to the surface, bores are not prone to the loss of supply as readily as spearpoints.

In order to establish a bore water supply there are two essential requirements to be considered initially. These are that the work itself must be licensed and the driller selected to carry out the installation is licensed water bore drilling contractor.



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Groundwater Contamination

Unlike rivers, which flow in defined channels, groundwater is present everywhere beneath our feet. Manly of our activities, therefore pose potential threats to the quality of our groundwater resources. Many low lying sites were progressively filled in with industrial and urban waste during the mid 1900s, resulting in varying degrees of contamination. Contaminated groundwater systems can pose a threat to other connected systems.

Generally, contamination can be described as coming from either point (i.e. domestic tip sites, industrial landfill; etc) or diffuse sources (i.e. spreading of fertilizer onto agricultural land, urban runoff etc).

Along with threats from surface activities, there is a very large danger that pumping large volumes of groundwater will result in deterioration in water quality. The potential for salt water intrusion and realisation of Potential Acid Sulphate Soils issues are of particular concern.

If groundwater becomes polluted, it is difficult or impossible to clean up completely. The slow rates of groundwater flow and the low microbial activity limit any self purification. Processes which take place in days or weeks in surface water systems may take decades to occur in groundwater. In addition the costs of remediating groundwater systems are extremely high. It is, therefore better to prevent or reduce the risk of groundwater contamination than to deal with its consequences.

With groundwater becoming an increasingly important resource for the irrigation of Councils parks and reserves, it is vital that ongoing monitoring programs complement extraction processes. The inclusion of comprehensive monitoring measures from the planning to operational phases can assist in preventing immediate or cumulative detrimental effects to the site, surrounding properties, infrastructure and the environment.

Council Groundwater Extraction

In the years preceding the release of this report, Council drilled a number of test bores within the Manly Cove study area in attempt to identify sustainable sources of groundwater for irrigation purposes.

Following initial investigations, Council constructed a water storage sump adjacent to the Manly Art Gallery in West Esplanade Reserve during 2006. The sump collects both stormwater runoff from the sub-catchment and groundwater from a year round surface discharge point. Each source accounts for approximately 50% of the irrigation requirements for West Esplanade Reserve.

Irrigation usage is approximately 2,800 litres 2-3 times per week which equates to a total of 8,600 litres a week. As 50% supply is derived from groundwater collection (and the other 50% from stormwater) the estimated groundwater use is 4,300 litres/week or 0.23 ML/year.

While the exact volume of the retention capability is unknown the quality of groundwater has been identified through past water quality testing. The extent to which the permanent dry weather base flow is sourced from groundwater vs. stormwater is unknown.

Following a thorough testing procedure, a bore was also drilled in East Esplanade Reserve during August 2005 for the purpose of irrigating the portion of the Reserve east of Manly Wharf to Manly 16 Foot Skiff Club. The bore intercepts the water table at a depth of 3.5 m and extracts ground water from a depth of 5.8 metres. The extraction rate is set at 0.5 L/sec for 150 minutes 2-3 times per week, which equates to between 9,000 and 13,500 litres per week (0.7 ML/year) irrigation usage.

As the groundwater is applied to parklands directly over the aquifer from which it was extracted, it serves a recharge function. Groundwater testing since 2005 has shown that water quality is very good and well within the parameters set for irrigation requirements.

A third extraction point, in the form of a bore, was drilled into (and underneath) the median strip garden beds opposite Coles supermarket in Manly Corso. The bore was installed at a depth of 8.54 m depth to penetrate the

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aquifer at a depth of 4.88 m. The bore was installed in August 2005 and is currently inactive due to lack of suitable power supply and demand. Groundwater quality at this location was found to be more variable in key parameters, including nutrients and heavy metals, than other sites and would require further analysis prior to the establishment of any extraction regime.

While there has never been any holistic mapping of groundwater in the Manly LGA, information sourced as part of the Coastline Management Planning process is being collated for mapping on Councils GIS system.

Private Groundwater Extraction

Council sought information on private groundwater extraction through the Department of Environment, Climate Change & Water's Compliance and Licensing Division. In reviewing, the data provided it was apparent that only one private bore is licensed within the Manly Cove study area, located at 48 Darley Street (DP115867) within sub-catchment MA-08. The quota for extraction within private bores is determined by DWE and is set at 1mL/year.

The identification of only one licensed bore within the study area may not provide an accurate indication of private groundwater extraction as a number of illegal bores may also exist.

5.14 SEDIMENT ANALYSIS

Although the water quality in the greater Sydney Harbour has improved in recent years and is now relatively good, the sediments in parts of the Harbour floor are of extreme concern. Sediments are not as easily flushed of contaminants as water quality, and pollutants tend to accumulate in them over time. Certain pollutants can actually bind or attach to fine sediment (mud) particles, making their dispersal and flushing even more difficult. Decades of unregulated heavy foreshore industry and poor stormwater management practices have resulted in a toxic array of pollutants finding their way into the Harbour. In 2004 Birch & Taylor published a comprehensive book about the contamination of sediments throughout all areas of Sydney Harbour. They concluded that Sydney Harbour's sediments contain mean concentrations of pollutants such as heavy metals, organochlorin compounds, and polycyclic aromatic hydrocarbons that are among the highest in the world.

Sediment Type

Sediments within Sydney Harbour vary considerably in grain size from gravely sand to fine mud. Generally, sediment covering the floor of the Harbour coarsens toward the ocean where sediments derived from the catchment mix with marine sands delivered to the mouth of the estuary by longshore and tidal currents from the adjacent continental shelf (Birch & Taylor, 2000).

Sediments within the Manly Cove study area are identified as clean marine sand with <5% mud content. Fine detritus brought into the cove by the drain at the head of the bay, is reworked in the shallow bay-head area and accumulates in the deep central basin. A small steep fluvial delta occupies the upper part of the North Harbour embayment (Birch & Taylor, 2000).

Sediment Quality

Sediments are increasingly being used to monitor the aquatic environment as they integrate contaminants such as heavy and trace metals, organic and other contaminants over time. Sediments are able to provide information on contaminant source, accumulation and dispersion (Birch & Taylor 2000). Sediment quality guidelines have been published as part of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).

Trace Metals

It is well known that marine sediments contain varying levels of contaminants, such as trace metals, that have been discharged into the marine environment. The level of contaminants recorded depends on the hydrodynamic environment and how effective it is at dispersing those contaminants. Concentrations of trace

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metals are influenced (in the upper 10cm of sediment) by mud content, bioturbation and physical resuspension.

Birch and Matthai (2000) noted that the receiving waters of Sydney Harbour receive trace metals from natural estuarine discharge as well as from anthropogenic sources such as coastal and deepwater ocean sewage outfalls and off-shore dumping of dredged harbour sediments.

Birch and Matthai (2000) found that trace metal and TOC (Total Organic Carbon) concentrations decreased seawards, thereby indicating a significant contribution from land-based activities. They also stated that in Sydney's case higher concentrations of trace metals were unlikely to be due to natural enrichment processes.

Heavy Metals

Birch and Taylor (1999) claim that general drainage from the larger surrounding catchments (stormwater), leachate from reclaimed lands and atmospheric contributions (contributed by cars and industry emitting heavy metals into the atmosphere) are major sources of heavy metal contaminants in Sydney Harbour.

Stormwater input from smaller catchments and sewage overflows in general within the harbour contribute significantly to nutrients and bacteria in the water, however Birch and Taylor (1999) found an absence of additional heavy metals adjacent to sewage overflow and stormwater facilities (in smaller catchments). As a result Birch and Taylor concluded that sewage overflows, and for smaller catchments stormwater, are not significant factors in contributing to the presence of heavy metal contaminants. They identified that the highest concentrations of heavy metals in sediments occur at the headwaters of embayment's and tributaries in the estuary.

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs form from a variety of sources, mainly involving both natural and man-made combustion such as combustion of fossil fuels, coal gasification and liquification processes, waste incineration, production of coke and bushfires. PAHs, because of their nature, may accumulate to high concentrations in sediments.

The spatial distribution of PAHs resulting from tests undertaken in Sydney Harbour suggests that they predominantly derive from urban run-off, which is suggested by a general increase in PAH concentrations towards the bay ends, similar to heavy metal distributions found by Birch and Taylor (1999). McCready et al found that wind also played a significant factor in the distribution of PAHs, and as a result PAHs are often found in locations far removed from their likely sources.

In McCready's study 124 sample locations were used across Sydney Harbour including 6 in North Harbour. Comparing results of this study with PAH guidelines from the US indicated that most of the sites studied within Sydney Harbour have levels of PAHs that are expected to occasionally or frequently result in adverse biological effects (McCready et al, 2000). McCready et al note that PAHs are not the only source of contamination and that combining the PAH data with results of all metallic and organic contamination concentrations would afford a more accurate representation of potential impact on benthic biota.

Dioxins

Dioxins are a generic term for a group of environmentally persistent chemicals, including 17 related polychlorinated dibenzodioxins (PCDDs) and dibenzofurans (PCDFs), considered by the World Health Organisation to have significant toxicity, as well as 12 compounds, called dioxin-like polychlorinated biphenyls (PCBs) out of a group of 209 PCBs (NSW Food Authority, 2006)

These chemicals are not manufactured intentionally but often formed by natural processes such as volcanoes and forest or grass fires, with bushfires thought to contribute at least 20-30% of the total dioxin-like compounds to the Australian Environment. Dioxins are also produced as by-products of industrial processes such as waste incineration, pulp and paper bleaching and the synthesis of certain chemicals. PCBs however were manufactured for approximately 50 years for use as components of insulating fluids in transformers and other electrical equipment but are no longer manufactured.

Although humans and the environment have been exposed to dioxins for many hundreds of thousands of years, some have been found to concentrate in body fat and accumulate as they move through the food chain. These

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properties mean that even low levels of dioxins in the environment may eventually pose risks to animals and humans.

Dioxins have gained a reputation of being the most toxic of organic compounds with acute and chronic effects including skin lesions in humans and reproductive and immune disorders and some types of cancer in animal experiments. Given the potential for accumulation and the occurrence of toxicity at very low levels of intake in animals, the main health concerns for human are likely to be associated with long term intake through food.

Bioaccumulation refers to the ingestion of substances by fauna, and subsequent transfer of those substances up the food chain. Invertebrates living within the sediments, such as yabbies and worms, play an important function in turning and cleaning the sediments, known as bioturbation. When elevated levels of toxins are found within the sediments, these are ingested by the invertebrates, and then passed up the food chain as they are consumed by predatory fish, and those fish are in turn consumed by larger fish. Birch and Taylor (2004) suggest that toxic chemicals are enriched in fish species within Sydney Harbour due to the contamination of sediments. As fishes move throughout the greater Harbour, this means that affected fish will be found within the study area.

In November 2005, the NSW Food Authority received reports from the NSW Interdepartmental Committee on Contaminants in Fish of elevated levels of dioxins in prawns from Sydney Harbour. The initial sampling of prawns was urgently supplemented by further prawn sampling and testing of bream as a representative of bottom feeding fin-fish species likely to contain higher levels of dioxins.

Results from sampling of Prawns (36) displayed a mean of 11.3 pg TEQ/g fresh weight and those from bream (40) a mean of 29.1 pg TEQ/g fresh weight. These samples were well in excess of the 6 pg TEQ/g fresh weight Action Level thus triggering an investigation of consumption patterns in relation to risk.

In March 2006 the I&I NSW distributed health signage to all Local Government Areas bordering the harbour and its tributaries to alert the public to the potential risk associated with consumption of fish from Sydney Harbour. **Table 5.14** provides a summary of the dietary advice provided by I&I NSW, regarding the consumption of Harbour caught fish.

Table 5.14 Recommended maximum intake based on eating a single species caught east of the Sydney Harbour Bridge

Species	Number of 150 gram serves	Amounts per month
Prawns	4 per month	600 g
Crab	5 per month	750 g
Bream	1 per month	150 g
Flounder	12 per month	1800 g
Kingfish	12 per month	1800 g
Luderick	12 per month	1800 g
Sand Whiting	8 per month	1200 g
Sea Mullet	1 every 3 months	50 g
Silver Biddie	1 per month	150 g
Silver Trevally	5 per month	750 g
Tailor	1 per month	150 g
Trumpeter Whiting	12 per month	1800 g
Yellowtail Scad	8 per month	1200 g

Source: Industry & Investment NSW, 2008

Organic Contaminants

Organic contaminants have been identified as major contributors to degradation of the marine environment. While no data is available for the Manly Cove study area Birch and Taylor conducted a study in 2000 which aimed to determine the sediment size with which a range of organic contaminants (Chlordane, HCB, Lindane,

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Heptachlor, Aldrin, H-epoxide, DDT, DDD, DDE) are associated. They used the north western part of North Harbour as their study area.

Birch and Taylor established that North Harbour comprises a deep (5-10m) mud basin containing greater than 50% mud. The basin is surrounded by steep margins and a shallow sandy (greater than 90% sand) bay head beach. Fine detritus brought into the cove by the drain at the head of the bay, is reworked in the shallow bay-head area and accumulates in the deep central basin. A small steep fluvial delta occupies the upper part of the bay" (Birch & Taylor, 2000).

To gain a more accurate understanding of sediment contamination, variable grain size of sediments need to be considered. Birch & Taylor state that usually finer grained sediments are associated with higher organic contaminants. Grain size can influence organic contaminant concentrations probably more so than proximity to the contaminant source (Birch & Taylor 2000). With this in mind, organic contamination of the larger sediments found in Manly Cove would be markedly less than those of the finer sediment recorded at the north-western North Harbour location.

5.15 FORESHORE DEVELOPMENTS

Development of the foreshore has been extensive in the study area. Some of these are described below:

5.15.1 Seawalls

Seawalls, both public and private, exist throughout the study area. They are now common features of landscape in shallow coastal waters of urbanised areas. In some areas, they have replaced considerable portions of natural habitats, such as natural rocky shores or beaches. In Sydney Harbour, approximately 50% of the shore is composed of retaining seawalls or other built habitats (Chapman & Bulleri 2003). Similarly, within the study area, total length of seawalls is 0.95km (**Figure 5.15.1a**), accounting for approximately 51% of the foreshore length.

Low lying land behind coastal barriers, such as the Manly Cove seawalls, tend to remain completely protected until a certain critical combination of waves, elevated water levels and possibly beach erosion occurs. Inundation then commences, typically by wave run-up and overtopping. The inundation of protected areas can also occur via backflow through stormwater pipes. This is often a gradual process. However, if the barrier is completely overtopped or breached, inundation of back areas can be rapid. If back areas are poorly drained, flooding behind a breached or overtopped barrier may persist for some time when coastal water levels fall.

Two prominent seawalls are Manly Cove West Beach Seawall & the Manly Cove East Seawall (See **Figure 5.15.1a**). During the Coastline Hazard Definition Study process undertaken in the development of the Manly Cove Coastline Management Plan, both of these seawalls were inspected through:

- visual assessment of the condition of the seawall;
- excavation of inspection pits seaward of the seawall to determine foundation levels and soil properties; and,
- geotechnical analysis to determine the stability of the seawall under scour conditions.

Manly Cove West Beach Seawall

The seawall that runs behind Manly Cove West Beach was constructed around 1900 and extends approximately 230m between Oceanworld to the west and Manly Wharf to the east.

At the time of inspection the seawall varied in height above beach level from 1.0 at the western end to 1.8 at the eastern end. The seawall forms the southern edge of the Esplanade, which comprises a flat, brick paved surface with a grassed area behind. Large Norfolk Island Pines line the grassed area (PB&P 2004).



Figure 5.15.1a Seawall locations within the study area

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The seawall is of sandstone masonry construction with a concrete facing of 0.15 to 0.20 m thickness along its entire length. At approximately 0.3 below beach level, the facing is stepped into the masonry wall behind. The width of the crest of the seawall could not be determined without damage to the Esplanade, however the crest level varies between approximately 3.4 to 3.7 m AHD (PB&P, 2004).

There are two large sets of access steps to the beach at the western end near Oceanworld and four smaller sets located from the middle to the eastern end of the beach. The seawall was generally in good condition.

Historical Performance

The history of storm damage in Manly Cove can be summarised as follows:

1913	Damage to changing sheds and seawall
1925	Swimming Baths destroyed
1955	Damage to seawall
1967	Damage to seawall
1968	Damage to seawall
1974	Major damage to seawall, swim baths and UTA Jetty



Figure 5.15.1b – Destruction resulting from 1974 storm activity

The exact location and extent of seawall damage in each instance is not known (with the exception of the 1974 storm event). Though some of the seawall damage was limited to capping stones, this data indicates that a damaging storm affects Manly Cove on average every 12 years (though the interval between events ranges from 1 to 30 years).

The Manly Cove West seawall is not known to have suffered any significant damage during the 1974 storms. This could be explained by a number of factors including:

- The protection afforded by the wave energy dissipated by the harbour pool structure (that was severely damaged during the storm);
- The additional beach width in comparison to Manly Cove East; and
- The higher seawall crest level than the Manly Cove East seawall.

Stability Assessment

Consulting geotechnical engineers, Jeffery & Katouskas Pty Ltd were commissioned by Patterson Britton as part of the Coastline Hazard Definition Study to investigate the seawall construction and condition and to comment on the future stability.

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These investigations involved surface observations and the excavation of a total of three test pits in the front of the seawall to determine the shape of the wall and the level of the toe. All test pit locations were founded on beach sands. The footings supporting the seawall were either absent (TP 7) or comprised sandstone masonry approximately 0.7 m thick that stepped out a horizontal distance of 80 mm (TP 6). The concrete footings supporting the access steps (TP 5) near the western end of the beach were approximately 0.5 m thick and stepped out a horizontal distance of 0.8 m.

The crest of the seawall ranges between approximately 3.3 and 3.6 m AHD. The seawall at test pit locations was founded at depths ranging between 2.35 and 2.65 m below the crest of the seawall, i.e. at levels between 0.8 and 1.25 m AHD.

From the surface the seawall appears to be in reasonable condition, however the concrete face in one portion contained some horizontal and vertical hairline cracking to 2 mm wide. The rendered surface (about 3mm thick) has spalled off at some locations.

Groundwater seepage was encountered in TP 5 and TP 7, at levels corresponding with the tidal level at that time.

The test pit investigation revealed that the seawall is a gravity retaining wall with an intermittent toe. Limited probing beneath the base of the seawall indicated that the base of the footings extended back horizontal distances of at least 0.6 m from the leading edge of the footing.

As the cross section of the wall is not known, it is not possible to rigorously analyse the structural integrity of the wall. It can therefore only be determined that the wall does not show signs of stress, weakness or failure and appears to be structurally stable. In the event of a severe storm however, the beach level in front of the seawall would be lowered. The loss of sand from the toe of the seawall would effectively increase the potential for the following failure mechanisms:

- Overturning failure;
- Failure by forward sliding of the wall; or
- Circular slip failure beneath the wall.

From the storm demand analysis (**Section 5.9**) it is estimated that the beach level at the seawall would be lowered in an extreme storm event in the order of 0.5 to 1 m, i.e. to 1 to 1.5 m AHD (assuming that the average beach level is currently at approximately 2.0 m AHD). The test pit investigation revealed that most of the seawall was founded between 0.8 and 1.05 m AHD. It is therefore unlikely that the stability of the seawall would be significantly undermined in such an event. The risk of undermining and damage to the seawall would be expected to increase over time due to ongoing loss of sand from the beach. However, increases to sea level as a result of sea level rise may counteract this prediction.

A detailed risk to life assessment was not carried out as the expected occupancy of the area immediately behind and in front of the seawall would be low. Furthermore it was expected there would be some warning before collapse, resulting in a greater likelihood of evacuation of the area. The risk to life should a portion of the seawall fail during a severe storm event when a person was standing behind the wall was determined to be acceptable.

Recommendations

Though it is likely the concrete faced masonry wall has been in its present condition for some time and that there would be warning signs before any collapse. It is recommended that the seawall be monitored on a regular basis for signs of movement, particularly following heavy rainfall and severe storm events.

Manly Cove East Seawall

The seawall along the back of Manly Cove East Beach was probably originally constructed in the late 1800's as evidenced by the historical photographs of the area. The original wall in these photographs appears to have a

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lower crest level than the present wall which must have been added to or rebuilt at a later date. The current seawall crest varies between 2.2 and 3.2 m AHD.

The Manly Cove East seawall is approximately 270 metres long extending between Manly Wharf and the eastern end of the beach. At the eastern end of the beach the seawall curves around approximately 90° towards the south-west and was observed to be directly founded on sandstone bedrock. The seawall is generally of sandstone masonry construction.

A limited portion of seawall (approximately 10 m long) at the western end adjacent to the Manly Wharf steps appears to have been replaced and realigned as part of the 1988 wharf redevelopment. From observation this portion of the seawall appears to be built in front of the old seawall and is of concrete construction with a sandstone masonry facing. Concrete steps adjacent to the realigned seawall provide access from the western end of the beach up to the timber decking surrounding the Manly Wharf Hotel. Due to low beach level, there is currently a significant drop from the bottom of the steps down onto the beach.

The seawall forms the southern edge of the East Esplanade, which comprises a flat concrete and brick paved surface with grassed area behind. Large Norfolk pines line the grassed area. At three locations along the seawall face stormwater pipe outlets discharge onto the beach. Two pipes were located at the eastern end of the beach and one towards the middle of the beach. The pipes ranged in size from 450 to 675 mm in diameter. The seawall appears to be in a reasonable condition.

Historical Performance

As noted above, Manly Cove has experienced a damaging storm on average every twelve years since the early 1900's, the most significant being the storm in 1974 when large sections of the seawall collapsed. A drawing "Reconstruction of Seawall – East Esplanade Beach" (Plan No. 2/015) provides details of the portions of seawall requiring reconstruction following the 1974 storm event. There are three areas of seawall of length of approximately 40 m each, one being located at each end of the seawall and the third in the centre section.

The drawing also includes a structural cross-section showing that these sections of seawall comprise a sandstone block wall with 24mm vertical bars installed in 40 mm diameter holes at 930 mm centres and pressure grouted. The sandstone block wall is founded on a concrete footing of 600 mm thickness.

Test pit investigations were carried out near these locations in an attempt to confirm the structural cross-section shown in the drawing. The only area where there were footings resembling that shown in the drawing was at the western end of the beach (TP 3 and TP 4). However, this portion of wall appears to have been realigned some time since 1974. The test pit investigations were unable to confirm the presence of the vertical bars in those areas of seawall.

Stability Assessment

A total of four test pits were excavated by consulting geotechnical engineers in front of the seawall to determine the shape of the wall and the level of the toe. The test pits revealed that the seawall is founded on beach sands at depths ranging from 0.45 m (at the western end) and 2.6 m (at the eastern end) below the November 2003 beach level. The foundations of the seawall are generally at approximately 0.6 m AHD with the exception of the most western pit which was founded at -0.6m AHD. The footings supporting the seawall were either absent or comprised a sandstone masonry footing that stepped out 0.6 to 0.8 m from the face of the seawall. The concrete footing was found to be 0.45 to 0.6 m thick in this area.

From the surface the seawall appears to be generally in reasonable condition, though some sandstone blocks were noted to have eroded back approximately 50 mm in length and the mortar in some joints has been weathered. Sandstone block also appear to have been recently replaced in some locations.

The top footing was exposed along the realigned portion of wall at the western end of the beach. Test pit excavation indicated that the concrete footing has a depth of 0.45 to 0.6m. A significant lowering of the sand level in this area by wave action could lead to undermining of the toe of the seawall which in turn could potentially lead to failure of the wall by one of the following mechanisms:

- Forward sliding of the wall;

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- Circular slip failure beneath the wall; or
- Toppling forward.

Though it is believed that this area of beach has presently stabilised and is not suffering from significant long term sand losses, in the event of a severe storm it is possible that sand levels could drop below the seawall toe level and thus put this section of wall at risk.

From the storm demand analysis it is estimated that the beach level at the seawall would be lowered in an extreme storm event in the order of 1.5 to 2.0 m i.e. to 0.3 and -1.0 at the eastern and western ends of the beach respectively. The test pit investigation found that most of the seawall is founded at 0.6 m AHD with the exception of the eastern end that was at -0.6 m AHD. It is therefore evident that the eastern end of the seawall is unlikely to be significantly undermined while the western end is very likely to be undermined in an extreme storm event. Groundwater seepage was detected at all test pit locations, with all levels corresponding with the tidal level at the time of inspection.

As the cross-section of the wall is not known, it was not possible to rigorously examine the structural stability of the wall. It can therefore only be determined that the wall does not currently show any significant signs of stress, weakness or failure and would therefore appear to be structurally stable in its current configuration under 'normal' conditions. In the event of a severe storm however, as discussed above, the beach level at the toe of the seawall would be eroded and it is likely that the western end of the seawall would be undermined leading to possible failure.

Recommendations

The realigned portion of seawall at the western end of Manly Cove East where the footing is currently exposed may be at risk of failure if sand levels drop in a severe storm event. It is not possible to quantify this risk as the cross sectional details of this portion of seawall are not known. It is therefore recommended that in order to reduce the risk to the seawall, as well as improve amenity of this area, action be taken to reinstate the beach in accordance with the options provided in various reports commissioned to investigate this issue.

5.15.2 Boating Facilities

The embayment of Manly Cove offers a diverse range of opportunities for recreational and commercial boat and watercraft use. The study area is also used as a temporary and permanent anchorage and mooring site. Wind surfing, canoeing, dragon boating, kayaking, outriggering and a variety of sailing activity is conducted in the vicinity of the Manly Cove study area.

A number of boating facilities exist within a "Boat Club Precinct" located between the eastern end of Esplanade Reserve and Stuart Street including the Manly Yacht Club, Manly Rowing and Sailing Club, the Manly 16 Foot Skiff Club and the Manly Cove Launch Club. Some rationalisation has occurred amongst these uses whereby Manly Yacht Club has now taken over the old Manly Baths buildings and their original club demolished. These clubs provide boatshed storage facilities, slipways and some licensed facilities for club members. They arrange yacht races, patrol and sea rescue work, sailing instruction and recreational sailing. The clear majority of submissions received during consultation called to retain and enhance the existing visual character of this precinct.

A number of restrictions on boating activities presently apply in the study area, which are designed to assist in the protection of seagrass and to aid in providing a safe environment for user groups. Non-compliance with the regulations was identified as an issue for seagrass management and has been addressed in the management recommendations of this report.

The wash from Ferries and large vessels accessing Manly Wharf and the Cove, coupled with natural wave action, causes problems for small craft and also results in deterioration of the seawall and the lower level of waterside developments. Spackman and Mossop (2005) identified that it is not possible to reduce this wash because the ferries require a minimum speed to manoeuvre and berth at Manly Wharf.



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A number of concerns in relation to the activities of commercial jet-boat operators have been identified in the development of this study, with particular reference to little penguin conservation, noise and risk to non-motorised vessels.

The Manly Cove study area houses a number of key waterside facilities which provide for water based recreation, particularly sailing activities. The boating precinct located on the eastern foreshore of Manly Cove was first established by early European settlers during the 1870s, growing with Manly's popularity as a seaside resort. Today the club precinct remains relatively unchanged and creates distinct characteristics which the community has recognised as being important to retain into the future. These heritage values are support in Councils LEP and the Sydney Harbour Catchments Regional Environment Plan 2005.

Views of the water from Ashburner Street are identified as important in the Manly Town Centre Urban Design Guidelines for improving visual links between the suburb and Manly Cove. Similarly, the views from Stuart, Wood and Osbourne Streets provide important links to the water. The club precinct is viewed from the water as a low level cluster of predominantly heritage buildings in a park-like setting with an urban backdrop (Spackman and Mossop, 2005). The aesthetics of boats moored or being work on in slipways are an integral part of the heritage and visual character of the area. The area is also visually exposed to travellers on the Manly Ferry and FastFerry. These views are important as they define the first impressions of Manly for the approaching visitor.

Water-based developments in Manly Cove west has been subject to significant change over the years. The Manly Bathers Pavilion, incorporating tea rooms, public baths and a boardwalk were opened in the 1930s. The boardwalk was destroyed during significant storm events during 1974. Oceanworld was built in 1964 and extended to its current form in 1988. In 1980 the Manly Waterworks were built in the southern wing of the Pavilion. The Manly Art Gallery opened in 1930 and the Museum extension opened in 1992. Any future expansion or intensification of Manly Pavilion and/or Oceanworld will lead to a requirement for increase parking availability which is currently in short supply.

Normally, at the end of commercial leases, NSW Maritime requires structures to be removed or seeks new lessees through public competition. Over the past 10 years, NSW Maritime has been approached by lessees of both Oceanworld and Manly Pavilion with a number of ideas for redevelopment of the existing buildings. NSW Maritime are obliged to put to the commercial marketplace any change in use or intensification of development of premises in the interests of probity and maximising returns on the public asset. Therefore, NSW Maritime does not support proposals from existing lessees where the proposal is different from the permitted use under the lease. (Urban Design Advisory Service, 2004).

In recognition of growing concern over the adverse impacts of marina development on the biophysical environment, a moratorium has been placed on the development of any new marinas in Sydney Harbour, except on four (4) designated sites identified as appropriate for marinas related to the working harbour's facilities. The moratorium allows for the completion of the Boat Storage Strategy presently being prepared by NSW Maritime and Department of Planning. None of the four (4) marina sites identified are located along Manly's foreshores.

Mooring and anchoring

Boat storage facilities within Manly Cove consist predominantly of private swing moorings and commercial moorings licensed to the various clubs situated on the eastern foreshores of Manly Cove by NSW Maritime. Manly Cove has proven to be a popular mooring location, offering a convenient location in relatively calm and secure conditions. Moored boats are usually accessed either by dinghies that are stored by the clubs or through tender services operated by individual clubs. All moorings in Manly Cove are positioned within 150 metres of the mean high water mark and are consequently located within important seagrass beds.

Manly Cove is a popular boating area, with 96 moorings available in addition to those anchored in the area on a summer weekend day. Boating activities are known to cause damage to seagrass through propeller scarring, swing moorings and boat anchoring. Recreational boating and anchoring is considered the most significant source of damage to seagrass beds in the study area. However, further studies would be required to assess the intensity of boating and the level of disturbance to seagrass in the study area as a result.

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All of the moorings in Manly Cove are swing moorings, with chains dragging across the seafloor damaging the seagrass beds within their range. Swing moorings have resulted in bare patches within the Manly Cove seagrass beds with approximately 65% of moorings positioned over seagrass (*Zostera and Posidonia spp.*). The design and location of the existing mooring systems poses significant degradation of the seagrass habitat through circular dragging of the mooring chains across the seabed. This continual action has created a fragmented seagrass habitat within Manly Cove.

NSW Maritime is currently trialling seagrass friendly moorings in an attempt to minimise the impact of boating on seagrass beds and the aquatic environment. Further, during extreme low tides, boat propellers act like harvesters on seagrass resulting in significant damage and dislodgment of seagrass plants and other aquatic flora. Boat anchorage can have a similar effect on aquatic flora.

Department of Primary Industries has undertaken an inventory of seagrass in NSW including Manly Cove. It is intended that this information will be included in NSW Maritime's boating maps to assist recreational boaters in the avoidance of areas where significant seagrass beds exist and to identify more suitable areas for mooring.

NSW Maritime have advised that there are limits on the number of moorings per bay in Sydney Harbour which is calculated by a number of variables such as size of embayment, parking availability, dinghy storage facilities and activities operating within a site.

In preparation of the Manly Cove East Framework Plan, NSW Maritime has confirmed with Council that the total number of moorings within Manly cove will be capped at the existing number of 96 moorings (Refer to **Table 5.15.2**).

Table 5.15.2 - Mooring use within Manly Cove

Mooring User	No. of Moorings
Private Use	87
Commercial Use	9
TOTAL	96

Some community concerns have arisen in relation to the use of existing moorings by "mooring minders" whereby a vessel of low value remains attached to a mooring until a more valuable vessel is to be moored. The specific issue relates to the lack of maintenance of the moorings used for this purpose. There is a risk posed to other vessels and water users from moorings dragging as a result of a lack of maintenance. NSW Maritime should be encouraged to undertake mooring audits and to certify each mooring has had an annual mooring service.

In 2004 NSW Maritime and the NSW Department of Planning prepared a Boat Storage Policy for Sydney Harbour. The policy aims to provide a more strategic and certain approach to regulating boat storage facilities on the harbour and outlines the NSW Government's policy for achieving a balance between promoting a prosperous working harbour, maintaining a healthy waterway and promoting recreational uses of the foreshores and waterways.

There is currently a lack of public wharf facilities within Manly Cove. Prior to the current lease agreement, recreational vessels were able to use Manly Wharf for transfer of passengers and goods in a safe user-friendly location. However, vessels are now charged at premium rates to utilize Manly Wharf regardless of the time they are berthed. This issue has been raised by numerous groups and individuals during the consultation process, including the Little Manly and Fairlight Precincts. It is likely that the provision of public wharf facilities in Manly Cove will lead to a decreased need for moorings within the embayment.

Council has raised concerns with NSW Maritime over the alteration to the lease but was unable to confirm reasoning behind the decision. Council continues to work to identify a suitable location for a public wharf facility. Many vessels are found to utilise Manly Coves beaches as a substitute, which has been identified through the consultation process as creating conflicts with other beach users.

Seagrass Friendly Moorings at Manly Cove

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Industry & Investment NSW in partnership with Sydney Metropolitan Catchment Management Authority, Manly Council, and NSW Maritime are in the process of undertaking a 3-year trial of seagrass friendly mooring systems in Manly Cove. It is expected that up to 33 Seagrass Friendly Moorings can be installed as part of this trial. By October 2009, 22 seagrass friendly moorings have been installed.

Manly Wharf

The first Wharf, also known as “the Pier at Manly Cove”, was built by Henry Gilbert Smith in 1855 as part of his promotion of Manly (or New Brighton) as a holiday resort. With the construction of the wharf regular ferry services began between Manly and Circular Quay. Over the next century, as Manly became a more popular destination for the residents of Sydney, the wharf underwent numerous upgrades and additions.

In the late 1870s Manly Wharf was the property of the Port Jackson Steam Boat Company (formed 1876) which ran the ferry service. In 1881 it was renamed the Port Jackson Steamship Company. Up to this time the Manly Council had no control over the wharf or the ferry service provided by the Company. It was not until 1882 that the Council acquired control of the foreshore.

A second wharf was required, tenders were invited in 1878, and by 1879 the Brightside wharf, or Stuart Street wharf, was completed. In 1886 the New South Wales Government built a cargo wharf on the eastern side of the existing ferry wharf. In 1893 the Manly Co-operative Steam Ferry Company was set up in competition to the existing company. A fare price war ensued in 1896 resulting in the amalgamation of the two companies as the Port Jackson and Manly Steamship Company.

In the wake of an outbreak of bubonic plague centred on the wharf area, in 1900 the newly formed Sydney Harbour Trust, later the Maritime Services Board of NSW, determined the demolition of the existing buildings on the ferry wharf, including the Camera Obscura. New facilities, including the strengthening of the wharf, were completed in 1903.

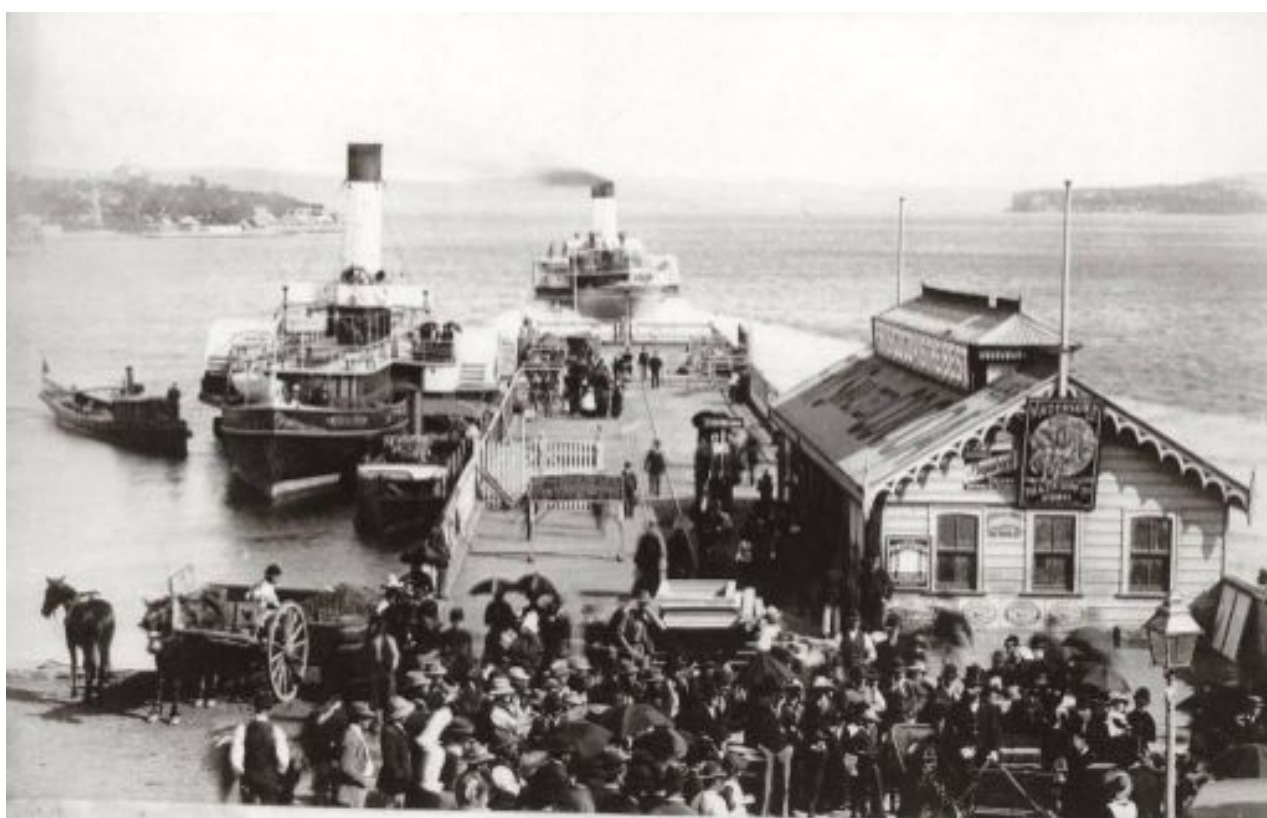


Figure 5.15.2a - Manly Wharf in 1887, Fairlight and Brighton ferries

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Also in 1900 the Port Jackson and Manly Steamship Company leased the government cargo wharf. The western side was reserved for company shipping, while the eastern side was sub-leased. In 1918 the sheds on the ferry wharf were upgraded with the addition of a clock tower and a façade in half-timber. Turnstiles were introduced in 1926.



Figure 5.15.2b – Manly Wharf showing Camera Obscura 1890s

With the opening of the Spit Bridge in 1924, the traffic on the cargo wharf diminished, forcing its closure in 1928. At about this time a shark aquarium was built on its western side, and in 1931 it opened as an amusement pier, which has continued to the present day.



Figure 5.15.2c – The view from Hotel Manly in 1922

In 1931/2, the promenade, a raised wooden walkway, was constructed between the ferry wharf and the dressing pavilion (opened in 1933) at the western end of the Esplanade. Shark-proof nets were incorporated in the walkways to create a large swimming area. The Promenade originally joined the western walkway at the stairs now used for the water taxis or aqua cabs. The walkway was severely damaged and subsequently demolished in 1974 after storm damage.

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Circa 1940, the navigational light standard was put in place, the seawall and concrete stairs were elevated and the clock tower was built. The wharf building was erected, reinforced concreting was laid in the vestibule and in each of the wings, and roller doors were introduced. In 1946 the side openings to the wharf building were added.

The wharf remained unchanged until the early 1980s when a major reconstruction took place, involving the construction of a new bus/ferry interchange and addition of the two-level passenger facilities for the new government ferries. Further reconstruction took place leading up to the 2000 Sydney Olympic Games period. (Manly Wharf Research Team *Research Study into the Development of Manly Wharf* (1998))



Figure 5.15.2d - Manly Wharf after 1980s reconstruction

During mid 2006 works commenced on a multi-million dollar upgrade of the Manly Wharf commuter terminal. The key elements of the upgrade include the following:

- Improved views through the wharf and out to the harbour;
- Improved commuter convenience and comfort;
- Reinstated original roof profile on the eastern side of the wharf;
- Removal of the existing JetCat platforms and installation a new JetCat berthing facility;
- New passenger waiting areas at the southern end of the wharf;
- Upgraded passenger waiting areas on each side of the wharf;
- Improved passenger flows by modifying ramps and relocating ticket booths;
- New disabled access features on the wharf; and
- Improved passenger safety by introducing a ferry arrestor at the end of the wharf.

NSW Maritime will also be removing and remediating existing lead paint in the older sections of the wharf as a part of this project. The refurbishments will take into account the heritage character of the wharf (NSW Maritime, 2007).

The newly renovated Manly Wharf, currently leased to private operators by NSW Maritime, encompasses a range of diverse uses providing waterfront restaurants, shopping and entertainment for the enjoyment of tourists and local day-trippers as well as Manly locals. However, this popularity has resulted in a range of management issues which must be addressed through collaboration between NSW Maritime, Wharf Management and Council.

Fishing from Manly Wharf is currently prohibited, however the practice is often observed, particularly during early morning and evening when the location is not monitored by Wharf security. The banning of this activity relates predominantly to protection of Little Penguins but also to waste, hygiene and safety issues.

Manly 16 Foot Skiff Club

The Manly 16ft Skiff Club traces its beginnings to the 1921/22 sailing season when a number of members of the

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Delwood Canoe Club decided to band together and conducted sailing races on Sunday afternoons. The Club was actually formed at a meeting held on Friday 23 February 1923 and was to be known as the Manly Sailing Club. In 1952, with the Club now only racing 16ft skiffs, the name was changed to Manly 16ft Skiff Sailing Club. By that time there was a fleet of about twelve 16ft skiffs racing with the Club and further extensions were carried out to the building to provide a social area on top of the boat storage facilities already constructed.



Figure 5.15.2e - Manly Skiff Club viewed from Stuart Street, Manly

The latter half of the 1950s and early 1960s was a period of rapid and dramatic change both for the Club and the 16ft skiff class. In early 1960, the Club applied for a Liquor License. This was ultimately granted on 1 July 1960. The increased revenue which resulted from the operation of the Club as licensed premises, was, and still is, applied solely to maintaining Club facilities and promotion of sailing. Since the Club obtained its Licence in 1960 membership had steadily grown from around 300 to just fewer than 800 in 1972.

To comply with the State Government requirements, the Club was incorporated as a company (limited by guarantee) in November 1972. The purpose of this requirement was to protect the liability of members if a club became insolvent.

On 26th May 1974, the Club building was severely damaged by a very severe storm which, combined with an exceptionally high tide, saw waves actually breaking over both the concrete and timber decks. This same storm caused considerable damage around the Manly/North Harbour foreshore, including the total demolition of the North Harbour Sailing Club (and all boats stored therein).

In 1979 the Club's financial position had improved to the extent that a new boat storage area (the old Manly Diggers Swimming Club building) was purchased adjacent to the existing Club and significant refurbishment was carried out to the main building with the completion of a new bar, toilets, office and kitchen. In 1988, the Liquor Administration Board approved an increase from 800 to 2,000 in the allowable maximum number of members.

Despite the Recession during the early 1990s, the Club continued to be in a strong financial position. During the off-season in 1992 extensive rebuilding work was undertaken on the Club's main premises to provide larger and improved facilities including a licensed bar and restaurant. This work brought to fruition the sort of facilities which were envisaged, but eluded for various reasons, the Club's administrators during the 1960's.

At the end of the 1998/99 season work commenced on redevelopment of the boat storage area located between Club and Manly Yacht Club. After an initial delay of three months due to concerns about the Manly



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Skiff Club retaining wall on East Esplanade, the project was finally completed in March 2000 at a cost of \$660,000. After being forced to trail their boats for most of the season, both the junior fleets were able to occupy the new boat shed and ramp for the last few races.

By the end of the 2003/04 season the Club had nearly 3,900 members. Also in May 2004, the Board decided that the Club should take over the catering operation after more than 40 years of contracting it out. In August 2004, a successful application was made to the Licensing Court to increase the maximum number of members from 4,000 to 6,000.

The Club has been operating profitably for many years and as a result has been able to provide the sailing activities with the necessary resources to allow its sailing fleet to become one of the most competitive in Australia. At the same time the licensed facilities have become very popular with the members and their guests in recent years as a boutique club venue over the water in Manly Cove.

During weekend racing, Members of the Manly 16 Foot Skiff Club utilise the portion of East Esplanade Reserve between Osborne Road and Victoria Parade for the purposes of rigging. An agreement had been reached between Council and the Club confirming that this use is permissible following the Club's significant contribution to access upgrades in the area. However, a number of concerns were raised during the public consultation process in relation to the duration that some vessels and trailers are left in this location with some seemingly on a permanent basis. Further, the popularity of the sailing activities and the associated use of the area for rigging of vessels often extend far beyond the original zone agreed to by Council. During 2006 the rigging of vessels was seen to dominate use for the entirety of the Reserve (i.e. from Osborne Road to Manly Wharf).

In 2003 an inspection was made to the existing facility which identified extensive structural problems as a result of concrete spalling. This provided an opportunity to look into redevelopment opportunities which satisfy Club sailing activities and community needs in a manner that respects the 'low-key' nature of development in this area. During the development of this report, Manly Skiff Club had met with Council to discuss the feasibility of a number of proposals to redevelop the facility.

Community consultation clearly identified that the majority of respondents stated that they value the heritage characteristics of the area and would not support significant changes to building design in this location.

Manly Yacht Club

Manly Yacht Club was formed in 1950 as the Manly 14 ft Sailing Club. Members of this club designed the successful 'Manly Junior' training dinghy in 1960 and these dinghies are still used for junior sail training at the Club today.

In March 1965, the Manly 14 ft Sailing Club became incorporated as the Manly Yacht Club, a non-profit public company limited by guarantee. The objectives of the Club as outlined in the Articles of Association were, and remain, to "promote the sport of yachting and boating".

The original Club premises located north of the existing premises in Manly Cove were extensively damaged by storm in the mid 1970s. In July 1975, the Club decided to move to the old Manly Baths Building (owned by Manly Council) to create a new club house. The Baths Building had also been extensively damaged by the storm and was unused at the time. The Club refurbished this building and in return was granted a long term lease.

The Club has two yacht divisions, a centreboard division as well as the Manly Juniors and last season carried out a sailing activity on 94 separate occasions. In December 1998, a Sailability Division was formed to allow the Club to provide sailing opportunities for every-one regardless of age or disability.

In 2001 the Club built a ramp and pontoon complete with small crane to improve access to the water for all members and in particular, our Sailability members. The project was funded by two grants from the NSW Department of Sport and Recreation totalling \$20,000 and supplemented with Club funds. The facility, valued at

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in excess of \$100,000 was built with volunteer labour from the Club and the Manly Sunrise Rotary Club who also support Sailability.

This ramp and pontoon has been the catalyst for the spectacular growth in the Sailability Division in the past two years. The Club now has a fleet of eight special purpose 'Access Dinghies', over 40 regular disabled sailors and we provide our dinghies, equipment and facilities free of charge to eight major disability groups from all over Sydney (pers comm. Wilson 2005).



Figure 5.15.2f Manly Yacht Club viewed from the waters of Manly Cove

Sailability is a non-profit organization dedicated to increasing sailing opportunities for all disabled people, regardless of age, ability or sailing experience. Sailing days provide social sailing with some opportunities for competition for the more able sailors. Currently the club owns 8 access dinghies specifically designed to allow novices of any ability to sail.

Also operating from Manly Yacht Club premises is Penguin Sail Manly. This commercial operator has been operating in conjunction with the Club for several years and offers training from beginners to coastal skippers. The school is fully accredited by the Australian Yachting Federation and uses two identical 8 metre sail training vessels, along with 12 metre offshore boats.

On-site inspections with representatives of the Yacht Club highlighted the impact that the wash from larger vessels is having upon operations across the "Club Precinct". The large wake created from Ferry moments is found to cause considerable disruption and difficulty to the activities of the Sailability Program as well as general boat use and storage. Upon meeting the foreshore, the wake often breaks underneath the lower deck of the Club, casting water through the floor panels and into the boat workshop and storage areas.

Manly Launch Club

The Manly Cove Launch Club is situated in the North East corner of Manly Cove fronting the park and pathway to East Esplanade. The club premises are located partly on the rocky foreshore and the waters of Manly Cove and, as such leased from NSW Maritime.

The club is relatively young compared to other club premises which date back to last century. While it may be young, the club has an interesting history and purpose. In 1956, there were some colourful locals with a common vision of constructing a member's only boatshed in the Cove for the purpose of maintaining traditional timber boats, with dinghy storage and facilities, all in easy rowing distance to the moorings.

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They were successful in gaining a lease from the Department of Lands on the position affectionately known as “Fisherman’s Rock”. It has been said that for many years fishing lines and nets were cast from this rock and kingfish and other fish were caught making their way to the now enclosed wall. Upon this rock are the foundations of the clubhouse, as can be seen at the entrance rock steps leading to the building.

A plan was agreed upon for a small club house, and the materials came from far and wide in the tradition of the many trades becoming involved. Some hardwoods came from the 1957 Royal Easter Show and other timbers from the original Harbord “Picture Show” premises on Crown Road. The main beam supporting the committee room floor is an original telegraph pole from Addison Road.

In the 1960s some committee meetings were held at the board room office premises in the “Capricorn” building opposite the Cove, until the upstairs locker room was utilized, and is still the location of meetings of the current committee.

Today the club boasts 95 members, half being boat owners, the other half associates. Associates are commonly part owners of a members’ vessel, crew members of members’ boats, or display a genuine interest in traditional boat repair and maintenance. The club has dinghy storage, a workshop, locker and committee room, foredeck and slipway, which is available to members for 1 week per year. The premises are constantly maintained by members during organized work bees. All works are voluntary based, with much donated materials, equipment and labour. Of the 96 moorings in Manly Cove, members have approx. 35, with another 6 in nearby locations. The club encompasses a wide range of traditional timber boats, adding to the vista of the Manly Cove foreshores.



Figure 5.15.2g Manly Launch Club viewed from the waters of Manly Cove

The Manly Cove Launch Club’s mission statement is: ‘To keep the clubhouse appearance traditional’, as it was in 1957, and to maintain boats in the traditional and modern way. The club is a non-profit organization run by an executive committee totalling six. 2007 will mark the clubs 50th Anniversary.

The Launch Club has contacted Manly Council to highlight the issues surrounding the lack of a public wharf facility in North Harbour which results in the public periodically utilising Club facilities for such purposes.

Manly Rowing and Sailing Club

This heritage-listed boatshed is home to a club that was established in 1875 as one of the earliest waterside clubs in New South Wales. At the time rowing was an extremely popular activity within Manly Cove.

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The shed is about 19 metres long, built to accommodate 8-oars shells or skiffs. A second shed was constructed in 1885 to house canoes and sailing boats as well as boats that were raced for wagers.

The Club initiated the first Manly Regatta in 1890 and played a prominent part in the Venetian Carnivals. These were major events with parades, fireworks and a water pageant. They were called 'Venetian' because they were reminiscent of water-based life in Venice.

There are currently 94 members of the Club with 28 members having moorings in Manly Cove, 14 utilising 12ft dinghy racks and 4 with moorings in other areas. The balance is of joint members and older members who no longer have boats but have retained their membership. Approximately 85 per cent of members reside in the Manly Council area. Members have access to a slipway to service their vessels. The club also slips the "Sailability" disabled sailing rescue craft and the Skiff Club rescue craft as a cost sharing strategy.

Oceanworld

In 1963 an ambitious new development took place with a South African company selected Manly as the centre for a giant oceanarium – one that was to rival the best in the world. It was named Marineland.

The announcement of the location for the 1.14million litre seawater complex at Manly's West Esplanade beach met with mixed reaction. A number of local residents, each with a different opinion, publicly stated that the complex would be an utter failure. One prominent member of the public claimed it would be impossible to keep large fish in such an environment. The years have proved him wrong.

Planning and building Marineland called for the best technology available in the world at the time. The basic plans were drawn from the parent company's original Marineland at Durban, South Africa, and modified to meet local requirements. Experts from Scotland provided the special one-inch thick plate glass for the oceanarium viewing ports, and British engineers advised on a special concrete mixture that would stand up to salt water over the years.



Figure 5.16.2h & 5.16.2j - Marineland mid-1977.

Source: *Manly Daily* Thursday 6 January 1977, p31 (souvenir issue)

The original intention for Marineland was that it would stock only corals and smaller fish life – one man suggested that the tank should be stocked entirely with sea-horses. After a few years it became apparent that Marineland was serving more than just Manly's tourist industry. Schools and research students were using the denizens of the tank for special marine biology studies and it was decided to extend the variety of sea life. Giant loggerhead and green turtles were added, as well as several large sharks.

About 1972 Marineland created a world first when Bill Foster, the chief diver, commenced feeding sharks from his bare hands. Despite being bitten several times, Mr Foster developed a technique of hand feeding that has thrilled thousands of visitors to the giant tank. The same feeding techniques are carried on today. In 1987 the Marineland building was demolished, and the following year Manly Oceanworld arose in its place.

Oceanworld comprises a wide public promenade around its perimeter, an aquarium and reptile enclosure. A small café and shop support these primary uses. The Jetty on the south side of Oceanworld is currently

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unused; however a proposal exists to allow passenger ferry trips between Manly Cove and Quarantine Station. This jetty may also be suitable for public use, particularly if existing usage of the area is altered.

A number of concerns have been identified in relation to this proposal due to potential impacts upon the marine environment and the fact the location was considered to be unsafe for berthing in the Manly Cove West Framework Plan (Urban Design Advisory Service, 2004). The location was considered unsuitable for berthing and mooring because of the exposure to southerly wind and ocean swells.



Figure 5.16.2k & 5.16.2l - Demolition of Marineland, 1987 and construction of Oceanworld, 1988

Oceanworld is leased for the purposes of an "Oceanarium and associated facilities" from NSW Maritime. Structural investigations of the Oceanworld building and substructure reveal that it is nearing the end of its economic life and considerable money will be need to be spent to extend its usability. Figure supplied by Oceanworld to NSW Maritime show that visitation has declined in the past 15 years from a peak of 500,000 visitors a year to less than 90,000 in 2002/2003.

A café is currently run from space within OceanWorld which provides light drinks and snacks along with outdoor seating.

Manly Bathers Pavilion

The Bathers Pavilion, which was constructed for the Port Jackson and Manly Steamship Company Ltd, opened in June 1933. The official opening of Manly pool and pavilion was 23rd October 1933, however the *Sydney Morning Herald* reported that the new bathing pool and pavilion was in fact opened on Saturday 14th October 1933.

The *Heritage Study of Manly* (1986) describes the building as follows: "Ferro-concrete two-storey tiled roof pavilion built on pier. Capitals to column have fish, shell and acanthus leaf decoration, and original wrought-iron balustrade between columns beside water. Pavilion walls have decorative tile inlays using burnt orange and ultramarine ceramic tiles. A Greek key motif pattern is surmounted by semi-circular tiles, surmounted by ceramic decoration in scrolls and by urns. There is a strong Spanish influence throughout. The toilet block is of the same period. Special elements include the tile inlay bearing the letter 'M'; the floral motif in cornice decoration, original tiling to walls, and the timber pagoda-style entry. The building is of major significance as one of the few remaining harbour pavilion structures of this period and style in Sydney.

In the 1930s 250,000 people were using the dressing pavilion annually. In 1939 new modern 'Hot Sea Baths and Massage Rooms' were opened as part of the dressing Pavilion complex. The use of the building as a dressing shed ended with the demolition of the boardwalk and swimming enclosure during the 1974 storms.

Two commercial businesses currently operate out of the Manly Pavilion building which includes a kayak hire business and a café.

According to the *Manly Daily*, (19 Nov 1982) the Manly Pier Seafood restaurant began in 1932. It had various owners: a French restaurant, then one of the Cahill's chain. In the 1960s and 70s it was Doyle's Seafood

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Restaurant. A fire in the Manly Pier Seafood Restaurant in September 1979 destroyed the restaurant's interior, but after refurbishment it re-opened in December 1979. The restaurant celebrated its 50th anniversary in November 1982.



Figure 5.16.2m – Manly Dressing Pavilion in 1985

The Manly Bathers Pavilion is listed under the Heritage Act 1977 as an item of State Significance for its landmark, aesthetic and social values. The external fabric of the original building is of exceptional heritage significance although many decorative features have suffered deterioration. Internal spaces and fabric have been further eroded through progressive adaptation over a 30 year period.

However, the building design contains solid wall elements which do not lend themselves to modern day uses. A DA submitted to Council during 2003 for adaptive re-use of the building was rejected as the proposal was seen to detract from the unique visual character and heritage significance of the building.

The Manly Cove West Framework Plan (2004) identifies that the lessees of Manly Pavilion and Oceanworld believe that change is necessary to ensure the survival of the buildings. They seek to make Manly Cove West and alternative site to Manly Wharf by upgrading food and beverage outlets and introducing a new range of water-based recreation uses.

The community were concerned that any such proposals will create parking and noise problems and will reduce the amenity of public spaces. In particular, the food and beverage proposals in this location are seen as inappropriate in the context of the nearby availability of such facilities at Manly Wharf and the potential adverse impacts on local residents arising from the late night trading and sale of alcohol.

Manly Pavilion occupies dry and submerged lands and as a consequence is leased from two landlords, NSW Maritime and Department of Lands with differing lease arrangements and management styles. The lease from NSW Maritime is for business purposes and terminates in 2014.

Personal Water Craft (PWCs)

The use of personal watercrafts (PWCs) including jet skis, in Sydney Harbour (including the study area) was prohibited in September 2001.

6. COASTLINE HAZARDS

The New South Wales Government's Coastline Management Manual (NSW Government, 1990) identifies seven hazards namely:

- Beach erosion hazard;
- Shoreline recession hazard;
- Sand drift hazard;
- Coastal inundation hazard;
- Stormwater erosion hazard; climate change; and
- slope and cliff instability hazard

Each of the above hazards is discussed individually in the following sections. The assessment of the hazards draws widely upon the information set out in the preceding sections.

6.1 BEACH EROSION HAZARD

Erosion is part of the natural response of a beach to changing wave and water level conditions. During storms, large waves, elevated water levels and strong winds can cause severe erosion to sandy beaches (NSW Government, 1990). The hazard of beach erosion relates to the limit of erosion that could be expected due to a severe storm or from the effects of a series of closely spaced storms.

The erosion can be measured in terms of the volume of sand transported offshore or in terms of the landward movement of a significant beach feature. The volume is usually expressed in terms of cubic metres per metre run of beach (m^3/m), as measured above Mean Sea Level (MSL) or Australia Height Datum (AHD). The significant beach feature is usually taken to be the back beach erosion escarpment, however in the case of the beaches of Manly Cove, the presence of an artificial seawall limits landward movement of the erosion line (relative to seawall stability).

The beach erosion hazard is analogous to the "storm demand" discussed in Section 5.10. In that section it has been established (based on photogrammetric analysis carried out as part of the Davis Marina to Manly Point Coastline Hazard Definition Study) the available sand volumes on Manly Cove East Beach and Manly Cove West Beach and experience, that a storm demand or beach erosion hazard value for a 100 year Average Recurrence Interval (ARI) storm event of up to $20 \text{ m}^3/\text{m}$ and 20 to $30 \text{ m}^3/\text{m}$ respectively is considered reasonable for these beaches.

6.2 SHORELINE RECESSION HAZARD

Shoreline recession is the progressive landward shift of the average long term position of the coastline. Recession is a different phenomenon to beach erosion, although they both may be caused by the same processes. The two causes of shoreline recession are sediment loss and an increase in sea levels.

6.2.1 Long Term Recession Due to Net Sediment Loss

Recession of a sandy beach is the result of a long term and continuing net loss of sand from the beach system. According to the sediment budget concept, this occurs when more sand is leaving than entering the beach compartment. Recession tends to occur when, for example:

- The outgoing longshore transport from a beach compartment is greater than the incoming longshore transport;

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- Offshore transport processes move sand to offshore "sinks" from which it does not return to the beach; and
- There is a landward loss of sediment by windborne transport.

While it is convenient to express shoreline recession due to sediment loss as a rate (metres per year) the process of recession is not uniform over time but is associated generally with storm activity (PBP, 2004).

6.2.2 Long Term Recession Due to Sea Level Rise

A progressive rise in sea level will result in shoreline recession through two mechanisms: first by drowning low lying coastal land and second, by shoreline readjustment to the new higher coastal water levels. The second mechanism is probably the more important as deeper offshore waters expose the coast to attack by larger waves, the nearshore refraction and diffraction behaviour of waves will change and a significant volume of sediment will move offshore as the beach seeks its new equilibrium. Sea level rise is discussed in more detail under Section 7 which describes predictions for Climate Change.

For Manly Cove beaches the most appropriate method of determining any long-term shoreline recession is by an assessment of change in the volume of sand on the beach. The long term sand movement at Manly Cove Beaches has been examined using the results of DECCW's Profile Area Volume (PAV) analysis, by considering the changes in volume of sand above AHD on the beaches over time between the first and last dates of available photography. However, caution needs to be exercised in the interpretation of this information due to a number of factors including:

- The relatively short time period of the historical data;
- The frequency and severity of storms over the time span for which the volume changes were measured;
- The fluctuations in sand volumes due to storms which can often mask long-term trends; and,
- The influence of sea level rise which causes a reduction in the volume of sand above AHD and which has been operative for the period of the photographic record.

The Manly Cove beaches are subject to erosion during severe storm events. Manly Cove West Beach is experiencing some relatively minor long term sand loss (recession) possibly as a consequence of sand which is eroded from the beach during severe storms not being fully reworked back onshore during calmer swell periods, given the degree of shelter at the beach. The longer term sand loss is expected to increase over time due to Greenhouse sea level rise, as the beach readjusts to the higher sea level.

The predicted loss of beach width for Manly Cove West Beach over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 2 to 4 metres. The current width of the beach, measured at a mean sea level is approximately 20 metres (PB&P, 2004).

For Manly Cove East Beach the predicted loss of beach width over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 5 to 10 metres. The current width of the beach, measured at mean sea level, is zero to approximately 15 metres (PB&P, 2004).

6.2.3 Consideration of Long-term Recession Rates

The total loss of sand from Manly Cove West Beach between 1951 and 2001 was 5.4 m³/m (based on five profiles as identified within the Davis Marina to Manly Point CHDS during 2004). Therefore, a total volume of some 920 m³ of sand was eroded from Manly Cove West Beach over the 50 year period or about 0.11 m³/m per year. If the average height of sand on the back beach is taken to be about 2.0 AHD (based on photogrammetric data) this would correspond to a landward shoreline movement of about 0.05 m/year (volume/(height x length x no. years)). In summary Manly Cove West Beach has undergone relatively minor longer term sand loss.

Manly Cove East Beach underwent accretion over the period 1974 to 2001. The total gain of sand on Manly Cove East Beach was 3.3 m³/m between 1974 and 2001 or 1.9 m³/m between 1986 and 2001 (based on profiles 1 to 10 total length of beach 180m). Therefore there was a total sand volume gain of some 342 m³

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between 1986 and 2001. This overall accretion in Block 4 can, however, generally be accounted for by artificial beach nourishment that took place after 1986 (in 1989, 1991 and 1992).

MHL concluded (MHL, July 1997) from a review of hydrographic surveys dating back to 1895 that the beach profile has not changed significantly over the past 100 years. In order to be prudent, it is considered reasonable to adopt a low rate of shoreline recession for future planning purposes equal to 0.05 m/year (PBP, 2004).

It is important to note that any volume changes determined from historical data will contain some influence of sea level rise which occurred in the period of the historical record. The assessment of the contribution to sea level rise to historical beach behaviour over the analysis period can be best estimated using the so-called "Bruun Rule" (Bruun, 1983). If this contribution is significant, historical recession rates are adjusted (discounted) to represent recession due to sediment loss only since, in the prediction of the future behaviour of the coastline, shoreline recession due to sediment loss and shoreline recession due to sea level rise are calculated separately (refer to Section Davis Marina to Manly Point CHDS for further detail).

The NSW Governments Coastline Management Manual (NSW Government 1990) provides some indication of historic sea level rise in the Sydney area based on analysis of average annual mean high tide levels for the Fort Denison tide recorder. This analysis indicates that the average sea level rise over the last 100 years has been 0.5 mm/year. WRL (2003) noted, based on studies by the Royal Australian Navy (1998) that the average long term rate of sea level rise at Fort Denison between 1910 and 1999 was 0.86 mm/year.

The shoreline recession rates which would apply due to sea level rise over the historical period covered by photogrammetric analysis, based on the Bruun Rule, for the two rates of sea level rise referred to above are summarised in Table 6.2.3.

Table 6.2.3 Estimated Shoreline Recession Rates Due to Historical Sea Level Rise Using the Bruun Rule

Location	Analysis period	Adopted Rate of Historical Sea Level Rise	Estimated Shoreline Recession Rate
Manly Cove West	1951-2001	0.5 mm/yr	0.008 m/yr
		0.86 mm/yr	0.013 m/yr
Manly Cove East	1974-2001	0.5 mm/yr	0.017 m/yr
		0.86 mm/yr	0.028 m/yr

6.3 SAND DRIFT HAZARD

Sand drift is a result of the aeolian movement of beach sediment and as such can be controlled to a large extent by the existence of a well vegetated foredune or the presence of an artificial structure such as a seawall. Sand drift leads to a number of hazards depending on the volume of sand involved. At one extreme, sand drift is only of nuisance value while at the other extreme it can represent a permanent loss of sand from the active beach system, thereby causing shoreline recession, and can result in the inundation of coastal developments (NSW Government, 1990).

The hazard posed by drifting sand is not considered significant for Manly Cove Beaches due to the presence of artificial seawalls which prevent the loss of any significant volumes of sand by aeolian processes.

6.4 COASTAL INUNDATION HAZARD

Coastal inundation is the flooding of coastal lands by ocean waters, which is generally caused by large waves and elevated water levels associated with severe storms. Severe inundation is an infrequent event and is normally of short duration, but it can result in significant damage to both public and private property (NSW Government, 1990).

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The still water level that occurs during a storm can be much higher than that experienced during calm weather. Other than astronomical tide, there are three components that can contribute to an elevated still water level during a storm; namely barometric setup, wind setup and wave setup which are interrelated but are all independent of astronomical tide. Whether the peak of a storm event coincides with high or low tide is a very significant factor in determining the level of erosion damage (PBP, 2004). Individual waves cause further temporary water level increases above the still water level due to the process of wave run-up or up rush. The components which give rise to elevated still water levels at times of storms have been referred to in Section 4.1 of this report.

The height of wave run-up on beaches depends on many factors that include wave height and period, the slope, shape and permeability of the beach, the roughness of the foreshore area and wave regularity. Wave run-up can be difficult to predict accurately due to the many factors involved. Anecdotal evidence and the surveying of debris lines following a storm event are often the best indicators of wave run-up levels.

Waves occurring within Manly Cove may be result of a combination of ocean swell entering the Harbour during storm events and local wind conditions generating wind waves from the south-south-west direction (PBP, 2004).

Figure 6.4 shows waves overtopping the Manly Cove East seawall in an extreme event. This portion of the seawall has a crest level of approximately 3.2 m AHD. Debris on the foreshore west of Manly Wharf following the 1974 storms showed that wave overtopping of the Manly Cove West seawall occurs in extreme events. The Manly Cove West seawall crest level varies between 3.4 and 3.7 AHD.



Figure 6.4 – Wave overtopping of Manly Cove east seawall during 1974 storms

The Coastline Hazard Definition Study identifies that from calculations and available photography, that the seawalls crest level and adjacent esplanade path level along Manly Cove Beaches is below the limit of wave run-up in severe storms. Any raise to the seawall is, however, considered both impractical and undesirable from an aesthetic point of view. The potential for wave overtopping does need to be taken into consideration in the design of drainage systems behind the seawall.

6.5 STORMWATER EROSION HAZARD

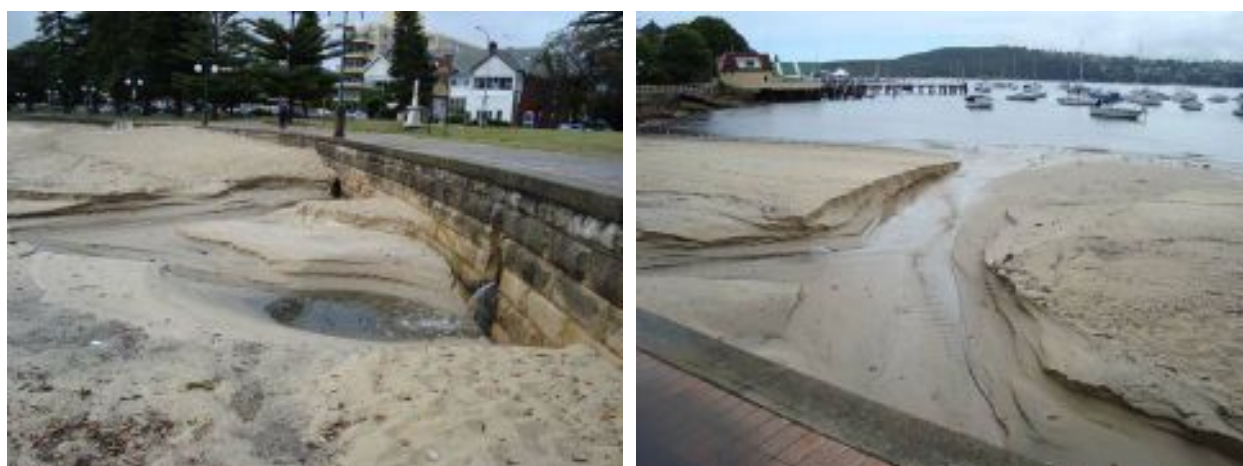
Many back beach areas are naturally drained by semi-perennial small creeks that cross the beach berm to discharge stormwater into coastal waters. However, urban development has led to the construction of stormwater infrastructure to replace natural stream lines and seawalls in place of natural coastal dunes and foreshores.

Major stormwater runoff events can cause significant erosion to beaches onto which stormwater outlets discharge through direct erosion and changes to coastal processes. One of the major factors affecting

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stormwater erosion potential is the degree of development in the catchment area draining to a beach or foreshore location. Urban developments such as car parks, roads, shops and other buildings result in the replacement of pervious natural surfaces (very much so in the case of sandy areas) with impermeable surfaces. This has two effects on stormwater runoff. First, the volume of runoff tends to increase significantly. Second, the peak rate of runoff also increases. Both effects result in a significant increase in the erosion potential of stormwater discharges onto beaches, rocky shores and natural creeks. Issues relating to stormwater management are described in detail in Section 5.14.

There are three stormwater outlets ranging in size from 450 to 675 mm diameter which discharge through the seawall onto Manly Cove East Beach. Two are located at the eastern end of the beach and one toward the middle of the beach. These outlets scour channels through the beach sand as the stormwater flows across the beach into the harbour. In particular, the eastern two outlets currently create significant channels due to the high beach sand levels relative to the outlet level at this end of the beach (**Figures 6.5a and b**). This also leaves filthy holes of pollution and rubbish.



Figures 6.5a and 6.5b – Scour of Manly Cove East Beach resulting from stormwater outlet flows onto beach

The discharge velocities associated with these stormwater flows are insufficient to entrain and transport this sand-sized material any significant distance offshore (MHL, 1997). The delta formed by these sand deposits is redistributed along the beach by wave action and currents.

A Council operated beach rake (tractor) grades the beach each morning to ensure the pipe outlet is clear and redistributes sand and reduces the size of the scoured channel to improve the amenity and aesthetics of the beach.

There are two stormwater pipes discharging onto Manly Cove West Beach. One is located at Oceanworld in the west and the other under the wharf in the east. Neither of these outlets poses a significant erosion hazard to the beach as they discharge some distance offshore.

During high intensity rainfall events, significant overland flows occur across the paved area between Manly Art Gallery and Oceanworld. Investigations highlight that the drainage system is under capacity in this location with the grate regularly blown open during high intensity rainfall events. This flow contributes to regular scouring of the beach sand to the far west of Manly Cove west beach (Refer to **Figures 6.5c and 6.5d**).



Figures 6.5c and 6.5d – Excessive scouring of the beach to the west of Manly Cove West Beach

6.6 SLOPE & CLIFF INSTABILITY HAZARDS

Slope and cliff instability hazards refer to the possible structural incompetence and associated potential problems with the foundations of buildings, seawalls and other coastal works (NSW Government, 1990).

Patterson Britton and Partners engaged geotechnical engineering firm Jeffery and Katouskas in October 2003 to investigate the section of foreshore between Delwood Beach and Manly Point. The purpose of the investigation was to identify potential slope and cliff instability hazards and the consequences should a hazard occur. These investigations involved surface investigations of the topographic, surface drainage and geological conditions of the foreshore, cliffline and surrounding area of the study area. Investigations were carried out from a boat and on foot.

Qualitative 'risk to property' and 'risk to life' assessments were undertaken based on the frameworks outlined in the 'Landside Risk Management Concepts and Guidelines' presented in *Geomechanics, Vol 35, No. 1, 2000*. The assessment methodology involved rating the 'likelihood' of a hazard occurring and rating the 'consequence to property' of the hazard occurring. These ratings, when combined determined the 'Risk Level Implication' which range from 'very low risk' to very high risk'. Refer to the Davis Marina to Manly Point Coastline Hazard Definition Study for further information.

The Davis Marina to Manly Point Coastline Hazard Definition Study has been formally adopted as 'Council Policy'(10 May 2004) to enable Council to flag the hazards identified in the reports on the relevant Section 149(2) Certificates and prior to notifying individual property owners of the nature and extent of risk posed by the hazard.

The slope and cliff instability hazards relating to private properties may restrict future development of the site. Council has formally notified a number of private property owners that their properties may be potentially affected by specific hazards identified through the CHDS process. This was done in the form of a letter to each owner notifying the nature of the hazard, the extent (if known), any recommendations from the CHDS and that a copy of the report is available upon request. Concurrently hazard information will also be recorded on 149 Certificates for those properties affected.

The remediation of hazards identified on public land is the responsibility of Council who has gained external funding to conduct further geotechnical assessments as recommended within the original CHDS. Once completed the additional geotechnical assessments will enable Council to prioritise remediation based on the level of risk posed to both life and property by individual hazards.

A summary of the findings of the investigation are presented below.

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6.6.1 Site Description

The study area between Federation Point and Manly Point is approximately 2 km in length and can be broadly described as follows:

- from the point east of Delwood Beach to the steps leading down to Oceanworld is characterised by a sandstone cliff face, ranging in height from 3 to 6 m. The cliff line contains a number of undercuts (at the base) and overhangs (at the top), generally of 5 to 20 m. The undercuts and overhangs were of between 0.5 and 1 m in height and extended back (horizontally) distances of between 0.5 and 1 m. The Manly Scenic Walkway was set back at least 5 m from the edge of the cliff and was lined by the rear yards and walls adjoining residences to the north;
- The area behind Oceanworld and the adjoining cafes and Art Gallery comprised a sandstone cliff of about 3 to 6 m height with a vegetated soil batter slope above and landscaped area immediately behind the Art Gallery. The western end of the Esplanade above the Art Gallery is supporting by a sandstone masonry wall of between 0.5 and 2.5 m height.
- At the eastern end of Manly Cove East Beach, the seawall curves around approximately 90° towards the south-west and is founded on sandstone bedrock. The Manly Cove Beach seawalls and immediate environs are described in Section 7.
- Located immediately to the north of the seawall, the foreshore area is covered by timber structures and wharves associated with the Manly Cove boating precinct (as described in 5.2.1) and includes a concrete path leading up above the seawall to the East Esplanade behind the club buildings.
- Southwest from the Manly 16ft Skiff Sailing Club to Manly Point the foreshore is lined by the rear yards of residential houses and unit blocks. The rear yards comprise pools, flat grassed surface areas or stepped rear yards (supported by retaining walls) with portions of cliff lines. The foreshore area forms a generally continuous sandstone bedrock wave cut platform and towards Manly Point intermittent sandstone outcrops of between about 3 and 6 m height.



6.6.2 Potential Geotechnical Hazards

The geotechnical assessment associated with the Davis Marine to Manly Point Coastline Hazard Definition Study identified the following potential hazards within Manly Cove study area:

- localized erosion of undercuts and overhangs with subsequent rock falls from part of the cliffline;

Figure 6.6.2 - Potential cliff and slope instability hazards identified within the Manly Cove

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- toppling (or forward rotation) of blocks/overhangs and rock falls from parts of the cliffline;

In addition the following coastal hazards were identified in specific locations (See Figure 6.2.1):

- Collapse of overhang or undercut feature within the cliffline causing collapse of rear yards, retaining walls, footbridge and/or staircases above and consequently impacting on coastal path. Fig trees growing over cliffline or outcrop could also be destabilised;
- collapse of dilapidated structures including retaining walls and staircases impacting on coastal path above or below structure;
- collapse of existing piers, underpins and/or sandstone masonry walls etc supporting overhangs and undercuts within the cliffline or detached blocks, causing collapse of the above portion of cliffline or detached block;
- earth slide of the existing fill slopes adjacent to foreshore;
- earth slide of over-steep excavation batters;
- earth slide of over-steep existing colluvial slopes.

More specifically potential coastal hazards were identified as presenting a risk to property and in some cases life. **Table 6.6.2** provides a summary of all potential cliff and slope instability hazards identified within the study area. For further actions consult the Davis Marina to Manly Point Coastline Hazards Definition Study (PB&P, 2004).

Table 6.6.2: Summary of potential risks to locations of geotechnical hazards

Item No.	Potential Geotechnical hazard	Assessed likelihood	Assessed consequences	Risk to property	Risk to life
34	Federation Point - collapse of fill platform	Unlikely	Unlikely (path) Medium (viewing platform)	'Very Low - Low' to 'Low - Moderate'	Acceptable
35	Portions of masonry wall or detached blocks of sandstone falling onto steps below	Possible	Minor to insignificant	'Very Low to Low' to 'Low to Moderate'	Acceptable
36	Earthslide of fill or natural soil batter, collapse of dilapidated brick wall	Possible	Minor (footpath above or buildings below)	Low to Moderate	Acceptable
37	Collapse of overhang	Possible	Minor	Very Low to Low	Acceptable
38	Earthslide of fill or natural soil batter, collapse of dilapidated brick wall	Possible	Electricity substation at top of slope)	Moderate	Acceptable
39	Earthslide of fill or natural slide batter	Possible	Minor	Low to Moderate	Acceptable
41	Collapse of natural masonry wall	Possible	Insignificant (coastal path) Minor to medium (road above)	'Very Low to Low' to 'Low to Moderate'	Acceptable
42	Undercut collapse destabilising fig tree above	Possible	Minor (Destabilise fig tree above)	Very Low to Low	Acceptable
43	Undercut collapse destabilising fig tree above	Possible	Minor (Destabilise fig tree above)	Very Low to Low	Acceptable
44	Seawall – Manly Cove East	N/A	N/A	N/A	N/A
45	Collapse of sandstone	Possible	Minor to insignificant	Very Low to Low	Acceptable

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Item No.	Potential Geotechnical hazard	Assessed likelihood	Assessed consequences	Risk to property	Risk to life
	undercut feature				
46	Collapse of pier supporting overhang and house above	Possible	Minor to medium (depending on extent of overhang collapse)	'Low to moderate' to 'Moderate'	Acceptable
47	Collapse of piers supporting overhang and rear yards above	Possible	Minor to medium (depending on extent of overhang collapse)	'Low to moderate' to 'Moderate'	Acceptable
48	Collapse of piers supporting overhang and rear yards above	Possible	Minor to medium (depending on extent of overhang collapse)	'Low to moderate' to 'Moderate'	Acceptable
49	Collapse of overhang (& piers if present) impacting rear yards (above) & boat sheds (below)	Possible	Minor to medium (depending on extent of overhang collapse)	'Low to moderate' to 'Moderate'	Acceptable to tolerable
50	Collapse of overhang supporting overhang and rear yards above	Possible	Minor to medium (depending on extent of rear yard affected)	'Low to moderate' to 'Moderate'	Acceptable to tolerable
51	Collapse of undercut supporting steps above	Possible to unlikely	Minor	Low to Mod to Very Low to Low	Acceptable to tolerable

6.6.3 Risk Assessment

Risk to Property

An assessment of the risk to property was undertaken for the Items listed above. Other Items were not considered to represent a risk to property. The assessed risk to property ranged from 'very low to low' to moderate. The following Items had the higher risk rating of 'moderate':

Item 36 - Collapse of undercut

The base of the cliff that extended to the north behind Oceanworld contained an undercut feature of about 10 m in length, about 4 m in height and which extended back 2.5 m horizontally. To the north a dilapidated (leaning out) brick wall was located at the top of the cliff face. Above the cliff face the uneven surface sloped at about 30° and a number of detached blocks of sandstone (about 1m x 1m) were observed within the slope surface.

Item 38 - Earthslide of batter

The grass and tree covered uneven surface sloped down to the east at grades of between 30 and 45. A number of detached blocks of sandstone (about 1m x 1m) were observed within the slope surface. A small electricity substation was located at the top of the soil slope.

Generally the hazards with the assessed 'moderate to high' risk to property would be considered to be unacceptable in their current condition. Hazards with assessed 'low to moderate' risk would be considered tolerable in their current condition and those with 'very low to low' risk considered as being acceptable in their current condition.

Risk to Life

Risk to life was also determined using indicative probabilities associated with the assessed likelihood. Where appropriate it has been assumed that collapse of the overhang undermines the rear yard above, and that a person was in the yard and/or a person was below the overhang, either on the beach or the wave cut platform.

The temporal and vulnerability factors that were adopted are outlined in more detail within Appendix D of the Davis Marina to Manly Point Coastline Hazards Definition Study (PBP, 2004)].

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The majority of the potential hazards creating a risk to life were existing slopes, with an assessment ranging from 1×10^{-5} to 1×10^{-8} , which is considered to be acceptable in relation to the criteria provided within the Davis Marina to Manly Point Coastline Hazards Definition Study (PBP, 2004). Other potential hazards were assessed to have 'tolerable' to 'acceptable' risk levels and are discussed below:

Items 46, 47 & 48 - Collapse of overhang or undercut due to failure of the pier

The assessed risk to the person most at risk was assessed as being 1×10^{-5} which is considered to be 'acceptable'.

Items 49, 50 & 51 - Collapse of overhangs affecting rear yards, retaining walls above and boat shed below

The assessed risk to the person most at risk ranged from 1×10^{-5} to 2×10^{-5} which is considered to be 'acceptable' to 'tolerable'.

A number of potential stabilisation works have been recommended, which may involve erecting such structures as concrete or masonry piers, rock bolts or removal of overhangs. Prior to any such works being undertaken it is important to evaluate the impact of those structures on the area's heritage, amenity and physical environments. These impacts should be carefully weighed against the level of risk in order to determine whether the works and their impacts are justified before proceeding.

6.6.4 Recommendations

It is recommended that the specific hazards discussed above (Items 36, 38, 46, 47, 48, 49, 50, and 51) be further assessed so that the risk to life can be further considered together with risk treatment options to reduce risks to an acceptable level. This is of particular note to Items 46 and 49.

In the interim consideration should be given to posting signs along the path and foreshore area warning of the cliff edge. With regard to the potential hazards along the eastern end of Manly Cove East Beach, it is apparent that seats are present. Consideration should also be given to posting warning signs regarding the possibility of falling blocks of sandstone (from the walls above) or de-stabilised fig trees due to continued degradation of the sandstone below.

Likely stabilisation measures for overhangs were considered to be concrete or Masonry Piers, rock bolts or removal of the overhangs. Likely stabilisation measures for the steep excavation batters adjacent to the path were considered to be reconstruction or regrading of the slopes. It was recommended that further geotechnical inspection (and possibly subsurface investigation) be undertaken in order to provide information to enable a detailed design of the likely stabilisation measures.

For hazards that are located on private property all owners have been contacted by way of formal letter making them aware of the nature of the hazards and that it is possible that individual hazards will require remediation in the near future.

7. CLIMATE CHANGE & ADAPTATIONS

7.1 THE HAZARDS OF CLIMATE CHANGE

Over the past 200 years, human activities have significantly altered the world's atmosphere. While much progress in understanding the climate change issue has been made, uncertainties continue to exist about aspects of the climate change science, and regarding societal developments that will affect the extent of future climate change and societal vulnerability. Some impacts of climate change are now inevitable. However, more certainty and understanding is needed to guide decision-makers towards the most effective and cost-efficient means to adapt to climate changes in the near-term (next decade), and to avoid unacceptably large climate changes in the longer term (multi-decades to centuries) through emissions reductions measures (Australian Greenhouse Office, 2007).

The Intergovernmental Panel on Climate Change (IPCC) has released its Fourth Assessment Report in early 2007 with the following key conclusions on climatic patterns on a global scale:

- warming of the climatic system is unequivocal;
- most of (>50%) of the observed increase in global average temperatures since the mid-20th century is very likely (confidence level >90%) due to the observed increase in anthropogenic (human) greenhouse gas concentrations;
- hotter temperatures and rises in sea level "would continue for centuries" even if greenhouse gas levels are stabilised, although the likely amount of temperature and sea level rise varies greatly depending on the fossil intensity of human activity during the next century
- the probability that this is caused by natural processes alone is less than 5%;
- World temperature could rise by between 1.1 and 6.4°C during the 21st century and that:
 - Sea levels would probably rise by 18 to 59 cm
 - there is a confidence level >90% that there will be more frequent dry spells, heat waves and heavy rainfall;
 - there is a confidence level >66% that there will be an increase in droughts, tropical cyclones and extreme high tides.
- Both past and future anthropogenic carbon dioxide emissions will continue to contribute to warming and sea level rise for more than a millennium;

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values over the past 650,000 years.

Climate change is likely to have significant impacts on Australia (Preston & Jones 2006). From 1910 to 2004, the Australian-average maximum temperature rose 0.6°C and the minimum temperature rose 1.2°C, mostly since 1950 (Nicholls and Collins 2006).

A key federal initiative of early action on climate change is the National Climate Change Adaptation Framework endorsed by the Council of Australian Governments in April 2007. This framework, intended to guide actions by all levels of government over the next five to seven years, identifies coastal zone vulnerability to climate change as a priority area for action (COAG, 2007). Governments at all levels recognise climate change as a major pressure on the sustainable management of the social, economic and environmental well-being of coastal areas (Natural Resource Management Ministerial Council, 2006; COAG, 2007).

The National Climate Change Adaptation Programme, a federal Govt. programme, costing some \$14 million over four years is being made available to help Australia start to address the adaptation challenge. Partnerships with industries, research bodies, communities and governments will commence work towards practical

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solutions. Guidelines, planning tools and information about climate change impacts form the basis of the Programme. One of the recent outputs is Climate Change Adaptation Actions for Local Government.

Climate Change in New South Wales

CSIRO (2006) has studied impacts of climate change through simplified scenarios for ten regions of Australia, including NSW. These scenarios for 2030 are suitable for the purpose of an initial assessment of risks and are presented as changes relative to 1990.

Table 7.1a: Changes in climate for New South Wales by 2030, relative to 1990

Feature	Low Global Warming Scenario		High Global Warming Scenario	
	Estimate of change	Uncertainty	Estimate of change	Uncertainty
Annual average temperature	+0.6°C	±0.2 °C	+1.3 °C	±0.6°C
Average sea level	+3cm		+17cm	
Average annual rainfall	0%	±6.5%	0%	±15%
Seasonal average rainfall				
Summer	+ 1.5%	±8%	+ 3.5%	±18.5%
Autumn	+1.5%	±8%	+ 3.5%	±18.5%
Winter	-3%	±6.5%	-7%	±15%
Spring	-3%	±6.5%	-7%	±15%
Annual average potential evaporation	+2.4%	±1.9%	+5.6%	±4.4%
Annual average number of hot days (>35°C)	+1 day		+25 days	
Annual average number of cold nights (<0°C)	-5 days		-30 days	

Source: CSIRO, 2006

NSW is likely to become warmer, with more hot days and fewer cold nights. For example, the number of days above 35°C could average 4-7 in Sydney (now 3). In cities, changes in average climate and sea level will affect building design, standards and performance, energy and water demand and coastal planning. Increases in extreme weather events are likely to lead to increased flash flooding, strains on sewerage and drainage systems, greater insurance losses, possible black-outs and challenges for emergency services.

In a recent study, regional variability of SLR estimate from the global average has been further refined. In the case of South-Eastern Australia, strengthening of the East Australian Current is likely to lead to a contribution of around 12cm of additional SLR, relative to the global average (McInnes *et al.* 2007). These additional amounts bring the upper end of the SLR projection envelope for the New South Wales coast to around 91cms. Whilst there is currently no guidance from the State or Federal Governments on the SLR figures which should be used for future planning and climate change adaptation purposes, the NSW Floodplain Risk Management Guideline: Practical Consideration of Climate Change suggests the figure of 91cm be used as the upper boundary for sensitivity testing of flood models (DECCW 2007). In fact, Lake Macquarie City Council has resolved to publicly exhibit a proposal to adopt the upper sea level rise figure for the year 2100 of 91 cm as the basis for Council staff to proceed with risk assessment, policy development, community empowerment, and other planning and development decisions (Farrell *et al.* 2008).

The NSW Government has released (February 2009) a draft Sea Level Rise Policy Statement for public consultation. The primary objective of this Sea Level Rise Policy Statement is to minimise the social disruption, economic costs and environmental impacts resulting from long-term sea level rise. To achieve these objectives, the NSW Government will:

1. promote an adaptive risk-based approach to managing sea level rise impacts
2. provide guidance to local councils to support their sea level rise adaptation planning
3. encourage appropriate development on land projected to be at risk from sea level rise
4. continue to provide emergency management support to coastal communities during times of floods and storms
5. continue to provide updated information to the public about sea level rise and its impacts.

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The Climate of the Sydney Metropolitan Catchments

Summers in the Sydney Metropolitan Catchments are relatively warm, with average maximum January temperatures of approximately 26°C (Table 7.1b). However, the catchments do experience approximately 3 days above 35°C each year. Winters are cool to mild, with average maximum July temperatures of 17°C. Temperatures rarely fall below 0°C. The catchments receive approximately 1,100 mm of rainfall each year. Peak precipitation occurs between January and March, and the variability in rainfall from one year to the next is high. Hail storms are common, the worst being the April 1999 event which cost \$2.3 billion (IDRO, 2006). Bushfires are also common, often occurring near residential properties.

Since 1950, the region has experienced warming of around 0.8°C. This is likely to be partly due to human activities. The catchments have also experienced a significant drop in annual rainfall at a rate of approximately 55 mm per decade. The contribution of human activities to this rainfall decline is hard to distinguish from natural variability (CSIRO, 2004).

The future climate of the Sydney Metropolitan Catchments is likely to be warmer and drier. Such trends would also increase evaporation, heat waves, extreme winds and fire risk. Nevertheless, despite this trend toward drier conditions, the possibility of increases in extreme rainfall events remains.

Further details about these changes are described in the following table, which compares average conditions for the present climate with ranges of potential change in 2030 and 2070. These projections account for a broad range of assumptions about future global greenhouse gas emissions, as well as differences in how various climate models represent the climate system (CSIRO, 2004). When considering projections identified in Table 7.1b it can be noted that a warming of 1.0°C and a 5% decrease in rainfall (a moderate scenario for 2030) would make the climate of Sydney similar to the current climate of Paterson to the north west of Newcastle.

Table 7.1b - Current and projected climate change in the Sydney Metropolitan Catchment

Climate Features	Present (1990) ¹	Projected Changes	
		2030	2070
Temperature			
Average	17-26 °C ²	+0.2 - +1.6°C	+0.7 - +4.8°C
No. of days below 0C	0	0	0
No. of days above 35C	3	4-6	4-18
No. of days above 40C	0	0-1	1-4
Rainfall			
Annual Average	1094mm	-13 - +7%	-40 - +20%
Extreme Rainfall ³		-3 - +12%	-7 - +10%
Evaporation		+1 - +8%	+2 - +24%
No. of droughts per decade ⁴	3	2-5	1-9
Extreme Winds		-5 - +8%	- 16 - +24%
No. of Fire Days⁵	9	9-11	10-15

¹ Present day conditions for temperature and rainfall represent long-term averages from the Bureau of Meteorology. For extreme temperatures, the present average is based on 1964-2003. For fire danger, the present average is based on 1974-2003. For drought, the present average is for a period centred on 1990.

² Range represents average July and January maximum temperature.

³ Defined as 1 in 40 year 1 day rainfall total. Values represent the range in seasonal projections from a limited set of climate models for central eastern NSW. However, given the strong spatial gradients in extreme rainfall projections, these regional results may not be applicable to Sydney.

⁴ The values for drought represent average monthly drought frequencies, based upon the Bureau of Meteorology's criteria for serious rainfall deficiency.

⁵ Number of days annually with a "very high" or "extreme" fire danger index. Changes are for 2020 and 2050 respectively.

7.2 IMPACTS OF CLIMATE CHANGE IN THE SYDNEY REGION

Although changes in average temperature, rainfall and evaporation will have long-term consequences for the catchments, the impacts of climate change are more likely to be felt through extreme weather events. Projections suggest there will be more hot days, bushfires, droughts and intense storms. These can all place human life, property and natural ecosystems at increased risk. Additional details regarding climate change impacts to various activities and assets in the catchments are discussed below.

Water

Changes in rainfall and higher evaporation rates are likely to lead to less water for streams and rivers in the Sydney Metropolitan Catchments, which will have downstream consequences for storages and place strains on water resources. In addition, much of Sydney Metro's water resources are sourced from the neighbouring Hawkesbury-Nepean Catchment, where a number of key storages are also at less than 50% capacity. In fact, the main impacts of climate change on Sydney's water supply may result from effects in upstream catchments.

Various studies of stream flows in NSW indicate that climate change is likely to reduce flows in the future (Hassall and Associates, 1998; Jones and Page, 2001; Beare and Heaney, 2002; Bates et al., 2003; Warner, 2003). Under the National Water Initiative, the Commonwealth, State and Territory Governments have agreed that water users should bear the risk of such reductions in water availability. Other modelling studies have also indicated the potential for increased flooding in catchments upstream from Sydney (Schreider et al., 2000).

Lower flows and higher temperatures may also reduce water quality within the catchments. For example, low flows, higher temperatures and elevated nutrients create a more favourable environment for potentially harmful algal blooms. Greater fire activity could contaminate water catchments with sediment and ash. Salinity problems in the catchments may be exacerbated by changes in rainfall, temperature and stream flows (Beare and Heaney, 2002). In addition to effects on surface water, the quality of coastal groundwater aquifers may be adversely affected by rising sea levels and salt-water infiltration.

Sea Level Rise and Coastal Inundation

Predicted global warming could lead to a number of changes in climate, weather and sea levels. These in turn could cause significant changes to coastal processes with other changes in climate, such as rainfall, storm intensity/frequency and sea-level rise likely to be associated with this warming. On a local scale, the increased severity and frequency of storms will create increased wave heights and, therefore, erosion potential (CMM).

In addition to climate change, global warming may also produce a worldwide sea level rise (eustatic rise). The Fourth IPCC Report was released during early 2007 and included a Summary for Policy Makers. The Summary for Policy Makers (SPM) provides the following table of sea level rise projections:

Table 7.2a – IPCC 2007 predictions in Sea Level Rise (m at 2090-2099 relative to 1980-1999)

Case	Model-based range excluding future rapid dynamical changes in ice flow
B1 scenario*	0.18 – 0.38
A1T scenario	0.20 – 0.45
B2 scenario	0.20 – 0.43
A1B scenario	0.21 – 0.48
A2 scenario	0.23 – 0.51
A1FI scenario	0.26 – 0.59

- * The **B1** scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter.
- A1T.** The scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies, with non-fossil energy sources
- B2.** The scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability.
- A1B.** The scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies, with a balance across all sources (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).
- A2.** The scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities.
- A1F.** The scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies, with fossil intensive energy sources

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It is this table on which the often-cited range of 18 to 59 cm is based. The accompanying text, extracted directly from the SPM (2007), reads:

- Model-based projections of global average sea level rise at the end of the 21st century (2090-2099) are shown in Table 23. For each scenario, the midpoint of the range is within 10% of the IPCC Third Assessment Report (TAR) model average for 2090-2099. The ranges are narrower than in the TAR mainly because of improved information about some uncertainties in the projected contributions. TAR projections were made for 2100, whereas projections in the IPCC Report 2007 are for 2090-2099. The TAR would have had similar ranges to those in Table SPM-3 if it had treated the uncertainties in the same way.
- Models used to date do not include uncertainties in climate-carbon cycle feedback nor do they include the full effects of changes in ice sheet flow, because a basis in published literature is lacking. The projections include a contribution due to increased ice flow from Greenland and Antarctica at the rates observed for 1993-2003, but these flow rates could increase or decrease in the future.
- If radiative forcing were to be stabilized in 2100 at A1B levels, thermal expansion alone would lead to 0.3 to 0.8 m of sea level rise by 2300 (relative to 1980-1999). Thermal expansion would continue for many centuries, due to the time required to transport heat into the deep ocean.
- Contraction of the Greenland ice sheet is projected to continue to contribute to sea level rise after 2100. Current models suggest ice mass losses increase with temperature more rapidly than gains due to precipitation and that the surface mass balance becomes negative at a global average warming (relative to pre-industrial values) in excess of 1.9 to 4.6°C. If a negative surface mass balance were sustained for millennia that would lead to virtually complete elimination of the Greenland ice sheet and a resulting contribution to sea level rise of about 7 m. The corresponding future temperatures in Greenland are comparable to those inferred for the last interglacial period 125,000 years ago, when paleoclimatic information suggests reductions of polar land ice extent and 4 to 6 m of sea level rise.
- Dynamical processes related to ice flow not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. Understanding of these processes is limited and there is no consensus on their magnitude.
- Current global model studies project that the Antarctic ice sheet will remain too cold for widespread surface melting and is expected to gain in mass due to increased snowfall. However, net loss of ice mass could occur if dynamical ice discharge dominates the ice sheet mass balance.
- Both past and future anthropogenic carbon dioxide emissions will continue to contribute to warming and sea level rise for more than a millennium, due to the timescales required for removal of this gas from the atmosphere.

The number used in modelling are derived from four separate components: thermal expansion, glaciers and ice caps (excluding Greenland and Antarctic ice sheets), ice sheet surface mass balance and sheet dynamical imbalance.

The main conclusions of this analysis is that sea level uncertainty is not smaller than it was at the time of the IPCCs Third Assessment Report, and that quoting the 18-59cm range of sea level rise does not identify the "worst case" due to a number of uncertainties currently experienced.

Regardless of the degree of sea level rise, it will result in shoreline recession through two mechanisms: first by drowning low lying land, and second, by shoreline readjustments to the new higher coastal water levels. The second mechanism is probably the more important: deeper offshore waters expose the coast to attack by larger waves; the nearshore refraction and diffraction behaviour of waves will change. It is anticipated that sediment located within Manly Cove will move offshore as the beach seeks its new equilibrium profile, however this movement will be less than that expected on open coastal beaches (PBP, 2004). In some cases, the magnitude of the slope and cliff instability hazard, and the design of stabilisation measures, would be influenced by climate change such as an increase in sea level and increased storm frequency, intensity and duration.

During October 2009 the NSW Government released a Technical Note to support the *NSW Sea Level Rise Policy Statement*. The Policy Statement includes sea level rise planning benchmarks that can be used for sea level rise

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adaptation and also for consideration when land-use planning and development decisions are made for coastal areas.

The Policy Statement's sea level rise planning benchmarks are an increase above 1990 mean sea levels of 40 cm by 2050 and 90 cm by 2100. The components of these sea level rise planning benchmarks are noted in **Table 7.2b**, with details of the derivation of these components provided in the full document. These benchmarks were based on the sea level rise projections developed by Australian and international experts and considered most appropriate for NSW, while acknowledging the uncertainty associated with these projections.

Table 7.2b - Components of the sea level rise planning benchmarks

Component	Year 2050	Year 2100
Sea level rise	30 cm	59 cm
Accelerated ice melt	(included in above value)	20 cm
Regional sea level rise variation	10 cm	14 cm
Rounding*	-	-3 cm
Total	40 cm	90 cm

Biodiversity

Changes to the climate will have significant effects on the catchment's plants and animals. Currently, 149 species, nine populations and 21 ecological communities (i.e., collections of species or habitat) in the Sydney Metropolitan Catchments are classified as threatened or endangered (DEC, 2006). Although current threats to the catchment's biodiversity are largely a product of historical land clearing, alterations of river flows and water extraction, climate change is likely to heighten the need for conservation efforts.

The geographic distribution of a species is often defined by its 'climate envelope,' reflecting species-specific tolerances to extremes of temperature and moisture. Climate change is likely to drive changes in the distribution of some plant and animal species, driving some species out of the catchments or enabling invaders to move in. Meanwhile, even those species capable of coping with climate change alone may succumb to the cumulative effects of multiple stressors. Despite such impacts, little is actually known regarding how climate change may affect the catchments' rich biodiversity or ecosystems.

Other risks to biodiversity in the Sydney Metropolitan Catchments include:

- Reductions in stream flows are likely to have a negative impact on aquatic biodiversity and wetland ecosystems;
- Plants and animals may become 'stranded' in isolated remnants of vegetation due to changing climate and continued development within the catchments;
- More frequent droughts and fires are likely to increase stress on plants and animals; and
- Sea-level rise is likely to inundate coastal wetlands and alter the discharge of freshwater into estuaries, with potential adverse effects on coastal wetland habitat.

Human Health

Warmer winters are likely to reduce cold-related illnesses, but warmer summers are likely to increase the risk of heat-related health problems, especially in the elderly (McMichael, 2003).

For example, climate change and population growth and ageing may increase annual heat-related deaths in those aged over 65 in Sydney from 176 at present, to 364–417 by the year 2020, and 717–1,312 by 2050 (McMichael et al., 2003). Warmer temperatures may also contribute to the spread of infectious diseases, although the spread of tropical diseases such as dengue fever into the Sydney Metropolitan Catchments remains unlikely.

Built infrastructure

The built environment is also vulnerable to climate change. As well as impacting on homes, it will affect infrastructure, commercial buildings and other physical assets. Changes in average climate will affect building design and performance, including structural standards and cooling and heating demand (PIA, 2004). Higher summer temperatures, for example, may induce an evaluation of building design and standards to ensure thermal comfort at minimal cost, while potential increases in extreme winds may necessitate more robust construction. In addition, a study by Austroads (2004) concluded that climate change would contribute to increases in road maintenance costs in NSW of up to 25% by 2100, largely due to assumptions about the effects of climate change and population growth on traffic volumes.

Given increases in the intensity of the heaviest rainfall events, flash flooding and strains on water infrastructure such as sewerage and drainage systems would rise, particularly in population centres. For example, a study by Minnery and Smith (1996) found that climate change may double flood-related damages in urban areas of NSW, although more recent modelling suggests that extreme rainfall events along the NSW coastline may decline, but increase further inland (Hennessy et al., 2004b). Regardless of changes in such extremes, higher temperatures and lower average rainfall are likely to lead to increased pressure on urban water and energy supplies, unless moderated by demand management measures. For example, McDonald (2006) estimated that per capita water demand in Sydney would have to decline by 54% by 2030 in order to remain within sustainable yields. Higher temperatures would increase summer peak energy demand for air-conditioning (Howden and Crimp, 2001), increasing the risk of black-outs.

The risk of property loss due to bushfire is also likely to increase. For example, on average Sydney is likely to experience 0–2 more days with a fire danger index of “very high” or “extreme” by 2020 and 1–6 more days by 2050 (Hennessy et al., 2005; see Table xxx). Given the large number of properties in bushland and the exposure of critical infrastructure, this would pose challenges for emergency management. As a consequence of these and other changes in extremes, such as winds and floods, insurance risk assessments and premiums are likely to be affected.

Other Impacts

Cyclone intensities may be expected to increase with temperature, however climate models give no consistent indication of whether tropical storms will increase or decrease in frequency or intensity with increasing temperature.

Mid latitude storms, unlike tropical cyclones, may actually decrease in intensity and frequency with global warming due to a reduction in equator to pole temperature gradients, however as with tropical cyclones, climate modelling at present lacks the resolution to accurately predict changes associated with global warming.

Given the above uncertainty, no specific account can be taken of any potential changes to storm frequency and intensity or changes in wave directions. However, this uncertainty should be taken into consideration when assessing the risk and consequences of recession occurring in the future. The potential for a climate change related recession needs to be continually reviewed as more information comes to hand from the scientific community.

Climate change also has the potential to impact on other coastline hazards such as the coastal inundation hazard and the slope and cliff instability hazard. An increase in sea level, for example, would directly impact on (*increase*) the magnitude of the coastal inundation hazard. There are, in addition, indirect impacts on this hazard due to sea level rise, since the heights of waves which reach the shoreline and influence the wave setup and wave run up components of elevated water levels are a function of the available water depth, which in turn would be affected by any increase in sea level.

In some cases, the magnitude of the slope and cliff instability hazard, and the design of stabilisation measures, would be influenced by climate change such as an increase in sea level and greater storminess, e.g. where the slope and cliff instability is due to wave undercutting.



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It is difficult to be precise about the potential effects of climate change on these other coastline hazards. For these reasons it is important to monitor shoreline behaviour, monitor trends in climate change predictions, and take into account up-to-date predictions in the assessment of management options and the design of any mitigation or stabilisation measures.

7.3 CLIMATE CHANGE WITHIN MANLY LGA

7.3.1 General

On October 29, 2006 Council's Manly Environment Centre conducted a very successful Climate Change Forum titled 'Weathering the Storm'. During this session many views were expressed about what climate change will mean for Manly and some of the management options were outlined.

At Council's Ordinary Meeting of 20 November 2006, Council resolved to adopt a Mayoral Minute entitled Global Warming: Local Solutions - Time for Action, which requires the establishment of a "Climate Change Working Group" to identify likely impacts of climate change and to provide advice on prevention and mitigation strategies.

In 2006, Council established a Climate Change Working Party to formulate recommendations for action to manage, and to respond to the likely impacts of Climate Change.

Cardno (2008) has made an assessment of the likely effects of climate change. A preliminary mapping has been prepared based on DEM (Digital Elevation Model) to provide a broad indication of the likely spatial effects of climate change. North Harbour Reserve and its surrounds are likely to be affected by sea level rise.

In 2008, Manly Council received funding through the Federal Government's Department of Climate Change (DCC) Local Adaptation Pathways Program to undertake a climate change risk assessment and to subsequently develop a Climate Change Adaptation Action Plan for Manly LGA. The risk assessment has been completed and a Draft Action Plan prepared in consultation with the community. It is expected that the Action Plan will be finalised in 2009/10 and will provide a strategic approach to climate change risk management and adaptation for Manly Council and community.

In 2009, Council embarked on Carbon Management Project, to reduce greenhouse gas emissions for Council corporate and the community by at least 25% of year 2000 level by 2020.

In March 2009, Council established "The Sustainability and Climate Change Committee (SCCC)" as one of Council's special purpose advisory committees following the September 2008 Council elections. The SCCC meets to provide strategic advice and input into Council's projects, plans, policies and strategies that relate to sustainability and climate change

Prior to this, Manly Council has remained a leading member of the (inter) national Cities for Climate Protection Programme (CCP) since 1998. CCP is a program delivered by ICLEI in collaboration with the Australian Greenhouse Office and is aimed to help local governments and their communities to reduce greenhouse gas emissions and their impact on the environment. Manly Council was the second Council in the State to complete all 5 Milestones of the program and move on to CCP Plus, the advanced programme.

Through this program Manly Council has undertaken several greenhouse projects including education programs, energy efficient lighting and retrofits of public amenities (including the beachfront and several sports fields), installation of a solar hot water at our Swim Centre and energy efficient equipment in our offices. Through these and other actions Manly Council to date has achieved over 1600 tonnes of greenhouse gas abatement in the corporate sector and over 26,600 tonnes of greenhouse gas abatement in the community sector.

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7.3.2 Vulnerability

Vulnerability is the degree to which a system is susceptible to, or able to cope with, adverse effects of climate change, including climate variability and Extremes (IPCC, 2001). The Sydney Coastal Councils Group has undertaken research on regional approaches to managing climate vulnerability on the Sydney region.

During the first stage of this project, an assessment of the vulnerability of the SCCG region and its' member Councils to climate change was conducted. In conducting these assessments, simple conceptual models identifying the key processes and assumptions were developed for each of the above impact areas. These models were subsequently utilized to select a broad range of climate, landscape, household and Council indicators reflecting the three components of vulnerability: exposure, sensitivity and adaptive capacity. Each of the indicators identified above were subsequently scored, mapped and then integrated within a GIS to develop spatial representations of vulnerability to different impacts at the regional level. The results were then averaged over each local government area.

This assessment indicated that, on average, Manly Council possesses a moderate degree of vulnerability to climate change relative to other Councils within the SCCG Region (**Table 7.3.2**). However, due to its coastlines and coastal development, vulnerability to sea-level rise and coastal hazards was assessed to be particularly high. In addition, Stormwater management may become a challenge in the future due to development and projected increases in future rainfall. The vulnerability of the coastline and the paucity of natural landscapes suggest the Councils' natural ecosystems have a low resilience to the effects of climate change. Meanwhile, bushfire vulnerability was assessed to be particularly low. Despite these broad generalizations, vulnerability in general varied significantly throughout the Council.

Table 7.3.2 - Climate Variability Scores for Manly Council

Impact Area	Extreme Heat & human health effects	Sea-level Rise & coastal management	Extreme Rainfall & stormwater management	Bushfire	Natural Ecosystems & Assets	Overall
Vulnerability Score*	5	8	8	1	7	6

*Vulnerability was scored on a scale from 1-9, with 1 indicating low and 9 indicating high vulnerability

Source: SCCG/CSIRO Climate Change Vulnerability Assessment

It is important to note that although significant focus is often placed on the climatological and biophysical hazards associated with climate change (e.g. temperature extremes or storm events), factors such as demographics, socio-economic conditions and human agency and decision-making are often equally, if not more important in dictating vulnerability. Such factors frequently determine the sensitivity of a given sector or location to climate change. They also influence adaptive capacity through their association with financial and social capital as well as institutional processes and relationships.

7.3.3 Adaptations

Effectively managing the effects of coastal hazards and the progressive changes to the occurrence and magnitude of such hazards associated with climate change is fundamental to maintaining or developing sustainable and resilient coastal communities (NZ Government, 2008).

Climate change impacts are occurring now. Future changes are inevitable, irrespective of mitigation efforts to reduce greenhouse gas emissions. However, climate change considerations alone are unlikely to stimulate or engender local government action. Rather, through a risk management approach, an assessment and prioritisation of possible responses to coastal hazard and climate change effects can provide the impetus to change policy, planning and resource consenting outcomes and to develop a proactive approach to adapting to climate change.

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The emphasis of managing the impacts of climate change on coastlines is on understanding the scope and variation of climate change, and using risk assessment as a method to determine adaptation responses appropriate to the risks. Climate change will impinge on a wide range of local government functions. The most effective approach to incorporate climate change impacts into decision-making is to include it alongside the range of coastal hazard and other factors that local government already takes into account as part of its planning and consenting functions. That way, climate change can be assimilated across the wide range of local government functions rather than applied as a separate exercise.

Climate change will obviously affect many natural and human systems and activities. However, the impact of a given climate change on a particular system or activity depends on its vulnerability and adaptability. If a system or activity does not adapt to the change, the impacts will be larger. Adaption may be automatic, or it may be conscious and planned. Automatic adaption tends to occur in natural systems, such as the migration of flora and fauna to more suitable environmental regions. Planned adaption tends to occur in human systems. (Greenhouse Office 2003).

Adaptation is a risk management strategy involving actions to reduce the negative impacts of climate change and take advantage of new opportunities that may arise. The types of adaptation measures adopted will vary from region-to-region. Because some of the decisions we make today will have lasting implications for future climate vulnerability, we must start planning our adaptive responses now. By doing so, we may help to lessen some of the environmental, economic and social costs of climate change (CSIRO, 2007).

Planned adaptation is part of a balanced and prudent response to climate change. Adaptation has been, and continues to be, an integral part of how natural and human systems have developed and evolved in response to climate and its variability. Fundamentally, it is about proactively enhancing our capacity to adapt to the future effects of climate change (ie, building adaptive capacity) through minimising, adjusting to or taking advantage of the consequences of climate change.

A number of common themes and characteristics have led to good adaptation. Many of these principles are consistent with good participatory decision-making and hence apply more widely than to just climate change considerations. Principles include:

- work in partnership with coastal communities;
- understand existing risks and vulnerabilities to coastal hazards and climate change and their critical thresholds;
- identify the most adverse coastal hazards and compounding climate change risks and focus on actions to manage the most vulnerable areas;
- seek opportunities to incorporate adaptation into all new and existing developments within the coastal margin;
- incorporate flexibility (ie, adaptive management) to deal with changing risks and uncertainties. Recognise the value of a phased approach to adaptation;
- recognise the value of no-regrets, low-regrets and win-win adaptation options to managing climate change risks:
 - no-regrets: policies and decisions that will pay off immediately under current climate conditions
 - low-regrets: low-cost policies, decisions and measures that have potentially large benefits
 - ☐ win-wins: policies, decisions and measures that help manage several coastal hazard or climate related risks at once, or bring other environmental and social benefits, eg, preservation of natural character.
- adopt a sequential and risk-based approach to decision-making regarding coastal development;
- avoid actions that will make it more difficult to cope with coastal hazard and climate risks in the future; and

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- review the effectiveness of adaptation measures and planning processes through continual monitoring and evaluation.

Some examples of potential adaptation measures relevant to the Sydney Metropolitan Catchments identified by the CSIRO include:

- Improving water-use efficiency, recycling and public education about water usage;
- Enhancing water supplies through groundwater extractions and desalination, subject to environmental impact assessments;
- Implementing early-warning and public communication systems for heat waves;
- Designing energy efficient buildings;
- Retrofitting old and designing new, infrastructure to cope with climate change;
- Reviewing flood and fire management arrangements;
- Reviewing coastal zone management practices; and
- Maintaining green spaces and ecological refuge in urban areas.

Making sure the catchment has the necessary capacity to implement such adaptation measures means continually expanding research, education and communication. It is the intention of the Manly Cove Coastline Management Plan to identify measures which facilitate adaptive approaches in the planned future management of climate change within the study area. This will be guided by the outcomes of the Climate Change Adaptation Action Plan for Manly LGA once the Plan is finalised.

It is important to recognise that Section 7 refers to the impacts of climate change without adaptation. Unfortunately, perfect adaptation depends upon perfect anticipation of climate changes. As this is not possible, adaptation will never be perfect. One of the aims of climate change science is to improve the accuracy and credibility of projections of climate change and associated impacts, in order to improve the ability to make optimal adaptations. Without accurate projections it is vital that government identify the costs and benefits associated with adaptation relative to the latest scientific information.

7.3.4 Council's Current Climate Change Programs

Council developed a "Manly Sustainability Strategy" in 2006. This Strategy provides overarching guidance for climate change adaptation and mitigation within the Manly LGA. More specific documents and policies are outlined below.

Mitigation & Adaptation

Climate Change Strategy

Council plans to develop a Climate Change Strategy which will provide an umbrella framework for Climate Change management and issues in Council. It will provide a strategic approach to climate change, drawing together various initiatives such as Carbon Management Plan, Climate Change Risk Adaptation Action Plan, Climate Change Education Strategy outlined below.

Climate Change Actions for Manly LGA (Cardno Report) – September 08

In 2008, *Cardno*, a multi-disciplinary firm of consultants, was commissioned to carry out an independent analysis of the likely impacts of Climate Change on the Manly LGA and to establish a set of objective criteria for advising Council on an appropriate range of response measures (and their relative priority) for implementation within the framework of an integrated strategy to deal with likely effects of Climate Change on the Manly Community.

In order to affect the measures identified in the *Cardno Analysis Report*, Council needs the support of its ratepayer for a special levy. In this regard, Council decided at a recent meeting to gauge the level of support of



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the community for such a levy at the September 08 local government election. Only 38% of voters supported such a move.

In addition, Council is in the process to undertake a full review and risk assessment. It is expected that this process will be conducted through a workshop process and a review panel using the recently published guidelines from the Australian Greenhouse Office.

Climate Change Fund

Council has established a Climate Change Fund into which residents can make voluntary contributions when paying their rates.

Council intends to use the funds for planned climate change mitigation and adaptation measures. Some examples of planned priorities include; Council using 100% green energy for street lights and community facilities, and retrofitting community buildings with energy efficient lighting technologies.

Funds from this voluntary contribution will be used to accelerate Council's response to climate change mitigation and adaptation and is not a substitute for existing Council funded programs.

Mitigation

Carbon Management Plan

Council has embarked on Carbon Management Project, to reduce greenhouse gas emissions for Council corporate and the community by at least 25% by 2020. This is to be achieved through application of the energy hierarchy of avoiding energy consumption, increasing energy efficiency, fuel switching, renewable energy and carbon offsetting for Council corporate and the community.

Cities for Climate Protection Plus (Local Air Quality & Greenhouse Action Plan / Carbon Management Plan)

Council has been a part of the CCP program since 1998 and the CCP Plus program since about 2006. The CCP Program was delivered by the International Council of Local Environmental Initiatives (ICLEI) in collaboration with and funded by the Australian Government.

As part of this program, Councils were able to estimate and evaluate energy consumption and greenhouse gas emissions for Council (corporate) and the community through the CCP's greenhouse gas inventory software, the Greenhouse Gas Application (GGA). The GGA tool also enabled Council to track greenhouse gas emissions reductions.

In May 2009, the Australian Government advised that it would cease to fund the CCP Program effective from 1 July 2009. Thus the CCP milestone and support program and associated GGA tool is no longer available to Council. Council has retrieved Manly's inventory data from the (GGA) tool for use, as required, in a new carbon management tool to be secured through the Carbon Management Project.

Manly Council: Renewable Energy Generator Scoping Study

Council staff have prepared a scoping study to investigate the feasibility of Manly Council generating considerable solar power for Council's own supply to reduce carbon emissions. This involves the placement of PV solar panels on available roof space in the Manly LGA. This is in response to a Council resolution of 10 November 2008. Council has decided not to proceed further at this stage.

Climate Change Icon Project

Council has allocated funds to develop a "Climate Change Icon Project". This Project will aim to achieve real greenhouse saving for Council and the Community and will also encourage the community to act on similar initiatives. Senior management has decided to focus this project on energy efficient street lighting.

Carbon Planet

Council engaged a company "Carbon Planet" to conduct a preliminary calculation of Manly Council's greenhouse gas emissions for the 2007/08 financial year. This assessment included scope 1, 2 and some scope 3 emissions.

Council Fleet

Manly Council reviewed leaseback vehicles in July 2008. Following this, Council introduced more fuel efficient diesel 4 cylinder vehicles in the leaseback scheme. The use of biodiesel on Council's heavy fleet was also expanded during 2008/09.

Other initiatives

Manly Council runs a free community bus "Hop, Skip and Jump" providing a service to Manly, Fairy Bower, Little Manly, Fairlight, Balgowlah, Balgowlah Heights, Clontarf, Seaforth and Warringah Mall, encouraging residents to hop on the bus and leave their car at home. The bus runs on part biodiesel.

Council developed a "Manly Sustainability Strategy" in 2006. This Strategy provides overarching guidance for climate change adaptation and mitigation within the Manly LGA.

Adaptation**Climate Change Risk and Adaptation Project**

Council has received funding from the Department of Climate Change (DCC) as part of the DCC's Local Adaptation Pathways Program for the development of a Climate Change Risk and Adaptation Strategy. This will provide a strategic approach to climate change risk management and adaptation for Manly council and community and will incorporate elements of the Cardno report for the Climate Change Levy. Separate community/stakeholder and Council staff climate change risk and adaptation workshops have been held. Outcomes from the workshops, have been incorporated into A Draft Adaptation Action Plan.

Integration of Climate Change in the Development of Coastline Management Plans

Since 1997 Manly Council has been developing Management Plans (CMPs) in response to legislative requirements and community issues. This approach encourages current best practice for the management of coastal and estuary foreshores in line with the Coastline Management Manual (1990).

The Manly Coastline Management and Manly Harbour Foreshores Management Committees are in place to oversee the preparation and implementation of the various Coastal and Estuary Management Plans and associated Coastline Hazard Definition Studies (CHDS's). The identification of specific coastal hazards forms an integral part of CMP development. The CHDS's identified a number of specific coastline hazards on both public and private lands and proposed management actions to address each hazard. Those hazards identified on public land owned and/or managed by Council have been incorporated into the relevant Coastline Management Plan, which, once adopted, will be implemented on a priority basis by Council.

The hazards examined within CHDS's correlate with those set out in the NSW Government's Coastline Management Manual (1990) and include beach erosion, shoreline recession, sand drift, coastal inundation, stormwater erosion, slope and cliff instability and climate change. An assessment of the stability of the existing seawalls was also undertaken. As part of the initial hazard assessment process conceptual coastal management options to address identified hazards were also developed.

Coastline/Estuary Management Plans have been developed and adopted for:

- Cabbage Tree Bay Management Plan (2000)
- Little Manly Cove Coastline Management Plan (2003)
- Forty Baskets Coastline Management Plan (2003)
- Manly Lagoon Integrated Catchment Management Strategy (2004)
- Manly Ocean Beach CMP and Emergency Action Plan for Coastal Erosion (2008)
- Clontarf/Bantry Bay Estuary Management Plan (2008)

Council is currently undertaking the development of CMPs for:

- Manly Cove
- North Harbour

Emergency Action Plan for Coastal Erosion (EAP)

Manly Council has developed an Emergency Management Plan for Coastal Erosion (EMP) for Manly Ocean Beach. Emergency Action Plans provide the following for Council:

- Identification of the roles and responsibilities of parties that may be involved in coastal erosion emergencies;
- Describes the levels of activity that can be identified in an EMP and the trigger mechanisms that might apply in proceeding from one level of activity to another;
- Clarify the approvals required to implement emergency protection measures for coastal erosion;
- Discussion of the types of emergency protection measures that are potentially available and recommends a preferred emergency protection measure.

Participation in Sydney Coastal Council's Group (SCCG) Systems Approach to Regional Climate Change Adaptation Strategies in Metropolises Project.

Council, as one of the fifteen member Councils of the SCCG, participated in a project run by the SCCG in partnership with CSIRO, a "Systems Approach to Regional Climate Change Adaptation Strategies in Metropolises". This project involved developing and testing an integrated, systems approach to assist Member Councils assess their vulnerability to climate change and the barriers and opportunities associated with adaptation at the Local Government scale.

Development of GIS tool to assess Vulnerability of coastal Infrastructure and building to Catastrophic Marine Floods

Council has partnered with the Sydney Coastal Councils Group (SCCG) and University of New South Wales (UNSW) Natural Hazards Research Lab to undertake a research project that will apply and test a newly developed and highly novel GIS tool to assess the vulnerability of coastal infrastructure and buildings to catastrophic marine floods. The outputs of the assessment aid council in making decisions about long-term strategic planning and development. The project is about the development of an adequate assessment tool rather than a specific tsunami event. Consequently, the tool's methodology will be equally applicable for the assessment of building vulnerability to storm surge floods. Comprehensive GIS mapping identifying vulnerability of individual buildings throughout the low lying areas of Manly CBD and Lagoon catchments has been incorporated into Councils management processes.

It is the intention of Manly's overall Coastline Management Strategy to identify measures which facilitate adaptive approaches to the management of climate change within each study area. This proactive approach has created positive outcomes for Manly, however successful adaptation to coastal risk and vulnerability still relies heavily in the responsibility of the upper tiers of government to initiate, regardless of the current political systems and ensure Australians are given the best possible support and protection from the increasingly certain future.

Integration of Climate Change into Planning processes

General information is provided on the section 149(5) on the potential for some properties to be impacted by climate change.

S.149 (5)

The Environmental Planning and Assessment Regulation (2000) (Item 7 of Schedule 4) requires that the following information be disclosed in a Section 149(2) Certificate:

Whether or not the land is affected by a policy:

(a) adopted by the council, or

(b) adopted by any other public authority and notified to the council for the express purpose of its adoption by that authority being referred to in planning certificates

issued by the council, that restricts the development of the land because of the likelihood of land slip, bushfire, flooding, tidal inundation, subsidence, acid sulphate

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soils or any other risk.

Therefore in order to include the potential hazards information relating to specific private properties on the relevant Section 149(2) certificates, Council was required to adopt the Coastline Hazard Definition Study reports 'as Council Policy'.

LEP Review

Council is currently amending the LEP/DCP in line with the NSW Government's Planning Reforms. No allowances have been made for specific climate change adaptation, with further research/studies need to be conducted to inform this process.

The NSW government has not included any climate change provisions in the new LEP template, however, Council is attempting to build the consideration of climate change into the objectives etc.

Note: Individual councils such as Lake Macquarie have introduced a SLR policy. SHOROC councils are in the process of discussing these issues.

Education Initiatives

Education for Sustainability Strategy

The Education for Sustainability Strategy is currently being updated and will incorporate climate change mitigation and adaptation. The new strategy will encompass EfS (Education for Sustainability) principles and practices outlined in the Learning for Sustainability: NSW Environmental Education Plan 2007-10.

In terms of greenhouse emissions and climate change education, Manly Council has taken an active role in making our community become more aware of these highly important issues. The Manly Environment Centre (MEC) is a shop front on Belgrave Street staffed with trained environmental educators on hand to provide education material (including brochures, education kits & media clippings) to the general public.

Manly Council works with local businesses to improve energy management through a number of programs. The Sea Change for Sustainable Tourism Project is aimed at making Manly's local tourism industry more sustainable through a number of environmental management practices including energy management, and the annual Green Business Awards incorporates energy management education.

Manly Council has pledged to reduce emissions by 25 per cent by 2010. To help reduce community greenhouse gas emissions, the following programs for residents and businesses have been implemented:

- Enviro Saver energy audits gives residents and business the opportunity to install free energy efficient light globes, water efficient showerheads, as well as obtain advice on the installation of other energy efficient products.
- The Fridge Buyback scheme provided a financial reward and free pick-up for the removal of old, second fridges.
- The Manly Appliance Rebate Program (MARP) provided up to \$200 for residents who installed a more energy efficient air conditioner, or switched from electric heating or cook tops to gas. Grant funding for MARP was provided by the Demand Management Planning Project.
- In the past year posters, displays and materials helped raise awareness and promote Green Power at community events and in the quarterly rate notices. In addition, a Green Power competition was held with the winner receiving "Green Power for a year".

7.4 SPECIFIC INFORMATION FOR THE STUDY AREA

The study area will experience many of the impacts of climate change, with the low lying areas close to the foreshore likely to be subject to more of the impacts than the elevated areas. These impacts are likely to include: sea level rise; increases in extreme weather events; temperature increases; reductions in water availability; altered hydrology and increased flash flooding (Hennessy et al, 2006).

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At a few pockets of the study area contains properties that extend right to the foreshore. Sea levels are expected to rise, but they only need to rise marginally for low lying properties to be at risk of inundation. Predictions estimate that for sandy beaches the coastline could retreat 50 – 100 times the distance of the vertical sea level rise (Australian Greenhouse Office, 2007). This sandy beach shoreline recession would also be exacerbated by the expected increase in severe weather events (e.g. - storm surge), to make the threat of inundation for relevant foreshore properties within the study area even more severe. Areas with stable rocky shores will not experience the same shoreline recession, however the frequency of rock falls may increase and the width of the intertidal rock platforms will decrease as the sea migrates inland (Manly Council Scientific Advisory Panel, 2005).

Temperature increases will affect the ability of some ecosystems to function as they currently do. Slight increases in temperature may be enough to change the balance of some vegetation communities, which can then have flow-on effects to the entire surrounding ecosystem. The temperature increases will also affect water availability. Changes in rainfall are expected, and with higher evaporation demand (due to increased temperatures) this will lead to a tendency for fewer run-offs into waterways (Hennessy et al, 2006).

Although there will be a net decrease in water run-off into waterways, the increase in extreme weather events means that the rainfall we do receive will be more intense, and is predicted to lead to more frequent flash flooding, erosion and strains on water infrastructure. The stormwater system is under capacity now, and is broadly designed to cope with 1 in 20 year storms, but these same storms may become as frequent as 1 in 7 year events. Sewer overflows will also become more frequent as a result of the higher intensity storms. Again it will be the low lying parts of the study area that will be most affected by this impact (Manly Council Scientific Advisory Panel, 2005).

Patterson & Britton (2004) have calculated shoreline recession resulting from sea level rise using the “Bruun Rule”, as described in **Section 6.2**. In essence, the shoreline recession allowance is calculated by multiplying the predicted sea level rise amount by the slope of the active beach profile.

For Manly Cove East and Manly Cove West Beaches, the slope of the active beach profile has been conservatively estimated to be 33 and 16 respectively. Accordingly, the shoreline recession allowances for 50 year and 100 year planning time frames for these beaches are summarised in **Table 7.4**.

Table 7.4. Estimation of Shoreline Recession allowances for beaches within the study area.

Location	Planning Period (yrs)	Sea Level Rise (m)*	Shoreline Recession Allowance (m)
Manly Cove East Beach	50	0.19	7
	100	0.47	16
Manly Cove West Beach	50	0.19	3
	100	0.47	7

* Mr. Mark Moratti, DECC, Personal Communication, based on available information in 2003.

The shoreline recession allowances in **Table 7.4** are additive to the shoreline recession allowance due to sediment loss in severe storms discussed in **Section 6.2**, i.e. 0.013 m/yr recession for Manly Cove West Beach and 0.0017 m/yr movement for Manly Cove East Beach. Accordingly, the predicted loss of beach width for Manly Cove West Beach over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 2 to 4 metres. The current width of the beach, measured a mean sea level is approximately 20 metres (PB&P, 2004).

For Manly Cove East Beach the predicted loss of beach width over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 5 to 10 metres. The current width of the beach, measured at mean sea level, is zero to approximately 15 metres (PB&P, 2004). The loss of beach width over time would lead to a greater risk of damage to the existing seawall at Fairlight Beach during severe storms and would also impact adversely on beach amenity.



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Monitoring of the Manly Cove East and Manly Cove West seawalls and monitoring of beach width is recommended. Should the reduction in beach width become a concern in regard to increased risk of damage to the seawall, several options are available:

- do nothing, and repair/reconstruct the seawall in the event of damage;
- implement emergency protection measures when and where the erosion hazard occurs;
- undertake stabilisation works to prevent or minimise damage to the seawall in the event of a severe storm;
- undertake beach nourishment to restore the volume of sand on the beach so that the seawall would not be damaged in the event of a severe storm.

The last option has the advantage of also improving beach amenity, should the reduction in beach width due to shoreline recession also become a concern in this regard.

8. ECOLOGICAL ENVIRONMENT

The ecosystems within the study area are highly fragmented and likely to only represent a selection of the ecosystem/habitat types that would have been present prior to development of the area. The different habitat types have signs of the many pressures placed on them through development and high usage. **Figure 8.0** (below) provides an overview of the ecological communities present within the study area, while the following sections look at each component in more detail.

The aquatic environments covered by this CMP include the waters of North Harbour between Federation Point in the west and Manly Point in the southeast. North (Sydney) Harbour exhibits a diversity of habitat with a wide range of substrata, vegetation, depths, exposures and their combinations with aquatic plant communities being among the most abundant and conspicuous habitats of sub-tidal reefs in Sydney Harbour.

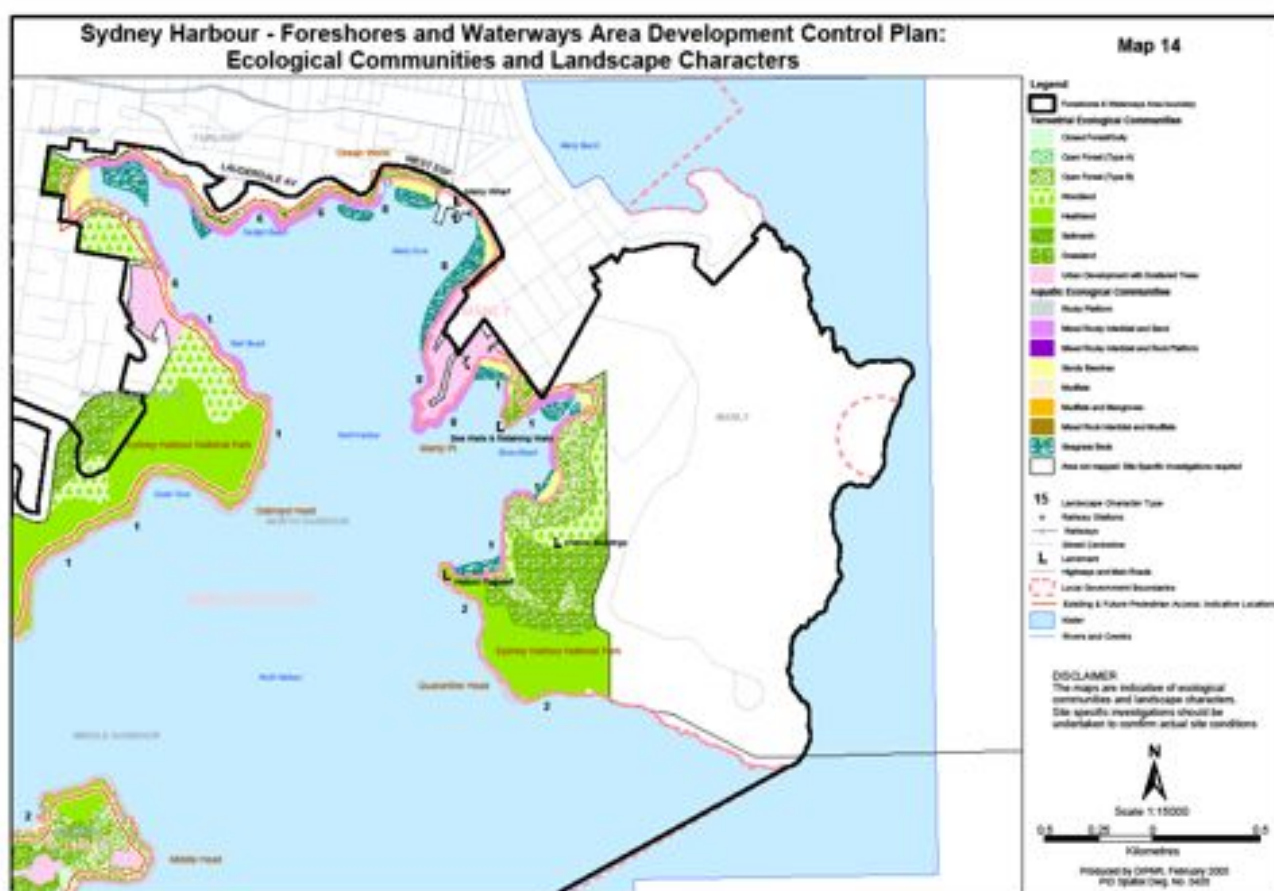


Figure 8.0 Overview of Ecological Communities within the Study Area (Source: DIPNR, 2005)

8.1 MARINE ECOLOGY

Manly Cove exhibits a diversity of habitat with a wide range of substrata, vegetation, depths, exposures and their combinations with aquatic plant communities being among the most abundant and conspicuous habitats of sub-tidal reefs in Sydney Harbour.

Sydney Harbour is subject to a variety of stresses from human activities that have the potential to decrease species diversity and abundance. Understanding the various physical and biological processes that influence

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the structure of marine ecosystems in the study area is important, therefore, because it will allow for improved predictions on the changes that are likely to occur under certain conditions and allow managers to make informed decisions about the conservation and management of these systems.

Very few published studies have been undertaken to describe and assess the ecological characteristics of these waters. Those studies that have been undertaken are specific to assessing particular aspects of the marine environment or the impact of a particular activity on the area's aquatic ecology.

The lack of scientific data regarding the aquatic flora of this area represents a significant data gap, which is reflected in the management responses detailed for this section. However, it is important to note that the management of the area's marine ecology is primarily the responsibility of Department of Primary Industries. Councils control over aquatic issues is therefore limited to the impact that the Local Government Area has on the marine environment and the important regulatory and educational role.

8.1.1 Habitat & Flora

Manly Cove houses a diverse marine environment which ranges from rocky intertidal zone to the seagrass beds of North Sydney Harbour. Sydney Harbour itself is an estuary and can be described as a partially enclosed body of water connected to the ocean. The area's marine environment is rated as 'highly sensitive' by *The Coastal Resources Atlas for Oil Spills in Port Jackson* (EPA, 1994).

The Department of Planning documented terrestrial and aquatic ecological communities in and around Sydney Harbour and its tributaries during the development of the *Sydney Harbour Foreshores and Waterways Area Development Control Plan (2005)*. Intertidal and sub tidal habitats around Sydney Harbour were classified into eight broad categories according to substrate type, position in the tidal zone and types of vascular plants detectable.

Three predominant aquatic communities were classified along the foreshore of the study area; 'mixed rocky intertidal & sand', 'sandy beaches' and 'seagrass beds'. The conservation status of these three ecological units is 'high', 'medium' and 'high' respectively as described in **Table 8.1.1**.

Table 8.1.1 Conservation status of Ecological Communities in Manly Cove (Dept. Planning, 2005)

Habitat	Description	Conservation Status
Mixed Rocky Intertidal & Sand	Intertidal rock shelf gradually changing into a sub tidal sandy beach away from the shoreline.	High
Sandy Intertidal	Sandy beach occupying both intertidal and sub tidal.	Medium
Seagrass Beds	Seagrass beds in intertidal and sub tidal areas. Well defined from surrounding unvegetated areas. A number of species of seagrasses occur and these form several types of seagrass communities.	High

Mixed Rocky Intertidal

Rocky foreshores also provide an important recreational resource for many visitors and residents.

The foreshores which form the west and south-eastern boundaries of Manly Cove are predominantly made up of intertidal wavecut platforms composed of the Hawkesbury Sandstone formation forming extensive horizontal surfaces that suit many species of intertidal flora and fauna.

Where waves undercut a cliff, large angular blocks collapse onto the rock platform and weather into rounded boulders. On some sections of the Manly Point foreshore this has created what is known as a boulder shore.

The waves dissipate most of their energy as they roll across the wide expanse of platform with some rocky shores strongly contorted and broken while others form flat or horizontal platforms and reefs. Every rocky

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headland type has a wide range of habitats and microhabitats, available for colonisation by animals and algae such as in rock pools, along cracks and gutters, and under boulders lying on rock and sand.

Rocky shores provide, on a very restricted spatial scale, an enormous diversity of plants and animals living in close proximity while being subjected to obvious patterns of physical and environmental factors. In the management of such environments it is important to understand the complex interactions occurring between species known to colonise this habitat type.

The entire foreshore within the Manly Cove study area is utilised as a bait harvesting location and, as a result, biodiversity may be reduced when compared to other areas of Sydney Harbour. The foreshore between Dobroyd and Quarantine Headlands is the only portion of Sydney Harbour not designated as Intertidal Protection Area by NSW Department of Primary Industries

Sandy Beaches

Sandy beaches, such as those found in Manly Cove East and West, occupy a dynamic position between sea and land. Despite a lack of site specific data such environments are known to hold a large number and diversity of animals such as crabs, pipis and worms living in or on the upper sand layers. A large number of microscopic animals live between the sand grains. Few attached plants are found in these environments due to the dynamics of sand movement and the lack of protection from wave energy.

Upper Beach Zone: The upper intertidal zone is the most terrestrial of the beach environments and, therefore exhibits the widest variation of heat and cold. As a result, desiccation is a significant problem for marine organisms in the summer and cool temperatures a problem in the winter. Fresh water, both surface water from rainfall and subsurface flow, can also impact populations. Because of the limited inundation time, marine food resources are limited.

In times of rough weather, dislodged seaweed is often found to accumulate in the upper beach zone. These seaweed deposits, also known as wrack, provide important ecological functions through the provision of shelter and food as well as in the nutrient cycle. A recent study confirmed that wrack represents a vital link in a complex food chain based on near shore primary production so its accumulation is important to beach and near shore communities (Fairweather & Henry 2003). Most wrack is returned to the sea by high tide with the remainder entering interstitial and macro-faunal food chains. The wrack that is returned to the surf zone off a beach can provide important shelter and indirect food source for juvenile fishes. It provides food for semi-terrestrial crustaceans and insects, washed up carrion is important for aquatic crustaceans and scavenging gastropods and filter feeders rely on suspended particles and surf-zone diatoms (Brown & McLachlan 1990). The dry upper beach zone is typically inhabited by several species of amphipods, isopods, insects and ghost crabs (Brown and McLachlan 1990, in Barros 2001).

Mid Zone: The mid-littoral zone is characterized by a moderate inundation time, but is subject to many of the same rigors as the upper zone (temperature extremes, fresh water). The mid zone is more subject to rapid sediment removal during winter storms, requiring extreme mobility of its fauna.

Swash Zone: The swash zone, where wave breaking and run-up often occurs, is characterized by the highest water movement, so consequently has a high degree of mechanical stress and possibility of rapid sediment removal. It remains inundated over half the time, and so is less subject to extremes of temperature and salinity.

The number of species and abundance of individuals has been found to be greater in the swash zone than upper areas of the beach (James and Fairweather, 1996). Debate exists as to whether there are unique assemblages of species in different parts of the swash zone or whether the whole assemblage simply alters position with the tide. Physical and chemical factors are thought to explain many patterns observed for infauna on beaches and predation is claimed to be the most important biotic factor (Reise 1985, in Jones and Short 1995).

Low Intertidal: The low intertidal zone, extending into the shallow sub tidal, is almost fully marine, being aerially exposed for short periods only on the lowest tides. The low intertidal is subject to almost constant wave action,

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requiring that the inhabitants be either rapid burrowers or protected against mechanical damage. It houses the most diverse faunal assemblage of the beach zones.

Seagrass

Intertidal and subtidal vegetated communities contribute to estuarine food chains and offer shelter for juvenile and adult species of fishes, crustaceans and molluscs. The location and extent of these plants changes through time and their distribution needs to be regularly assessed in order to guide estuarine management decisions (West *et. al*, 2004).

Seagrass is a flowering plant that provides food and shelter that is critical to the survival to a wide range of aquatic biota. Under the Fisheries Management Act, 1994, all seagrass is protected, and must not be damaged or collected (DPI, 2007).

This breakdown of organic matter also drives nutrient cycling which promotes the growth of bacteria and protozoa's which in turn are consumed by planktonic invertebrates with biomass being transferred as animals higher in the food chain feed on this food source. The surface of seagrass leaves and stems also provide opportunities for colonization by epiphytes which are plants which grow on the surface of other plants. Epiphytes themselves are then grazed upon by a variety of fish and invertebrate species (DPI, 2006).

Council, in conjunction with Department of Primary Industries and NSW Maritime, undertook a literature review of existing seagrass studies which included the information gathered by The Ecology Lab Pty Ltd in the preparation of adjacent CMP study areas. Due to close proximity of Manly Cove to Little Manly and Forty Baskets, this information and associated management options for seagrass beds can be applied to the Manly Cove Study area. A summary of the main findings is presented in the following section.

The management and protection of seagrass beds in the Manly Cove area was identified through the community consultation process as a significant issue to be addressed in the Manly Cove Coastline Management Plan. The vast majority of submissions identified that the protection of native marine and threatened species, the creation and maintenance of marine reserves and the control of introduced species are all important factors in achieving improved management of aquatic resources. The conservation of Manly's endangered Little Penguin population and critical habitat was also raised as an issue of concern.

Importance of Seagrass

Since European arrival the distribution and abundance of seagrass has declined significantly within the waterways of NSW. The remaining seagrass habitat provides a valuable resource and must be managed in a way that recognises the important functions of seagrass in maintaining ecosystem health. The leaves and upright stems of seagrasses act as baffles to water currents, slowing suspended particles which are then deposited onto the sea bed, thus maintaining water quality and encouraging binding and accretion of bottom sediments which reduces erosion and serves to protect shorelines.

Seagrass beds provide extremely important aquatic habitat by providing food and shelter for a variety of juvenile fish and invertebrate species, many of which settle into seagrass beds at the end of their planktonic stage. Many such species are of considerable value to recreational and commercial fishing industries.

Seagrasses grow fast, producing a great amount of organic material with a single hectare of seagrass meadow producing up to 20 tonnes of leaf material each year (NSW DPI). The main grazers of seagrasses in temperate regions are sea urchins and small crustaceans. However, most of the organic material produced by seagrasses enters the food chain as particle-sized detritus through the breakdown of organic material and subsequent consumption by various organisms within seagrass.

This breakdown of organic matter also drives nutrient cycling which promotes the growth of bacteria and protozoans which in turn are consumed by planktonic invertebrates with biomass being transferred as animals higher in the food chain feed on this food source. The surface of seagrass leaves and stems also provide opportunities for colonization by epiphytes which are plants which grow on the surface of other plants.

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Epiphytes themselves are then grazed upon by a variety of fish and invertebrate species (NSW DPI, 2006).

Seagrass Species & Distribution

Seagrass beds within the study area may also be important foraging grounds for Manly's endangered population of Little Penguins (*Eudyptula minor*). Current research by NPWS (now DECC) on the diet and foraging ecology of the population indicates that the penguins eat fish species such as sand sprat, anchovies and hardyhead which inhabit kelp and seagrass beds (NPWS, 2002). Critical habitat for the Little Penguin population was declared in 2002 and further information can be found in Sections 8.2 of this report.

Seagrass beds are found within the study area growing in shallow sub tidal areas along the foreshore, in depths where sunlight is available for photosynthesis. Of the 6 species known to colonise the NSW coast three native species of seagrass have been identified within the study area, these being:

- *Posidonia australis* or strapweed is the largest with straplike leaves, 6-14 mm wide and 30-60 cm long;
- *Zostera capricorni* or eelgrass which has narrower straplike leaves, 1-5 mm by up to 50 cm; and
- *Halophila ovalis* or paddleweed with paired oval leaves, 5-20 mm wide and 1-5 cm long.

Distribution and occurrence of seagrasses is affected by the age, catchment area and stability of each individual estuary. In general, there is a higher area of coverage by seagrass about 3 km back from the estuary entrance, although *Zostera* may be found in feeder creeks and cut-off bays further upstream. The species distribution also depends on substrate type and its stability with seagrass genera occurring predominantly on marine sand (Department of Environment & Heritage, 2006).

Within Manly Cove, *Zostera* will readily recolonise seaward facing sands subjected to frequent disturbance by heavy seas and storms. However, *Posidonia australis* is known to recolonise less readily: for example, at Jervis Bay, seismic testing 20 years ago blasted holes in the *P. australis* communities (West, Larkum & King 1989). These patches remain bare, even though they are surrounded by *P. australis* plants

The most recent map available illustrating the distribution of seagrass within the study area is provided in **Figure 8.1.1a**. This mapping exercise was commissioned by the NSW Department of Transport and was undertaken by Department of Primary Industries in 2002 with funding assistance from the *National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances*.

Impacts upon seagrass in the study area

Seagrasses are fragile ecosystems which can be easily destroyed. NSW DPI estimates that as much as two-thirds of seagrass beds within NSW estuaries have been lost over the past 30 to 40 years. The re-establishment of seagrasses following disturbance can vary between seagrass species. In particular, the re-establishment of the slowly growing, infrequently seeding *Posidonia australis*, is very slow.

Further, seagrasses generally occur where there are slow currents. Where the speed of flow has increased due to removal of sand, rock or other substrates, seagrasses often cannot re-establish from seed.

In general seagrasses are negatively affected by a number of anthropogenic activities including reclamation, dredging, the construction of jetties, pontoons, wharves and ramps, water pollution and increased turbidity, poor land management and some recreational activities. The Ecology Lab's 1993 review and analysis for the neighbouring embayment of Little Manly Cove identified boating and moorings/anchoring, marine pest species, pollution (both terrestrial and marine), recreational fishing and commercial fishing as likely impacts on seagrass beds. The significant impact resulting from moorings is apparent in **Figure 8.1.1a**.

Major impacts on the health and distribution of seagrass also include the decrease of light penetration through the water column due to increased turbidity and increased shading by marine structures, which inhibits the ability of seagrass to photosynthesize and siltation, which smothers seagrass and also reduces light availability. Water based development and beach nourishment may potentially impact upon seagrass within Manly Cove if not properly managed.

Kelp



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Mapping released during 2002 by the NSW Department of Transport and NSW DPI indicates that kelp (*Ecklonia radiata*) beds are present on rocky substrate on the western border of the study area adjacent to Federation Point.

Kelp is known to anchor itself to rock substrata with a holdfast, root-like organ, which differs to the roots of terrestrial plants. They often form dense communities, sometimes called 'forests', which exhibit a distinct



Figure 8.1.1a: Distribution of seagrass and kelp areas in Manly Cove

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zonation. In the intertidal zone, green algae are predominant. Below this zone, brown algae are found. These include bladderwrack and knotted wrack, which rely on gas-filled pods for buoyancy and to stay upright in the water.

Below the brown algae, red algae occur in the lowest intertidal zone, and far below them come the large kelp species such as blade kelp. Every algae zone is a distinct habitat type, with a typical assemblage of flora and fauna species.

Kelp forests and beds are highly productive and provide a special habitat for a host of marine organisms. However, no more than an estimated 10% of the algae biomass produced finds its way into the food web via plant consumers. The vast majority only becomes available for consumption as detritus or dissolved organic matter (Hammond & Synnot, 1994).

The creation of artificial 'rocks' such as structural foundations and piles can bring about local increases in algae species diversity by creating additional potential habitat. On the other hand, marine pollution occurring from terrestrial and water based sources has caused a decline in species and promoted more resilient species to the detriment of others.

Growth of native flora on the netted swimming enclosure located within Manly Cove east is an issue which requires the development of suitable management practices. Improved water quality over the past decade has resulted in increased growth of aquatic flora and fauna species including invertebrates and sponges. Such marine growth provides important habitat for protected Syngnathids with a number of seahorse species known to colonise the net structure. Cleaning regimes must therefore aim to ensure that seahorse conservation is taking into account.

Beach Accumulation of Macro algae (Wrack)

Beach wrack is an important yet poorly studied component of marine ecology and greater effort is required to better understand the ecological effects of wrack on sandy beaches (Fairweather & Henry, 2003). Beach wrack is an essential component to a healthy and diverse sandy beach ecosystem, as it acts as a direct food source and shelter for many species living above the sand (and potentially fish) and provides nutrients to fauna living in the sand (The Ecology Lab, 2006).

An Australian study of beaches in the Peel-Harvey Estuary (1999), Western Australia concluded a decline in epi-fauna richness immediately after harvesting appears to be directly related to removal of macrophyte wrack and took approximately two months to recover coinciding with re-accumulation. Harvesting in contrast with the above study had short-term or little effect on organic content of underlying sediments and infauna, and in highly eutrophic, poorly flushed systems cleaning may mimic natural flushing and be a potentially beneficial beach management tool.

However, the study was clear to state the conclusions are drawn without baseline information on epi-faunal and in-faunal communities. Based on observations in Peel Inlet, Western Australia loaders to remove macroalgal from beaches over seventeen years have compacted the sediment, beach sand collected with algal and rushes that stabilise the foreshore were destroyed resulting in erosion and recession of beaches by approximately 10-12 metres (Morand & Merceron (1993).

A recent study (Fairweather & Henry, 2003) stated wrack represents a vital link in a complex food chain based on near shore primary production so its accumulation is important to beach and near shore communities. Most wrack is returned to the sea by high tide with the remainder entering interstitial and macro-faunal food chains. The wrack that is returned to the surf zone off a beach can provide important shelter and indirect food source for juvenile fishes. It provides food for semi-terrestrial crustaceans and insects, washed up carrion is important for aquatic crustaceans and scavenging gastropods and filter feeders (clam *Donax*) rely on suspended particles and surf-zone diatoms. Freshly deposited wrack on a beach can be colonised by a number of macro-faunal species within 24 hours. Thus wrack is an essential component to a thriving and diverse sandy beach ecosystem attracting terrestrial and marine species.

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Caulerpa taxifolia & Introduced Marine Flora

Marine flora and fauna species are introduced to new locations through human activities such as hull fouling, boat washing, dry ballast and aquaculture, and by natural processes such as drifting logs and seaweed.

In 2003 *Caulerpa taxifolia* was identified in the waters of Sydney Harbour including a number of locations within North Harbour. This noxious species has the potential to grow rapidly, degrading marine ecosystems and threatening biodiversity. It must be noted that the distribution and density of *Caulerpa* can change markedly over time, either expanding or contracting.

It is important to note that the distribution of marine vegetation is known to change considerably over time and between seasons. The map provided in **Figure 8.1.1b** identifies the distribution of *Caulerpa taxifolia* in North Harbour at some point between 2003 and 2006 and is not necessarily an accurate depiction of distribution at any one point.

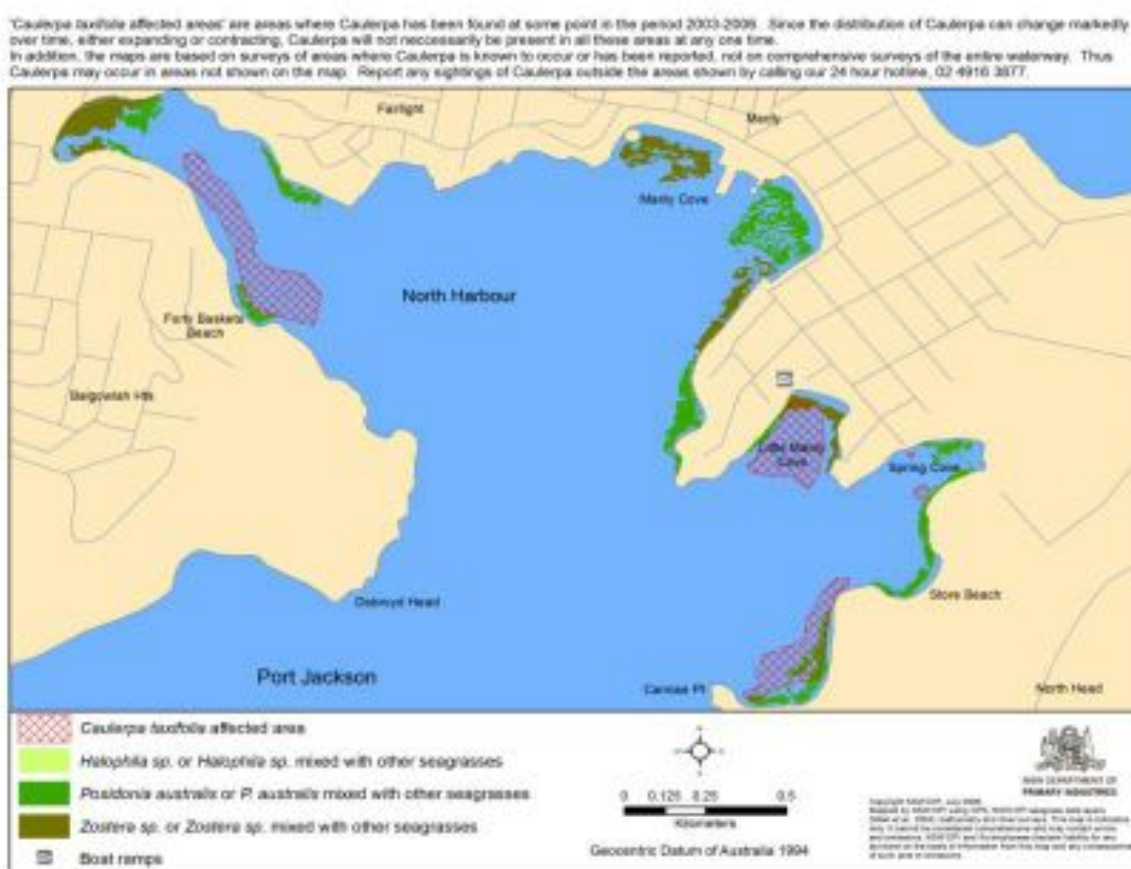


Figure 8.1.1b Distribution of *Caulerpa taxifolia* in Manly Cove 2003-2006

Caulerpa taxifolia is normally only found in warm tropical waters. It has been widely used as a decorative plant in the marine aquarium trade. The 'aquarium strains' can invade cool temperate waters, and *Caulerpa taxifolia* has become established in several waterways along the NSW east coast. Research by NSW DPI has indicated that the strain of *Caulerpa* found in NSW is the same (as far as anyone has been able to demonstrate so far) as that occurring naturally in coastal Queensland.

Caulerpa taxifolia is a green alga with regularly-spaced feather-like fronds growing along a running stolon that is attached to the bottom. The fronds vary in length but can reach 60 cm or more. It can colonise most kinds of

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substrates including rock, sand, mud and seagrass beds. It has been found in depths ranging from less than 1 m to over 100 m and is capable of rapid growth.

Reproduction of the invasive strain is asexual and dispersal occurs through fragmentation. It has been demonstrated in laboratory experiments that a fragment as small as 1 mm can settle and start growing. Growth rates are greatest in the summer months and lowest during winter. In the Mediterranean it has spread into thousands of hectares and is so abundant that there may be hundreds of tonnes of the seaweed per hectare.

In 2001 the Sydney Ports Authority, with support from the Department of Transport NSW and the Australian Navy commissioned the Australian Museum Business Services (AMBS) to undertake baseline studies with the aim of documenting the occurrence of marine pest species in the port of Sydney Harbour. The survey was undertaken in 2001. None of the survey sites were located within North Harbour.

The AMBS report recommended that the Sydney Ports Authority undertake ongoing monitoring for introduced species every three (3) to five (5) years. The report also recommended that additional areas outside the immediate port should be included in the survey program (AMBS, 2001). Due to the regional importance of North Harbour's marine ecosystem, which has been acknowledged through the area's designation as an aquatic reserve, Council should liaise with the Sydney Ports Authority regarding the location of survey sites within the boundaries of the North Harbour Aquatic Reserve.

Caulerpa taxifolia has been declared a Class 1 noxious species in all NSW waters under the *Fisheries Management Act 1994*. It is illegal to possess or sell the seaweed; and fines of up to \$11,000 apply. The noxious listing also provides NSW DPI with the power to seize and destroy *Caulerpa taxifolia*, or require its destruction.

Management of *Caulerpa taxifolia* in Sydney Harbour

It is usually extremely difficult to eliminate aquatic weeds once they have become established in the wild. It is therefore vital to prevent noxious species such as *Caulerpa taxifolia* from entering or spreading further within and between waterways.

Results of initial research suggest that *Caulerpa taxifolia* can co-exist with the native seagrass species found within the Manly Cove study area. More specifically, *Caulerpa taxifolia* seems to co-exist with dense *Zostera*, although sparse stands of *Zostera* appear less resistant to invasion. Following colonization and dieback of *Caulerpa taxifolia*, *Zostera* recovers in a less dense cover than prior to *Caulerpa* invasion. It might be that *Caulerpa* enhances (or causes) the decline of sparse *Zostera*, but it might also be that the *Zostera* died of its own accord, as it is known to do naturally in locations where there is no *Caulerpa*. DPI has also confirmed that *Caulerpa taxifolia* can thrive in areas of decaying seagrass. No obvious adverse effects have been identified on *Posidonia* species.

Contrary to initial public concern and media reports from the Mediterranean, NSW DPI research has to date found minimal effects of *Caulerpa* on seagrasses. Research on the effects of *Caulerpa* on fish populations (by the University of Technology in conjunction with NSW DPI) indicates some differences in the types of species in *Caulerpa* compared to native seagrasses (*Posidonia* and *Zostera*), with seahorses and pipefishes being rare in *Caulerpa* compared to seagrass. Work done by researchers at other NSW universities indicates that *Caulerpa* may have some negative effects on the reproduction and distribution an estuarine cockle. No large-scale impacts of *Caulerpa* on marine biodiversity have been documented in NSW or elsewhere. All these factors make it difficult to justify a large-scale ongoing control program for *Caulerpa* in NSW. Consequently, NSW DPI has shifted the focus to small-scale control work, vector management, community education and ongoing research.

In 2006 NSW DPI completed a risk assessment which showed that in the majority of estuaries, ongoing control work using salt would have little or no impact on the risk of further spread of *Caulerpa* within or between estuaries. This is primarily due to the scale of the infestations, making it impossible to salt all areas that could potentially be a source of new outbreaks. The only method that has been demonstrated as effective on a large scale – converting a lake to freshwater – is not applicable in any of the affected NSW estuaries. Other methods such as chlorine (the application of which has the same logistical constraints as applying salt) would have

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significant negative environmental impacts which NSW DPI believes would outweigh the impacts of Caulerpa, and its limitations are the same as those for salt – i.e. all fragments of Caulerpa need to be treated.

Based on 5 years experience, the Industry & Investment NSW has adopted a revised Caulerpa Control Plan in October 2009.

The overall goals of the 2009 revised control plan presented are to:

- prevent the further spread of Caulerpa within and between NSW estuaries
- reduce the impacts of existing populations of Caulerpa on biodiversity and fisheries productivity
- maximise the efficient and effective use of available resources by prioritising management programs and utilising best-practice techniques
- continue to support research into the environmental impacts of Caulerpa in NSW waters
- ensure that future management of Caulerpa is underpinned by rigorous, quantitative science and appropriate monitoring and evaluation
- continue to educate the community about the impacts of Caulerpa and the role of the community in management strategies to prevent spread and counteract impacts
- coordinate education programs and management of Caulerpa with the actions of relevant local and State government agencies.

The scopes of the revised control plan are actions into the following areas:

- a) Vector management – fishing closures, education, noxious listing
- b) Compliance, education and community involvement – advisory materials, signs, direct communications, community monitoring and reporting
- c) Control and treatment in high-priority areas – physical removal (hand picking, dredging), smothering (conventional dredging or trawling, smothering with used conveyor belt, smothering with black plastic, smothering with sand-filled geo textile bags, smothering with jute matting), osmotic shock (application of domestic pool salt, fresh water), chemical treatment (chlorine, other chemicals) and biological control (grazing by herbivorous fish)
- d) Survey and monitoring
- e) Research

To protect the existing range of habitat available in Manly Cove, the NSW State Government, under its Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005, has zoned large parts of the study area as Environmental Protection (see **Figure 8.1.1c**). The aim of this zoning is to “provide for the protection, rehabilitation and long term management of the natural and cultural values of the waterways and adjoining foreshores (NSW Department of Infrastructure, Planning & Natural Resources, 2005).

Artificial Habitats

A large proportion of the Manly Cove foreshore has been modified since European settlement, with seawalls, wharves and waterside developments now existing throughout the study area. Understanding the ecological role of artificial structures in shallow coastal waters is necessary in order to plan sound strategies of conservation and management of natural habitats (Bulleri et al, 2005).

Most traditional foreshore protection structures tend to be vertical, as opposed to natural shorelines, which tend to be flatter. As a consequence, traditional structures have very little intertidal area and the surfaces are often smooth, providing few different sorts of microhabitats (Chapman & Bulleri, 2003).

Previous research has shown that many animals found on rocky shores also live on seawalls. Some species, however, show differences in density and size between rocky shores and seawalls. Additionally, some animals, such as several species of sea anemones, whelks and starfish, are not found on seawalls. It is therefore reasonable to conclude that seawalls do not provide a suitable habitat for the whole suite of organisms living on natural rocky shores (Moreira, 2005).



The Manly Cove netted enclosure consists of a 10 cm square mesh and has a total length of 150 m. The average maximum depth of the net is 2.8 m however this varies depending on the size of the incoming tide. The deepest section of the net was recorded at 3.5 m. The net is strung between nine wooden pilings which are spaced 25 m apart. The net is held up by surface floats and is in direct contact with the sandy bottom. The epibiota observed on the net included bryozoans (*Schizoporella errata*, *Watersipora subtorquata*), mussels (*Mytilus galloprovincialis planulatus*), green algae (particularly *Codium cuneatum*), brown algae (*Zonaria* sp., *Sargassum* sp., *Ecklonia radiata*), colonial and solitary ascidians (*Diplosoma listerianum*, *Pyura stolonifera*, *Styela plicata*, *Botrylloides leachi*, *Herdmania grandis*), and several sponges.

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The protective swimming net is surrounded by seagrass meadows consisting of *Halophila ovalis*, *Posidonia australis* and *Zostera capricorni*. Four dives of 30 minutes duration were conducted in the seagrasses over different months to determine if animals from the net were utilising the seagrass as habitat. The closest rocky reef is approximately 100 m away.

Given that seahorse abundance and distribution on the net is related to the presence of epibiota, it is recommended that future maintenance and cleaning of the net be undertaken utilising methods to minimise the impact on seahorses.

The obvious solution is to leave the net as is and allow growth to remain however this scenario may not be viable as the excess weight can cause the net to break from its support. If growth must be removed, the most suitable approach for councils is:

1. Leave epibiota on the bottom of the net (from a height of 1.2m from the seafloor to the bottom) and only remove growth from the top section of the net. This ensures that seahorses still have suitable epibiota for habitat and food whilst reducing the weight of the net.
2. It is recommended that the cleaning of the net be undertaken during the winter period (non-breeding season) when seahorse abundance on the net is reduced and ensures that mating animals are not affected by the cleaning.
3. Finally, to minimise large scale disturbance to the seahorses in one event, it is recommend that only a maximum of half the net be cleaned each year to ensure there is sufficient epibiotic growth to maintain the seahorse population.



Figures 8.1.1d and 8.1.1e – Opportunities and threats created for marine species by Manly Cove netted swimming enclosure

8.1.2 Fauna

Very few published studies have been undertaken to describe and assess marine fauna of the waters within the Manly Cove study area. Those studies that have been undertaken are specific to assessing particular aspects of the marine environment or the impact of a particular activity on the area's aquatic ecology.

It is clear, however that over the past decade there have been considerable advances in environmental management both terrestrially and in marine related issues. As a result water quality within Sydney Harbour has

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greatly improved and many species which were previously in decline or absent are now found to be re-populating suitable habitats in increasing numbers. The future of such populations relies greatly upon the future proper management of Sydney's marine resources both through terrestrial and marine planning, education and regulation through appropriate legislation.

However, it is important to note that the management of the area's marine ecology is primarily the responsibility of Department of Primary Industries. Council's control over aquatic issues is therefore limited to the impact that the Local Government Area (LGA) has on the marine environment.

Fish

Sydney Harbour is identified as one of the richest urban estuarine areas in the world from a species diversity perspective (Australian Museum, 2007). It is home to around 570 different species of fishes and a diversity of underwater habitats. There are two main factors which contribute to this richness of fish life and habitat:

1. Sydney sits on the Australian coast at a point where the warm tropical waters from the north and cooler temperate waters from the south meet and mix. As a consequence both tropical and temperate fish species can be seen in the harbour.
2. The outer portion of the harbour with its deep, wide mouth, more closely resembles open coastal habitat than a true estuarine habitat. This is also the area where the highest diversity of fish species occurs.

Each summer larval (baby) tropical fishes are carried by the 'East Australian Current' from north-eastern Australia southwards providing areas such as Sydney Harbour with an exotic sprinkling of tropical fish.

The East Australian Current is a warm tropical current which flows from the hot equatorial top end of eastern Australia south to the southern regions of New South Wales and occasionally as far as Tasmania. Rapid changes in water temperature are often experienced along the New South Wales coast in early summer. These are caused when warm eddies being swept towards the shore from the East Australian Current as it travels down the coast displace the local cooler water. The cool waters are then replaced by upwelling near the coast during the northerly winds.

Many tropical fishes such as surgeonfishes, barramundi cod *Chromileptes altivelis*, rainford's butterflyfish *Chaetodon rainfordi*, moorish idol *Zanclus cornutus*, damsel fishes and wrasses can be seen on the temperate reefs of Sydney Harbour during the summer and autumn. Most of these 'vagrant species' start to disappear by about May. In winter when the harbour is dominated by much cooler currents from the south the tropical residents becomes less active and much more susceptible to predation. While many adult tropical fishes do survive Sydney winters, the cooler waters prevent them from breeding (Australian Museum, 2002).

A list of fish species recorded in Sydney Harbour, which has been extracted from the Australian Museum Ichthyology Database, is provided in Appendix D. While the list is not specific to the Manly Cove study area, it represents species for which the Australian Museum Fish Collection holds a specimen. It is therefore not definitive list but does cover the majority of species currently known to live in (or have swum into) the Harbour. As the Manly Cove includes the diversity of habitats to support a wide range of species the list is considered to provide a comprehensive overview of the species found within the study area.

Appendix C1 details a species list that was prepared by the Australian Museum (2007) on the fishes found within Sydney Harbour. The list details out species for which the Australian Museum Fish Collection holds a specimen from Sydney Harbour. Although Sydney Harbour incorporates much more than just the study area, it is likely that many fishes from throughout the Harbour may at some stage be present within the study area. Hence, it has been included as a likely species list for the study area. It is worth mentioning here that (unlike many terrestrial species) there are no barriers to recruitment from other areas. Fish abundance will be determined by available habitat.

Appendix C2 details other fauna species (not just fishes) that have been recorded within the study area or Sydney Harbour. It is again assumed that species recorded in other parts of Sydney Harbour are also likely to have at some stage visited the study area if their preferred habitat type is represented here.

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The species present within the study area changes throughout the year. Many species will be present throughout the year; however some species will only be present seasonally. Whales, for example, will only be present at the start of winter when they pass Sydney on their way north to warmer waters, and at the start of summer, when they return south. Many of the pelagic species are also seasonal, with fish such as Kingfish preferring the warmer months, and fish such as Silver Trevally preferring the cooler months.

Marine Mammals

Marine mammals, such as whales and seals, would have been a common sight around Sydney Harbour in the early 1800s. Whaling took a heavy toll on large whales such as the southern right whale *Eubalaena australis* and humpback whale *Megaptera novaeangliae* before it was banned in the 1970s. Fortunately humpback and southern right whale numbers are now on the increase and it is possible to see them once again off the coast of Sydney, as well as inside the Harbour entrance.

The other marine mammal that is still seen fairly regularly around the harbour area is the bottlenose dolphin *Tursiops truncatus*. This relatively common species was known to have two different 'forms' an inshore and offshore that are now recognised as two distinct species, the bottlenose dolphin, *Tursiops Truncatus*, and the long-beaked bottlenose dolphin, *Tursiops aduncus*. A range of other marine mammals from this area have made it into the Australian Museum collections (generally found dead). Many of these occur outside the harbour or are occasional visitors to the harbour. These include; common dolphin, risso's dolphin, pygmy sperm whale, sperm whale, killer whale, spotted dolphin, Australian fur-seal, leopard seal, crab-eater seal, southern elephant seal and dugong.

Marine Reptiles

Three species of marine turtles are recorded from the Sydney Harbour region with certainty. These are the green turtle, *Chelonia mydas*, loggerhead turtle, *Caretta caretta*, and leatherback or luth turtle, *Dermochelys coriacea*. The green and loggerhead turtles are widely distributed in the tropical and warm waters of northern Australia and there is no evidence that either species breeds in New South Wales waters. As such, the status of these species in Sydney Harbour can be regarded as vagrants or strays to the area. The leatherback turtle is known from a broad area of the east Australian coastline and is frequently sighted in temperate waters indicating this species actively uses these waters as feeding grounds.

Endangered, Vulnerable and Protected Species

A number of populations of protected, endangered and vulnerable marine fauna species are found in the vicinity of the Manly Cove study area. Each species will display differing ecological needs and be subjected to a range of varying pressures, and as such must be managed appropriately. A summary of threatened species is provided below:

Endangered Species:

- Green sawfish (*Pristis zijsron*)
- Grey nurse shark (*Carcharias taurus*)
- Loggerhead turtle (*Caretta caretta*)
- Dugong (*Dugong dugon*)

Vulnerable Species:

- Great white Shark (*Carcharodon carcharias*)
- Black cod (*Epinephelus daemeli*)
- Australian fur seal (*Arctocephalus pusillus doriferus*)
- Sperm whale (*Physeter macrocephalus*)
- Humpback whale (*Megaptera novaeangliae*)
- Southern right whale (*Eubalaena australis*)
- Leatherback turtle (*Dermochelys coriacea*)
- Green turtle (*Chelonia mydas*)

Protected Species:

- Big belly seahorse (*Hippocampus abdominalis*)
- White's seahorse (*Hippocampus whitei*)

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- Crested pipefish (*Histiogamphelus briggsii*)
- Girdled pipefish (*Festucalex cinctus*)
- Hairy pipefish (*Urocampus carinirostris*)
- Javelin pipefish (*Lissocampus runa*)
- Mother-of-pearl pipefish (*Lissocampus runa*)
- Ornate ghost pipefish (*Solenostomus paradoxus*)
- Red pipefish (*Notiocampus ruber*)
- Robust ghost pipefish (*Solenostomus cyanopterus*)
- Sawtooth pipefish (*Maroubra perserrata*)
- Spiny pipe horse (*Solegnathus spinosissimus*)
- Spotted pipefish (*Stigmatopora argus*)
- Stick pipefish (*Trachyrhamphus bicoarctatus*)
- Tiger pipefish (*Filicampus tigris*)
- Upside down pipefish (*Heraldia nocturna*)
- Wide-body pipefish (*Stigmatopora nigra*)
- Bottlenose dolphin (*Tursiops truncatus*)

Syngnathiformes

Some of the most decorative and elusive fish in NSW waters belong to the families 'Syngnathidae', 'Solenostomidae' and 'Pegasidae'. These unique and delicate groups of fish include seahorses, seadragons, pipefish, pipehorses, ghostpipefish and seamoths, known collectively as 'Syngnathiformes'.

Syngnathiformes are not like most other bony fish. Instead of having internal bones for support and scales for protection, they have an elongated semi-flexible stiff body covered with bony plates and rings. The different species have a variety of specialised tubular snouts with a small mouth at the tip. These adaptations allow them to capture their preferred prey that usually consists of small crustaceans (NSW DPI Website).

Off the NSW coast syngnathiformes are found in a variety of habitats ranging from deep reefs to coastal algae, weed or seagrass habitats, or around man made structures such as jetties or mesh nets. Like most animals, syngnathiformes are found in the habitats where their food resources are plentiful. Often the ends of jetties are rich with seahorses due to water circulation patterns that sometimes present rich patches of zooplankton on which they feed. Seahorses in particular are able to wrap their tails around structures and feed on passing organisms. Pipefish are present among many reed-like seagrasses where their bodies resemble their environment. Here they are able to employ their "sit and wait" feeding strategy to attack passing or unsuspecting small crustacean prey. Information on the distribution of a number of species is limited due to the depths they inhabit and because of their highly successful camouflage techniques. Following is a description of Syngnathiformes known to colonise waters of the Manly Cove study area:

Seahorses

Seahorses have elongate bony bodies and long snouts. They swim slowly upright in the water, or wrap their tails around objects such as seagrass fronds to hold them in place for feeding or for stabilisation during turbulent water conditions such as storms. Seahorses use camouflage to blend in with their surroundings before using an ambush predatory feeding behaviour on small crustaceans.

The Big-belly seahorse *Hippocampus abdominalis* and White's seahorse *Hippocampus whitei* are known to occur in the waters of Manly Cove, with a large population of seahorses colonising artificial structures within the study area, particularly the netted swimming enclosure as well as substructures of Manly Wharf, Ocean World and the various boating facilities along the eastern boundary of the study area.

NSW Department of Primary Industries staff have been monitoring the seahorse population known to colonise the Manly Cove netted swimming enclosure over a period of 14 months during 2006/07. The project aims include:

- To determine the relationship between epibiota growth on net and seahorse distribution and abundance;
- Assess if abundance on net varies over 12 months;
- Obtain population estimate for net;

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- Assess the impact of council cleaning on local seahorse populations;
- Provide recommendation for most suitable cleaning procedures.

Individual seahorses were tagged over a period of 8 months to allow for a population estimate to be conducted using mark-recapture techniques. Using a "Petersen" mark-recapture model and data from the survey it appears that the seahorse population on the net is at least 400 individuals. **Figure 8.1.2** provides an overview of seahorse abundance during the survey period.

The research identified the following:

- Seahorse abundance on the net varies in accordance with breeding season;
- Population of *Hippocampus whitei* on Manly Net is approx 400 animals;
- 96% of all seahorses observed within 1.2 metres of seafloor (prior cleaning);
- No significant difference between non- clean net sections (control sites) and top clean treatments.

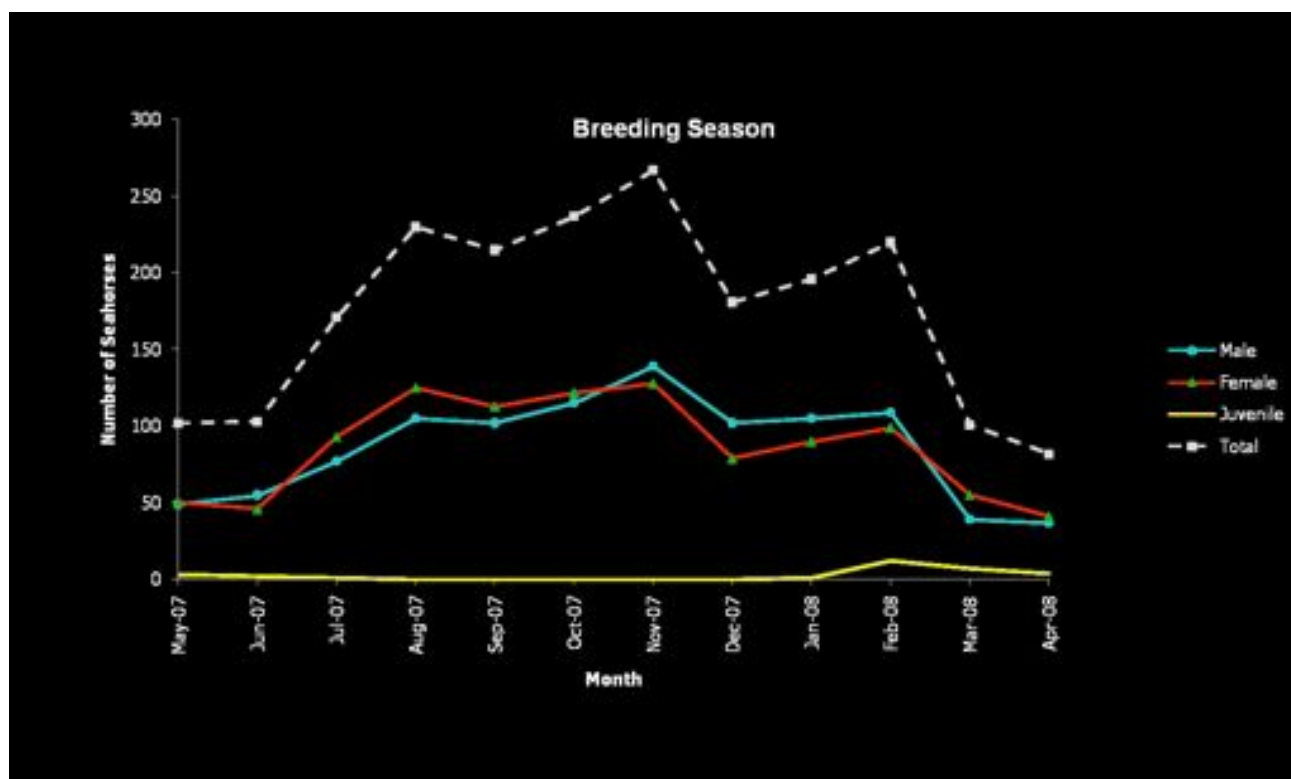


Figure 8.1.2 – Seasonal abundance of White's seahorse *Hippocampus whitei* on the Manly Cove netted swimming enclosure

8.1.3 North Harbour Aquatic Reserve

Aquatic reserves have been established to protect biodiversity and provide representative samples of our wonderfully varied marine life and habitats. New South Wales currently has 12 aquatic reserves declared under the *Fisheries Management Act 1994*. Although aquatic reserves are generally small compared with marine parks, they play a significant role in the NSW marine protected area system. Apart from protecting important habitat, nursery areas and vulnerable and threatened species, aquatic reserves also have valuable research

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and educational roles. Community involvement is critical in the management of aquatic reserves. Through public involvement in management planning processes, the government seeks to achieve community partnership in these important places, providing ongoing protection for the future.

North (Sydney) Harbour Aquatic Reserve lies between an imaginary line from the headlands at North Head and Grotto Point and another line joining Little Manly Point, Manly Point and Forty Baskets Beach (Figure 8.1.3). The reserve extends from the seabed at these outer boundaries up to the mean high water mark between them and covers an area of approximately 260 hectares.

At the Ordinary Meeting of 17 March 2008, Manly Council moved a resolution to extend the boundaries of the North Harbour Aquatic Reserve to include both Little Manly Cove and North Harbour (Figure 8.1.3). A formal proposal has now been submitted to DECCW for its review and approval.

The reserve's intertidal rock pools provide homes for many invertebrates, including anemones, worms, sponges, shrimps, crabs and molluscs. Sheltered bays and inlets provide seagrass and algal habitats for species, including seahorses and sea dragons. In summer, tropical fish are a common sight, carried from the Great Barrier Reef by the East Australian Current. The rocky reefs and kelp are also home to both invertebrates and fish. Read about the marine life of Sydney's rocky shores.



Figure 8.1.3 North Harbour Aquatic Reserve

Within the reserve, line fishing is allowed only for fish with fins. Otherwise, the collection or disturbance of marine life or habitat is prohibited. This includes collecting shellfish, pumping for worms, spear fishing and collecting dead or empty shells.

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Baseline data on diversity and abundance of marine and estuarine species within the Reserve can be viewed at: <http://www.urgdiveclub.org.au/Research/NHARProject/tabid/71/Default.aspx>

The NSW Department of Environment, Climate Change and Water (DECCW) is currently responsible for the administration and management of NSW Aquatic Reserves. Community consultation confirmed that residents are well aware of issues relating to the protection of the marine environment with 87% of respondents identifying the protection of such environments as being a primary concern.

8.2 INTERTIDAL ECOLOGY

This refers to:

1. the area between the mean high water and mean low water marks, and
2. flora and fauna that occurs in both the marine and terrestrial environment

8.2.1 Habitat & Flora

In recent years, especially around Sydney and other metropolitan centres, the abundance of invertebrate animals in the intertidal zone has declined due to collection for use as food or bait. Organisms of particular concern found in intertidal areas include the octopus, cunjevoi and molluscs, which inhabit rocky shores, and pipis and cockles found along sandy and muddy shores.

Intertidal Protected Areas (IPAs) are a fishing closure managed by DPI. The IPA protects all invertebrates (except rock lobster and abalone) from the mean high water mark to 10m seaward of mean low water mark. Fishing, from terrestrial and intertidal areas within an IPA is permitted provided bait is brought from outside the protected area.

In July 1993, 14 intertidal protected areas (IPAs) were declared in the Sydney region. The entirety of the foreshore of Sydney Harbour is declared an IPA, with the exception of North Harbour, from Manly Point around to the western end of Manly Cove Beach. As such harvesting of intertidal species continues within the area.

Trampling along the rocky foreshores crushes and kills many species of marine invertebrates, potentially increasing algal growth. Increased algal growth on rocks presents a safety hazard. Over longer time scales, intertidal areas can become depopulated and contain very little biodiversity. The Manly Council has requested that this IPA be extended to include North Harbour, however as yet NSW Fisheries has not agreed (GIS, 2004).

The rocky habitat mentioned in section 8.1.1 (above) extends in parts of the study area into the terrestrial zone, creating an intertidal zone in between. This rocky intertidal zone is an exceptionally harsh environment, with organisms having to tolerate long periods of drying under the full summer sun, large changes in salinity levels as rock pools full of salt water dry up or are flushed with rainwater, and perhaps even frosts in winter (Edgar, 2001).



The rocky outcrops and headlands are predominantly sandstone and shale, with a mixture of flat shelves and boulders. Despite the harsh environment, the weathered sandstone, with its many cracks and crevices, along

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with the boulders and flat surfaces, provides significant habitat for many intertidal species. Many types of algae (e.g. - red, green, brown) also inhabit the intertidal zone, providing a food source for the many grazing invertebrates. These algae generally differ from those in the marine zone, as they are never submerged to any great depth, and hence do not grow as tall. Encrusting algae that form dense mat-like layers over the surface of rocks are very common (Edgar, 2001).

The many layers of sediments within sandy flats and beaches, and the resulting changes in amounts of organic material, moisture, oxygen levels and bacteria, provide a range of habitat in what often appears to be a barren environment. Numerous types of invertebrates, such as worms, crabs and molluscs, can be found in the sediment. Some are surviving through filtering food from their surrounds and others through predation. Washed up seaweed and seagrass are extremely important on sand flats and beaches, with many invertebrates at the base of the food chain dependant on it as a source of food for survival (Edgar, 2001).

Although the extent of wetland habitat in the study area is limited, large areas have been designated as a Wetlands Protection Area (WPA) by the NSW State Government (see **Figure 8.2.1**). This area is designed to allow for future growth, as well as preserving and protecting the existing populations (NSW Department of Infrastructure, Planning & Natural Resources, 2005).

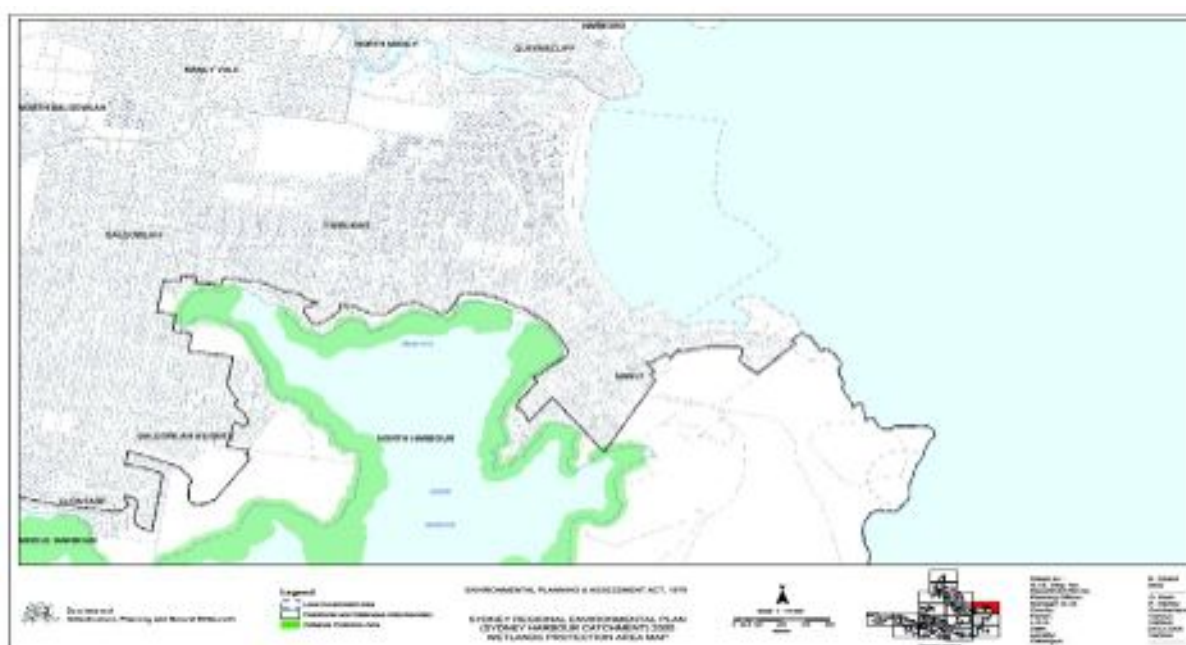


Figure 8.2.1 Wetlands Protection Area in North Harbour (Source: DIPNR, 2005)

8.2.2 Fauna

Information on flora within the intertidal zone of the study area is extremely limited, although information about fauna in the general Manly Cove and North Harbour intertidal zone provides some detail. **Table B5 in the Appendix B** lists species that are known to be present in or directly adjacent to (and hence expected to also be in) the study area. The majority of these species are invertebrates. There are also likely to be many species that live in the sediments of the beaches and sand flats (see section 8.2.1) that are not represented within the list. The majority of these species are also invertebrates, ranging from those visible to the naked eye, to microscopic species. Although they are not represented in the species list, they are extremely important to the ecology of the intertidal zone (Edgar, 2001).

The Little Penguin is included in this list, as it feeds in the estuary during the day and nests on land during the night.

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The fauna in the intertidal zone plays an extremely important role in the greater ecosystem. Invertebrates on the rocks feed on the surrounding algae, ensuring it does not over colonise, while they provide a food source for many marine fishes at high tide. Invertebrates within the sand on beaches and flats clean the sand by filtering it for food, and again themselves provide a food source for marine fishes at high tide. Both of these groups of invertebrates also provide a vital source of food for terrestrial fauna, such as wader birds.

8.2.3 Little Penguin Critical Habitat and Wildlife Protection Area Declaration

In December 2002, the Minister for the Environment declared Critical Habitat for Manly's endangered population of little penguins. The Declaration and Regulations came into effect on 1 January 2003 with a map of declared critical habitat and the extent of properties within planning controls as a result of this declaration identified in **Figure 8.2.3a**.

Three areas were identified to which specific regulations apply. The area around the foreshore of Dobroyd Head-Grotto Point Reserve was identified in the declaration as 'Potential Critical Habitat'. The regulations do not currently apply to this area however it has been earmarked as potential nesting and foraging grounds for the population.

The declaration of Critical Habitat provides greater protection and stricter controls over particular activities within the defined area. While the main habitat for Manly's little penguin population is around Manly Point and along the foreshore of Sydney Harbour National Park – North Head, individual penguins are regularly seen foraging in the waters off Manly Cove as well as occupying a number of nest sites along the rocky foreshore.

There are two areas of critical habitat (refer to **Figure 8.2.3a**). Area A starts from west of Collins Beach and extends to the northern side of Cannae Point and includes Collins, Store and Quarantine Beaches to the northern side of Cannae Point. On the land, the critical habitat boundary includes ridgetop habitat where penguins currently nest and areas of potential nesting habitat. Area B extends from 11A Oyama Avenue around Manly Point to 26 Addison Road. The land side of the critical habitat boundary includes the area from the mean high watermark, up the rocky foreshore slope to the beginning of the ridgetop in residential areas (ie the rocky foreshore upslope to the boundary of the formed backyard is included as critical habitat, but the backyard and residential area is not included):

Under the *National Parks and Wildlife Act 1974* Section 118C – a person must not, by an act or an omission, do anything that causes damage to critical habitat. For the little penguins this means the following restrictions are in place:

- no companion animals (except assistance animals)
- no fishing between sunset and sunrise during breeding season (start July to end Feb)
- no tampering with or damaging little penguin nest boxes or burrows, or approaching within 5 metres of a penguin on land.
- no anchoring or mooring a vessel in the little penguin critical habitat Area A between sunset and sunrise during the breeding season.
- no vessel (other than a non-motorised tender) to enter or remain in the little penguin critical habitat Area A between sunset and sunrise during the breeding season.

In regard to statutory environmental assessment, Council, as a consent authority must give consideration to both the status of the little penguin colony as an endangered population in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act 1979), and the recent declaration of critical habitat in accordance with the *Threatened Species Conservation Act 1995* (TSC Act, 1995) in determining development applications or activities.

Due to the high vulnerability of little penguins to dog attack and human disturbance and following numerous incidents and concerns from residents a Wildlife Protection Area was declared in May 2006 in the area of

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foreshore between Federation Point and Manly Wharf (See **Figure 8.2.3b**). A number of penguins are known to nest at this location with evidence to suggest individuals also nest underneath Manly Wharf.



Figure 8.2.3a – Area declared as Critical Habitat for Manly Little Penguin population



Figure 8.2.3b – Aerial view of Manly Cove West Wildlife Protection Area.

Restrictions now apply and dogs must be on a leash at all times within this location. The area of foreshore in the vicinity of Federation Point has also been declared a dog exclusion zone. Appropriate signage has been developed and erected at various locations throughout the area. Despite attempted controls by Council, conflicts between humans, companion animals and penguins were commonly experienced in the location of Manly Wharf and Federation Point over the recent breeding season

8.3 TERRESTRIAL ECOLOGY

8.3.1 Habitat & Flora – Urban Bushland

Manly has a rich diversity of natural landscapes protected in around 55 hectares of bushland reserves, ranging in size from Wellings Reserve (7 hectares) to smaller parcels about the size of an average house block. Manly's bushland contains a variety of vegetation types, supporting a wide diversity of native plants, mammals, birds and reptiles. Manly's bushland is a valuable resource, providing residents and visitors with:

- areas for recreational use
- a better urban environment in which to live
- habitat for native birds and animals
- preservation of native flora
- an educational resource

Nearly 90% of Manly's natural environment has been degraded to some extent due to human activities (Manly Council 1997). The impacts of urban development can tip the balance - native vegetation is gradually replaced

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by weeds, resulting in a loss of biodiversity. Some of the impacts and causes of degradation in urban bushland are:

- increased levels of high nutrient stormwater runoff entering bushland, creating ideal conditions for weed growth
- dumped garden refuse and rubbish.
- altered fire regimes - some native plants rely on fire for regeneration
- urban encroachment on reserves
- the impact of domestic pets on flora and fauna
- poisoning trees for views

The fragmentation of natural bushland areas in Manly has reduced the viability of habitat in many bushland reserves to support populations of native fauna.

Skelton *et al.* (2004) identified that there is little remnant bushland within the study area. Most of the vegetation has been planted in landscaped areas along the Esplanades and Federation Point. The majority of the open space is landscaped, grassed, beach or rocky foreshore (including offshore seagrass beds). Resilience and habitat value of the planted natural vegetation is generally of low resilience and habitat value, especially in the garden beds and lawn. There is a reasonable patch of vegetation at Manly Point that has moderate habitat value.

However, a reasonable patch of remnant vegetation can be found on Manly Point which forms part of the important Critical Habitat area for Manly's little penguin population with numerous burrows located at this location. Nesting sites have also been identified in the area of foreshore between Federation Point and Oceanworld which was declared a Wildlife Protection Area during 2006.

Along the eastern boundary of the study area between Ashburner and Wood Streets there are a number of mature Morton Bay Figs (*Ficus macrophylla*) with an understorey dominated by grass and planted exotic species. To the east of the study area along to Federation Point the area consists of Norfolk Island Pines with grassy understorey. A number of native shrub species have also been identified at this location including coastal banksia (*Banksia integrifolia*), coastal rosemary (*Westringia fruticosa*), ball honeymyrtle (*Melaleuca nodosa*) and coastal tea-tree (*Leptospermum laevigatum*). Along East Esplanade and West Esplanade are well established norfolk pine trees and a grassy understorey. Tree poisoning and removal of seedlings by residents to maintain views is an issue within the study area and many other areas in Manly. However, no tree poisoning was noted in this survey.

Skelton et al (2004) indicates that there are four specific vegetation communities present within and/or adjacent to the study area reserves, which can be grouped into two broad types of vegetation communities. The communities described are largely based on a classification system developed by Benson and Howell (1994), but were modified slightly by Skelton *et al* (2004) to suit local conditions in Manly. The vegetation communities contain an array of different species. This range of communities offers a range of habitat, which provides suitable conditions for many different species of fauna. They are detailed in **Table 8.3.1**.

Table 8.3.1 - Vegetation Communities within the Manly Cove Study Area

Subcategory Description	Broad Vegetation Community
Low Open-forest of Casuarina glauca and Baumea juncea	Estuarine Complex
Coastal Banksia - Eucalypt Woodland	Sydney Sandstone Gully Forest
Creek line Rainforest	Sydney Sandstone Gully Forest
Woodland/Low woodland: Corymbia gummifera - Eucalyptus haemastoma	Sydney Sandstone Ridgetop Woodland

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A combined native and exotic flora species list for all of the reserves and communities in the study area is presented in **Table 8.3.2**.

Weeds are exotic/non-indigenous species that can colonise and spread in disturbed areas, affecting native vegetation communities, reducing biodiversity and habitat value for fauna and reducing aesthetic values. These plants may pose serious threats to the integrity of remnant native vegetation communities, native landscapes by competing with native plants for nutrients, light, space and water. Some weed species can cause allergies, induce asthma attacks and hayfever when in large densities in urban areas.

Table 8.3.2 : Flora species per habitat type located within the Manly Cove study area

Genus and Species	Family	Habit	Common Name	Status
<i>Araucaria heterophylla</i>	ARAUCAREACEAE	Tree	Norfolk Island Pine Weed	Weed
<i>Ficus rubiginosa</i>	MORACEAE	Tree	Port Jackson Fig	Native
<i>Coprosma repens</i>	RUBIACEAE	Shrub	Looking-glass Bush	Weed
<i>Hibiscus sp.</i>	MALVACEAE	Shrub	Hibiscus	Planted
<i>Hedera helix</i>	ARALIACEAE	Vine	English Ivy	Planted
<i>Clivia miniata</i>	AMARYLLIDACEAE	Herb	Kaffir Lily	Planted
<i>Acalypha wilkesiana</i>	EUPHORBIACEAE	Herb	Beefsteak Plant	Planted
<i>Taraxacum officinale</i>	ASTERACEAE	Herb	Dandelion	Weed
<i>Nerium oleander</i>	APOCYNACEAE	Shrub	Oleander	Planted
<i>Pennisetum clandestinum</i>	POACEAE	Grass	Grass Kikuyu	Planted
<i>Solanum nigrum</i>	SOLANACEAE	Herb	Blackberry Nightshade	Weed
<i>Leptospermum polygalifolium subsp.</i>	MYRTACEAE	Shrub	Lemon Scented Tea Tree	Native
<i>Lophostemon confertus</i>	MYRTACEAE	Tree	Brush Box	Planted
<i>Pittosporum undulatum</i>	PITTOSPORACEAE	Tree	Sweet Pittosporum	Native
<i>Hibbertia scandens</i>	DILLENIACEAE	Vine	Golden Guinea Flower	Native
<i>Tetragonia tetragonoides</i>	AIZOACEAE	Herb	Warrigal Greens Native Spinach	Native
<i>Crinum pedunculatum</i>	AMARYLLIDACEAE	Herb	Swamp Lilly	Native
<i>Cynodon dactylon</i>	POACEAE	Grass	Common Couch	Native

In New South Wales, there are classifications of species of weeds that are designated as particularly harmful to the environment. Legally these weeds must be removed or controlled in accordance with the *NSW Noxious Weeds Act 1993* and Council is required enforce this Act in keeping with the legislation.

Weeds can also provide habitat for native fauna. Inappropriate removal of weeds can dramatically reduce habitat for birds, mammals, insects and reptiles. When weed removal will reduce habitat for native fauna, especially threatened species, it is important to incorporate staged removal of weeds with revegetation of the area.

There are herbaceous weeds along the retaining wall, adjacent to East Esplanade, opposite Woods and Stuart Streets. On the embankment between East Esplanade and the Manly Rowing & Sailing Club there are several Oleanders which are poisonous and should be removed from this public area.

Several of the Morton Bay Fig trees along the retaining wall on East Esplanade are approaching an age where replacement Fig trees should be considered. The understorey along this embankment and directly beneath the retaining wall could be enhanced with the introduction of native trees and shrubs to enhance its attractiveness to nectivorous and fruit eating birds and visual amenity to recreational users.

Further information on the vegetation communities and the flora species specific to each reserve within the study area can be found in section 8.3.2.

8.3.2 Parks & Reserves

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Esplanade Park (4.71ha): This is a narrow foreshore stripe of public land. The park contains grassy lawn areas with isolated native trees and remnant patches of bushland. Exotic plants and small gardens have been planted in some parts of the reserve. The reserve has high recreational and scenic values. Manly Scenic Walkway runs the entire length of the park. There are facilities and man-made structures, including garbage bins, park benches, signage, a swimming pool, public toilets, a bin for dog faeces, footpath and streetlights. The reserve is a popular dog off-leash area. A total of 19 bird species, 4 mammal and 2 native species of reptile recorded in this reserve. The vulnerable Grey-headed Flying-foxes were recorded in this reserve. The dominant canopy species are Norfolk Island pines and *Banksia integrifolia*. Extremely high visitor use, sewer leaks, weed infestation, encroachment of exotic plant species and eutrophication from dog faeces are threats to this bushland.



Figure 8.3.2 Parks and reserves within the study area

Oyama Street Reserve (0.17ha): The public access reserve adjacent to the Oyama Avenue – Bruce Avenue junction was investigated. The Oyama Avenue reserve is degraded with embankment erosion and weeds with encroachment of grass, garden plants and a statue from the property on the south-west boundary. Evidence of

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water and sewage flow across the adjacent property and onto the public reserve was noted. No evidence of penguins or other native fauna was found.

8.3.3 Fauna

Fragmentation, clearance and degradation of native vegetation in the Manly Cove study area have reduced habitat value for native fauna. Small pockets of remnant bushland do exist between Oceanworld and Federation Point and on Manly Point, providing important habitat for the endangered colony of little penguins (*Eudyptula minor*). Grassed areas within the study area are also known to provide nesting and foraging habitat for the endangered North Head population of long-nosed bandicoots (*Perameles nasuta*).

While fauna surveys of natural bushland did not extend to these pockets a total of 22 bird species (2 introduced), 9 mammals (5 introduced) and 4 species of native reptiles were recorded in adjacent bushland reserves. Full fauna species lists are provided in Table 8.3.3 (GIS 2003a).

The retaining wall on East Esplanade is an excellent habitat for reptiles, particularly skinks. Refer to Appendix B for a list of fauna located within the study area. One threatened fauna population (Little Penguin) was recorded in the study area and is addressed in the following section of this report. Dogs frequent Manly Cove and there is a designated "off leash" area backwards from the beach retaining wall. Within these areas owners must be in control of their animals at all times and must pick up faeces if their animal defecates. Dogs can have negative impacts on native fauna and the environment. Domestic dogs sometimes chase and kill native animals when unleashed and dog faeces are sources of nutrients. As dog faeces degrade, nutrients are washed into the soils of the native bushland

Table 8.3.3 : Fauna species per habitat type located within the Manly Cove study area

Type	Common Name	Genus/species	Status
Bird	Australian Magpie	<i>Gymnorhina tibicen</i>	Native
Bird	Crimson Rosella	<i>Platycercus elegans</i>	Native
Bird	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Native
Bird	Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	Native
Bird	Little Penguin	<i>Eudyptula minor</i>	Endangered pop.
Bird	Masked Lapwing	<i>Vanellus miles</i>	Native
Bird	Noisy Miner	<i>Manorina melanocephala</i>	Native
Bird	Pied Cormorant	<i>Phalacrocorax varius</i>	Native
Bird	Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	Native
Bird	Rock Dove	<i>Columba livia</i>	Introduced
Bird	Silver Gull	<i>Larus novaehollandiae</i>	Native
Bird	Spotted Turtle-Dove	<i>Streptopelia chinensis</i>	Introduced
Bird	Welcome Swallow	<i>Hirundo neoxena</i>	Native
Mammal	Black Rat	<i>Rattus rattus</i>	Introduced
Mammal	Brown Rat	<i>Rattus norvegicus</i>	Introduced
Mammal	Cat	<i>Felis catus</i>	Introduced
Mammal	Common Brushtail Possum	<i>Trichosurus vulpecula</i>	Native
Mammal	Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Native
Mammal	Dog	<i>Canis familiaris</i>	Introduced
Mammal	Long-nosed Bandicoot	<i>Perameles nasuta</i>	Endangered pop.
Mammal	Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>	Threatened Sp.
Mammal	Rabbit	<i>Oryctolagus cuniculus</i>	Introduced
Reptile	Copper-tailed Skink	<i>Ctenotus taeniolatus</i>	Native
Reptile	Eastern Water Dragon	<i>Physignathus lesueurii</i>	Native
Reptile	Eastern Water-skink	<i>Eulamprus quoyii</i>	Native

See Table C6 in Appendix C for the full species list of fauna recorded within the study area.

Threatened and Endangered Fauna

Little penguins - *Eudyptula minor*

The colony at Manly is reported to have been active since the early 1850's. While the Manly population of little penguins represents only a small percentage of the State's total population it is of state significance as it represents the only breeding colony on the NSW mainland (NPWS, 2000).

Ideal penguin nesting habitat has been created along Manly's foreshore from rock falls due to erosion and weathering. Little penguins have been observed nesting under seaside homes, garages, under stairs, in woodpiles and beneath overhanging vegetation. Further information on habitat and ecology of the population is provided below (DECC, 2007):

- A range of nest sites are utilised by the penguins at Manly including under rocks on the foreshore, under seaside houses and structures, such as stairs, in wood piles and under overhanging vegetation including lantana and under coral tree roots.
- Male penguins start returning to the colony in May/June to find or reconstruct a suitable burrow for nesting and to attract females. At this time they may spend all day in their burrows.
- Time of egg-laying varies slightly from year to year but has been recorded at Manly as early as the first week of June. The peak breeding season however is generally from July to December.
- Little penguins usually lay a clutch of 2 white eggs of about 55 g in weight. Although both eggs hatch, usually only one chick fledges successfully. At Manly, however, it is common for both chicks to successfully fledge.
- It is also common for the Manly penguins to double brood, that is, to produce a second clutch of eggs later in the season after the chicks from the first clutch have fledged.
- The incubation period varies between 33 and 37 days with the male and female sharing incubation duties and shifts usually lasting 1 to 2 days.
- For 2 to 3 weeks after the chicks have hatched, adults alternate between remaining in the nest and foraging at sea. The adults swap these guarding and feeding roles each evening.
- After the chicks have developed enough to maintain their body temperature, they are left unguarded during the day while both adults forage at sea. As the chicks grow, parents visit the nest less often, except for regular evening feedings.
- Chicks leave the nest after 7 to 9 weeks to mature at sea. Once the young have fledged (left the nest), adults increase their fat stores in preparation for the moult (when they replace their plumage).
- Penguins spend about 2 to 3 weeks ashore when moulting during which time they cannot forage until their new plumage is waterproof. This requires extreme physiological effort and increases energy loss and by the end of the process, they are emaciated.
- The Manly penguins moult between December and February and it is at this time when they are most vulnerable as they do not always moult deep in the burrows, but often only in shallow depressions.
- They appear to be opportunistic feeders foraging in relatively shallow waters preying on small schooling fish and squid.
- Penguins forage closer to their colony and trips are short in duration during the breeding season but may range for days over hundreds of kilometres outside this period.
- The foraging range and breeding success is very much dependant on the availability and abundance of food.

MANLY COVE COASTLINE MANAGEMENT STUDY

The colony of little penguins at Manly was listed as endangered in Part 2 of Schedule 1 of the New South Wales *Threatened Species Conservation Act* 1995 (TSC Act, 1995) on 31 January, 1997.

A Recovery Plan for the little penguin population has been prepared in accordance with the *NSW Threatened Species Conservation Act* 1995. The Recovery Plan for the Population of Little Penguins at Manly was approved in October 2000.

The little penguin population at Manly is considered endangered due to an extremely small number of individuals, its disjunction from other populations, its occurrence in Sydney Harbour and because its former range on the mainland has been reduced. The decline in little penguin numbers is mainly due to loss of suitable nesting habitat, predation by dogs, cats and foxes and human disturbance (NPWS, 2000).

Human activities both on land and in the water have the potential to impact on little penguins' nesting and feeding activities. Threats to little penguins include;

- pollution may adversely impact the colony. Stormwater runoff and rubbish dumping can destroy nesting habitat and expose penguins to pollutants. Oil spill incidents are another threat to the colony.
- pollution from stormwater, sewerage overflows, watercourses and atmospheric fallout affect water quality and substrate composition and may affect penguin health.
- industrial and urban inputs into the harbour can also contaminate the penguins' food source.
- the major threat to the Manly population is the loss of suitable habitat. Past development has greatly reduced available habitat in the area. Habitat still has the potential to be lost as residents renovate or develop their properties around the foreshore.
- predators such as dogs and foxes pose a threat particularly if penguins are in shallow burrows and as they move between the water and their nests. Many people walk their dogs around the foreshore, often without a leash. Dogs have also come ashore and accessed the penguin colony via boats.
- the area the colony occurs is heavily utilised by humans. Disturbance around nesting areas from movement, noise and light from nearby buildings, waterway and fishing activities is another threat.
- penguins will delay their arrival to the nest to feed their chicks if they perceive any disturbance. This means that there is less food for the young as the longer the adults are delayed, the more food will be digested by them.
- as awareness of the population grows, there is increased interest from some people to access the penguins. There have been incidences of nests being deliberately tampered with or completely destroyed.
- weed removal around the foreshore is another major threat to the colony. The penguins rely on vegetation for cover and many nests and penguin access and egress routes are hidden by and amongst weeds, particularly lantana.
- as well as providing cover from predators and humans, vegetation, both native and non-native, helps to protect the penguin's habitat by stabilising topsoil, slowing and scattering surface runoff and providing shade which reduces heat.

Careful management is essential for the penguins to survive and to co-exist with recreational and commercial user groups and property owners. Recommended management options as outlined in the Little Penguin Recovery Plan include:

- monitor the population and identify potential habitat in the area;
- threat management;
- establish a mortality register
- educate and provide advice to the community – to provide advice to residents on how to manage vegetation including lantana on their properties without threatening penguin habitat
- erect appropriate signage – Penguin Critical Habitat and Wildlife Protection Area signs

MANLY COVE COASTLINE MANAGEMENT STUDY

- educate the community regarding responsible pet ownership and continue to enforce the *Companion Animals Act*
- undertake pest management in Sydney Harbour National Park
- include the colony in planning for marine pollution management
- enforce North Sydney Harbour waterway regulations
- monitor fish stocks in Sydney Harbour and surrounds
- manage nesting habitat through appropriate bush regeneration and community education;
- continue the community outreach program;
- protect habitat of the little penguin population at Manly through the environment planning and assessment process;
- co-ordinate and support research into the ecology of the population ;
- convene a recovery team meeting to re-evaluate recovery plan priorities based upon information generated in the monitoring program described in Action 1

Priority actions which provide specific, practical activities that must be done to recover a threatened species, population or ecological community. The Department of Environment and Climate Change has identified 9 priority actions to help recover the little penguin population in the Manly point area in New South Wales.

To ensure holistic management of the endangered population of little penguins, and to comply with requirements of the TSC Act 1995, the performance criteria (target) and recovery actions outlined in the 'Endangered Population of Little Penguins (*Eudyptula minor*) at Manly Recovery Plan' have been incorporated into this CMP. As DECC and Manly Council are the primary managers of little penguin habitat, a co-operative management approach must be adopted by both authorities to manage the population in accordance with the adopted Recovery Plan.

Long-nosed Bandicoot *Perameles nasuta*

One fascinating species, which until the early 1960s was widespread and common around the harbour, is the long-nosed bandicoot. There is now a single isolated population still present on North Head which extends to the eastern portion of the Manly Cove study area. Although long-nosed bandicoots are regarded as common in the eastern parts of their range, this small colony in a city with almost four million people is remarkable, and has been classed as an 'endangered population'.

The population of long-nosed bandicoots (*Perameles nasuta*) at North Head is listed as endangered on Schedule 1 of the *Threatened Species Conservation Act 1995* (TSC Act). This species nests and forages within the study area, where there is some suitable nesting (thickets of low dense vegetation) and foraging habitat (grassland, including lawns).

Revegetation of parts of Little Manly Cove Reserve and Beach to create nesting habitat for the Long Nosed Bandicoots is proposed. Increasing the amount of nesting and foraging habitat for this species will allow for a potential increase in the size of the population.

Predation by cats is a serious threat to this population. Additionally, cats are carriers of the *Toxoplasma* parasite. This parasite is lethal to small mammals, including the Long Nosed Bandicoot, that come in contact with carriers including a scratch or a single bite. Other threats to this population include habitat loss, modification, degradation and fragmentation. Weeds, competition from rabbits and inappropriate fire regimes all can influence habitat quality.

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Inbreeding and genetic drift are also threatening processes for this isolated population. Research is currently underway which will define the critical habitat for the population and a draft recovery plan is being prepared by NSW NPWS.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

Grey-headed flying foxes can be seen around in a number of locations around Sydney, in groups called camps. Flying fox camps can be made up of many thousands of bats hanging from the branches of trees. The camps are often located in gullies of eucalypt forests or in mangrove forests. Grey-headed flying foxes also roost in trees of urban parks.

The Grey-headed flying fox (*Pteropus poliocephalus*) was recorded in West Esplanade Reserve during the surveys for the *Flora and Fauna of Manly Council's Bushland Reserves*, 2003. The Grey-headed flying-fox is listed as a vulnerable species on Schedule 2 of the Threatened Species Conservation Act 1995 and is listed as vulnerable under the Commonwealth *Environmental Protection & Biodiversity Conservation Act 1999*.

Grey-headed flying foxes eat nectar and pollen from the blossoms of native trees, in particular gum trees, native fruits, especially of rainforest trees, and orchard fruits when their preferred foods are not available. They may travel up to 50 km each night from their camp to feed.

Flying-foxes can be seen in many parts of Sydney leaving their roosts just after sunset. October to March is the best time to see large groups. During the rest of the year, numbers drop as individuals move around or disperse to other colonies. Females can be seen carrying infants in October and November, while juveniles can be seen learning to fly in January (Australian Museum, 2007).

8.4 ECOLOGICAL IMPACTS

8.4.1 Marine

As noted in section 8.1 the marine environment within the study area has a diverse range of habitats, many of which are in relatively reasonable condition. However, there are still many human activities that adversely impact on its health.

Recreational Fishing

Manly Cove is a popular ground for recreational fishers due to the easy access throughout the study area and the safe fishing platform provided. The rocky foreshores and Manly Wharf facility are often occupied by recreational fishers, particularly very early morning or after dark when the study area has minimal usage by other user groups. A Recreational Fishers Licence must be carried by law when line fishing, spear fishing, hand lining, hand gathering, trapping and bait collection and prawn netting in NSW.

Although no data exists that identifies the number of recreational fishers in Manly Cove, community concerns were raised in relation to the improper use of the area by recreational fishers. Issues concerning the impact of recreational fishing on intertidal marine life through the collection of shellfish and vegetation for bait and collecting of shellfish for culinary purposes were also identified through consultation. As a result the community has requested that all rules and regulations that apply to recreational fishers be rigorously enforced.

In late 2005 tests were conducted by NSW Department of Primary Industries and NSW Health to investigate contamination of fin-fish within Sydney Harbour. Results revealed elevated levels of dioxins in fish and crustaceans across the Harbour, including from test sites adjacent to the Manly Cove study area. As a result a fishing closure was placed on commercial fishing as a precautionary measure from February 2006 and remains in effect until 9 Feb 2011, unless sooner amended or revoked.

Recreational fishing in the Harbour has not been banned, but fishers are urged to follow dietary advice on the consumption of seafood from the Harbour and to be aware of existing fishing restrictions. For fish caught east of the Sydney Harbour Bridge, you should generally not eat more than 150 grams per month. Higher amounts of some fish and crustacean species may be eaten.

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The wide media attention given to this issue may have reduced the numbers of recreational fishers utilizing the study area, however, licensed recreational line fishing is permitted throughout the Manly Cove study area in line with legal bag and size limits for saltwater species identified under the Department of Primary Industries administered *Fisheries Management Act 1994*. Detailed information on bag and size limits along with fishing licence requirements and regulations are provided through various educational mediums including pamphlets, signage and via the internet.

Whether estuarine fish stocks across NSW have declined in recent decades is ultimately unknown. The commonly held view amongst recreational fishers is that individual angler catches have decreased (Department of Primary Industries, 2002). However, anecdotal evidence suggests that since the ban of commercial fishing in 2006 species abundance and diversity has increased with many species identified through recreational fishing activity.

Increased education and patrol of fishing activities within the study area may be required to raise awareness of the impacts of prohibited activities, prevent damage caused to the intertidal marine life, alleviate concerns over perceived reductions in fish stock and encourage compliance with fishing regulations.

Commercial Fishing

As described in Section 5.15, test results on fin-fish taken within Sydney Harbour during late 2005 revealed elevated levels of dioxins in fish and crustaceans across the Harbour. Further tests undertaken by NSW DPI confirmed the extent of the contamination issue and subsequently a ban has been placed on commercial fishing activity with Sydney Harbour as a precautionary measure. This fishing closure took effect on 10 February 2006 and remains in effect until 9 Feb 2011, unless sooner amended or revoked.

Marine Pollution

Boat users have the potential to pollute the marine environment through improper disposal of waste generated whilst on the water. Further, land based disposal of waste by boat users' increases the pressure on Council's waste facilities and collection processes, particularly during weekends and peak holiday periods.

Under the *Protection of the Environment Operations Act 1997 (POEO Act)*, it is an offence to pollute any waters unless permitted under a licence issued by the Environment Protection Authority. NSW Maritime Authority officers can issue on-the-spot infringement notices of \$750 to an individual or \$1500 to a corporation where cases of pollution from vessels are detected.

The POEO Act is complimented by the *Marine Pollution Amendment (Waste Discharge and Oil Spill Response Plans) Regulation 2003*, which came into effect on 1 July 2003. This new Regulation is designed to improve the management of sewage pollution from vessels and simplify the capacity requirements for sewage holding tanks.

Specific provisions of the new Regulation include:

- the prevention of the discharge of untreated sewage from vessels into navigable waters, except into a waste collection facility such as a pump-out or on-shore toilet;
- the prevention of the discharge of treated sewage from vessels into certain environmentally sensitive waters (so-called 'no discharge zones');
- requirements for Class 1 (passenger carrying) and Class 4 (hire and drive) vessels to be fitted with toilets and toilet waste holding tanks or to have an approved plan of management for the disposal of waste;
- requirements for certain commercial vessels (essentially those built after January 1 2005 and used on Sydney Harbour, or those belonging to either the passenger carrying or hire and drive classes and built after that date) to be fitted with grey water tanks; and
- requirements for marinas operating on a commercial basis in the Sydney Harbour locality (regardless of size) to provide adequate and accessible vessel waste collection facilities.

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The above measures will help protect human health and sensitive marine life, taking into account the risks related to certain waterways, activities and vessel types. A key aspect of this risk-based approach is the designation of certain areas as 'no discharge zones'; for treated sewage. These include all inland waterways, intermittently opening lagoons, Aquatic Reserves and Marine Parks, and all waters within 500 metres of aquaculture, bathing, mooring and anchoring areas, persons in the water, beaches and marinas. No pump-out facilities current exist within the study area, however vessels can access d'Albora Marinas at the Spit and/or through limited access at either of the two commercial marinas within North Harbour for this purpose.

There are no specific requirements for recreational vessels. However, all vessel operators must ensure that they do not pollute. NSW Maritime recommends the installation of holding tanks, but owners of smaller vessels can use a portable toilet instead. Community consultation identified the need to increase controls on pollution from recreational boating.

Water borne gross pollutants are regularly washed onto the beaches and netted swimming enclosure of Manly Cove. While the exact origin of these pollutants is unknown much of it is identified as having been blown by wind from areas outside the Manly LGA and, therefore it is difficult for Manly Council to control or minimise. A large proportion of marine pollution can be attributed to terrestrial waste being transported via the stormwater system into the harbour. Prevailing wind and wave conditions then move this waste from the southern tributaries of Sydney Harbour toward the Manly Council managed beaches (See **Figures 8.4.1a and 8.4.1b**).



Figure 8.4.1a – Marine litter accumulating on Manly Cove West Beach

As is the case for many urban beaches, Council contributes significant resources annually to beach raking and through manual cleaning of gross pollutants which entangle themselves on the netted swimming enclosure.

Council maintains the aesthetics, amenity, utility and safety health and aesthetic reasons by raking the upper layer of beach sand on a daily basis. The BeachTech 2000 rake/sieve (**Figure 8.4.1b**) rakes the upper 200mm surface layer of sand, although sifting depends on the conditions and time available. Raking collects litter and debris (e.g. wrack, bottles, cans, and cigarette butts) while sieving gives a 'combed' finish to the sand.

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The beaches of Manly Cove are cleaned every day with results being influenced by weather and tidal conditions. Each day the beach rake collects between 1-3 m³ of rubbish from Manly Cove West beach and approx 1 - 2 cubic meters of rubbish from east/west esplanade.

As this work must be undertaken during times of least public use (i.e. early morning) there are occasions when litter and wrack may be deposited on beaches after the daily clean takes place. When such reports are received, and where resources permit, manual collection may be undertaken. There are few options to alter the current cleaning regimes.

NSW Maritime has a statutory responsibility concerning hazards on navigable waters and powers to ensure removal of rubbish from the waters of Sydney Harbour. About 3600 cubic metres of rubbish is collected per annum, ranging from large objects such as trees and tyres to the debris washed into the Harbour from suburbs after heavy rain to small items left behind on beaches and other foreshore locations.



Figure 8.4.1b - BeachTech 2000 rake/sieve used to clean litter and debris off Manly Cove beaches

NSW Maritime has a fleet of vessels and equipment designed to combat the rubbish pollution problem for the entire Sydney Harbour area including foreshores and tributaries. The latest vessels also include power generated ramps which allow direct access to beaches and enable transport of beach cleaning equipment to and from appropriate locations. The larger vessel intercepts and mechanically collects rubbish floating in the harbour before it reaches the foreshore.

NSW Maritime Environmental Services also monitor the use of pump out stations available in Sydney Harbour to recreational and commercial vessel operators. Pump out facilities are available at Treharnes Boatshed to the north of the Manly Cove study area and numerous locations within Middle Harbour.

Boating is also an extremely popular recreational activity within the study area, but unfortunately it can have detrimental impacts on the marine environment. Anchors, moorings, propellers and hulls can all damage the seafloor and associated seagrass. Also, boating can contribute to water pollution which also degrades the marine environment.

Boat users can potentially impact on many other areas and users of an estuary besides just creating waves. For example, boat generated waves over time can weaken sea walls leading to their collapse; they cause foreshore erosion and can impact on habitat. Boating can impact on water quality via spills, anti-foul paints, littering from boats and from marinas where boats are washed and fixed etc.

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Moorings are fixed in place with a heavy anchor weight with a chain, rope and buoy attached. The chain drags along the bottom with the current in a circular motion around the anchor, and has the effect of scouring the sea floor. If the mooring is located in a seagrass bed, the scouring will damage or destroy the seagrass within the limit of the chain. There are currently 96 permanent moorings within the study area and its vicinity. Seagrass friendly moorings are currently being trialled by NSW Maritime, although none are located within the study area.

Maintenance of Netted Swimming Enclosure

Following the 2004 designation of syngnathiformes (seahorses, sea-dragons and pipefish) as "protected" under the *NSW Fisheries Management Act 1994* the cleaning methods employed for cleaning of marine growth from the netted swimming enclosure pre-2004 no longer satisfy the requirements of NSW Department of Primary Industries.

During late 2006 Council's Natural Resources and Urban Services Branches have been investigating methods used by other local authorities in the maintenance of netted swimming enclosures with focus upon the sensitive nature of the identified threatened species. Various methodologies have been presented to Council by potential contractors and discussed in detail with NSW Department of Primary Industries (NSW Fisheries) as administrators of the *Fisheries Management (FM) Act 1994* and the *Fisheries Management Amendment Acts 1997 and 2001*. As a result Council have rejected a number of proposals which did not meet the requirements of NSW Department of Primary Industries.

One proposed methodology involves diver hand cleaning of marine growth from the nets in a staged approach. This progressive cleaning technique will enable Council to reduce the overall stress to the structure and, most importantly ensure minimal impact upon the seahorse population.

NSW Department of Primary Industries have indicated that they intend to undertake an extensive monitoring program of the Manly seahorse population in order to ascertain the impact of the proposed cleaning method and ability of the species to recolonise following cleaning. This exercise will assist other Councils in NSW in undertaking similar cleaning activities.

Maritime Operations

There are a number of safety and environmental issues associated with maritime operations within Sydney Harbour with responsibility balanced between various government agencies. Issues such as incident (including spills) management, water traffic safety and ballast water and marine pest management are controlled by Sydney Ports Corporation, NSW Maritime, NSW Department of Primary Industries and the Commonwealth Department of Agriculture, Fisheries and Forestry Australia (DAFF), through the Australian Quarantine and Inspection Service.

Incident Management – Spills and other incidents

The potential for oil and other hazardous substances to spill to Sydney Harbour is greater than for most other waterways in New South Wales. This is because of the considerable traffic of commercial, military and recreational vessels, the vehicular traffic adjacent to the water, and the existence of refinery and other industrial operations (West et al, 2004).

One key to protecting the natural, commercial and recreational resources of Sydney Harbour is the formal recognition of ecological, socio-economic and cultural resources. Another is the rapid response to oil spill incidents.

Emergency and incident response are of paramount importance in the operation of any port. Emergency situations of many types may arise, including spillage of dangerous or hazardous substances, fires and other accidents. Sydney Ports Corporation is charged with the fulfilment of stringent conditions linking the safety of shipping with the preservation of the marine environment through the execution of its Port Safety Operating Licence.



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In addition to maintenance of safe navigation in the ports for commercial shipping and administration of the Dangerous Goods Regulations for Port Areas, the Licence also gives Sydney Ports responsibility for emergency response to marine-based incidents, and for the clean-up of any environmental spills.

Of particular significance to this Coastline Management Plan, is the Corporation's responsibility for addressing all 'on water' oil, chemical or other spill incidents within its jurisdiction, including Sydney Harbour. This includes not only emergency response and clean-up but also investigations into the causes of on-water spills. In response to oil spills, Sydney Ports has responsibility for the Harbour, Botany Bay and for 90km of the NSW coastline, for three miles out to sea.

Sydney Ports has the largest inventory of oil spill equipment of any Australian port. To ensure emergency response efforts are maintained at the highest level, Sydney Ports conducts regular emergency response training exercises.

Sydney Ports maintains a 24 hour response capability for any incident within its jurisdiction. Residents, port users and the general community can contact Sydney Ports at any time to report an environmental incident, from harbour pollution to noise. Approximately 98% of marine pollution reports that are reported to Sydney Ports are sourced from land or recreational vessels.

A Coastal Resource Atlas for Oil Spills in Port Jackson was developed by the NSW Environment Protection Authority (EPA) and the Australian Maritime Safety Authority in 1994 at the request of the NSW State Committee of Advice to the National Plan to Combat Pollution of the Sea by Oil. The Atlas was developed as an advisory document and was designed to complement existing plans/manuals for dealing with oil spills in general.

The document details and maps environmentally sensitive areas of the Harbour and includes recommendations to minimise the impact of a spill. The coastal resources are divided into four categories of sensitivity including extreme, high, moderate and low. In the case of an oil spill, the first priority is to protect the extreme and high sensitivity areas. The portion of Manly between 11 Oyama Ave Cove south to Manly Point is identified as being of extreme sensitivity due to the presence of Critical Habitat for the Little Penguin population.

The existence of seagrass beds along the eastern foreshore of Manly Cove also resulted in this area being considered as having a high sensitivity to oil spill events. The presence of the various boating facilities in this area has the potential to magnify this sensitivity through improper practice in boat and marina maintenance and operation.

In order to sustain fresh marine waters for exhibits and larger tanks, Oceanworld operate a water intake in water 3 metres deep and 1 metre above the seafloor, approximately 60 metres seaward of the building. The intake was also considered within the report as being susceptible to dispersed oil. The pumps can safely shut down for a period of 24 hours.

While Council is not responsible for, or capable of, responding to on-water incidents, it is important that Council rangers are aware of who is responsible in the case that Council received notification of an incident.

Transport of Hazardous Goods

The handling of dangerous goods in the Ports of NSW is controlled by the *Dangerous Goods (General) Regulation, 1999* under the *Dangerous Goods Act, 1975*.

Sydney Ports Corporation, in determining the conditions under which dangerous goods are handled and/or kept in operational areas within the Ports, draws on the information and advice from the International Maritime Dangerous Goods (IMDG) Code, AS 3846 – "The handling and transport of dangerous cargoes in port areas" and the IMO "Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas".

Ballast Water and Marine Pest Management

The responsibility for establishing or regulating processes for ballast water management lies with the Commonwealth Department of Agriculture, Fisheries and Forestry Australia (AFFA), through the Australian

MANLY COVE COASTLINE MANAGEMENT STUDY

Quarantine and Inspection Service (AQIS), which is the lead agency in Australia for the management of ballast water of international vessels. Sydney Ports is however responsible for complying with the requirements and protocols established by international and national bodies such as DAFF.

There are mandatory ballast water management arrangements for international shipping.

The National Introduced Marine Pests Corporation Group (NIMPCG) is responsible for the development of a National System for the prevention and Management of Marine Pest Incursions.

All major Australian Ports have been required to undertake baseline surveys to establish whether or not marine pests are present. A survey commissioned by the Sydney Ports Corporation and Transport NSW was undertaken in 2001.

Management of marine pest species which have established local populations in Sydney Harbour lies with Department of Primary Industries. Since the discovery of *Caulerpa taxifolia* in areas of Sydney Harbour, it is important that the role of the maritime industry in the spread of this noxious species be closely monitored. Further information regarding the presence of *Caulerpa taxifolia* within the study area is provided in Section 8.1.1.

8.4.2 Intertidal Area

Urban development has probably had the greatest impact on the intertidal environment within the study area. Losses of habitat from seawall and foreshore modification such as marinas etc have a big impact on intertidal ecology in the study area.

Water pollution has historically had detrimental effects on invertebrates on rocky shores within the study area. As water pollution is still evident within Middle Harbour, it is possible that invertebrate populations are still being affected. However, the limited data available suggests that populations of invertebrates in the intertidal zone may be increasing, regardless of pollution still being evident.

Harvesting species within the intertidal zone may also have impacted on its ecology, although data is not available to confirm this. The entire foreshore of the study area is not designated as Intertidal Protected Area (IPA), and harvesting is currently permitted. As a result, biodiversity may be reduced when compared to other areas of Sydney Harbour.

Marine debris such as seagrass wrack (not rubbish) washed up on the shore provides an important source of food for a diverse range of invertebrate species, which are an important part of the intertidal food chain.

8.4.3 Terrestrial

Urban development has been the single largest threat to the terrestrial environment within the study area. Development such as the construction of houses, roads, utilities and recreational facilities removes natural habitat in the footprint of each development.

The loss of natural habitat within the study area since European arrival has been extreme, with the majority of the study area now developed at the cost of the native habitat such as vegetation, rock shelters, mulch, soil and creek lines (see section 5.3.1). Further, some existing properties within the study area are encroaching into the remaining habitat through the extension of lawns and outdoor living areas. The loss of habitat has greatly reduced the carrying capacity of the study area for native wildlife, and natural ecological processes and biodiversity have been threatened (Skelton *et al* 2004). The fragmentation of natural bush land areas in Manly has reduced the viability of habitat in many bush land reserves to support populations of native fauna. Some of the impacts and causes of degradation in urban bush land are:

- increased levels of high nutrient stormwater runoff entering bushland, creating ideal conditions for weed growth
- dumped garden refuse and rubbish.

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- altered fire regimes – some native plants rely on fire for regeneration
- urban encroachment on reserves
- the impact of domestic pets on flora and fauna
- poisoning trees for views

There are also many secondary impacts as a result of the development within the study area. The invasion of exotic species is the most notable of these impacts. As indicated in Section 8.3, there were 19 species of flora recorded within the study area, and 10 (approximately 53%) of them are exotic. These species have reached bushland areas through escaping from gardens, illegal dumping of garden refuses, dispersion by fauna (e.g. - birds eating seeds) and illegal plantings. The spread of exotic fauna has also been exacerbated by nutrient pollution from stormwater and sewage overflows, and the dumping of garden soil. The largest area of high density weeds is in western side of West Esplanade Park.

Fire is a natural part of the environment, and many species are dependent on regularly spaced fires. Inappropriate fire frequency has also impacted on the terrestrial environment within the study area. Fire is important in many aspects of ecosystem functioning, such as seed germination, nutrient cycling and control of species diversity. Residential development around the bushland reserves means that fires are suppressed, rather than allowed to occur naturally. Back burning takes place in some reserves to reduce the fuel load and reduce the bushfire potential, although this rarely mimics the frequency and intensity of natural fires (Skelton et al, 2004).

Introduced fauna (see Table 8.3.3) have also impacted on the native fauna within the study area. Feral or semi feral cats are present at Manly Cove and are deadly predators of small native animals, including amphibians, birds, mammals, and reptiles. There is also a wide variety of feral bird species that compete with native species and unbalance the local ecology.

Feral and domestic cats are major predators of Australian fauna. Cats take a wide variety of prey species, including mammals, birds, reptiles and frogs. Feral cats are capable of killing vertebrates up to 2-3kg, with preference shown for mammals and birds weighing less than 220g and 200g respectively (NSW NPWS 2000). Predation by feral cats is listed as a Key Threatening Process in the *Threatened Species Conservation Act* (NSW Scientific Committee 2000). A small number of listed endangered and vulnerable species in NSW are currently threatened from predation from feral cats (NSW NPWS 2000).

Foxes have been sighted by the local community within the study area. Foxes are omnivores, eating insects, vertebrates and fruits. Both ground and tree dwelling native wildlife form a significant part of a foxes' diet, including Ring-tailed Possums, Bandicoots, Blue-tongued Lizards, Little Terns and Little Penguins. One fox eats about 375 grams of food each night. This is equivalent to ~100 Ring-tailed Possums or Bandicoots a year. Nonflying mammals weighing between 35g and 5500g and ground-nesting birds at greatest risk from fox predation (NSW NPWS 2001). Predation by the introduced European Red Fox has been listed as a Key Threatening Process under the *TSC Act* (NSW Scientific Committee 1998). Predation by foxes is listed as a threatening process for Bandicoots in the *Threatened Species Conservation Act*. Foxes also eat berries of noxious weeds such as blackberry, lantana and Bitou Bush and contribute to their spread through urban bushland. Foxes have been observed throughout Manly, a highly mobile species, moving between bushland reserves and not necessarily restricted to one reserve in particular.

The introduced birds, particularly the Common Myna, have most likely displaced native birds to some degree, although the extent is not known. Displacement occurs through competition for food and nesting sites, and aggressiveness of introduced birds towards natives (Australian Museum, 2007).

Domestic dogs were sighted in most of the study area reserves. Dogs impact on native fauna directly by predation and attack when unleashed, but they can also have indirect impacts. The smell of domestic dogs reduces the habitat potential of an area, as native animals become stressed and avoid the areas where the smell is present (Skelton et al, 2004). Parts of the study area, particularly the Manly Scenic Walkway and surrounds, are frequented by dogs being walked, meaning their scent would be nearly always present.

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Concerns raised with Council and DECC highlight the negative impact dogs are having upon the nesting and foraging habits of Little Penguins in the vicinity of Manly Wharf through to Federation Point. Measures are being implemented to restrict access to the foreshore.

Rabbits were recorded in some of the study area reserves, causing a myriad of problems, both to other fauna and the environment around them. Rabbits compete with, and often out compete, many native ground dwelling animals for food and shelter. They are extremely mobile and can reproduce rapidly, placing huge pressure on the more territorial and slow reproducing natives. Rabbits eat the seedlings of native plants, reducing the ability of the bush to regenerate, and they also graze on mature plants and damage its protective bark. They create erosion through digging burrows, which can also exacerbate any existing erosion (Skelton et al, 2004).

8.5 ECOSYSTEM HEALTH ASSESSMENT

In conclusion, an assessment has been made in tabular form that allows for an overview of the ecosystem health. Key indicators were chosen from the topics covered in this report. These findings will assist in developing appropriate management actions.

Table 8.5 – Assessment of Manly Cove Ecosystem Health

Indicator	Assessment
Water Quality – Aquatic Ecosystem Health Values	-
Water Quality – Recreational Ecosystem Health Values	Good. Sample Site showing 100% compliance with the <i>faecal coliform</i> guidelines 4 of the last 5 years and 100% compliance with the <i>enterococci</i> guidelines on four of the five years.
Erosion	Potential erosion issues in western Corner of Manly Cove East Beach. Stormwater scouring a issue for both Manly Cove East and Manly Cove West Beaches.
Sedimentation	Stable sedimentary environment.
Wetlands (mangroves and salt marsh)	None
Seagrasses	Medium sized meadows of seagrass with considerable degradation resulting from boating activity. Exotic species exist adjacent to study area.
Urban bushland	Fragmented, high degree of exotic species, high density of weed
Fish & fisheries	Large and increasing number of fish species (Commercial fishing banned at present)
Habitat on foreshore structures	Natural intertidal ecology limited due to over harvesting. Marine growth on artificial structures provides important habitat value.
Phytoplankton	- -
Zooplankton	- -
Benthic Macro invertebrates	- -
Terrestrial fauna	Few species due to urbanisation and identified threats.

- - No data to make a judgement on the indicator

9. SOCIO-ECONOMIC ENVIRONMENT

9.1 DEMOGRAPHY

Australia's coastal regions continue to undergo transition as traditional land uses decline and new land uses evolve. Many regions have changed from quiet rural coastal communities with declining agricultural or industrial sectors into popular tourist localities and, in some cases, have grown into large urban or suburban settlements. Other regions have also changed because of easy commuting distances to major cities (Smith & Doherty 2006). An understanding of population trends is important in coastline management.

Existing Population

Estimated resident population on June 30, 2008 stands at 39,667 in Manly LGA. However, it is difficult to accurately estimate the population of the Manly Cove study area (**Figure 9.1a**). The future management of Manly Cove must cater for the high volume of visitors experienced annually.

Aboriginal Population

In 2006, the number of people who identified themselves as Indigenous was 96 or 0.3% of the population, consistent with the previous Census figures. Although the population is small, Aboriginal people have a significant spiritual, cultural, social and economic interest in the area.

Projected Population

The latest ABS projection for Manly LGA population was 39,805 for 2006 and 40,278 for 2008 (**Figure 9.1b**). However, based on the Census data, the population growth rate, over the last three Census periods, has slowed down:

1991-1996: 3.93%
1996-2001: 3.64%
2001-2006: 1.54%

Gender & Age Structure

Manly LGA has a population where 48.7% are males and 51.3% females. Of the total, 17.5% were children aged between 0-14 years, and 24.8% were persons aged 55 years and over. The median age of persons was 37 years, compared with 37 years for persons in Australia.

Manly population is ageing with 30.7% of residents (or 11,375 people) over the age of 50. The ageing trend of the population is also evident in the declining proportion of young people. The proportion of people aged 15-24 years declined from 12.6% in 1996 to 10.4 % in 2006. There was a slight increase in the proportion of young children under 14 years of age but decline in the next two age groups between 15-29 years. The most significant changes in the age structure of Manly population indicating clear ageing trend are:

- steady decline in the proportion of young people aged 15-29 years.
- steady increase in most age groups over 40 years.

According to ABS projections for Manly between 2001 to 2019, the only age groups forecast to increase are those aged 25 years and over. The proportion of children aged 0-11 years are forecast to decline in numbers and the proportion of young people aged 12-24 years remains static.

Aged and Disability

On 30 June 2006, in Manly there were 187 aged care residents and 107 people received Community Aged Care Packages (ABS, *NSW Regional Statistics, 2007*). Based on 2006 Census, the number of people with a disability, long term health condition or old age who needed assistance with self-care, mobility and communication was 896. A total of 2,847 carers provided unpaid assistance to people with disabilities.



Figure 9.1a 2001 population distribution in the Manly Cove study area

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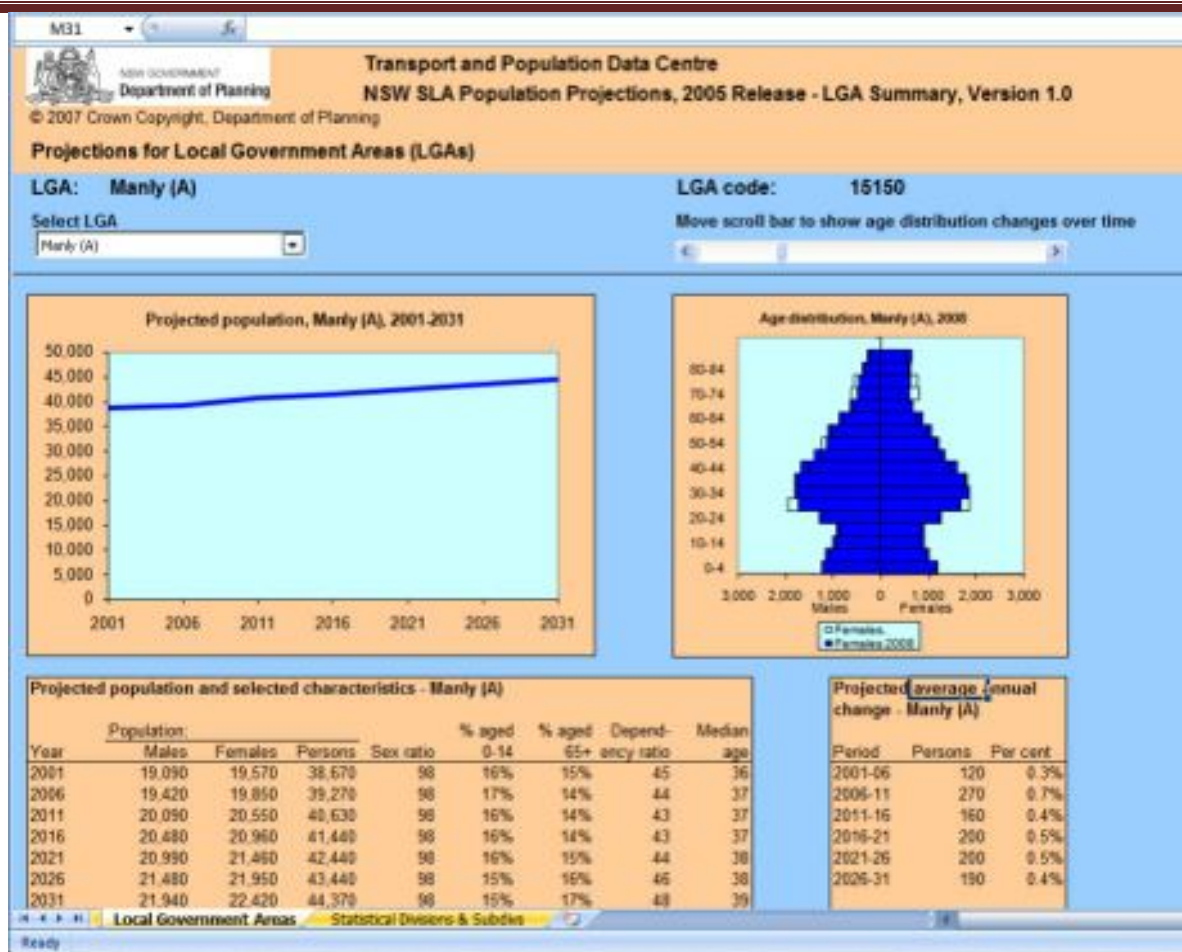


Figure 9.1b Population projection for Manly LGA area

Family Structure

The Manly community is characterised by atypical family and household structures with significantly less people living in a family household and more lone person, group and other households compared to Australia. In Manly, there are proportionally less married people, more people that never married, less couple families with children, more couples without children, and less single parent families than nationwide.

The household and family composition presented in the figures above is based on the 2006 Census. There were 9,278 family households in Manly, 3,816 lone person households and 938 group households. In terms of household family structure, since 2001, the balance has shifted in favour of couples with children and there were less

Dwelling Types

Manly is distinct of Sydney in its high concentration of flats with more than double the Sydney wide figure. Of all the occupied private dwellings in Manly, there has been no real increase in the number of separate houses. However, since 1991 there has been a steady increase in the number of flats, units or apartments and semi-detached, row or terrace houses and townhouses.

The majority of occupied dwellings in Manly are flats, units or apartments (48.3%), followed by separate houses (40.7%) and semi-detached houses (10.3%). The occupancy rate is 1.1 persons per bedroom or 2.4 persons per household, lower than the neighbouring Warringah (2.6) or Pittwater (2.7).

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Household Income

The gross weekly household income gives an indication of population socio-economic status. Manly residents earn significantly more than both residents of the Sydney region and the Northern Beaches. The median weekly individual income of Manly residents in 2006 was \$790 and the median weekly household income was \$1,705, with 44.4% of households earning \$1,700 or more a week.

9.2 TOURIST VISITATION

An important feature of the Manly LGA is that it receives approximately six million visitors annually, of which 75-88% are day visitors attracted to beaches, marine activities and the ferry ride (UWS 2005). These visitors mostly are focussed on Manly Cove, The Corso and Manly Ocean Beach. Manly Scenic Walkway, runs through the study area, attracting many tourists and residents.

In order to cater to additional demand, Council needs to create additional provision of public facilities. These include beach & street cleaning, shade, picnic tables, waste disposal, toilets & showers, signage, visitor information and maps. In line with community aspirations, Manly is being promoted as a place of ecotourism as a means to ensure care for natural and social fabric.

Community has noted the lack of financial support from the State and Federal Governments to support this major tourist destination. The ratepayers have to pay for everything.

9.3 SOCIAL INFRASTRUCTURE

Infrastructure provision, more specifically social infrastructure provision is important to people. The presence of such infrastructure has a direct impact on living conditions, health and potential for economic development. Social infrastructure are usually considered services, such as health care facilities, public toilets, schools, neighbourhood centres, parks, and open space etc. Some of these are described here:

9.3.1 East Esplanade Reserve

The Manly Cove study area consists primarily of the semi-natural, landscaped and built areas. It is characterised by natural and cut sandstone cliffs and escarpments with fringing native bushland pockets and landscaped areas along the walkway and esplanade reserves.

The study area is dominated by the wide concrete esplanade and grassed areas adjacent to the Manly Cove beach. Other hard surfaces include shower area to the east, paved pathways, sealed recreation areas, bases to seats and roads. Recreational facilities include swings, amenities blocks, showers, seats, Manly Wharf commercial area and bike racks between the bus interchange and Manly Wharf, as well as along the eastern boundary of Wharf (with bike lockers). The Council is investigating the possibility of improving the playground south of the large Morton Bay Fig tree on East Esplanade, particularly adding extra facilities compatible with the area.

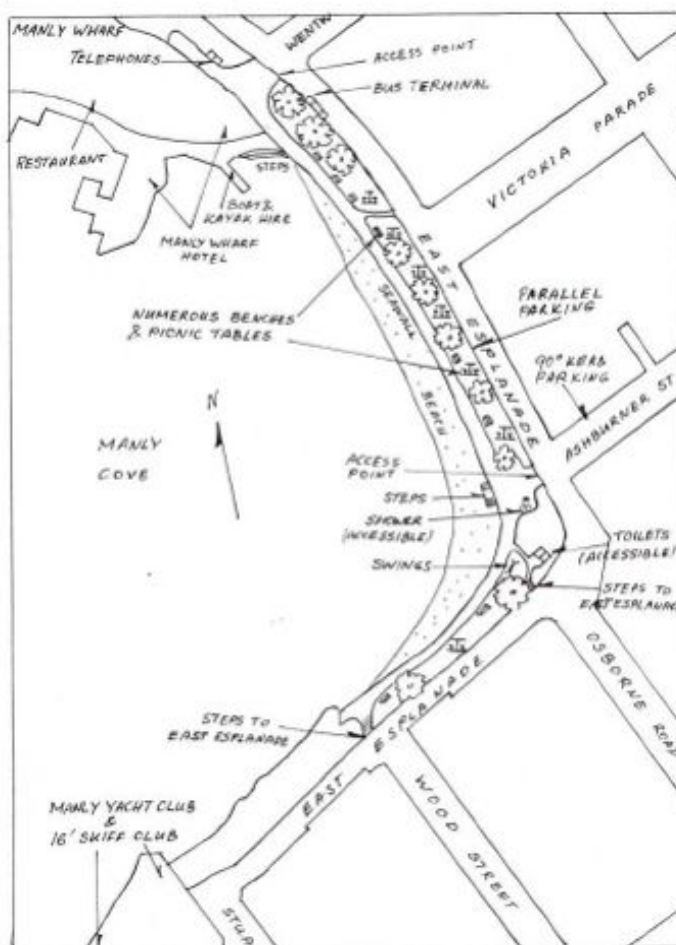


Figure 9.3.1 – Sketch of facilities in east Manly

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There are septic tanks adjacent to the footpath leading to the Sailing Club on the Eastern Esplanade. If these are not being used, they should be removed. Other existing infrastructure includes a Sydney Water Sewage pumping station for the Northern Suburbs Outfall System, a Gross Pollutant Trap and an Energy Australia Substation. The eastern most bike racks at Manly Wharf appeared less used than those closer to bus interchange (GPS Point 69). Lighting and security appear to be issues in regard to rack use. According to Bicycle NSW Inc, the Manly bike lockers next to the eastern most bike racks have a 100% occupancy rate with a waiting list. BNSW has submitted a request to DIPNR for an additional four lockers.

Street Directory Refs: UBD (198: B10-11, C11) Gregory's (288: G11, H11)

Description: small Scenic Park on a slightly sloped terrain next to Manly Wharf with access to Manly Cove East Beach.

Main features: Harbour and marine views, Norfolk Island pines, large fig trees, beach access, children's swings, and picnic facilities. The beach is used for launching sailing boats and sea kayaks. The park is suitable for picnics and beach activities. It is a common gathering place for celebrations such as the New Year's Eve fireworks at Manly Wharf.

Access:

Pedestrian: Level access from Manly Wharf and at the corner of East Esplanade & Ashburner St as indicated on the map. Stairs down from East Esplanade at the eastern end of the Park.

Vehicle: Parallel to kerb 2P parking along East Esplanade. Nearest accessible parking is at Manly Wharf car park or at Wentworth St car park, 100m north- west.

Public transport: Accessible bus and ferry connections at Manly Bus Interchange and the wharf, and taxis.

Beach access: Ramp to Stuart Street.

Facilities:

Toilets: Two accessible unisex cubicles at the eastern end of park: one accessible via a lift toilet in the underground car park at the Manly Wharf complex and one on ground level. People rate the toilet as fair to poor.

Showers: At the eastern end of the park there is an accessible shower and swings, as indicated on the map.

Shelter: Shade is provided generally by the trees. Wet weather cover may be sought at Manly Wharf at the western end of the Park.

Seats & Tables: Wooden benches with backrests and tables with benches are distributed throughout the Park. These are set on concrete platforms and access is over grass. They are not easily accessible due to the sloped terrain of the park.

Picnic area: Serviced area with garbage bins and tap is located of the eastern end of the Park as well as tables and benches with level access from the walkway.

Swings: Two swings accessible from the path at the eastern corner of the park.

Telephones: Two telephone booths, not wheelchair accessible, near Manly Wharf Hotel as indicated on the map. Nearest accessible telephones are at Manly Wharf.

Shops: Numerous shops in Manly Wharf complex. These include restaurants, cafes, takeaways, supermarket, newsagency, and more. Other shopping along The Corso Northwest of wharf.

Water adventures: Boat & kayak hire, harbour cruises, and tours are available at the western end of the beach.

Manly Visitors Information Centre: Located at the Manly Wharf square at the bus interchange.

9.3.2 West Esplanade Reserve

Street Directory Refs: UBD (198:A10, B10), Gregory's (288:F10)

MANLY COVE COASTLINE MANAGEMENT STUDY

Description: Situated on level terrain west of Manly Wharf between Manly Wharf and Oceanworld.

Main features: Harbour views and Norfolk Island pines, scenic walkway with tiles featuring "Manly Pathway of Olympians and Paralympians" along the seawall, access to beach with swimming enclosure, and picnic facilities. Access to Manly Visitor Information Centre at the Wharf, Manly Art Gallery & Museum, Oceanworld, and Waterworks at the western end.

Access:

Pedestrian: Level access from Manly Wharf complex and The Corso intersection. The Park is connected to East Esplanade Park via the walkway through Manly Wharf square.

Vehicle: Parallel 2P parking at West Esplanade. Nearest accessible car parking is at Manly Wharf underground car park or at Whistler St car park.

There is a designated car parking area for about 10 cars on the back of the Manly Pier Restaurant which is accessible via a ramp around Manly Art Gallery & Museum.

Public transport: Accessible buss and ferry connections at Manly Wharf at the eastern end of the park and taxis.

Beach access: Wheelchair access at the eastern end of the beach via a timber ramp in three sections.

Facilities:

Toilets: Male and female toilets at the western end of the Park have steps with rails on one side only. Nearest accessible toilet is in Manly Wharf.

Showers: One accessible shower is on the walkway at the centre of the promenade.

Another one is on the timber ramp at the eastern end of the beach (see cover photo).

Shelter: Shade is generally provided by the Norfolk Island pines. Weather shelters are provided at the Wharf square and at the bus stops. Refuge may be sought in Manly Wharf complex, the Oceanworld, the awnings of the Pier Restaurant and Art Gallery & Museum at the western end.

Seating & Tables: Numerous tables with benches and benches with backrests easily accessible on the walkway (see picture above).

Telephones: Two open-style booths at West Esplanade, as indicated on the map. More accessible telephones at Manly Wharf square.

Shops: Numerous restaurants, cafes, and shops at Manly Wharf complex. Access to Oceanworld gift shop and Boardwalk cafe, another sidewalk café, and Manly Pier Restaurant, at the western end.

Attractions:

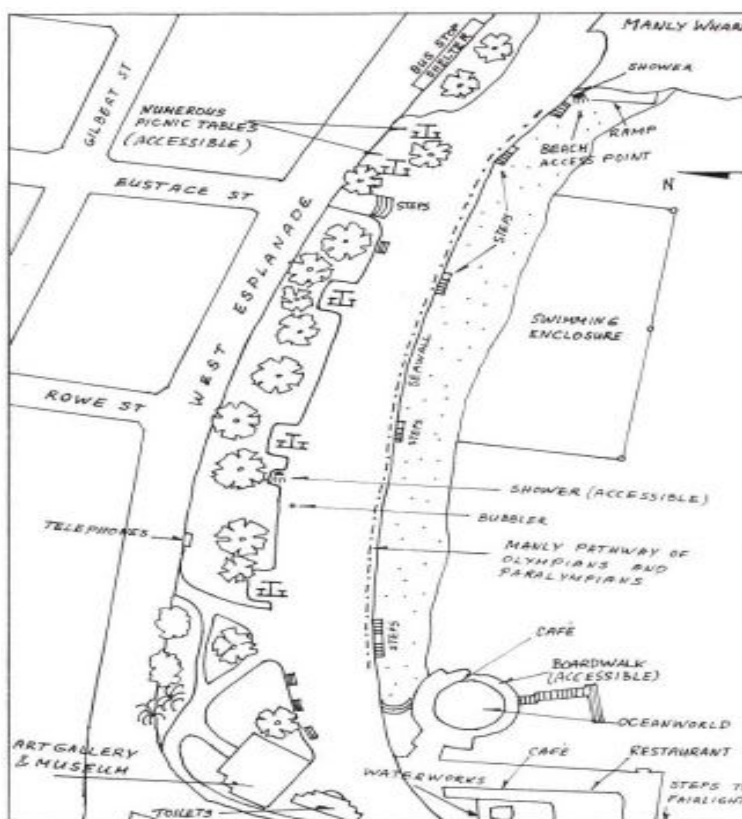


Figure 9.3.2 – Sketch of facilities in west Manly Cove



MANLY COVE COASTLINE MANAGEMENT STUDY

Manly Art Gallery & Museum: Phone: (02) 9949 1776. Open Tuesday to Sunday from 10am to 5pm. Entry is free. Connected to the West Esplanade by a continuous step-free path. Entry is level and most exhibits are accessible. The ceramics are in a small room which can only be accessed by eight steps.

Oceanworld: Phone: (02) 9949 2644. Open every day except 25 December 10am to 5.30pm. Exhibits are located on three levels of sharks, giant stingrays, reptiles, spiders, living coral and thousands of marine animals. Daily live shows and guided tours occur. Watch from underground tunnels as divers hand feed sharks. Ramp entry of Oceanworld and to the gift shop. There are good paths of travel through Oceanworld. Ground floor displays are accessible but wheelchair users cannot access the upper level. People with severe vision impairment are admitted free and assisted in using the touch pool. There is an accessible toilet on the ground floor.

9.3.3 Manly Scenic Walkway

As presented in section 4.1.1, walking and jogging are identified as the most preferred usage of the study area. Manly Scenic Walkway is used extensively by both visitors and residents.

Manly Scenic Walkway (MSW) was opened in 1988 and is jointly managed by the Manly Council and the National Parks and Wildlife Service (within DECC). It is almost 10 km long starting from Manly and reaching up to the Spit Bridge with approximately 1.6 km within the study area. There are couple of entrance points to allow shorter walks. All flora, fauna, Aboriginal sites, rock formations and historic structures are protected on the walk.

Of the 23 points of interest along the Manly Scenic Walkway (MSW Brochure), the following two points are within the study area:

- Manly Pathway of Olympians: Celebrating more than 100 years of Manly residents who represented Australia in the Olympic Games. There are more than 83 plaques on the walk, being updated following each Olympics.
- Manly Art Gallery & Museum: established in 1930 the gallery entertains and informs visitors with a changing program of exhibitions as well as an important permanent collection of paintings and pottery.
- Oceanworld: a magnificent aquarium which prides itself on it's interactive nature. Tour guides, touch pools, shark shallows and seal sessions are just part of what goes on in this circular building.

9.3.4 Swimming Enclosure

One netted swimming enclosure exists within the study area located between Manly Wharf and Oceanworld. The enclosure provides swimmers with protection from sharks with the nylon net being traversed by nine wooden piles. The dimensions are approximately 50m wide and 100m long with a maximum depth of approximately 4 metres. The enclosure is extremely popular for users of Manly Cove as it provides for safe harbour swimming in calm conditions. Further information on seahorses can be found in Section 8.1.

Concerns were raised in relation to the shark protection provided by the aging net structure. Council was encouraged to improve public safety while taking into consideration the resident seahorse population.

Council at it's Ordinary Meeting of 2nd February 2009 resolved that a report be developed on the construction of a pontoon or platform, appropriate for jumping off into the water, between the two centre poles that support the fence around the swimming enclosure between the Wharf and Oceanworld. The report, forming part of the implementation process of this Plan would detail risk assessment, examination of environmental impacts, design and cost estimates. This idea has now been shelved.



Figure 9.3.3 – Route of the Manly Scenic Walkway within the Study area



Figure 9.3.4 – View looking North West from Manly Wharf over seagrass beds and netted swimming enclosure

9.3.5 Amenities – Showers and Toilet Facilities

Two dedicated amenities/toilet blocks are located within the study area, located at either ends of East and West Esplanade they provide use to patrons within these locations. Public toilet facilities are also provided within the Manly Wharf development.

East Esplanade amenities/toilet block is an old sandstone building with separate male and female facilities. A total of two large accessible cubicles make up the building. They are in fair condition with no exterior/interior graffiti, and are maintained by Council staff on a regular basis.

West Esplanade heritage listed amenities/toilet block is a larger building and experiences higher usage due to their close proximity to Oceanworld, Cafes, Restaurants, Netting Swimming enclosures & Water Works. The female toilets house ten cubicles and the male toilets have four but none accessible.

The West Esplanade amenities block underwent a recent exterior paint job completed to improve degraded internal finishes. Heritage value was maintained throughout the minor upgrade.

In addition to the shower blocks located within the West Esplanade facility, beach showers are located in East and West Esplanade Reserve. Both being made up of a single pole with three water efficient shower heads and a foot shower. Similar showers are provided adjacent to the western side of the Manly Wharf development. The existing number of showers is considered sufficient for patrons in the area. Cold water is only being available from the showers.

9.3.6 BBQ

No barbecue facilities are currently provided within the Manly Cove study area. The decision to exclude this type of facility relates to the high use of the area and the difficulties in ensuring facilities are kept in a clean and in a hygienic condition. The area is Alcohol Free Zone.

9.3.7 Shelter

A number of man-made shelters are located within the study area including bus shelters, awnings and Manly Wharf itself. The main source of shade is provided by Norfolk Island Pine trees which traverse the length of East and West Esplanades.

Installation of any hard infrastructure to provide shelter within the study area must be sympathetic to the present natural environment and take into account view maintenance and heritage issues.

9.3.8 Playground

There are no designated playground areas within the study area except for the single set of swings located in the far eastern end of Esplanade Park. The two chained swings are surrounded with soft fall synthetic turf to minimise wearing and to provide increased safety for users.

9.3.9 Pay Phone Booths

There are a number of Payphone booths in and around the study area, including:

- Manly Wharf
- Manly Wharf Bus Interchange

These are maintained by Telstra.

9.3.10 Lighting

Along the promenades of East and West Esplanades a total of 28 lamp posts exist. Each pole houses two round globes. Manly Wharf provides its own lighting. Some lighting is impeded by the presence of trees in both East and West Esplanade, potentially raising safety concerns after dark.

The provision of lighting within the study area enhances the heritage feel of the area by emulating original lighting for Manly Cove. The rounded lighting, often referred to as a "ring of pearls" by visitors, incorporates Council emblems while providing safety and an attraction to the promenade area at night.

9.3.11 Seating and picnic facilities

The ease of access and aesthetic character of Manly Cove has resulted in the area being popular with visitors and day trippers for picnicking and gatherings. A variety of seating options are provided for these activities with 16 bench seats and 6 table/bench combinations located within East Esplanade Reserve. West Esplanade Reserve provides 10 bench seating, ample low wall seating and 21 bench/table combinations for patrons. The existing facilities were last upgraded during the major landscaping works in 1988.

Community consultation identified the fact that the picnic facilities are often extremely dirty and unhygienic as well as the fact that some chairs have been vandalised.



Figure 9.3.11 – Outdoor table and chairs are extremely popular during weekends and school holidays

9.3.12 Kiosks and Cafes

East Esplanade is free of any kiosk facilities whatsoever however, food and beverages are available from a range of outlets on Manly Wharf and within the adjacent Corso area. The Manly 16 Foot Skiff Club also provides seated meals for members and guests.

West Esplanade houses two café options; Oceanworld's Chill Café with seating for 38 and the Café Cruz which allows for 36 seated patrons. Restaurant quality meals are also available at Manly Pier Restaurant in the upstairs portion of the Manly Pavilion building.

9.3.13 Dog Exercise Area

Dog exercising is a popular activity for many members of the community. There are a number of leash-free areas along the foreshores that are frequented by the public and their companion animals. However, restrictions now apply and dogs must be on a leash at all times in the Federation Point Wildlife Protection Area to the west of the study area.

The area of foreshore in the vicinity of Federation Point has also been declared a dog exclusion zone. Appropriate signage has been developed and erected at various locations throughout the area. Despite attempted controls by Council, conflicts between humans, companion animals and penguins were commonly experienced in the location of Manly Wharf and Federation Point over the recent breeding season.

Due to the high vulnerability of little penguins to dog attack and human disturbance and following numerous incidents and concerns from residents a Wildlife Protection Area was declared in May 2006 in the area of foreshore between Federation Point and Manly Wharf (See Figure 8.2.3b). A number of penguins are known to nest at this location with evidence to suggest individuals also nest underneath Manly Wharf.

There is one dog poo bag dispenser within the Manly Cove study area.

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Dogs are not permitted on any beaches or in swimming enclosures.

9.3.14 Cycleway

Bicycle data point to the strength of cycling in the area. In particular, the Cycling in Sydney Report (Transport NSW, 2003) found that residents who live on the northern beaches have the third highest bicycle ownership per household of any area in Sydney. Also, the Northern Beaches has the third highest proportion of residents who use their bicycle to travel to and from work. The only locations with a higher proportion are Sydney CBD and the Eastern Suburbs.

The Manly Cycleway Network is extensive, consisting of both on-road and off-road cycle paths catering for the commuter and recreational cyclist (**Figure 9.3.14**). However, there are distinct impediments to improving links in the cycleway network, namely the hilly topography and road carriageways that are too narrow to provide cycle paths (unless at the expense of on-street parking or changing roads to a single direction of traffic). Following the approval of the Manly Cycleway Plan Study (1997), Manly Council has embarked on a cycleway improvement program.

A key proposal in the Study (1997) is a cycleway link between Commonwealth Parade and King Avenue, and the Scenic Walkway is identified as the potential location to provide this link. The strength of demand for an east-west cycle route is assessed in the Manly Bicycle Plan Study (1997). Demand for the east-west link is therefore from both recreational cyclists — who would like to ride safely to recreational attractors such as parks and the wharf — and from commuter cyclists — who need a safe route to and from Manly wharf.

The Manly East-West Cycleway, having now been upgraded, provides cyclists, joggers and walkers with a pleasant way to exercise and enjoy the beautiful surroundings between where the Corso meets the oceanfront and the nearby suburb of Seaforth. This is approximately 8 km in length one way.

Manly Council celebrates bike week each year to further encourage community to make use of extensive cycle ways through our exceptional scenery of bush, beach and lagoon. Council has recently approved plans for an East-West corridor that will link existing bike networks and provide greater options for cyclists and commuters.

9.3.15 Public Transport

Manly is highly accessible by public transport from a number of locations on Sydney's north shore, northern beaches and Central Business District. The Manly Ferries are part of Australia's social history with a large number of visitors taking the return journey across Sydney Harbour by either ferry from Pier 3 Circular Quay (30 minute trip) or the high-speed Fast Ferry from Pier 2 (15 minutes) to reach Manly Wharf. Bus travel between Manly bus interchange and the Sydney commercial business district across the Harbour Bridge is another alternative.

Ferry and Fast Ferry⁴

Ferry and JetCat patronage has fluctuated over the years prior to the development of this study. Petrol prices, tourism trends, other transport options and the reliability of service all contribute to the popularity of the services between Manly and Circular Quay. **Table 9.3.15a** identifies the frequency of services run by Sydney Ferries between Circular Quay and Manly Wharf. Passenger numbers and trends for the five years prior to the development of this plan are provided in **Table 9.3.15b**.

⁴ Fast Ferry has replaced JetCat in 2009



Figure 9.3.14 - Cycle ways within the study area

Table 9.3.15a - Number of Ferry and JetCats return journeys run between Circular Quay and Manly Wharf

Vessel	Monday - Friday	Saturday / Public Hols	Sunday
Ferry	35	28	27
JetCat*	19	11	10
TOTAL	54	39	37

*Jetcat has now ceased operation and has been replaced by FastFerry

Table 9.3.15b - Passenger numbers for Ferry and JetCats between 2001/02 and 2005/06

Indicator	2001/02	2002/03	2003/04	2004/05	2005/06
Ferry	5,082,110	4,124,500	5,499,451	5,452,231	5,147,155
JetCat	741,990	1,022,000	850,257	880,554	873,927
TOTAL	5,824,100	5,146,500	6,349,708	6,332,785	6,021,082

Ferry and JetCat movements were identified as posing a significant risk to recreational users of Manly Cove, particularly for those kayaking and boating. Problems arise when the ferry/JetCat departs the wharf allowing minimal warning for those in the channel. Despite speed restrictions in the area, a number of ferry captains have been observed fully accelerating directly from Manly Wharf.

Further, sediment transport within Manly Cove is influenced by the regular movements of the large commuter vessels. With vessels departing Manly Wharf in a southerly direction, wash is projected in a northerly direction. The water movement created by Ferry movement increases pressure on the nearest (southeast) corner of the netted swimming enclosure, with JetCat wash potentially contributing to the scouring of sand to the eastern side of the Manly Wharf development. Further information on sediment transport can be found in **Section 5.10 and 5.11** of this report

Sydney Buses

The Manly Cove/Wharf interchange provides bus linkages to a variety of destinations on the Northern Beaches, North Shore and Sydney CBD. During times of severe weather and swell additional buses are used to transport ferry passengers into Sydney CBD. Table 19.3.15c identifies the trends in usage for the period 2001 to 2005, highlighting the large number of people utilising these services annually.

Table 9.3.15c - Trends in Bus usage for the period 2001 to 2005

Indicator	2001/02	2002/03	2003/04	2004/05
Patronage (Manly Buses)	12,485,097	12,528,743	12,702,780	12,404,926
No. of scheduled bus trips	381,185	381,948	389,862	390,417

Hop, Skip and Jump Bus Service

Council has implemented a free regular route mini bus service, operating on four integrated routes throughout the Manly LGA, which interchange in Condamine Street, at the Totem Shopping Centre in Balgowlah, and run to Manly, to Seaforth, to Balgowlah Heights and to Warringah Mall (refer to **Figure 9.3.15**). The service operates between 7:00 a.m. and 6:30 p.m. seven days a week.

This bus services Manly Wharf and provides Manly residents with access to Manly Cove, especially those without private motor vehicles or driver's licences and those wishing to reduce private car usage and increase their use of active transport. Some of the benefits of the service include:

- Cleaner air and oceans
- A healthier, more active community
- Less traffic in the area, particularly at shopping centres and popular places like Manly's beaches
- Minimised pressure on parking availability in and around central Manly

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- Increased freedom for the community



Figure 9.3.15 - Routes serviced by Councils free community 'Hop, Skip & Jump' bus service

9.3.16 Manly Art Gallery

First opened in 1930 the Manly Art Gallery is located in the western portion of the study area adjacent to the Manly Waterworks. Operated by Manly Council the brick building is in good condition and well maintained. The Art Gallery Council retrofitted a rainwater collection system in 2006 with all water collected used to irrigate the open space and vegetation of West Esplanade Reserve. Entry into the Art Gallery became free during 2006.

9.3.17 Manly Visitors Information Centre

Manly Visitor Information Centre (VIC) is located in the forecourt of Manly Wharf, next to the bus interchange, at the entrance to Manly via the ferry. The Centre has approximately 255,000 people through the door annually with staff speaking to approximately 151,000 people face-to-face. The centre also receives approximately 7,500 email enquiries and 23,500 phone calls. The VIC moved to its current position in the forecourt of Manly Wharf in 2000 (see **Figure 9.3.17**). Prior to 2000 the VIC was located on the ocean beach front and did not serve as many day trippers as the current facility. The facility is staffed by the VIC Coordinator, a Visitor Information Officer, five casual employees and seven volunteers.

The VIC provides an accessible and customer focused centre that provides information to visitors about relevant programs, services and facilities available in the local area. The main functions of the VIC are to promote local tourism products and services, liaise with local operators, keeping up to date with major tourism icons and events and providing information on buses and ferries.

The VIC plays an important role in championing and promoting sustainable tourism and environmental stewardship to both visitors and the local tourism business sector. As a separate entity to Council, the VIC is actively participating in the *Sea Change for Sustainable Tourism* education and accreditation program. Under this program a business-specific environmental management plan (EMP) has been developed for the Centre and a substantial area in the facility has been set up explicitly to promote environmentally proactive businesses

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participating in the *Sea Change* program. The staff at the VIC also produces a monthly calendar of events, update the manlytourism.com website, book events and issue licences in the Corso.



Figure 9.3.17 – Councils Visitor Information Centre is located within the Manly Wharf forecourt.

9.3.18 Access & Traffic Management

Providing adequate access to and within public areas of the Manly LGA is performed under the guidelines of the Manly Access Development Control Plan (DCP). The aims and objectives of the Access DCP (MMC, 1996) are:

- to provide an environment which is accessible to all people, including those with disabilities;
- all community members have the right to full access to participate in all aspects of community life; and
- policies should aim to ensure Manly becomes accessible to all people regardless of abilities / disabilities.

An accessible community is defined as one where transport systems, physical environments, communication systems, political, cultural, bureaucratic, corporate, social institutions and employment practices are open and available to all including those with disabilities – providing those with disabilities the same opportunity, rights and responsibilities enjoyed by others. Key objectives of the Access DCP that are relevant to the Manly Cove study area are:

- to ensure access throughout the pedestrian network in the Council area including footpaths, through-site links, public arcades, overpasses and underpasses; and
- to provide convenient access to all public open space including parks, reserves, malls, plazas and squares.

Having regard to Council's Policy and Australian Standards AS1428.2, Council seeks to improve the accessibility of public open space and facilities by addressing matters such as signage, ramps, parking and toilet facilities.

Discussions with Council's Access Officer, community consultation and a review of existing facilities within the Manly Cove area highlighted that the study area provides varying degrees of accessibility. With the Manly Wharf area providing a major tourist and commuter link, this section of the study area provides safe, well maintained and lit access for a variety of users. However, there are a number of areas which have been identified as requiring improvement in order to meet the standard set by the Access DCP. It must be noted that

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Council discourages access to the foreshore around Manly Point due to the area being designated as critical habitat for the little penguin population.

Pedestrian Accessibility

Manly Cove is part of an expanding network of pedestrian walks which are highly utilised by visitors and local residents. The best known of these pedestrian walking routes is the Manly Scenic Walkway which stretches between Manly and the Spit Bridge, over a 10km route that takes approx 3 to 4 hours to complete and offers spectacular views of the entrance to the harbour and over to the city.

The Manly Scenic Walkway is comprised of a number of connecting walks over a variety of gradients. The walkway passes through Sydney Harbour National Park, Council bushland reserves, local harbourside streets and paved paths. The walkway is well signposted with a number of entry points and information boards along the length of the track. Newer section of the walk include Blue Fish track, taking in North Head and allowing walkers to access the clifftops of this remarkable headland via Shelly Beach.

Council adopted a Development Control Plan for Access in 1996 which incorporates the Manly Access Policy. The aim of the Policy is "to adopt and implement objectives and strategies which will enable Manly Council to provide an environment that is accessible to all people including those with disabilities". The DCP is now under review.

A high standard of level access is provided in the areas adjacent to Manly Wharf including the bus interchange and toward Manly Corso. Specific concerns raised during community consultation, including:

- The movement of pedestrians between Manly Corso and the Wharf interchange is considered by many to be poorly organised. The concept of an underground pathway to transfer pedestrians underneath East/West Esplanade was supported by a number of respondents during consultation.
- There is a need for the provision of improved beach access at the site identified as the curved set of stairs to the eastern side of Manly Wharf. Coastal processes, coupled with the redevelopment of Manly Wharf have resulted in the beach sediment levels dropping to a level which makes it difficult for users to access the beach. Improvements to beach access at the eastern side of Manly Wharf were being investigated during the development of this Study.

Vehicular access

Council's Manly Cove DCP recognises that, in general, access for the purpose of loading and parking is difficult in this location. Parking facilities are only provided where there is direct access to a roadway. Access driveways are not permitted at ground level across East or West Esplanade Reserves. All parking is provided below the ground floor level of any building. Parking structures below mean high water mark are also not permitted outside the footprint of the ground floor of any building and must be screened from view from the water. Where it is impractical to provide on-street parking a contribution towards the provision of parking in the Town Centre shall be required.

The Manly Cove DCP further states that access is to be provided in a manner that:

- All vehicles enter and leave the site in a forward direction;
- The minimum width of an access drive should be 5 metres;
- Vision of vehicles entering and leaving the site is not impaired by structures or landscaping;
- There is sufficient room for trucks to manoeuvre to and from any loading bays.

Vehicular access is provided onto East Esplanade Reserve directly off East Esplanade opposite Ashburner Street. This access point enables Council service vehicles onto East Esplanade Reserve including cleansing vehicles and Council's Beach Rake. This access point is also heavily utilised on weekends by members of the



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Manly 16 Foot Skiff Club for rigging and beach access. Community consultation identified the extended use of this public open space by 16 Foot Skiff trailers who often remain at this location on a semi-permanent basis

A vehicle access road is provided to the western end of the study area which includes Manly Art Gallery, Manly Water Works and Oceanworld. A locked boom gate system applies to users of this access point with the parking of vehicles for extended periods prohibited.

Aside from on-street parking, formal parking is provided in two locations, firstly under Manly Wharf where parking can be accessed via East Esplanade (opposite Wentworth St) and also adjacent to the Manly Dressing Pavilion where a number of car spaces can be accessed via Commonwealth Parade.

There is currently a lack of parking available for residents and patrons of the 'boating precinct' in east Manly Cove. This issue has been ongoing, with a 3 hour time limit placed on non-resident vehicles to discourage long-term parking in this location (Spackman & Mossop, 2005).

Traffic congestion was considered to be an issue for many who provided feedback during the consultation process. Council is combating this issue through its Active Transport Pack which encourages Manly residents and visitors to travel to and from work and school in a more environmentally, socially, and economically beneficial way. The project encourages people to leave the car at home and use alternative transport to help their health, their wallet, and the environment.

Cycle access

A shared path currently exists between Federation Point and Manly Yacht Club and extended to Skiff Club, providing safe off-road access for cyclists via a footpath shared with pedestrians. At two locations along this route cyclists are required to dismount due to an increased potential for accidents with pedestrians. These include the ramp adjacent to Manly Art Gallery, due to limited path width and the steep and curving layout of the path and the Wharf Forecourt, due to significant pedestrian volumes travelling perpendicular to the path of cyclists.

The shared path is signposted with a '10km/hr' advisory speed limit, designed to reduce the potential for accidents between the pedestrians and cyclists. Many of the cyclists use the path to access bike racks located adjacent to Manly Wharf, providing a good link to the Sydney Ferry.

The use of bicycles is encouraged as an alternative mode of transport with bike racks provided in a number of locations at Manly Wharf and adjacent to the study area. During 2007, Council opened a new secure bike storage facility in the Whistler Street car park which can accommodate up to 72 bikes.

By encouraging the use of bicycles Manly Council confirms a longstanding commitment to reducing greenhouse gas emissions in Manly, and the provision of bicycle parking is another step towards implementing Council's Local Air Quality and Greenhouse Action Plan, and fulfilling the commitments in the Corporate Plan and Manly Sustainability Strategy.

Despite the many positives associated with bike use, many people highlighted the need to impose tighter controls on their movement, particularly in areas where there is high pedestrian activity.

Boating access

There is currently a lack of public wharf facilities within Manly Cove. Prior to the current lease agreement, recreational vessels were able to use Manly Wharf for transfer of passengers and goods in a safe user-friendly location. However, vessels are now charged at premium rates to utilize Manly Wharf regardless of the time they are berthed. This issue has been raised by numerous groups and individuals during the consultation process, including the Little Manly and Fairlight Precincts. Manly Wharf is currently used by a number of commercial operators.

A number of formalised jetties are located along the eastern foreshore in the "Club Precinct" between Stuart and Osborne Streets, however these are exclusively utilised by members of the various clubs and not for

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general use by the public. The eastern jetty of the Manly Wharf development is leased for use by a variety of commercial operators.

The lack of public wharf facilities within the study area results in vessels having to beach themselves. This activity has the potential to increase conflicts between (and potentially the safety of) beach users, particularly during peak summer and holiday periods.

Parking

The close proximity of the study area to the Manly town centre and major transport link of Manly Wharf results in high visitation and limited parking availability. On-street parking within the study area is limited to a maximum of 2 hours. Limited parking is also available off Commonwealth Parade above the Manly Pavilion building.

In September 2001, Council engaged Consultants to undertake a Resident Parking Scheme Investigation on the Manly Area. Subsequently, resident permit parking schemes were introduced by Council to give priority to residents for on-street parking near their homes. Vehicles displaying a valid parking permit and parked within the relevant areas are exempt from timed parking restrictions. Permits must be renewed annually. This has also restricted parking opportunities.

Locked Gates

There are presently (2) locked gates restricting vehicular access within the study area:

- A locked gate restricts vehicle access onto the Manly Scenic Walkway at the point immediately west-south-west of the Manly Pavilion building and off Commonwealth Parade. Keys are held by Council's staff only.
- A vehicle access road is provided to the western end of the study area which includes Manly Art Gallery, Manly Water Works and Oceanworld. A locked boom gate system applies to users of this access point with the parking of vehicles for extended periods prohibited (**Figure 9.3.17b**). Keys are provided to commercial operators and relevant Council staff.



Figure 9.3.17b – Vehicle access to Manly Cove west and Ocean World

9.4 HERITAGE SITES / ITEMS

An item / site with historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic history and importance have a heritage value. These are, very often, specified in an inventory of heritage items made by different authorities and for different purposes. These can have global to local significance.

The NSW *Heritage Act 1977* provides for heritage management by government agencies. Section 170 of the *Heritage Act* outlines the special obligations of government agencies. In relation to conservation of local heritage, Manly Council is also committed:

- i. to promote the Manly Council area's environmental heritage and celebrate its diverse environment, including architecture, Aboriginal archaeology, industrial archaeology and landscape;
- ii. to set a good example with the Manly Council area's heritage and guide, encourage and educate others to further the appropriate conservation of the heritage items they own or administer; and
- iii. to continue an active program of public information and participation in heritage and conservation matters.

9.4.1 Aboriginal Heritage

Aboriginal places and objects are an important part of the rich heritage of Manly and are of great significance to Aboriginal communities, providing links to culture, environment and knowledge. The oldest Aboriginal site known in the Manly LGA is dated to about 4100 years before present. European development has had a great impact on Aboriginal heritage in these areas. It is important to look after and protect these special places for future generations. Coastal and foreshore areas are generally considered to have very high potential for Aboriginal sites. Sites can be found immediately above the tidal zone, on slopes above foreshore areas, and on ridge tops.

Manly Council, jointly with 6 councils, has established the Aboriginal Heritage Office (AHO) in a progressive move to protect Aboriginal Heritage in these areas. The office has prepared 3 volumes Aboriginal Site Management Report for Manly Council (2006). Part of the work of the Aboriginal Heritage office is to monitor these Aboriginal sites on a day to day basis. There are a total of 107 sites for Manly, of which 62 are considered to be within Council's direct or indirect planning and assessment responsibility. As information about some places is restricted by cultural protocols and relevant legislative regulations (*NSW Heritage Office* guidelines, *NPWS Act* and Aboriginal Heritage Information Management System database: *AHIMS*), the information offered must not be made public.

The Manly Cove study area provided shelter in all weather conditions in the various bays and valleys, with the extensive sandstone outcrops providing an abundance of overhangs and caves. There was also an abundance of food resources and fresh water, as evidenced by the many and extensive middens that can be found throughout. In excess of 1500 Aboriginal middens have been recorded along the coast, primarily as open sites (Sullivan 1988). Many middens are situated in rock shelters, reflective of relative abundance of cavernous overhangs to the shoreline. Middens are observed to be of varying size and length. Mounded middens are also found on the south coast. Estuarine shell fish species comprise approximately 50% of the shell in middens along the coast. Oyster is the dominant shell fish throughout the deposit. Most midden sites are within 200 meters of a water supply.

The AHO has recorded at least 5 Aboriginal sites within the study area (AHO & MC 2006). This includes the following types (there can be more than one feature at one site):

• Burial Site	• Open middens
• Shelters	• Rock Engravings

Further details of individual sites are as follows::

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- A burial and shelter site is situated on East Esplanade Reserve. Remains were recorded and exhumed in 1938 and the area covered with fill and grassed over in 1990. Possibility of further material is considered high.
- Shelter is in East Esplanade Reserve west. The site consists of two small rock shelters facing west.
- A rock shelter exists adjacent to Eustace Street. A large hollowed boulder of two levels includes visible hand stencil. A shell midden is recorded with oyster and cockle shells. Several potential shelter sites are located either side of the shelter.
- A rock engraving is located on a prominent rock ledge in the Fairlight Estate. The figure is a whale, and has a line cut across the body, posteriorly to the large fin. There is also a small foliated figure cut within the outline of the whale.

Historically, skeletal remains of Aboriginal descendents are recorded as having been removed from the Manly Cove' midden. Some artefacts recovered from the Manly Cove study area have been taken to the Mining & Geological Museum. Other remains are held by the University of Sydney and the Australian Museum. Foley documented the last skeletal remains as having been removed from Manly Cove in the 1970s.

An article in the Manly Daily recorded that: "*In the late 1980s relics and remains were found by two local men " which included engravings, hand stencils inside a rock shelter, a midden and the remains of several Aboriginals."* (MD, 1997). Eighteen rock carvings have been found on the land nearby to Manly Cove, which is now Sydney Harbour National Park. However, much of the evidence of Indigenous occupation and lifestyle has been lost due to extensive land modification and urban development since European arrival.

However, due to potential sensitivities in mapping specific sites and locations of Aboriginal significance, maps and detailed descriptions have not been included in this report. It is likely that further sites will be present in areas that have not been surveyed or where they are not visible at the surface. Aboriginal sites are vulnerable to many of the same processes that affect other assets, such as erosion, encroachments, development and earthworks, pedestrian traffic, graffiti and so on.

Based on landscapes or physical setting, the likely range of cultural evidence associated with the landscape and the landscape history, AHO & MC (2006) has identified Esplanade Park as exhibiting high potential area to find further Aboriginal sites.

General Recommendations for Aboriginal Heritage Management

The most succinct recommendation attached to *ad hoc* Aboriginal heritage management is "When in doubt, don't!" Any Aboriginal conservation works must be undertaken with the full co-operation and consent of the Metropolitan Local Aboriginal Lands Council. Bush regeneration works must be undertaken only after advice from Council's Aboriginal Heritage Officer who is available to conduct a field assessment.

Where there are grassed surfaces adjacent then the management practice should include periodic slashing in favour of mowing, tilling or planting of large shrubs or trees. This method means that sites are not interfered with and that sufficient flora exists to retain stormwater and prevent erosion and movement of material down slope.

Retention of sufficient vegetation over a deposit site is a prerequisite for preventing stormwater erosion or movement of deposit down slope. Many sites have only several centimetres of soil or vegetation protection and the retention of five to ten metres of curtilage protects sites from the majority of stormwater events.

AHO & MC (2006) made further two sets of recommendations:

Education & Training

1. Provide a Council Public Education Kit outlining information for residents and developers on the following:
 - Aboriginal culture of the North Shore

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- Significance of Aboriginal heritage
 - Site Identification
 - Aboriginal Heritage Office
 - The Metropolitan Local Aboriginal Land Council
 - The National Parks & Wildlife Service (Aboriginal Heritage Division)
 - Information for developers regarding restrictions and legislations
 - Information for Residents on issues relating to their land
 - Cultural Walks in Manly
 - General information on Manly
2. Education programs to school and the wider community
 3. Implement training in site & heritage awareness for Council and Bush care teams
 4. Train contractors working in bush generation or any work that involves weed removal and replanting in Aboriginal site identification and cultural awareness

Site Protection

- Keep site from general public knowledge
- Site may need regular monitoring
- No water or soil to be dumped near site
- Note site is of a high priority and should be protected at all costs
- Signage to be erected notifying of NPW legislation
- Signage showing some interpretation
- Fence off site
- Removal of graffiti and rubbish from area of site
- Bush care should not remove any plants from site
- Stop campers and day picnickers from using site
- Further education about the significance of this site
- Fire Management is implemented
- Consultation with the MLALC
- Site is a PAD and should be fully tested before works in this area
- If the site within private property, notify owner of the site as to the protection of the site under the NPW Act (refer to Section 149 certificate mechanism). Additional protection works may be undertaken around site to ensure its conservation during any works in a given area

9.4.2 Built Heritage (European)

Manly is rich in built heritage representing the historic development of the Manly Local Government Area (LGA). The community and Council seek to preserve the Manly LGA heritage and encourage sensitive management and conservation of heritage items both within public and private ownership. Retention and enhancement of the environmental integrity of the Manly Cove study area was also an important management recommendation identified in the community consultation process.

A list of architectural and archaeological items existing in the study area, built during European settlement period, as listed in different documents, is presented in **Table 9.4.2**.

Table 9.4.2 – Items of the architectural and archaeological items in the Manly Cove study area

ITEM	ADDRESS
Listed under State heritage Register	
Manly Cove Pavilion	West Esplanade, Manly



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ITEM	ADDRESS
Manly Wharf	
Listed under s.170 NSW State Agency Heritage Register	
Manly Cove Pavilion	West Esplanade, Manly
Manly Wharf	
Listed under Manly Regional Environmental Plan	
Manly Wharf	
Manly Rowing & Sailing Club	East Esplanade, Manly
Remains of Manly public baths	East Esplanade, Manly
Site and remains of Brightside cargo wharf	East Esplanade, Manly
Site and remains of harbour side pool and steps	East Esplanade, Manly
Site of Manly Fun Pier	Manly Wharf
Listed under Manly Local Environmental Plan	
Manly Cove Pavilion.	West Esplanade, Manly
Manly Wharf.	
Manly Wharf (façade & street returns only).	
Auckland Garage	Crn Gilbert Street and West Promenade, Manly.
Harbour Foreshores	Extent of Municipal boundary adjacent to the Harbour
Ilchester	46-48 East Esplanade, Manly
Item Residential buildings (private)	41-42 East Esplanade, Manly
Kilburn Towers	1 Addison Rd, Manly
Manly Dressing Pavilion Amenities Block	West Esplanade, Manly
Manly Fun Pier.	Manly Wharf
Manly Rowing and Sailing Club group of Buildings	East Esplanade, Manly
Merriwa, Residential buildings (private)	10 Wood Street Manly
Monument East Esplanade, Manly (marble monument erected on stone base).	West Esplanade, Manly
Monument Governor Phillip	West Esplanade, Manly

Source: Schedule 4 of Manly LEP 1988 (updated September 2006) (*Refer Clause 7*), *Manly Council Heritage Registrar*.



Figure 9.4.2 - Damage to Stewarts Boat Shed (Manly Launch Club) following 1974 storms

9.4.3 Natural Heritage

Landscape items, as listed in Manly LEP, are declared as heritage items and are presented in **Table 9.4.3**.

Table 9.4.3 – Landscape items, as environmental heritage, in the Manly Cove study area

ITEM	ADDRESS
Landscape Items	
Street Trees	Addison Rd (Bruce Ave to Reddall St)
Street Trees	Ashburner St
Monument	East Esplanade
Harbour Foreshores	Manly Municipal area boundary adjacent to the Harbour
East Esplanade Park	Manly Cove
West Esplanade Park	Manly Cove

Source: Schedule 4 of Manly LEP 1988 (updated September 2006) (*Refer Clause 7*)

10. COMMUNITY CONSULTATION: KEY ISSUES & THEIR MANAGEMENT

A vital part in the coastal management planning process is community involvement and action. Hence, the coastal management planning process requires widespread community awareness, cooperation and action.

This section provides a brief outline of community perceptions on key issues and their management identified through the consultation process undertaken in the development of the Manly Cove Coastline Management Plan.

The following section provides a brief outline of the consultation process undertaken in the development of the Manly Cove Coastal Management Plan. Community and stakeholder comment was sought in a number of ways.

Council held a number of community consultation events allowing residents (and visitors) of Manly to contribute to the identification of issues and opportunities for improvement which will then be incorporated into the Draft plan.

Extensive questionnaires were distributed at community events, via the Precincts and internet and through letter box drops. The Harbour Foreshores & Coastline Management Committee provided significant input into shaping these consultation events to ensure that they are appropriate for Council and stakeholders.

Consultation enabled the identification of the values and significance of the Manly Cove study area as a whole and for key features. Coastal processes, coastline hazards and current uses which may affect these values are described throughout this report.

10.1 COMMUNITY CONSULTATION

To be successful the Manly Cove Coastal Management Plan must incorporate the knowledge and support of the local community. Council actively involved representatives of the community in the preparation and review of the plan through involvement on the Manly Harbour Foreshores & Coastline Management Committee, community consultation events as well as via submissions and questionnaires.

Two separate opportunities were utilised for consultation including:

- Hill to Harbour Community Walk Tania Park to Manly Cove (3 September 2005), and;
- 'Boats and Beasties' Marine Environment Workshop East Esplanade (17 September 2005)

A call for community submissions was advertised in the 8 October 2005 Manly Daily and temporary display was set up in the library foyer which explains the CMP process and encourages community feedback.

A series of poster boards were displayed in the Manly Library Foyer and at community events to encourage additional feedback. The boards described the CMP development process as well as identifying a number of key issues. Copies of the poster display boards are also included in Appendix B.

Structured survey forms were prepared and distributed to obtain community responses on importance, key issues and specific suggestions for inclusion in the Coastline Management Plan. An advertisement was also placed in the Manly Daily calling for community submissions. An item was also included in the relevant Precinct newsletters

Consultation with the Little Manly, Fairlight, The Corso and Balgowlah Heights Precincts was undertaken through those representatives on the Manly Harbour Foreshores Management Committee, through written

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correspondence and calls for submissions placed in local media and on the Manly Council Website. Issues raised at Precinct committee meetings were reviewed and integrated into the community consultation process.

A total of 89 survey forms were returned from the community and community consultation events. Among them, 89% were from Manly residents who are regular visitors to Manly Cove, 11% were derived from day trippers and 1 survey from an overseas visitor.

In order to establish holistic management strategies, land and aquatic areas outside the study area boundaries, which impact on the biophysical or social environment within the boundary, must also be considered in development of the Plan. While Council does not have management responsibilities or jurisdiction for a number of the issues considered in this CMP, Council sought to liaise with relevant state government agencies responsible for each of those issues during the development of the CMP.

It is noted that this Plan may not reflect the complete thoughts, ideas and perspectives of those agencies however Council will seek their endorsement of the Plan and their commitment to its implementation.

Letters were distributed to stakeholders requesting written submissions with feedback provided by a number of key stakeholders. Further feedback was obtained from relevant government agencies via representation on the Harbour Foreshores Management Committee.

Comments on Community Consultation

- *"From what I heard, you (Council) are covering issues well"*
- *"I think that the Harbour Foreshores Committee is doing an excellent job. The Cove looks to be well maintained and proves to be a popular area of Manly"*
- *"Congratulations to Manly Council for doing a wonderful job with the management of the Manly Cove - much appreciated".*
- *"The council does a good job generally".*
- *"I am very impressed with today's (consultation) setup. There is a lot of information I have brought into consideration that I was not aware of before today".*
- *"Keep up the good work".*

10.2 IDENTIFICATION OF ISSUES

A total of 14 issues were identified on the questionnaire. Respondents were requested to identify issues of importance within the study area from among these 14 identified issues. **Figure 10.2a** identifies the most frequent responses to issues with the top six including:

- Protection of the aquatic environment (87%),
- The ability to undertake recreational activities (79%),
- Retaining aesthetic values of the area (77%),
- Protection of the Little Penguin population (77%),
- Maintenance of heritage values (76%); and,
- The provision of waste/recycling facilities (75%).

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The responses clearly highlighted that the community are aware of their local environment and eager to preserve aquatic habitats and threatened species within Manly Cove (and beyond). Respondents recognised the important roles Council (and other stakeholders) play in protecting marine environments and minimising waste through education, regulation and the provision of recycling systems. Further, the visual characteristics of the Manly Cove study area, from both overall aesthetics and a heritage perspective, were considered to be important to respondents.

However, the community wanted to maintain and improve their ability to undertake the range of recreational pursuits on offer within the study area, highlighting potential conflict between use and preservation of existing values.

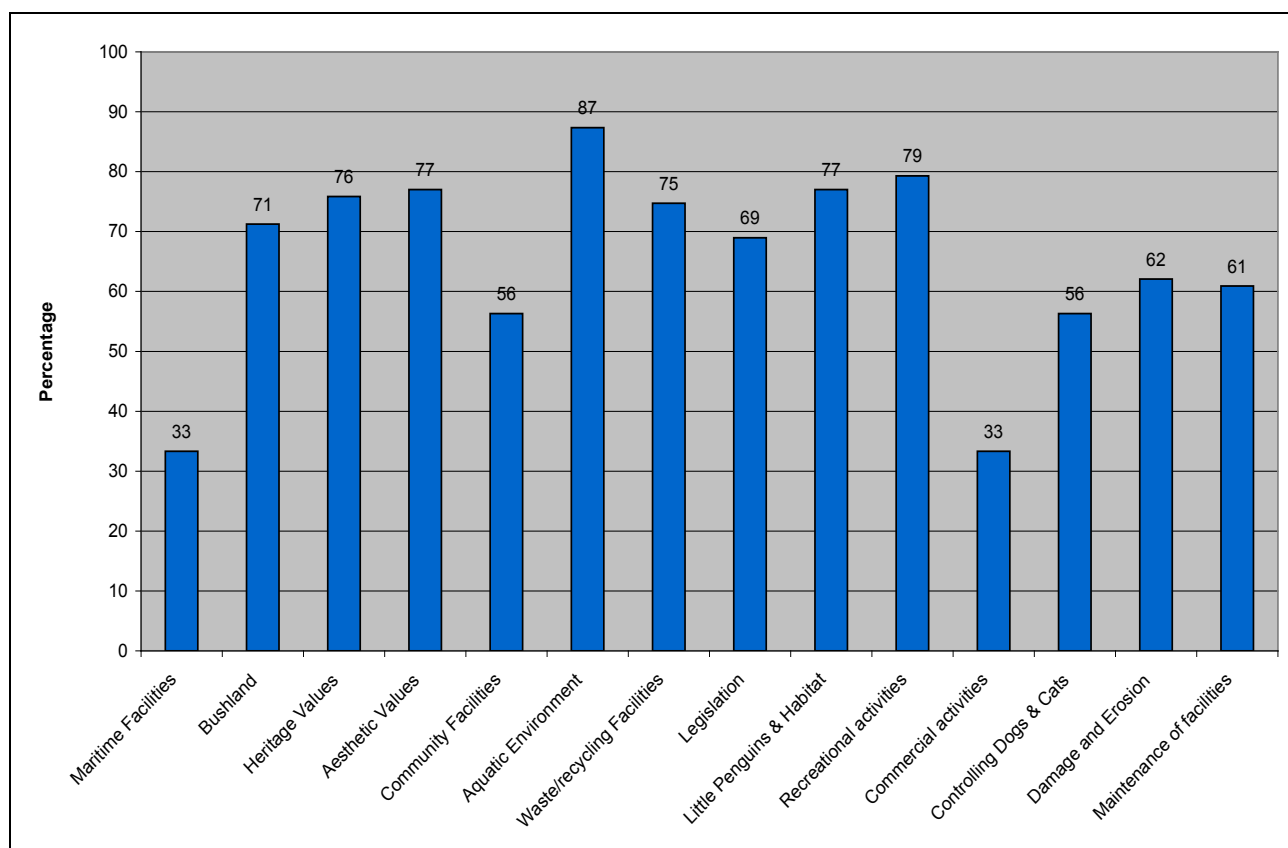


Figure 10.2a – Issues of importance identified through community consultation

A full compilations of specific comments recorded within the questionnaires is provided in **Appendix A**.

Respondents to the questionnaire were also asked to indicate the level of importance that they gave to eleven *activities* undertaken within Manly Cove. The results clearly identified the importance of Manly Cove as an exercise haven (See **Figure 10.2b**) with the following activities considered the most important to respondents:

- Walking and/or jogging (84%);
- Swimming (68%);
- Passive Recreation (63%);
- Picnicking (53%); and
- Commuting (43%)

It is the intention of the Manly Cove CMP to maintain existing recreational use trends of the Manly Cove study area in balance with environmental protection. It is important for Council and other stakeholders to ensure safe,

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well maintained and user friendly facilities are provided to residents and visitors. Such facilities must also sufficiently compliment the visual character of the study area.

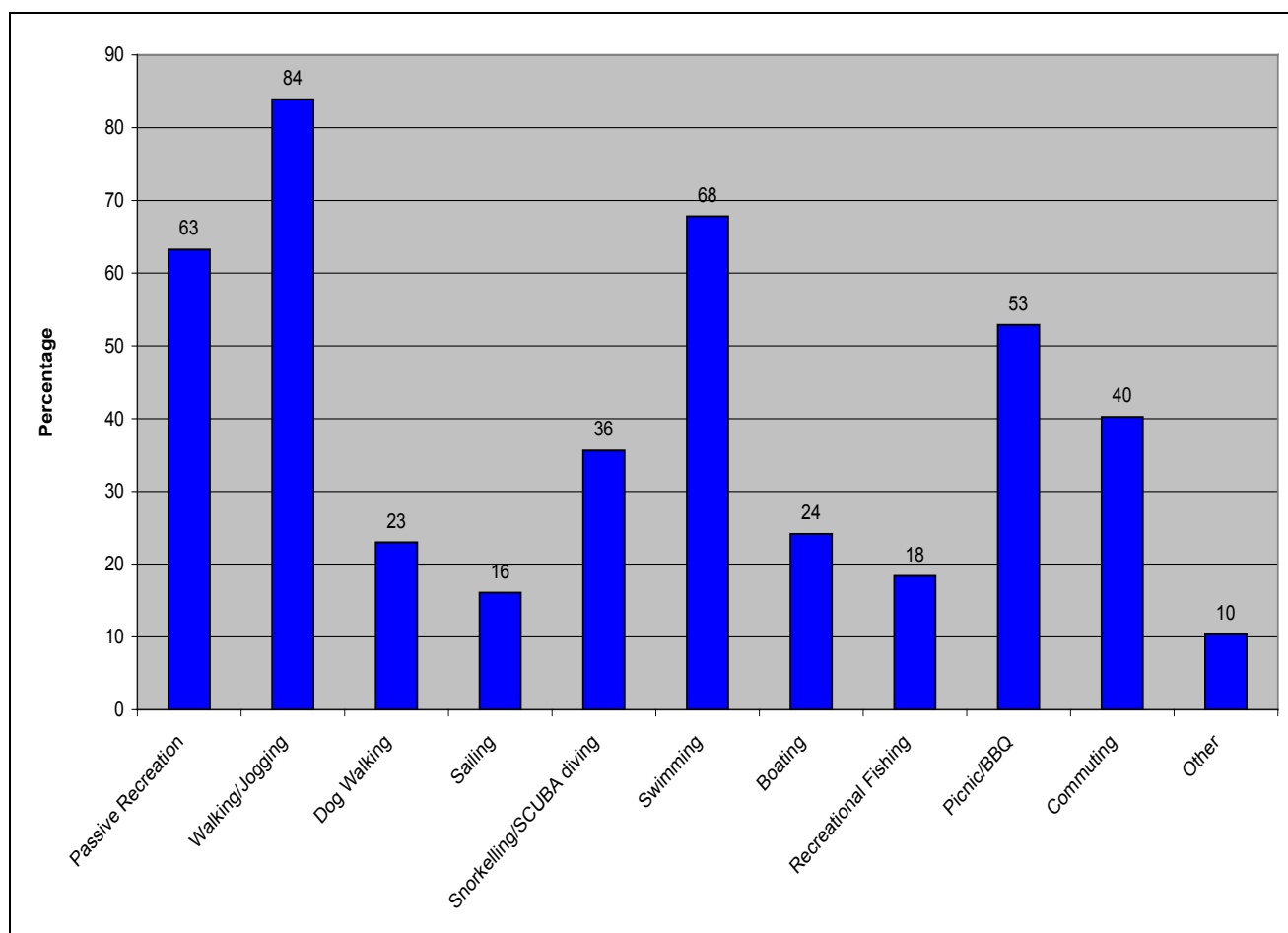


Figure 10.2b– Activities of importance identified through community consultation

Comments were also sourced from individuals who did not complete formal questionnaires. The most frequent written responses received during the “written” consultation process relate to:

- Water quality and the need to minimise pollution resulting from both terrestrial (sewerage, stormwater) and maritime sources (water borne pollutants, boating waste);
- Aquatic ecology - protection and management of threatened species and habitat value, improved controls on recreational fishing activity;
- The provision of facilities and opportunities for recreational activities;
- Heritage management must ensure the protection of values for built and natural environments;
- Waste management including need for additional waste facilities and improved cleaning regime;
- Speed of JetCats within study area and impact upon user groups and water-based development (JetCats were replaced by fast Ferries in April 2009);
- The degree of high-rise development and the need to sustain the visual appeal of the study area which provides an important "gateway" to Manly;
- Beach erosion and recession - sand volumes in relation to beach access;

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- Need for improved environmental education for residents and visitors;
- Access through and from the study area including need to improve access to "club precinct" and East Manly Cove Beach;
- Traffic management for both pedestrian and motor vehicles need to be reviewed and improved.

Issues Raised by Community Precinct Forums

Consultation with the Little Manly, Fairlight, The Corso and Balgowlah Heights Precincts was undertaken through those representatives on the Manly Harbour Foreshores & Coastline Management Committee. Issues raised by Precinct Committees meetings between 01/01/2005 and 01/01/2007 were recorded and integrated into the community consultation process. Issues relating to Manly Cove identified from Precinct include:

Aquatic Issues

- Concern of knowledge gap in the distribution of seagrass beds
- Request for seaweed to be cleared from the Beaches
- Concern over widespread increase in the noxious weed *Caulerpa taxifolia* throughout Sydney Harbour with 5 hectares in North Harbour
- Concern over impact of commercial fishing activity on fish stocks and penguin feeding (commercial fishing has since been excluded from within Sydney Harbour)
- Call to protect Little Penguin habitat through staged bush regeneration
- Need for conservation of marine ecology through Aquatic Reserve expansion and improved management
- Concern in regard to protection of seahorse habitat and influence of cleaning regime on netted swimming enclosure

Interconnected Issues

- Concern over expanded use of East Esplanade Reserve by skiff sailing activities, need for Council to manage long term skiff storage
- Pollution at East Esplanade
- Request for seaweed to be cleared from the Beaches
- Concern at Dive Operators beaching in Manly Cove to pick up/drop off dive groups
- Precinct opposition to lifting of Sydney Harbour PWC ban
- Need for Sydney Water SewerFix to address overflows in Manly Cove East
- Support for provision of kayak hire operations
- Noise pollution emanating from boating precinct, Manly Wharf and boat users

Terrestrial Issues

- Residents propose that all Port Jackson Fig, Moreton Bay Fig and Tuckeroo trees together with all Norfolk Island Pines be placed on the Heritage Register
- Need for community reporting of crime and safety issues and identified need for improved Ranger patrols, CCTV and lighting.
- Need for Council to provide additional bins increases in rubbish experienced during peak visitation periods.
- Beach cleaning machines do not pick up cigarette butts off the beach
- Call for improved signage for public toilets
- Precinct pointed out that the anti social behaviour was generated by alcohol and that this should be the main focus of council
- Perceived lack of shade and thinning of the canopy near the art gallery
- Need for improved access for disabled sailors, prams and elderly adjacent to Manly Yacht Club.
- Lack of playground equipment in the area
- Rubbish & Noise from late night goers

10.3 KEY MANAGEMENT ISSUES

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A long list of management issues was identified during the public consultation process, mainly through completed survey forms (**Appendix A**). Further, specific local issues were derived during community consultation field days. These issues were presented and discussed at the Harbour Foreshore Management Committee meeting. The issues are summarised into management issues which are relevant to the entire study area and those which relate to a specific location, as identified in **Table 10.3** below.

Table 10.3 – Key management issues for Manly Cove study area

Study Area Wide Issues	Specific Area Issues
• Water Quality • Waste Management • Beach Erosion and Recession • Sea Level Rise and Coastal Inundation • Cliff & Slope Instability • Recreation & Competing Beach User Groups • Aquatic/Inter-tidal Habitat Conservation & Species Management • Conservation of Items of Heritage Significance • Threatened Species Conservation • Access	• Litter Accumulation & Beach Raking Practices • Eastern Foreshores & Club Precinct • Manly Wharf • Manly Cove West • Stormwater Erosion • Maintenance of Netted Swimming Enclosure

10.4 MANAGING KEY ISSUES

Identification of management issues was based on consultation with groups of internal (Manly Council staff) and external stakeholders (namely members of the Manly Coastal Management Committee including community and government representatives). Feedback was also obtained from community and Precincts through questionnaires, submissions and comments provided throughout the CMP development process. The NSW Coastline Management Manual (1990) was also used to guide the development of the Plan.

10.4.1 Study Area Wide Issues

Water Quality

Water quality in Manly Cove is generally of high standard due to the close proximity to the open ocean and resultant regular tidal flushing of the adjacent waters. However, during periods of heavy rain, water quality is known to be impacted by stormwater and sewage exfiltration/leaks delivered from the surrounding sub-catchments.

Review of available water quality data indicates that compliance with swimming guidelines within Manly Cove is generally high. During 2005-2006 Harbourwatch compliance was very good with results meeting *faecal coliform* and *enterococci* guidelines 100% of the time during both summer and winter.

Harbourwatch data recorded over the past decade appears to highlight improvements in water quality within Manly Cove. While these improvements may be attributed to improvements made to the existing sewerage system performance, these trends may be also influenced by sampling applied to the Harbourwatch monitoring regime and/or a decrease in rainfall experienced over this period.

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Despite the apparent improvements in water quality, algal blooms have been observed within the waters of Manly Cove over the 2006/2007 period, suggesting that the marine environment may exhibit high nutrient loading. The main sources of pollutants within the study area include:

- Stormwater pipes - 17 stormwater outlets collect overland flows from 12 sub-catchments over a range of land-use types.
- Sewerage Infrastructure - an extensive sewerage network exists across the study area including four designed overflows, two pumping stations and major sewerage lines transporting sewage from northern Sydney to North Head Treatment Plant. Much of the system is degraded and in need of improvement.

Management should take into account the complete urban water cycle in order to include all water flows, such as water supply, stormwater and wastewater. These flows have quantitative and qualitative impacts on land, water and biodiversity, and the public's aesthetic and recreational enjoyment of waterways.

Waste Management

Despite the presence of a range of rubbish bins within the Manly Cove study area, litter, both from harbour and land based activities, presents a continuing issue for the management and aesthetic quality of the Manly Cove study area. The high level of human activity on the harbour and surrounding urban areas contributes to an undesirably large amount of litter accumulating on harbour beaches.

The Manly Council Waste Management Committee have for many years campaigned for waste avoidance and minimisation, particularly within the commercial sector. Part of this campaign included writing to take away food outlets, especially those located at Manly Wharf, requesting the implementation of waste avoidance measures such as biodegradable packaging be introduced.

In addition, some outlets have been approached in person to remind management of their responsibility regarding the management of waste and reminding them of their own environmental care statements within corporate handbooks and reports. As the public waste bins at Manly Wharf are the responsibility of Wharf Management and not Manly Council, Council is unable to alter infrastructure such as the number and/or volume of bins.

Further problems arise when people leave waste, namely leftover food items on picnic tables and in open space areas. Birds, namely seagulls and pigeons, swoop to collect the food, scattering plastic and paper debris. Smaller pieces of litter are often collected in the birds' beaks and discarded elsewhere, generally over the water to be washed back onto the sandy beaches of Manly Cove.

The Manly Waste Committee expressed concerns about the effects of removing bins from Ferries, including waste overboard and the increased litter pressure on Manly in October 2004. Formal correspondence was sent to seek a response from Sydney Ferries on methods for addressing the problems, including announcements on the Ferries. Sydney Ferries now supply garbage bags at points of disembarking for waste disposal, however there has been no discussion to date on having then bins placed back on board the vessels.

Litter is of concern because it:

- reduces the aesthetic appeal of public places including streets, parks and waterways;
- can affect aquatic life directly (through physical harm) and indirectly through its impacts on water quality;
- can decrease oxygen levels through decomposition in the water column;
- can cause blockages of the drainage system and flooding;
- can be dangerous to people, particularly when it involves items such as broken glass, needles and syringes;
- may be a fire hazard (lit cigarettes being thrown from vehicles); and
- costs the community significant amounts of money to clean up each year
- Impacts upon the health of marine species including fish, seahorses, turtles and Little Penguins.

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Identified sources of litter in the Manly Cove study area include:

- food/drink containers, cigarette butts, paper, plastic bags etc, carelessly/intentionally deposited or left behind unawares after picnics, barbecues and general usage of the area;
- rubbish thrown from vehicles and boats;
- boat users dumping litter while moored around the Manly Cove embayment;
- illegal dumping of rubbish;
- organic litter accumulating in roadside gutters;
- building sites without adequate litter controls;
- full bins allowing litter to blow away;
- uncollected dog faeces;
- waste material washed onto the beaches from outside sources.

Beach Erosion and Recession

Waves in Manly Cove Beaches generally occur as a result of a combination of ocean swell entering the harbour during storm events and local wind conditions generating wind waves from a south-south-west direction.

Erosion is part of the natural response of a beach to changing wave and water level conditions. During storms, large waves, elevated water levels and strong winds can cause severe erosion to sandy beaches (NSW Government, 1990). The hazard of beach erosion relates to the limit of erosion that could be expected due to a severe storm or from the effects of a series of closely spaced storms.

Shoreline recession due to Greenhouse sea level rise results in a reduction in beach width over time and subsequent loss of beach amenity, and greater risk to foreshore assets.

Shoreline recession is the progressive landward shift of the average long term position of the coastline. Recession is a different phenomena to beach erosion, although they both may be caused by the same processes. The two causes of shoreline recession are sediment loss and an increase in sea levels.

The Manly Cove Beaches are subject to erosion during severe storm events. Manly Cove West Beach is experiencing some relatively minor long term sand loss (recession) possibly as a result of sand which is eroded from the beach during severe storms not being fully reworked back on shore during calmer swell periods, given the degree of shelter at the beach. The longer-term sand loss is expected to increase overtime due to Greenhouse sea level rise, as the beach readjusts to the higher sea level.

The predicted loss in beach width over the next 20 to 50 years due to sediment loss in severe storms and greenhouse sea level rise is, conservatively, in the order of 2 to 4 metres. The current width of the beach, measured at mean sea level, is approximately 20 metres.

Manly Cove East Beach has experienced some relative minor long term sand gain (accretion) between 1974 and 2001. This sand gain is a consequence of artificial sand nourishment placed at the western end of the beach to address the narrow beach width at this location. The natural beach behaviour is though to be one of relative stability or slight recession. Any longer term sand loss is expected to increase overtime due to Greenhouse sea level rise, as the beach readjusts to the higher sea level.

The predicted loss in beach width over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 5 to 10 metres. The current width of the beach, measured at mean sea level, is approximately 0 to 15 metres, highlighting the need for additional beach nourishment to be undertaken.

Sea Level Rise and Coastal Inundation

Predicted global warming could lead to a number of changes in climate, weather and sea levels. These in turn could cause significant changes to coastal processes with other changes in climate, such as rainfall, storm intensity/frequency and sea-level rise likely to be associated with this warming. On a local scale, the increased

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severity and frequency of storms will create increased wave heights and, therefore, erosion potential (NSW Government, 1990).

In addition to climate change, global warming may also produce a worldwide sea level rise (eustatic rise). The Fourth IPCC Report was released during early 2007 and included a Summary for Policy Makers. The Summary for Policy Makers (SPM) cited a range of 18 to 59 cm.

The main conclusions of this analysis is that sea level uncertainty is not smaller than it was at the time of the IPCCs Third Assessment Report, and that quoting the 18-59cm range of sea level rise does not identify the "worst case" due to a number of uncertainties currently experienced.

Regardless of the degree of sea level rise, it will result in shoreline recession through two mechanisms: first by drowning low lying land, and second, by shoreline readjustments to the new higher coastal water levels. The second mechanism is probably the more important: deeper offshore waters expose the coast to attack by larger waves; the nearshore refraction and diffraction behaviour of waves will change. It is anticipated that sediment located within Manly Cove will move offshore as the beach seeks its new equilibrium profile, however this movement will be less than that expected on open coastal beaches (PBP, 2004). In some cases, the magnitude of the slope and cliff instability hazard, and the design of stabilisation measures, would be influenced by climate change such as an increase in sea level and increased storm frequency, intensity and duration.

During February 2009 the NSW Government released a Technical Note to support the *Draft Sea Level Rise Policy Statement*. The Policy Statement includes sea level rise planning benchmarks that can be used for sea level rise adaptation and also for consideration when land-use planning and development decisions are made for coastal areas.

The Policy Statement's sea level rise planning benchmarks are an increase above 1990 mean sea levels of 40 cm by 2050 and 90 cm by 2100. The components of these sea level rise planning benchmarks are noted in Table 7.2b, with details of the derivation of these components provided in the full document. These benchmarks were based on the sea level rise projections developed by Australian and international experts and considered most appropriate for NSW, while acknowledging the uncertainty associated with these projections.

Cliff & Slope Instability

Slope and cliff instability hazards refer to the possible structural incompetence of these features and associated potential problems with the foundations of buildings, seawalls and other coastal works (NSW Government, 1990).

During 2004, Council undertook a Coastline Hazard Definition for areas between Davis Marina and Manly Point to identify potential slope and cliff instability hazards and the likely consequences should a hazard occur. These investigations involved surface investigations of the topographic, surface drainage and geological conditions of the foreshore, cliffline and surrounding area of the study area. Investigations were carried out from a boat and on foot.

The assessment methodology involved rating the 'likelihood' of a hazard occurring and rating the 'consequence to property' of the hazard occurring. These ratings, when combined determined the 'Risk Level Implication' which range from 'very low risk' to very high risk'. Refer to the Davis Marina to Manly Point Coastline Hazard Definition Study for further information.

The slope and cliff instability hazards relating to private properties may restrict future development of the site. Council has formally notified a number of private property owners that their properties may be potentially affected by specific hazards identified through the CHDS process. This was done in the form of a letter to each owner notifying the nature of the hazard, the extent (if known), any recommendations from the CHDS and that a copy of the report is available upon request. Concurrently hazard information will also be recorded on 149 Certificates for those properties affected.

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The remediation of hazards identified on public land is the responsibility of Council who has gained external funding to conduct further geotechnical assessments as recommended within the original CHDS. Once completed the additional geotechnical assessments will enable Council to prioritise remediation based on the level of risk posed to both life and property by individual hazards.

The geotechnical assessment associated with the Davis Marina to Manly Point Coastline Hazard Definition Study identified the following potential hazards within Manly Cove study area:

- localized erosion of undercuts and overhangs with subsequent rock falls from part of the cliffline;
- toppling (or forward rotation) of blocks/overhangs and rock falls from parts of the cliffline;

In addition the following coastal hazards were identified in specific locations:

- collapse of overhang or undercut feature within the cliffline causing collapse of rear yards, retaining walls, footbridge and/or staircases above and consequently impacting on coastal path. Fig trees growing over cliffline or outcrop could also be destabilised;
- collapse of dilapidated structures including retaining walls and staircases impacting on coastal path above or below structure;
- collapse of existing piers, underpins and/or sandstone masonry walls etc supporting overhangs and undercuts within the cliffline or detached blocks, causing collapse of the above portion of cliffline or detached block;
- earth slide of the existing fill slopes adjacent to foreshore;
- earth slide of over-steep excavation batters;
- earth slide of over-steep existing colluvial slopes.



Figure 10.4.1 - Potential cliff and slope instability hazards identified within the Manly Cove

A number of potential stabilisation works have been recommended, which may involve erecting such structures as concrete or masonry piers, rock bolts or removal of overhangs. Prior to any such works being undertaken it is important to evaluate the impact of those structures on the area's heritage, amenity and physical environments. These impacts should be carefully weighed against the level of risk in order to determine whether the works and their impacts are justified before proceeding.

Recreation & Competing Beach User Groups

While Manly Cove serves as a major transport and commuter access point, the study area also provides opportunities for a wide range of water and land-based recreational activities. Community consultation survey results highlighted that 80% of people surveyed considered the ability to undertake recreational activities as being of importance to them. As such, Council aims to enhance usability of the foreshore by improving access

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and safety and encouraging water based recreational activities such as sailing, kayaking, swimming and boating.

The impact of recreational activities upon the environment is exacerbated through the high visitor numbers observed within Manly Cove. However, the hardened and managed nature of the promenade and parklands minimises these impacts for much of the study area. Most effects will be indirect - such as litter impacts upon aquatic and terrestrial species, sunscreen dispersal and its impact upon local water quality/aquatic organisms, damage to rock platforms, fuel and pollutant discharge from motorised craft, minor recreational fishing impacts and resource usage and energy implications of the study areas role as a major tourist destination.

The high visitor numbers also result in a number of conflicts between recreational groups. Issues relating to recreational use of the study area that warrant consideration in the preparation and implementation of the Manly Cove Coastline Management Plan include:

- Potential safety of swimmers through recreational boat movement - power boats are often observed moving in close proximity to swimmers while "beaching" vessels in Manly Cove;
- Potential conflict between kayakers/non-motorised vessels with Ferry and fast ferry movements due to the minimal warning provided when commuter vessels leave Manly Wharf in a southerly direction;
- Impact of Skiff sailboat rigging activities upon the general use of East Esplanade Reserve. While this activity has been ongoing for many years and contributes to the historic use of Manly Cove, rigging during weekend competition often results in East Esplanade Reserve being dominated by one use and undesirable for many users. is particularly evident during summer weekends;
- Boat wakes created as a result of fast ferry movement from Manly Wharf results in disruption and safety issues for water-based recreation activities in the eastern 'boating precinct'. The impacts are particularly evident for Sailability activities.
- Conflicts between cyclists and other users continue despite cycling being currently banned in Esplanade Park. Prohibition is advised by 'No Bicycle' stencils on the path surface at each entry, on the footpath, and on pole signs.

Council has received advice from its Risk Manager regarding cycling in Esplanade Park and the potential public safety risk. The key aspects of this advice are that:

- The path is already too narrow for current use;
- Cycling would lead to a conflict with pedestrians. Due to the risk of collision, the behaviour of current users would need to be modified if cyclists were permitted on the path. Parents of small children who can now relax and permit them to run along the path would not be able to do so were cycling permitted.
- Cycling would lead to a conflict with dogs. Dogs are allowed to be off leash in this area. This would pose a hazard to cyclists if they were permitted to ride along the path. The off-leash policy would need to be reconsidered if the ban on cycling were lifted.
- Conflicts between pedestrians and traffic are common due to the high pedestrian and traffic movements between Manly Cove and Manly Corso;
- Concerns relating to conflicts between companion animals and other users - conflicts may now decrease following the declaration of the area between Federation Point and Manly Wharf as a (Little Penguin) Wildlife Protection Area. Specific controls apply to the control of dogs with dog walkers now required to ensure dogs are kept on-leash at all times within this section of East Esplanade Reserve;
- Need for better control of anti-social behaviour and alcohol consumption which has been identified as a problem in a number of locations within the study area. Particular focus to be given to activities of patrons leaving Manly Wharf Bar, Skiff Club and other establishments, as well as groups known to consume alcohol in East and West Esplanade Reserves;
- A number of general concerns have been expressed regarding diver use of the area. These have predominantly been related to pre- and post-dive land-based use of West Esplanade reserve as opposed

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to any problems with the actual dive activities or impact on biodiversity and habitat. One concern relates to congregation of divers and their equipment in the boat launching area and on the beach.

- Despite the activity being prohibited on Manly Wharf the activities of recreational fishers often result in negative impacts upon the amenity of the area for visitors, residents and commuters through improper disposal of waste and potential for injury through fishing practices.
- Sand quality and coverage is a critical determinant of visitor satisfaction on Manly Cove beaches. Substantial long-term reductions in sand area, or sand quality, would adversely impact upon visitors' enjoyment of the area.
- Visitor use of Manly Cove may be negatively impacted in terms of exacerbated crowding and user conflicts should there be any further reduction in beach sand volumes. This would particularly be the case for Manly Cove east beach which may benefit (from a user and aesthetic perspective) from a beach nourishment exercise.
- Access to the beach zone for people with disabilities or mobility challenges is poor at present and could be improved.
- High usage levels will require that Council continue in the routine high quality maintenance and periodic refurbishment of the landscape works and visitor facilities across the study area in order to maintain current amenity and enjoyment levels.
- Visitors' use and enjoyment of the beach will need to be balanced with the amenity of local residents/neighbours in the area's future development and management.

Aquatic/Inter-tidal Habitat Conservation & Species Management

The ecological issues relating to Manly Cove are related to the potential interaction of socio-cultural and natural systems. Potential impacts to natural systems of Manly Cove are important as they can affect sensitive nearby environments and biota, and effect different user groups of the study area.

Protection of the aquatic environment was considered to be the most important issue for those who provided feedback during the community consultation process. Issues identified include:

- Beach raking - In order to retain appearance of beaches for safety and aesthetic reasons Council undertakes mechanical cleaning of accumulated macro algae (or wrack) from beaches. The removal of wrack may therefore have adverse side effects upon beach ecological processes. Raking may also potentially compact areas of the beach and/or enhance sediment loss.
- Over harvesting of intertidal organisms - The entire foreshore within the Manly Cove study area is utilised as a bait harvesting location and, as a result, biodiversity may be reduced when compared to other areas of Sydney Harbour. The foreshore between Dobroyd and Quarantine Headlands is the only portion of Sydney Harbour not designated as Intertidal Protection Area by NSW Department of Primary Industries.
- Trampling by recreational users - may also contribute to compacting of beach sediments. Barros' (2001) finding that fewer ghost crab burrows were found on urban beaches than non-urban beaches supports this theory.
- Beach nourishment - results in impacts on organisms caused by changes in habitat. In addition, nourished sand may move out of the nourished area to neighbouring habitats or to somewhat deeper water, potentially affecting benthic communities offshore (Verhagen, 1996). An impact of particular concern would be the potential for the movement of sand from a nourished beach to smother seagrass habitats within Manly Cove.
- Water quality - although recent Harbourwatch data for Manly Cove indicates that water quality is generally good during dry weather, Manly Cove is exposed to some stormwater (and sewage) discharges. Marine organisms are sensitive to the impact of pollution and associated increases to nutrient and heavy metal levels, turbidity, temperature etc. and contamination of marine fauna from diseases.

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- Mooring and anchoring - the design and location of the existing mooring systems has resulted in significant degradation of the seagrass habitat through circular dragging of the mooring chains across the seabed. Boat anchoring has a similar impact on marine vegetation and can potentially act as a vector for the re-distribution of *Caulerpa taxifolia* from affected areas adjacent to Manly Cove.
- Lack of available information - very little published information specific Manly Cove is available. More information on the components of the natural systems, and anthropogenic influences upon these systems, will enable better management.

Conservation of Items of Heritage Significance

Manly Cove is rich in its cultural heritage, including indigenous, natural and the built heritage representing the historic development of the Manly Local Government Area. The community and Council seek to preserve items of heritage significance and encourage sensitive management and conservation of heritage items both within public and private ownership.

Issues relating to indigenous heritage that warrant consideration in the preparation and implementation of a Coastline Management Plan for Manly Cove include:

- The active involvement of Aboriginal people and organisations in the management of indigenous cultural heritage. The Metropolitan Local Aboriginal Land Council and Aboriginal Heritage Office (Sydney North) should be consulted and involved in the management and knowledge delivery of Aboriginal cultural sites/values throughout Manly Cove;
- A range of Aboriginal sites were previously identified throughout Manly Cove, and unknown/unrecorded sites may still be found within the study area, despite it being highly modified. The possibility for the existence of unknown/unrecorded Aboriginal sites warrants consideration in the development assessment process;
- Tangible Aboriginal objects and sites are protected by legislation. Any objects and sites located within the study area, including those uncovered during development or management works, will require appropriate protection and management;
- The areas Aboriginal history, heritage, sites and contemporary associations/significance are all of potential interest to residents and visitors.

Issues relating to post-European heritage that warrant consideration in the preparation and implementation of the Manly Cove Coastline Management Plan include the following:

- several identified sites of historic heritage significance occur within or adjacent to the study area. These sites are of different levels of significance and are afforded varying degrees of legislative protection. The impact of any proposed works on the heritage values of these places must in all cases be identified and fully considered in the planning and development process.

Threatened Species Conservation

A number of populations of protected, endangered and vulnerable marine and terrestrial fauna species are found in the vicinity of the Manly Cove study area. Each species will display differing ecological needs and be subjected to a range of varying pressures, and as such must be managed appropriately.

For successful threatened species management it is recommended that elements of research and planning, removal of threats, restoration of habitat, species recovery and mechanisms to retain gains are considered. Species recorded within the Manly Cove study area requiring specific management responses include:

- Little Penguin (*Eudyptula minor*)
- Long-nosed Bandicoot (*Perameles nasuta*)
- Snygnathiiformes - Seahorses, Seadragons & Pipefish

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- Grey-headed flying fox (*Pteropus poliocephalus*)

Access

Discussions with Council's Access Officer, feedback received during community consultation and a review of existing facilities within the Manly Cove area highlighted that the study area provides varying degrees of accessibility.

With Manly Cove, and more specifically Manly Wharf, acting as a major tourist and commuter link, this section of the study area provides safe, well maintained and lit access for a variety of users. However, there are a number of areas which have been identified as requiring improvement in order to meet the standard set by the Access DCP and to meet community needs.

It must be noted that Council discourages access to the foreshore around Manly Point due to the area being designated as critical habitat for the Little Penguin population and the potential risk posed from cliff and slope instability.

10.4.2 Specific Area Issues

Litter Accumulation & Beach Raking Practices

As is the case for many urban beaches, Council contributes significant resources to maintain the aesthetics, amenity, utility and safety of Manly Cove beaches. To achieve this, Council rakes the upper layer of beach sand on a daily basis. A BeachTech 2000 rake/sieve is used to rakes the upper 200mm surface layer of sand, although sifting depends on the conditions and time available. Raking collects litter and debris (e.g. wrack, bottles, cans and cigarette butts) while sieving gives a 'combed' finish to the sand.

As this work must be undertaken during times of least public use (i.e. early morning) there are occasions when litter and wrack may be deposited on beaches after the daily clean takes place. When such reports are received, and where resources permit, manual collection may be undertaken. Numerous responses received during consultation identified the accumulation of rubbish on Manly Cove beaches as being a concern.

While the practice of litter and wrack removal minimises impacts on marine fauna, a number of ecological issues have also been identified in relation to beach raking, including:

- regular removal of wrack may adversely impact upon faunal diversity. Wrack is an essential component to a healthy and diverse sandy beach ecosystem, as it acts as a direct food source and shelter for many species living above the sand (and potentially fish) and provides nutrients to fauna living in the sand (The Ecology Lab, 2006). Hence, its regular wholesale removal through beach cleaning practices is a removal of an important component of the beach ecosystem and ultimately, faunal diversity (The Ecology Lab, 2006).
- regular removal of wrack may result in sand loss and encourage sediment movement - Fairweather and Henry (2003) finding that accumulations of wrack can buffer wave action and assist in the stabilisation of sediments. Raking and sifting can also break the hard pan of the beach sub-surface, making it more susceptible to wind erosion.
- The volumes of litter which accumulate on Manly Cove beaches is considered to be a major issue in regard to maintaining beach amenity and user safety as well as protection of marine species.

Eastern Foreshores & Club Precinct

The waterside strip at Manly Cove East has always stood in a direct relationship to the Harbour with its proud tradition and involvement with the historic Manly 16 Foot Skiff Club, Manly Yacht Club, Manly Rowing and Sailing Club and Manly Launch Club.

Today that relationship is being recast as old uses give way to an emphasis on public access and a recognition that the conservation and interpretation of heritage may co-exist with enterprising community activity. To this end, new and exciting possibilities are being created by:

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- A clear determination by the community to safeguard and celebrate what is left of the 'working harbour';
- A continued interest by Council in developing an integrated approach to the management of foreshore land and waterways;
- The development of "Framework Plans" by NSW Maritime which summarise the land and water issues and future opportunities relating to Manly Cove;
- The decision by the Board of the Manly 16Ft Skiff Sailing Club *"to embark on a 5 year plan to rebuild the Club. A business Plan has been developed to achieve this objective"*.

The confluence of these events suggests now is the opportune time to create a vision that would support the Clubs to seize opportunities, capitalise on strengths, confront weaknesses and minimize threats.

Manly Wharf

The newly renovated Manly Wharf (currently leased to private operators by NSW Maritime) encompasses a range of uses providing waterfront bars and restaurants, shopping and entertainment and water based recreation. These attractions are popular with tourists and local day-trippers as well as Manly locals. However, this popularity has resulted in a range of management issues which must be addressed through collaboration between NSW Maritime, Wharf Management and Council. The main issues of concern include:

- Fishing from Manly Wharf is currently prohibited, however the practice is often observed, particularly during early morning and evening when the location is not monitored by Wharf security. A number of concerns were expressed during public consultation and through direct correspondence received by Council over the past years. The banning of this activity relates predominantly to protection of Little Penguins but also to waste, hygiene and safety issues.
- When sound is offensive and undesirable to the listener, it is regarded as noise pollution. There are three different undesirable effects of noise – amenity, health and communication. Noise pollution stemming from Manly Wharf is periodically an issue, particularly for neighbouring residents.

Noise not only impacts on residents and visitors to the area, but it can also significantly impact on wildlife such as Little Penguins who are known to nest underneath the Wharf structure. Water and land based noise emissions within NSW are regulated under the *Protection of the Environment Operations Act 1997*. This legislation identifies 'offensive noise' rather than specifying specific noise levels. NSW Maritime also offers general noise guidelines for different boating vessels.

- Anti-social behaviour, mostly as a result of alcohol consumption, is an ongoing problem in the areas surrounding Manly Wharf and the Manly town centre.
- Skateboarding in the forecourt area of Manly Wharf has been identified as posing safety concerns for users of the area. Numerous items of correspondence have been forwarded to Council during the development of this study; mostly from elderly residents and parents with prams who identify the risk of injury should a collision occur.
- Little penguins have been observed in a number of areas adjacent to and beneath the Manly Wharf development. More recently it has been confirmed that a number of penguins are known to nest in this location which has raised a number of concerns in relation to the threats posed by people, noise and bright lights, particularly during the early morning and evening when the species is known to become mobile during feeding activity.

In early 2006 Council contacted DECC Penguin Recovery Team staff to alert them to a number of incidents over the New Year Period with people attempting to photograph and handle the penguins in the Manly Wharf and Oceanworld areas. Council was advised that the declaration of a Wildlife Protection Area near Oceanworld was urgent, given the number of dogs and people using the area, however that such declaration was not viewed as necessary or practical for the area under the Wharf. At the time it was suggested that the barriers currently in place to keep people out from under the wharf need to be extended and replaced in sections and regularly maintained. It was also recommended at this time that volunteer Penguin Wardens be rostered on for those areas during peak times.

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- With Manly Wharf acting as a gateway for many thousands of tourists and commuters annually, the problems associated with litter is of great concern. The responsibility of waste management at Manly Wharf lies with the lessee (via conditions set by NSW Maritime as owner) as they manage retail and commercial operations in this vicinity.

Council has received ongoing complaints in relation to excessive litter, food waste, foul odours and feral bird problems as a result of through inadequate bin/table maintenance and the level of waste created by a number of retailer outlets.

Manly Cove West

Land Use Issues

- The foreshore is zoned Existing Recreation under the Manly LEP 1988. In general, Council seeks to maintain the area for public use with a preference for aquatic and recreational activities. Future improvements should maximise scenic qualities and public amenity.

The Manly Town Centre Urban Design Guidelines 2002 and the DCP for Manly Cove 1996 contain guidelines for this portion of the study area relating to appropriateness of activities, vistas and landscaping. In general activities within Manly Cove West are intended to be more passive than those in the vicinity of Manly Wharf.

- Esplanade Park is Crown Land under the care, control and maintenance of Manly Council. The Manly Cove Coastline Management Plan will act as a Plan of Management for this portion of land, with the Department of Lands (as land owner) continues to play a role in ensuring any proposed development is consistent with the Reserves purpose. Council does not support any new buildings in the area or increase in the bulk of existing buildings. Views of the heritage listed Pavilion building from the water are partially blocked by the Oceanworld building.
- Service vehicle access to the Manly Art Gallery, Pavilion and Oceanworld is via a shared pedestrian path through Esplanade Reserve. This poses a slight risk to pedestrians using the park.
- The area between Commonwealth Parade and the buildings is steep and provides an important vegetated backdrop to the buildings when viewed from the water and Esplanade Park. A natural stream also flows under the Art Gallery.
- Any expansion or intensification of use of the Manly Pavilion and/or Oceanworld will lead to a requirement for additional parking which is already in short supply and cannot be increased.
- The foreshore public open space is used by the local community as well as visitors who are drawn to the area for a variety of reasons including heritage values and its position on the Manly Scenic Walkway. However, night time safety is an issue, particularly in the area between the Pavilion and toilet block which attracts undesirable behaviour, leading to noise and litter problems.

Business Issues

- Manly Pavilion occupies dry and submerged lands and as a consequence is leased by two landowners, NSW Maritime and the Department of Lands with differing lease requirements and management styles. The lease terminates in 2014.
- Oceanworld is leased for the purpose of an “Oceanarium and associated facilities” from NSW Maritime. The lease terminates in 2017.
- Normally at the end of commercial leases NSW Maritime requires structures to be removed or seeks a new lessee through public competition. Over the past decade NSW Maritime have been approached by lessees of the Pavilion and Oceanworld with a number of Ideas for redevelopment of the existing buildings.

NSW Maritime is obliged to put to the commercial marketplace any change in use or significant intensification of development of existing premises in the interests of probity and maximising returns on the

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public asset. Therefore, NSW Maritime does not support proposals from existing lessees where the proposal is different from the permitted use under the lease.

- Structural investigations of the Oceanworld building and substructure reveal that it is nearing the end of its economic life and considerable money will need to be spent to extend its usability. Figures supplied by NSW Maritime highlight that visitation has declined in the last 15 years from a peak of 500,000 a year to less than 90,000 in 2002/03. No new data is available for inclusion in this report.
- The Manly Pavilion Building including substructure is deteriorating and is in need of heritage conservation works. The Manly Pavilion Building design contains solid wall elements which do not lend themselves to current day uses.

A Development Application submitted to Council for consideration in 2004, which intended to achieve adaptive reuse of the building, was not supported by Council as the proposal was seen to detract from the unique visual character and heritage significance of the building when viewed from the water. The Sydney Harbour Design Review Panel sought revisions to the design.

The lessees of Manly Pavilion and Oceanworld believe the changes are necessary to ensure the survival of the buildings. They seek to make Manly Cove west an alternative destination to Manly Wharf by upgrading food and beverage outlets and introducing a new range of water based recreational uses.

- The community is concerned that any such proposals will create parking and noise problems and will reduce the amenity of public spaces. In particular, food and beverage proposals in this location are seen as inappropriate in the context of the nearby availability of such facilities at Manly Wharf and the potential adverse impacts on local residents arising from late night trading and the sale of alcohol.

Natural Environment Issues

- While not within the North Harbour Aquatic Reserve, this area shares many similar marine characteristics and has a rich marine diversity. Extensive areas of seagrass, including *Zostera* and *Halophia*, and beds of kelp, corals and algae have been identified in the western portion of Manly Cove.
- The hydrology of the Cove is relatively shallow with a gradual sloping seabed reaching 3 metres of depth on the southern side of the Manly Pavilion and at the jetty adjacent to Oceanworld.
- The area shows a rich geodiversity, including sandstone cliffs, sandy beaches, rocky intertidal and remnants of the original stream (now piped).
- The Cove includes areas identified as Critical Habitat for the endangered colony of Little Penguins. Due to the high vulnerability of Little Penguins to dog attack and human disturbance and following numerous incidents and concerns from residents a Wildlife Protection Area was declared in May 2006 in the area of foreshore between Federation Point and Manly Wharf. A number of Penguins are known to nest at this location with evidence to suggest individuals also nest underneath Manly Wharf.

Restrictions now apply and dogs must be on a leash at all times within this location. The area of foreshore in the vicinity of Federation Point has also been declared a dog exclusion zone. Appropriate signage has been developed and erected at various locations throughout the area.

- The Cove, in particular the netted swimming enclosure, is recognised habitat for two species of protected seahorse (pot-bellied and Whites Seahorse).
- The invasive weed *Caulerpa taxifolia* has been found in the waters adjacent to Oceanworld.

Stormwater Erosion

Many back beach areas are naturally drained by semi-perennial small creeks that cross the beach berm to discharge stormwater into coastal waters. However, urban development has led to the construction of stormwater infrastructure to replace natural stream lines and seawalls in place of natural coastal dunes and foreshores.

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Major stormwater runoff events can cause significant erosion to beaches onto which stormwater outlets discharge through direct erosion and changes to coastal processes. One of the major factors affecting stormwater erosion potential is the degree of development in the catchment area draining to a beach or foreshore location. Urban developments such as car parks, roads, shops and other buildings result in the replacement of porous natural surfaces (particularly in the case of sandy areas such as the low lying areas of Manly Cove and CBD) with impermeable surfaces. This has two effects on stormwater runoff. First, the volume of runoff tends to increase significantly. Second, the peak rate of runoff also increases. Both effects result in a significant increase in the erosion potential of stormwater discharges onto beaches, rocky shores and natural creeks.



Three stormwater outlets discharge via the seawall onto Manly Cove East Beach, ranging in size from 450 to 675 mm diameter. Two are located at the eastern end of the beach and one at the middle of the beach. These outlets scour channels through the beach sand as the stormwater flows across the beach into the harbour. In particular, the eastern two outlets currently create significant channels due to the high beach sand levels relative to the outlet level at this end of the beach.

The discharge velocities associated with these stormwater flows are insufficient to entrain and transport this sand-sized material any significant distance offshore (MHL, 1997). The delta formed by these sand deposits is redistributed along the beach by wave action and currents.

Figure 10.4.2a – Scour from stormwater outlets, Manly Cove East Beach.

There are two stormwater pipes discharging onto Manly Cove West Beach. One is located at Oceanworld in the west and the other under the wharf in the east. Neither of these outlets poses a significant erosion hazard to the beach as they discharge some distance offshore.

During high intensity rainfall events, the stormwater system in West Manly Cove (Sub Catchment MA-12) is unable to cope with the flow rates being experienced. Subsequently the flows are expelled through existing grates and a 30 kg lid is dislocated from position, contributing to regular scouring of the beach sand to the far west of Manly Cove west beach (see **Figure 10.4.2 b & c**).

A Council operated beach rake (tractor) grades the beach each morning to ensure pipe outlet is clear and redistributes sand, removing the scoured channel to improve the amenity and aesthetics of the beach.



Figures 10.4.2 b & c – Scour of Manly Cove West Beach due to under-capacity stormwater system

Maintenance of Netted Swimming Enclosure

Following the 2004 designation of syngnathiformes (seahorses, sea-drivers and pipefish) as "protected" under the NSW Fisheries Management Act 1994 the cleaning methods employed for cleaning of marine growth from the netted swimming enclosure pre-2004 no longer satisfy the requirements of NSW Department of Primary Industries.

During late 2006 Council's Natural Resources and Urban Services Branches have been investigating methods used by other local authorities in the maintenance of netted swimming enclosures with focus upon the sensitive nature of the identified threatened species. Various methodologies have been presented to Council by potential contractors and discussed in detail with NSW Department of Primary Industries (NSW Fisheries) as administrators of the Fisheries Management (FM) Act 1994 and the Fisheries Management Amendment Acts 1997 and 2001. As a result Council have rejected a number of proposals which did not meet the requirements of NSW Department of Primary Industries.

One proposed methodology involves diver hand cleaning of marine growth from the nets in a staged approach. This progressive cleaning technique will enable Council to reduce the overall stress to the structure and, most importantly ensure minimal impact upon the seahorse population.

NSW Department of Primary Industries have undertaken an extensive monitoring program of the Manly seahorse population in order to ascertain the impact of the proposed cleaning method and ability of the species to recolonise following cleaning. This exercise will assist other Councils in NSW in undertaking similar cleaning and net replacement activities.

11. FRAMING VISION, GOALS & OBJECTIVES

This section presents vision (Section 11.1), a set of goals for each key issues and overarching management objectives for the study area relating to each of the issues (Section 11.2).

11.1 VISION FRAMEWORK

Visioning is an important element in any planning process. Setting the future vision ensures strategic long term thinking and avoids focus on daily issues. Such visioning must be approached in an integrated manner involving local, state and federal governments.

State & Regional Levels

NSW Government released the State Plan on 14 November 2006. It is tipped as 'A New Direction for NSW'. The Plan reflects the hopes and goals of people across NSW and the priorities for the public sector. The Plan sets out clear targets for improved outcomes and service delivery. The Plan contains 14 long term social, economic and environmental goals and 34 priority areas for action for NSW. The Priority E4 of the State Plan is

"Better outcomes for native vegetation, biodiversity, land, rivers and coastal waterways".

This has been translated into state-wide targets (Box) by the Natural Resources Commission (NRC) and adopted by the Government in the State Plan.

NRC targets adopted in the State Plan	
Biodiversity	
1. By 2015 there is an increase in native vegetation and an improvement in native vegetation condition	
2. By 2015 there is an increase in the number of sustainable populations of a range of native fauna species	
3. By 2015 there is an increase in the recovery of threatened species, populations and ecological communities	
4. By 2015 there is a reduction in the impact of invasive species	
Water and Coast	
5. By 2015 there is an improvement in the condition of riverine ecosystems	
6. By 2015 there is an improvement in the ability of groundwater systems to support groundwater dependent ecosystems and designated beneficial uses	
7. By 2015 there is no decline in the condition of marine waters and ecosystems	
8. By 2015 there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained	
9. By 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems	
Land	
10. By 2015 there is an improvement in soil condition	
11. By 2015 there is an increase in the area of land that is managed within its capability	
Community	
12. Natural resource decisions contribute to improving or maintaining economic sustainability and social well-being	
13. There is an increase in the capacity of natural resource managers to contribute to regionally relevant natural resource management	

Figure 11.1a – Natural Resources Commission State-wide targets

At regional level, the Sydney Metropolitan Catchment Management Authority (SMCMA), responsible for the coordination and management of Sydney's natural resources, adopted the following vision:

"The Sydney community has the knowledge and skill to achieve healthy waterways and bushland that all Sydneysiders can enjoy, now and in the future."

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The SMCMA has completed its Catchment Action Plan (CAP). The CAP will guide the activities of the SMCMA while forming the basis for partnerships with the community, business, industry and government. The CAP will assist the SMCMA in ensuring that natural resource management projects are undertaken in priority areas within the catchment, and that these projects lead to the best outcomes for the environment and the community. There are four themes: biodiversity, water & coast, land and community. Under each of these, there are Catchment Targets (Box), Management Targets and Actions. One of the key Catchment Target is shown translated into Management Targets and Actions (diagram).

SMCMA Catchment Targets	
Biodiversity	
Enhance ecological resilience and connectivity of bushland and aquatic habitats	
CTB1	By 2016 the extent and condition of terrestrial native vegetation in all landscapes is maintained or improved.
CTB3	By 2016 there is an increase in the connectivity of terrestrial native vegetation.
CTB4	By 2016 aquatic and terrestrial threatened species and Endangered Ecological Communities (EECs) and endangered populations are better conserved by implementing actions identified in the Priorities Action Statement.
CTB5	By 2016 the impact of terrestrial and aquatic invasive species on biodiversity is reduced by decreasing the number, distribution and impact of invasive weeds, pest animals and pathogens.
Water	
Enhance the positive connectivity of aquatic processes	
CTW1	By 2016 there is a net improvement in the health of modified waterways and riparian corridors and conservation of natural waterways.
CTW2	By 2016 there is an improvement in the condition and extent of wetlands.
CTW3	By 2016 there is measurable progress towards achieving the Water Quality and River Flow Objectives adopted for each waterway.
CTW4	By 2016 there is an improvement in the quality and sustainable use of groundwater systems so that they are able to support groundwater dependent ecosystems and designated beneficial uses.
CTECM1	By 2016 there is an improvement in the condition of estuaries and coastal lakes.
CTECM2	By 2016 there is an improvement in the condition of coastal and marine ecosystems.
Land	
Reduce the negative edge effects of urban expansion	
CTLD1	By 2016 there is an increase in the amount of land managed within its capability.
CTLD2	By 2016 implement actions under the Sydney Metropolitan Strategy that recognise, protect and improve key natural resources.
CTLD 3	By 2016 Indigenous cultural landscape values are identified, acknowledged and incorporated into all natural resource management activities and land use planning.
Community	
Improve community and institutional connections between natural resources, strong communities and robust economy	
CTC1	By 2016 more people, communities and organisations have increased capacity to engage in practices that contribute to improved natural resource management.
CTC2	By 2016 there is improved focus and collaboration between organisations that act in or influence natural resource management.
CTC3	By 2016 there is a framework for monitoring, evaluating and reporting natural resource indicators.
CTC4	By 2016 there is improved recognition across the community of the contribution of healthy natural resources to valued social and economic activities in the region.
CTC5	By 2016 there is improved awareness and willingness to adopt adaptive and mitigating strategies for climate change impacts on natural resource values.

Figure 11.1b – Sydney Metro Catchment Management Authority Catchment Targets



Figure 11.1c – Example of Sydney Metro Catchment Management Authority Catchment Target breakdown

Local level

Wider community participation is not only important but crucial. Manly Council has, as a matter of process, involved community in setting vision through programs like myManly, Futures Forum and Surfing the Future. Surfing the Future provides a direction to aim towards for the year 2025 for Manly Local Government Area. It establishes a 'road map' and identifies major themes. The Social Plan (MC 2004) and Manly Sustainability Strategy (MC 2006), short-term strategy documents, are developed based on themes established under Surfing the Future. The following vision statement has been adopted for 'Surfing the Future':

"A thriving community where residents and visitors enjoy a clean, safe and unique natural environment enhanced by heritage and lifestyle"

The same vision statement has been adopted in preparation of this Manly Cove Coastline Management Planning process. The vision aims to provide a general statement about the future desired state of the study area. This vision statement, from the onset, establishes importance of visitors, heritage and living in harmony with natural environment and influences setting up of management objectives.

11.2 MANAGEMENT GOALS & OBJECTIVES

The Coastline Management Plan is a tool for integrating the needs and values of the environment within the development-based planning framework of local and state government. Therefore, the focus of the plan should be on addressing environmental concerns through a series of management options that are both effective and easy to implement.

The basis for the Coastline Management Plan needs to be Ecologically Sustainable Development (ESD). ESD is development that aims to meet the needs of the present, while conserving our ecosystems for the benefit of

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future generations. By following the principles of ESD, we should be able to reduce the likelihood of serious environmental impacts arising from our present day economic activities.

11.2.1 Principles of ESD

The four basic principles of Ecologically Sustainable Development (ESD) assist to determine project suitability:

1. Conservation of biological diversity and ecological integrity;
2. Social equity, including inter-generational equity;
3. Improved valuation, pricing and incentive mechanisms; and
4. The precautionary principle.

11.2.2 Formulation of Goals and Management Objectives

A series of goals and objectives for the future management of the Manly Cove study area were developed based upon information received through the community and stakeholder consultation, input from the Harbour Foreshore Management Committee and a sound appreciation of coastal processes and human interactions.

Management Objectives provide the 'goal posts' towards which future management of the Manly Cove study area should be directed. In short, the objectives aim to rectify the problems or issues facing the study area, whilst preserving and enhancing its inherent values.

Goals and objectives have been defined under a series of key management issues, as described in Section 10.3. For each management issue a goal has been defined, along with a range of management objectives that will be further partitioned into management options in later chapters (Figure 11.2.2).

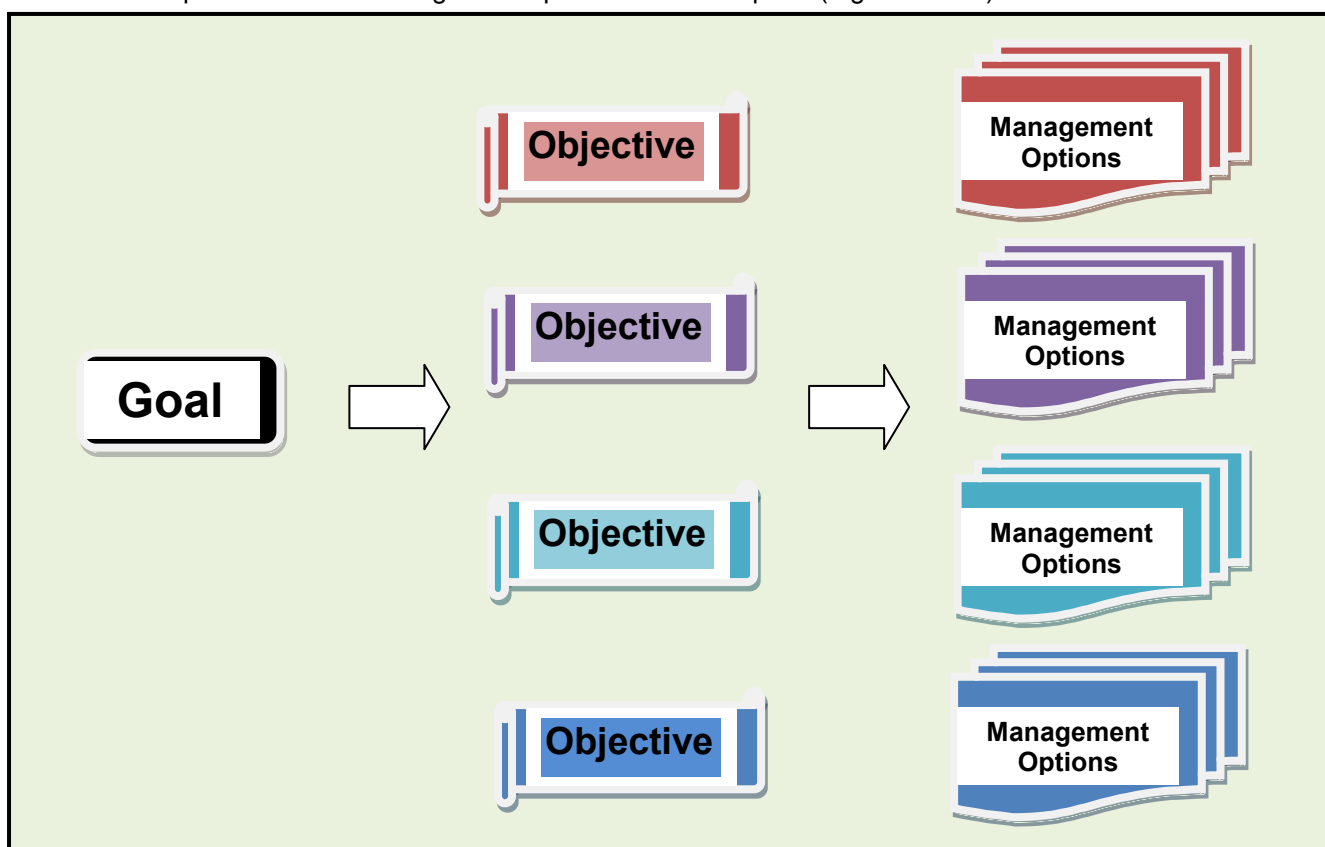


Figure 11.2.2 – CMP Management Framework



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Goals define the aspirations of the community and future direction for management with respect to the environmental, social recreational and economic sustainability and viability of the Manly Cove. For each goal, a series of specific objectives have been defined, which describe the requirements for specific aspects, necessary to achieve the goals. Linkages to existing policies, plan documents have been made. Coastline Management framework is detailed in Chapter 2.

The goals and their related objectives for the Manly Cove study area are presented below. These have been discussed, scrutinized and agreed at the Manly Harbour Foreshore Management Committee meeting held during April and June 2008.

In general, set goals and objectives relate to the general goals of the NSW Coastal Policy 1997, Coastal Protection Act 1979, management principles described in relevant regional plans (Sydney Regional Environmental Plan – Sydney Harbour Catchment 2005, Draft Subregional Strategy: North East Subregion, July 2007), Sydney Metropolitan Catchment Management Action Plan 2008 and also Manly Local Environmental Plans and other relevant legislation and/or strategy documents identified in Chapter 2.

Aquatic / Intertidal Habitat Conservation & Management

1.0	Goal Restore and maintain a healthy and diverse mix of aquatic and intertidal habitats that will maintain and improve biodiversity and ecological functions of Manly Cove
1.1	Objectives To achieve community awareness of and involvement in the conservation of marine ecology through education and participation
1.2	Ensure all areas of ecological significance are managed in an integrated and sustainable manner
1.3	To ensure the activities within Manly Cove are carried out in a manner that maintains or improves the ecological condition of marine habitats and species

Boating, Maritime Operations & Facilities

2.0	Goal To achieve the highest level of environmental protection and safety for maritime operations within Manly Cove
2.1	Objectives To improve the environmental sustainability of boating activities in Manly Cove
2.2	To ensure boating activities are conducted through positive interactions with other user groups
2.3	To support recreational (and commercial) boating activity through the provision of safe, user friendly facilities

Upgrading & Enhancement of Public Facilities, Infrastructure & Signage

3.0	Goal Public facilities, infrastructure and signage are upgraded and maintained to facilitate improved social amenity

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3.1	Objectives To provide well maintained and safe facilities and infrastructure on Manly Council owned and/or managed public lands
3.2	Provide up-to-date and appropriate regulation and interpretive signage appropriate for the locality and which meets Councils legislative requirements

Water & Marine Sediment Quality

4.0	Goal To ensure water and marine sediment quality meets the community's expectations and falls within acceptable standards suitable for fishing and swimming
4.1	Objectives Reduce sediment volume and associated pollution entering the marine environment
4.2	Encourage a reduction of effluent discharge/ exfiltration from sewerage infrastructure in the Manly Cove study area
4.3	Ensure sustainable groundwater extraction practices to avoid negatively impacting upon aquifer recharge and quality

Air Quality & Noise

5.0	Goal To ensure air quality and noise levels meet community expectations and fall within acceptable standards
5.1	Objectives Reduce localised air pollution
5.2	To maintain an acceptable level of noise generation within the community and regulate noise sources

Terrestrial Ecology

6.0	Goal To conserve and enhance the integrity and diversity of indigenous terrestrial flora and fauna, and their ecosystems
6.1	Objectives To ensure the activities within Manly Cove are carried out in a manner that maintains or improves the ecological condition of terrestrial habitats and species
6.2	To achieve community awareness of and involvement in the conservation of terrestrial ecology through education and participation

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Hazards & Climate Change

7.0	Goal Assess, minimize and mitigate risks from coastline hazards and climate change
7.1	Objectives Reduce to an acceptable level, the risk of damage as a result of beach erosion and shoreline recession
7.2	To ensure the effects of shoreline recession do not adversely impact on beach amenity
7.3	To ensure future development is compatible with the erosion and recession hazard
7.4	To ensure any protective works minimise impact on beach amenity and access, and where practical improve amenity and access
7.5	To reduce to an acceptable level, the risk to property and risk to life as a result of slope and cliff instability
7.6	To reduce to an acceptable level, the risk to property and infrastructure resulting from Sea Level Rise
7.7	Promote understanding of the likely environmental, social and economic impacts of climate change on Manly Cove
7.8	Limit and reduce the greenhouse gas emissions in the Manly LGA
7.9	Reduce water consumption within the study area

Waste Management

8.0	Goal Promote and facilitate sustainable waste management in Manly Cove
8.1	Objectives To reduce waste while maximising re-use and recycling in the Manly Cove study area
8.2	To minimise risk to beach users and marine fauna from beach and marine waste while maintaining natural ecosystems

Access & Traffic Management

9.0	Goal To provide an environment at Manly Cove that is accessible to all people
9.1	Objectives To improve and control access for pedestrians, cyclists, water based recreation and servicing vehicles, minimising conflicts and negative impacts

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Crime Prevention & Safety

10.0	Goal To provide public areas in which patrons feel safe and are safe
10.1	To control and minimise crime and inappropriate behaviour in the study area

Aesthetic & Landscape Character

11.0	Goal To maintain and enhance the aesthetic appeal of Manly Cove
11.1	Objectives To reduce the adverse impacts of features that detract from the visual quality of Manly Cove

Recreational Activities & User Groups

12.0	Goal To provide for the continuing, enjoyable and sustainable use of Manly Cove for a range of user groups
12.1	Objectives To minimise conflicts between differing recreational and commercial activities within Manly Cove

Geodiversity

13.0	Goal Conserve the significant geodiversity elements of the area's coastline
13.1	Objectives To protect and conserve the important elements of Manly's geodiversity through raising awareness, considering its values in all planning and management and integrating with biodiversity and cultural heritage management

Heritage Conservation & Management

14.0	Goal Ensure that all Aboriginal and European (cultural and natural) heritage sites within the study area are preserved and protected
14.1	Objectives Ensure that sites of Aboriginal heritage are properly and regularly maintained
14.2	Ensure that all sites of non-indigenous heritage are protected under the relevant legislation and in Council planning instruments

12. STRATEGIC MANAGEMENT OPTIONS

In chapter 11, issue based goals and objectives have been established. In the following chapter, objectives have been translated into specific and strategic management options. Many of these options have been proposed by community during consultation meetings. Some of the proposed options, before implementation, will be subject to further consultation with relevant agencies, Precincts and community.

12.1 BASIS FOR DEVELOPMENT OF MANAGEMENT OPTIONS

Management Options have been developed for the Manly Cove study area based on ESD principles and a number of practical considerations, with a focus on:

- options that require little or no additional out-of-pocket expenditure, with works/actions being done by Council staff, or in-kind contributions from other organisations, volunteers etc;
- innovative ideas and non-standard approaches to natural resource management;
- easy to implement on-ground works;
- options those are scientifically defensible.

12.2 INDICATIVE MANAGEMENT OPTIONS

The following Section identifies management options developed in response to management issues, values and community expectations. Brief titles of the options are provided in this Chapter. Detailed descriptions of each of the options are presented in Chapter 13.

Aquatic / Intertidal Habitat Conservation & Management

1.0 - Restore and maintain a healthy and diverse mix of aquatic and intertidal habitats that will maintain and improve biodiversity and ecological functions of Manly Cove

The key habitat management priority for the study area is to protect habitats of high ecological and coastal value. It is more cost effective to protect these areas now than to rehabilitate them in the future if such systems are allowed to deteriorate.

1.1

To achieve community awareness of and involvement in the conservation of marine ecology through education and participation

Sydney Harbour is subject to a variety of stresses from human activities that have the potential to decrease species diversity and abundance. Understanding the various physical and biological processes that influence the structure of marine ecosystems in the study area is important, therefore, because it will allow for improved predictions on the changes that are likely to occur under certain conditions and allow managers to make informed decisions about the conservation and management of these systems.

The management and protection of aquatic habitats was identified through the community consultation process as a significant issue to be addressed in the Manly Cove Coastline Management Plan. The vast majority of submissions identified that the protection of native marine and threatened species, the creation and maintenance of marine reserves and the control of introduced species are all important factors in achieving

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improved management of aquatic resources. This confirms that the local community is aware of the many issues and pressures faced by our marine environment. It also highlights an opportunity for managers to involve the community and user groups in the decision making process.

Indicative Management Options:

- 1.1.1 Continue to work with other stakeholders in the provision of marine focussed educational events**
- 1.1.2 Encourage the establishment of a community-based seagrass monitoring program to provide reliable data on any change to the distribution or health of seagrass in Manly Cove.**
- 1.1.3 Involve the community and user groups in the management planning process to ensure outcomes build public knowledge and meet community expectations**

1.2	Ensure all areas of ecological significance are managed in an integrated and sustainable manner

The aquatic environment of Manly Cove exhibits a diversity of habitat with a wide range of substrata, vegetation, depths, exposures and their combinations with aquatic plant communities being among the most abundant and conspicuous habitats of sub-tidal reefs in Sydney Harbour. Many of these ecologically important habitats are being threatened due to urban development and other external pressures. Moreover, climate change impacts are going to exert additional pressure on these habitats.

Sydney Harbour is subject to a variety of stresses from human activities that have the potential to decrease species diversity and abundance. Already many habitats have been declared as protected areas but enforcement still remains a concern.

North (Sydney) Harbour Aquatic Reserve lies between an imaginary line from the headlands at North Head and Grotto Point and another line joining Little Manly Point, Manly Point and Forty Baskets Beach. A formal proposal is now being prepared to extend the boundaries of the North Harbour Aquatic Reserve to include Manly Cove, Little Manly Cove and North Harbour. Once formally extended, it is proposed to pursue DECC to prepare and implement a management plan for the aquatic reserve. Community involvement is critical in the management of aquatic reserves. Through public involvement in management planning processes, the government seeks to achieve community partnership in these important places, providing ongoing protection for the future.

In December 2002, the Minister for the Environment declared Critical Habitat for Manly's endangered population of little penguins. The Declaration and Regulations came into effect on 1 January 2003. Three areas were identified to which specific regulations apply, with Area B extending along the south-eastern foreshore of the study area from 11A Oyama Avenue around Manly Point (to 26 Addison Road). The land side of the critical habitat boundary includes the area from the mean high water mark, up the rocky foreshore slope to the beginning of the ridgetop in residential areas (ie the rocky foreshore upslope to the boundary of the formed backyard is included as critical habitat. The declaration of Critical Habitat provides greater protection and stricter controls over particular activities within the defined area.

Due to the high vulnerability of little penguins to dog attack and human disturbance and following numerous incidents and concerns from residents a Wildlife Protection Area was declared in May 2006 in the area of foreshore between Federation Point and Manly Wharf. A number of penguins are known to nest at this location with evidence to suggest individuals also nest underneath Manly Wharf.

Extensive stands of seagrass, kelp and various algae exist across the Manly Cove sea bed. These habitats form fragile ecosystems which can be easily destroyed by a number of anthropogenic activities including reclamation, dredging, the construction of jetties, pontoons, wharves and ramps, water pollution and increased turbidity, poor land management and some recreational activities.

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A large proportion of the Manly Cove foreshore has been modified since European settlement, with seawalls, wharves and waterside developments now providing important habitat value to a range of marine species. More specifically, significant habitat value is exhibited by the existence of the west Manly Cove netted-swimming enclosure. The enclosure is popular with divers and snorkelers wanting to observe the large colony of protected seahorses known to live amongst the marine growth which accumulates on the net.

Marine flora and fauna species are introduced to new locations through human activities such as hull fouling, boat washing, dry ballast and aquaculture, and by natural processes such as drifting logs and seaweed.

In 2003 *Caulerpa taxifolia* was identified in the waters of Sydney Harbour including a number of locations within North Harbour. While there has been no infestation of *Caulerpa taxifolia* within the Manly Cove Study area, this noxious species has the potential to grow rapidly degrading marine ecosystems and threatening biodiversity. Following initial concerns on the impact of the species upon native endemic seagrass species, NSW DPI has stated that *Caulerpa taxifolia* is able to co-exist with native seagrasses.

Indicative Management Options:

- 1.2.1 Pursue a submitted proposal seeking the extension of the boundary of North Harbour Aquatic Reserve to include Manly Cove (Little Manly Cove and North Harbour).**
- 1.2.2 Continue work with DECCW to manage Little penguin Critical Habitat, the Wildlife Protection Area at Federation Point and known nesting sites in line with the Recovery Plan**
- 1.2.3 Protect and enhance marine/intertidal habitat within and adjacent to Manly Cove**

1.3	To ensure the activities within Manly Cove are carried out in a manner that maintains or improves the ecological condition of marine habitats and species

The distribution and occurrence of marine habitats is not only affected by the age, catchment area and stability of an estuary but are also largely influenced by human activities. Since European arrival the distribution and abundance of marine habitats has declined significantly within the waterways of NSW. As such, the remaining habitat provides a valuable resource and must be managed in a way that recognises the important functions of seagrass in maintaining ecosystem health.

In general seagrasses, kelp and algae are negatively affected by anthropogenic activities which include reclamation, dredging, the construction of jetties, pontoons, wharves and ramps, water pollution and increased turbidity, poor land management and some recreational activities. The Ecology Lab's 1993 review and analysis for the neighbouring embayment of Little Manly Cove identified boating and moorings/anchoring, marine pest species, pollution (both terrestrial and marine), recreational fishing and commercial fishing as likely impacts on marine vegetation.

Major impacts on the health and distribution of seagrass and other marine vegetation communities also include the decrease of light penetration through the water column due to increased turbidity and increased shading by marine structures, which inhibits the ability of plants to photosynthesize and siltation, which smothers marine vegetation and reduces light availability. Water based development and beach nourishment may also potentially impact upon seagrass within Manly Cove if not properly managed.

Following the 2004 designation of syngnathiformes (seahorses, sea-dragons and pipefish) as "protected" under the NSW Fisheries Management Act 1994 the cleaning methods employed for cleaning of marine growth from the netted swimming enclosure pre-2004 no longer satisfy the requirements of NSW Department of Primary Industries.

Significant habitat value is exhibited by the existence of the west Manly Cove netted-swimming enclosure. The enclosure is popular with divers and snorkelers wanting to observe the large colony of protected seahorses known to live amongst the marine growth which grows on the net. However, the rate of marine growth and

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importance of such growth as habitat has raised complexities in relation to ongoing maintenance of the facility. The net itself, also poses threats to a variety of marine species that may be come trapped when attempting to enter or leave the enclosure.

A number of general concerns have been expressed regarding diver use of the area and the pre and post-dive land-based use of West Esplanade reserve as opposed to any problems with the actual dive activities or impact on biodiversity and habitat.

Despite the activity being prohibited on Manly Wharf the activities of recreational fishers often result in negative impacts upon the amenity of the area for visitors, residents and commuters through improper disposal of waste and potential for injury through fishing practices.

Indicative Management Options:

- 1.3.1** *Minimise the impact that recreational fishing activities have on the intertidal and marine ecology, through education and regulation*
- 1.3.2** *Minimise the impact of diver/snorkeler activities and routine maintenance upon the colony of seahorses known to colonise the Manly Cove netted swimming enclosure.*

Boating, Maritime Operations & Facilities

2.0 - To achieve the highest level of environmental protection and safety for maritime operations within Manly Cove

The embayment of Manly Cove offers a diverse range of opportunities for recreational and commercial boat and watercraft use. The study area is also used as a temporary and permanent anchorage and mooring site. Wind surfing, canoeing, dragon boating, kayaking, outriggering and a variety of sailing activity is conducted in the vicinity of the Manly Cove study area.

There are a number of safety and environmental issues associated with boating and maritime operations within Sydney Harbour. Issues such as incident (including spills) management, water traffic safety and ballast water and marine pest management are controlled by a range of state and federal government agencies, with Manly Council supporting through education.

One key to protecting the natural, commercial and recreational resources of Sydney Harbour is the formal recognition of ecological, socio-economic and cultural resources. Another is the rapid response to oil spill incidents.

2.1

To improve the environmental sustainability of boating activities in Manly Cove

Sensible boating practices in the use and maintenance of boats on and adjacent to waterways will go along way to preserving aquatic environments for future generations. NSW Maritime, as the principal body charged with the management of boating activity in NSW waters provide a range of educational brochures which aim to minimise the impact of activities such as engine maintenance, boat cleaning, fueling, sewage effluent management, water conservation, anchoring and boat wakes on the marine environment. Environmental knowledge is also now incorporated into the NSW Boat Licence content.

Boating activities are known to cause damage to seagrass through propeller scarring, swing moorings and boat anchoring. Recreational boating and anchoring is considered the most significant source of damage to seagrass beds in the study area. Anchoring may also contribute to the spread of invasive marine species such

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as *Caulerpa taxifolia*. The popularity of Sydney Harbour for boating activity also means that the potential for oil and other hazardous substances to spill into the Harbour is greater than for most other waterways in New South Wales.

Boat storage facilities within Manly Cove consist predominantly of private swing moorings and commercial moorings licensed to the various clubs situated on the eastern foreshores of Manly Cove by NSW Maritime. Manly Cove has proven to be a popular mooring location, offering a convenient location in relatively calm and secure conditions. Moored boats are usually accessed either by dinghies that are stored by the clubs or through tender services operated by individual clubs. All moorings in Manly Cove are positioned within 150 metres of the mean high water mark and are consequently located within important seagrass beds.

All of the moorings in Manly Cove are swing moorings, with chains dragging across the seafloor damaging the seagrass beds within their range. Swing moorings have resulted in bare patches within the Manly Cove seagrass beds with approximately 65% of moorings positioned over seagrass (*Zostera* and *Posidonia spp.*). The design and location of the existing mooring systems poses significant degradation of the seagrass habitat through circular dragging of the mooring chains across the seabed.

Indicative Management Options:

- 2.1.1 To encourage boat user groups to play a role in educating the boating community on best practice**
- 2.1.2 Encourage the boating community to report marine pest sightings**
- 2.1.3 Ensure Manly Council Rangers are aware of Spill Response Procedures for both on-water and off-water incidents**

2.2	To ensure boating activities are conducted through positive interactions with other user groups

While Manly Cove serves as a major transport and commuter access point, the study area also provides opportunities for a wide range of water and land-based recreational activities. Community consultation survey results highlighted that 80% of people surveyed considered the ability to undertake recreational activities as being of importance to them. The impact of recreational activities upon the environment is exacerbated through the high visitor numbers observed within Manly Cove.

A small portion of the Manly Cove embayment is subject to speed controls for boating. A four (4) knot speed limit exists from the foreshore between Stuart Street south to Manly Point and extending 100 metres offshore from the MHW. This speed zone also lies adjacent to the area designated as Critical Habitat for Manly's Little Penguin Population. Assigned by NSW Maritime the designated 4-knot zones assist with the protection of seagrass beds and address safety concerns of passive foreshore user groups.

Stakeholders and community have identified the regular movement of Sydney Ferries and JetCats as having significant impact on the day-to-day activities conducted on the eastern foreshores. The wake generated by these vessels is found to create considerable wave heights resulting in increased noise and wash and unsafe conditions for passive recreational users, particularly during high tidal conditions. The impacts are particularly evident for Sailability activities.

In addition, the wash created by vessels berthing and leaving the western side of Manly Wharf has been found to increase strain on the south-eastern portion of the netted swimming enclosure which has the potential to result in structural damage to this structure.

With two commercial kayak operations and various sailing activities operating within the study area, conflict has arisen between passive recreation and ferry/JetCat movements. While operators are aware of the danger posed from regular activity of commuter vessels, it is recommended that Council encourage Sydney Ferries to

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implement a system which alerts users of Manly Cove prior to any vessel travelling south from Manly Wharf. Conflict has also arisen due the absence of a public wharf facility and the subsequent inability for recreational vessels to pick up and drop off passengers and supplies.

The potential safety of swimmers is put at risk through recreational boat movement with vessels often observed moving in close proximity to swimmers while "beaching" onto Manly Cove.

Skiff sailboat rigging activities have been identified as impacting upon the general use of East Esplanade Reserve. While this activity has been ongoing for many years and contributes to the historic use of Manly Cove, rigging during weekend competition often results in East Esplanade Reserve being dominated by one use and undesirable for other uses, particularly during summer weekends.

Indicative Management Options:

- 2.2.1 Encourage compliance with NSW Maritime boating regulations**
- 2.2.2 Sustainably manage the extent to which commercial operator's access and use the Manly Cove embayment**
- 2.2.3 Investigate the feasibility for the installation of a 'ferry underway' warning system for passive waterway users**
- 2.2.4 Ensure skiff rigging and storage activity does not negatively impact other users of East Esplanade Reserve**

2.3	To support recreational (and commercial) boating activity through the provision of safe, user friendly facilities

There is currently a lack of public wharf facilities within Manly Cove. Prior to the current lease agreement, recreational vessels were able to use Manly Wharf for transfer of passengers and goods in a safe user-friendly location. However, vessels are now charged at premium rates to utilize Manly Wharf regardless of the time they are berthed. This issue has been raised by numerous groups and individuals during the consultation process, including the Little Manly and Fairlight Precincts. Manly Wharf is currently used by a number of commercial operators.

A number of formalised jetties are located along the eastern foreshore in the "Club Precinct" between Stuart and Osborne Streets, however these are exclusively utilised by members of the various clubs and not for general use by the public. The eastern jetty of the Manly Wharf development is leased for use by a variety of commercial operators.

The lack of public wharf facilities within the study area results in vessels having to beach themselves. This activity has the potential to increase conflicts between (and potentially the safety of) beach users, particularly during peak summer and holiday periods.

The study area has a high number of moorings, offering convenient locations in relatively calm and secure conditions. All moorings are licensed by the NSW Maritimes. Moored boats are usually accessed by either courtesy vessels operated by boating facilities or private dinghies. There is concern for overcrowding of boats and dinghies which cause pollution in waterways and noise during high use periods. The moorings are taking up too much of the harbour leaving less open harbour. Moorings in Manly Cove encourage boats across shallow areas where there are reasonable stands of seagrass.

NSW Maritime, in conjunction with NSW DPI, the Sydney CMA, Council and local community dive group EcoDivers, are in the early stage of trialling seagrass friendly moorings in Manly Cove East to minimise the impact of boating on seagrass beds and the aquatic environment.

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Indicative Management Options:

- 2.3.1** *Work with organisations in the boating precinct to investigate the feasibility of providing public wharf facilities in Manly Cove*
- 2.3.2** *Encourage NSW Maritime, I&I NSW and mooring users to install seagrass friendly moorings throughout Manly Cove*
- 2.3.3** *Encourage and support the provision of safe, accessible boating facilities in Manly Cove*

Upgrading & Enhancement of Public Facilities, Infrastructure & Signage

3.0 - Public facilities, infrastructure and signage are upgraded and maintained to facilitate improved social amenity

Infrastructure provision, more specifically social infrastructure provision are important to people. The presence of these kinds of infrastructure has a direct impact on living conditions, health and potential for economic development. Social infrastructures are usually considered services, such as public toilets, schools, neighbourhood centres, parks, and open space etc.

3.1

To provide well maintained and safe facilities and infrastructure on Manly Council owned and/or managed public lands

Public reserves and beaches in the study area are used extensively year round for many purposes. It is important that high quality, user friendly taps, bubblers, shade, rain shelters, rails on steps, telephones, toilets, accessible toilets / showers / seating / pathways / parking / ramps / rails are provided. These facilities must also be sufficiently maintained. Graffiti on signage and public toilets is a problem.

The current condition of the West Esplanade toilet facility was raised as a concern during the public consultation process. Opportunities to improve water and energy conservation measures also exist.

The provision of lighting within the study area enhances the heritage feel of the area by emulating original lighting for Manly Cove. The rounded lighting, often referred to as a "ring of pearls" by visitors, incorporates Council emblems while providing safety and an attraction to the promenade area at night.

The availability of drinking water for users is confined to the amenities blocks and retail outlets throughout the study area. A single drinking fountain is also located in West Esplanade adjacent to the walkway and opposite the netted swimming enclosure. The accessibility of fresh water within Manly Cove was considered insufficient by respondents during community consultation.

The ease of access and aesthetic character of Manly Cove has resulted in the area being popular with visitors and day trippers for picnicking and gatherings. The existing picnic and seating facilities were last upgraded during the major landscaping works in 1988. Community consultation and visual inspection identified the fact that the picnic facilities are often extremely dirty and unhygienic and that many chairs have been vandalised.

A netted swimming enclosure is located between Manly Wharf and Oceanworld. The enclosure provides swimmers with protection from sharks with the nylon net being traversed by nine wooden piles. The enclosure is extremely popular for users of Manly Cove as it provides for safe harbour swimming in calm conditions. The net has also attracted a colony of protected seahorses

Indicative Management Options:

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- 3.1.1** *Investigate the feasibility of installing water conservation measures in the West Esplanade toilet facility*
- 3.1.2** *Investigate the upgrading of seating and picnicking facilities within East and West Esplanade Reserves*
- 3.1.3** *Ensure the netted swimming enclosure is maintained to ensure protection to users and in line with legislative requirements*
- 3.1.4** *Investigate the feasibility of providing additional freshwater bubblers within East and West Esplanade Reserves.*

3.2

Provide up-to-date and appropriate regulation and interpretive signage appropriate for the locality and which meets Councils legislative requirements

Signage within the study area is diverse and comprehensive and has been developed over many years of visitation. Signs have been strategically and prominently placed throughout the study area. Sizing and design are important encourage their reading and user compliance, while reducing aesthetic impact. There is a need to improve signage which alerts the public to the presence of Little Penguins at various locations in Manly Cove and details relevant compliance issues. In order to minimise human impacts upon Little Penguin roosting and feeding habits protective fencing must be constructed adjacent to west Manly Wharf as well as pedestrian access adjacent to Manly Pier Pavilion.

Indicative Management Options:

- 3.2.1** *Undertake review of existing compliance signage which meets Councils legislative requirements*
- 3.2.2** *Replace damaged and/or missing signage in line with findings of signage audit*
- 3.2.3** *To reduce negative impacts upon visual character of Manly Cove through signage consolidation*
- 3.2.4** *Upgrade signage and protective measures in relation to Little Penguin activity and compliance issues*

Marine Sediment & Water Quality

4.0 - To ensure water and marine sediment quality meets the community's expectations and falls within acceptable standards suitable for fishing and swimming

Water quality in Manly Cove is generally of high standard due to the close proximity to the open ocean and resultant regular tidal flushing of the adjacent waters. However, during periods of heavy rain, water quality is known to be impacted by stormwater delivered from the surrounding sub-catchments. Stormwater transports pollutants settled on roads and building surfaces including organic material, litter, sediments, oil, heavy metals and nutrients. These pollutants are piped into Sydney Harbour and diluted by tidal movements and wave action.

A number of pollutants are typically found in stormwater runoff generated from urbanised catchments. These pollutants originate from either point or non-point sources. Point sources are specific and identifiable locations where stormwater pollution can occur such as illegal discharges of trade wastes and sewer overflows. Non-point or diffuse sources are more general, and comparatively difficult to identify and control. Typical examples of non-point source pollutants include oils, heavy metals, litter, suspended solids and nutrients in runoff from road surfaces and rooftops.

The study area encompasses 12 sub catchments with a total of 15 stormwater outlets, each discharging into the receiving waters of Manly Cove. While much of the land use is comparable across the study area, the

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pollutant loads would vary considerably in the sub catchments centred on the commercial centre of Manly Corso and the Manly Wharf area.

4.1 Reduce sediment volume and associated pollution entering the marine environment

In such an urbanised area as the Manly Cove Catchment, it is not possible to incorporate sufficient treatment devices in the sub-catchments to achieve the long-term water quality objectives identified in the Northern Beaches Stormwater Management Plan (1999). The sustainable solution is to direct the community and industry to implement the control of pollutants at their source, before they enter the stormwater system.

However, as it usually takes a number of years for source control strategies to become effective and hence to prevent further degradation of the environment, source controls need to be combined with treatment devices such as gross pollutant traps, oil/grit separators, sediment traps and mini wetlands where suitable.

Indicative Management Options:

- 4.1.1** *Identify point sources of pollution within the study area and assess feasibility of installing suitable treatment measures*
- 4.1.2** *Evaluate the effectiveness of stormwater improvement actions undertaken within Manly Cove*
- 4.1.3** *Identify and implement opportunities for stormwater treatment, harvesting and reuse within Manly Cove*
- 4.1.4** *Develop a greater understanding of sediment quality and processes to guide future management responses with regard to the impact on the marine environment*
- 4.1.5** *Formulate a comprehensive Stormwater Management Plan for Manly LGA encompassing the study area*

4.2 Encourage a reduction of effluent discharge/ exfiltration from sewerage infrastructure in the Manly Cove study area

Another known pollutant entering Manly Cove is from sewage. Sources of sewage entering Manly Cove include exfiltration into the stormwater via illegal discharge from boats and overflow events. Sewage contains high levels of bacteria and nutrients and can pose significant health risks for human consumption and/or contact. Sewage entering Manly Cove can cause a general increase in nutrient levels in the water column, and is known to increased phytoplankton growth, and enhanced growth of macroscopic and microscopic algae on seagrass (AWT Ensight Pty Ltd, 1997). This may result in a decline in the seagrass beds due to competition for space and light (Connell Wagner, 1999).

Sydney Water have identified that sewage overflows and leakages contribute to a relatively large component of the bacterial load to stormwater on an average annual basis. It also has a significant contribution to the nutrient loads exported into the receiving waters (PBP, 1999)

There are presently four sewerage overflow points within the Manly Cove study area, all of which have the potential to significantly impact upon local water quality and the sensitive marine environs of Manly Cove and the North Harbour Aquatic Reserve.

Indicative Management Options:

- 4.2.1** *Continue to liaise with Sydney Water to ensure that all sewage overflows (and pumping stations) operate within established licensing requirements*

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- 4.2.2** *Continue to liaise with Sydney Water to ensure that sewage infrastructure operates within design capacity*
- 4.2.3** *Encourage property owners to undertake CCTV inspections of their properties sewerage systems and ensure they are adequately maintained*
- 4.2.4** *Identify and promptly repair sewage leaks from Council facilities*

4.3

Ensure sustainable groundwater extraction practices to avoid negatively impacting upon aquifer recharge and quality

Drought conditions experienced across eastern Australia in the years preceding the development of this report, combined with a greater demand on resources from an increasing population, have seriously depleted the water supplies on which Sydney depends. In response to restrictions placed on the use of mains water, there has been a significant interest amongst the community in accessing and using groundwater.

The use of groundwater in the Manly LGA generally involves the irrigation of public parks, playing fields, gardens and golf courses. Such irrigation requires high yields of good quality groundwater, particularly for golf courses, and therefore these applications are primarily found across the coastal sand aquifers. In areas where porous or fractured rocks occur, the groundwater yields may be too low, and the quality not suitable for such purposes (SCCG, 2006).

In the years preceding the release of this report, Council drilled a number of test bores within the Manly Cove study area in attempt to identify sustainable sources of groundwater for irrigation purposes. Following initial investigations, Council constructed a water storage sump adjacent to the Manly Art Gallery in West Esplanade Reserve during 2006. The sump collects both stormwater runoff from the sub-catchment and groundwater from a year round surface discharge point. Each source accounts for approximately 50% of the irrigation requirements for West Esplanade Reserve.

Irrigation usage is approximately 2,800 litres 2-3 times per week which equates to a total of 8,600 litres a week. As 50% supply is derived from groundwater collection (and the other 50% from stormwater) the estimated groundwater use is 4,300 litres/week or 0.23 ML/year.

While the exact volume of the retention capability is unknown the quality of groundwater has been identified through past water quality testing. The extent to which the permanent dry weather base flow is sourced from groundwater vs. stormwater is unknown.

Following a thorough testing procedure, a bore was also drilled in East Esplanade Reserve during August 2005 for the purpose of irrigating the portion of the Reserve east of Manly Wharf to Manly 16 Foot Skiff Club. The bore intercepts the water table at a depth of 3.5 m and extracts ground water from a depth of 5.8 metres. The extraction rate is set at 0.5 L/sec for 150 minutes 2-3 times per week, which equates to between 9,000 and 13,500 litres per week (0.7 ML/year) irrigation usage.

As the groundwater is applied to parklands directly over the aquifer from which it was extracted, it serves a recharge function. Groundwater testing since 2005 has shown that water quality is very good and well within the parameters set for irrigation requirements.

A third extraction point, in the form of a bore, was drilled into (and underneath) the median strip garden beds opposite Coles supermarket in Manly Corso. The bore was installed at a depth of 8.54 m depth to penetrate the aquifer at a depth of 4.88 m. The bore was installed in August 2005 and is currently inactive due to lack of suitable power supply and demand. Groundwater quality at this location was found to be more variable in key parameters, including nutrients and heavy metals, than other sites and would require further analysis prior to the establishment of any extraction regime.



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While there has never been any holistic mapping of groundwater in the Manly LGA, information sourced as part of the Coastline Management Planning process is being collated for mapping on Councils GIS system.

Indicative Management Options:

- 4.3.1 Undertake a comprehensive study on the Manly Cove aquifer to identify recharge volumes and to ensure sustainable extraction rates**
- 4.3.2 Monitor council bores for salinity and other parameters to ensure extraction does not lead to contamination**
- 4.3.3 Ensure Council staff working with or assessing groundwater issues are familiar with the SCCG Groundwater Management Handbook 2006**
- 4.3.4 Develop fact sheets outlining the typical occurrence, behaviour and characteristics of groundwater for distribution to community and building/ construction operators**

Air Quality & Noise

5.0 - To ensure air quality and noise levels meet community expectations and fall within acceptable standards

Having no formal boundaries, air pollution is subject to prevailing weather conditions and atmospheric circulation. The Metropolitan Air Quality Study (MAQS) demonstrated that overnight and early morning summer land breezes carry air borne pollutants out to sea. The afternoon sea breezes carry this pollution back on shore, over Manly, and concentrate it in the Sydney Basin.

5.1

Reduce localised air pollution

Odour is one of the most frequent air pollution complaints to Council. It is also one of the most difficult to investigate due to many factors including prevailing wind and weather patterns. Offensive odours can affect a person's health or relaxation. Many odours may contain irritants that can exacerbate asthma or other respiratory conditions.

While the management of air quality issues is best dealt with at a regional level, Manly Council continues to implement a variety of programs related to improving air quality.

Indicative Management Options:

- 5.1.1 Encourage residents to report incinerator use and illegal backyard burning activity in the study area**
- 5.1.2 Encourage Sydney Water to find a solution to alleviate problems associated with odours created by the sludge truck movements from North Head Sewage Treatment Plant.**

5.2

To maintain an acceptable level of noise generation within the community and regulate noise sources

When sound is offensive and undesirable to the listener, it is regarded as noise pollution. There are three different undesirable effects of noise – amenity, health and communication. Noise pollution within the Manly Cove study area was attributed to:

- boats/water crafts

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- rubbish removal trucks
- activities of club precinct (including work conducted on club slipways)
- private parties
- public entertainment
- traffic

Noise not only impacts on residents and visitors to the area, but it can also significantly impact on wildlife. Water and land based noise emissions within NSW are regulated under the *Protection of the Environment Operations Act 1997*. This legislation identifies 'offensive noise' rather than specifying specific noise levels. NSW Maritime also offers general noise guidelines for different boating vessels.

Charter vessels' operating with an amplified music system are required to comply with a Code of Conduct which states that offensive noise will not be emitted from any charter vessel at any time and specifies operating guidelines for different time periods of the day.

Similar to that of boats, noise emission from private residences is also regulated. In the event that noise complaints are conveyed to Council, warnings and infringement notices may be issued to offenders.

During the consultation process it was identified that noise from boats is usually temporary, minimal and limited to daytime. It is far less than the noise from private residences, the occasional group gathering at Manly Cove Reserve, garbage trucks and from the Club activities on the eastern side of Manly Cove.

Indicative Management Options:

5.2.1 Encourage local residents, through the Community Precinct system, to report all excessive or unreasonable noise pollution to either Manly Council or Police

Terrestrial Ecology

6.0 - To conserve and enhance the integrity and diversity of indigenous terrestrial flora and fauna, and their ecosystems

Fragmentation, clearance and degradation of native vegetation in the Manly Cove study area have reduced habitat value for native fauna. Small pockets of remnant bushland do exist between Oceanworld and Federation Point and on Manly Point, providing important habitat for the endangered colony of Little Penguins (*Eudyptula minor*). Grassed areas within the study area are also known to provide nesting and foraging habitat for the endangered North Head population of Long-nosed bandicoots (*Perameles nasuta*). Manly Council is well aware of the present need to protect and regenerate the areas of bushland still intact, in order to support the development of flora and fauna in these areas.

Surveys by GIS Consultants during 2003 revealed that there is little remnant bushland within the study area with a majority of the floristic makeup having been planted in landscaped areas along East and West Esplanades and Federation Point. East and West Esplanade Reserves form a narrow foreshore strip of public land which contains grassy lawn areas with isolated native trees and remnant patches of bushland. Exotic plants and small gardens have been planted in some parts of the reserve. The high edge:area ratio has important management implications for the remnant bushland in this reserve, which is bordered mainly by pedestrian pathways, residential properties and by the rocky foreshore (GIS Environmental Consultants Part B, 2003). Resilience and habitat value of the planted natural vegetation is generally low.

There are large lawn areas throughout these reserves particularly towards the eastern end of the park where the vegetation consists mainly of lawn with mature Norfolk Island Pines (planted) and some remnant coastal canopy such as *Banksia integrifolia* along the foreshore. The dominate canopy species in this reserve are



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Norfolk Island pines and *Banksia integrifolia*. The majority of the mid-story and understorey plants are planted native and exotic species.

Threats to these bushland areas arise through extremely high visitor usage, sewer leaks, weed infestation, encroachment and establishment of exotic plant species. East and West Esplanade Reserves are popular for dog walking which can be a problem for native wildlife and eutrophication from dog faeces (GIS Environmental Consultants Part B, 2003).

A reasonable patch of remnant vegetation can be found on Manly Point which forms part of the important Critical Habitat area for Manly's Little Penguin Population with numerous burrows located at this location.

Rock falls due to erosion and weathering have created ideal penguin nesting habitat.

A range of nest types are utilised by Little Penguins including under rocks on the foreshore, rock falls under seaside houses, garages, under stairs, in wood piles and under overhanging vegetation as illustrated by the Manly colony. Residential development around the Manly foreshores has greatly reduced the amount of native vegetation present. Remnant native species on slopes where penguins nest include Morton Bay figs (*Ficus macrophylla*), blueberry ash (*Eucalyptus reticulatus*) and coastal banksias (*Banksia* spp.). Introduced species such as lantana (*Lantana camara*) and asparagus fern (*Protoasparagus aethiopicus*) have grown very dense at a number of sites and screen some penguin nests from predators (Little Penguin Steering Committee 1996). Nesting sites have also been identified in the area of foreshore between Federation Point and Oceanworld which was declared a Wildlife Protection area during 2006.

GIS Environmental Consultants (2004) identified that herbaceous weeds along the retaining wall adjacent to East Esplanade and opposite Woods and Stuart Streets. On the embankment between East Esplanade and the Manly Rowing & Sailing Club there are several Oleanders which are considered poisonous and should be removed from this public area.

Several Morton Bay Fig trees along the retaining wall on East Esplanade are approaching an age where replacement Fig trees should be considered. The understorey along this embankment and directly below the retaining wall could be enhanced with the introduction of native trees and shrubs to enhance its attractiveness to nectivorous and fruit eating birds and to improve aesthetic appeal to recreational users of the reserve.

While fauna surveys of natural bushland did not extend to these pockets a total of 22 bird species (2 introduced), 9 mammals (5 introduced) and 4 species of native reptiles were recorded in adjacent bushland reserves. Full fauna species lists are provided in Appendix B of the Little Manly Natural Environment Assessment Report (GIS 2003a).

6.1

To ensure the activities within Manly Cove are carried out in a manner that maintains or improves the ecological condition of terrestrial habitats and species

Many of bushland remnants have been impacted upon through the development of urban areas within the Manly LGA.

When undertaking bush regeneration within the study area, it is important to take into consideration the critical habitat declared for this area. Bush regeneration must be done gradually to ensure the impact on habitat is minimal, and must be done in accordance with DECC license requirements. This also applies to weed control undertaken on private property that occurs within critical habitat areas.

Council, as the approval authority for private development, must also ensure that development proposals sufficiently consider and minimise impacts upon the nesting and foraging habitat for the endangered North Head population of Long-nosed bandicoots (*Perameles nasuta*) and endangered colony of Little Penguins (*Eudyptula minor*).

Indicative Management Options:



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- 6.1.1** *Maintain remnant vegetation on Manly Point to enhance Critical Habitat for the Little penguin population*
- 6.1.2** *Encourage planting of low dense clumping native flora species on private and public lands to provide improved potential foraging and nesting habitat for the Long-nosed Bandicoot*
- 6.1.3** *Encourage the planting of native flora species which provide habitat for the vulnerable Grey-headed flying fox*
- 6.1.4** *Ensure that Council's Street Tree Planting Program results in the planting of appropriate native species*
- 6.1.5** *Facilitate the construction of retractable barriers and appropriate signage to protect Little penguins adjacent to Manly Wharf*

6.2

To achieve community awareness of and involvement in the conservation of terrestrial ecology through education and participation

As part of Manly Council's ambition to make the Manly community more environmentally sustainable Council offers an extensive environmental education program. The program is offered to all schools, early childhood centres, before and after school care, vacation care and community groups within the Manly local government area.

Workshops cover topics such as living more sustainably, local environment issues, water use and awareness, stormwater, local fauna, tree planting, waste minimisation and management, recycling, energy use and awareness and green cleaning.

In addition, Council encourages residents to become a "Bush Friendly Neighbour" by enhancing private gardens through planting of endemic flora to provide habitat and food for native fauna, use of water efficient species and methods, responsible pet care and alternatives to fertilizer and pesticides.

Council continues to involve the community in bush regeneration work which is essential to maintain and re-establish healthy vegetation and quality habitat in the area. The Manly Council Bushcare Programme encourages the community to get involved and help protect and restore our precious urban bushland. Bushcare groups work each week in a variety of bushland areas.

Indicative Management Options:

- 6.2.1** *Continue to provide community education in line with actions identified in the Manly Little Penguin Recovery Plan and Draft Long-nosed bandicoot Recovery Plan.*
- 6.2.2** *Encourage community participation in Bush care activities within the study area*

Coastal Hazards & Climate Change

7.0 - Assess, monitor and mitigate risks from coastline hazards and climate change

Manly Cove faces a number of coastline hazards including beach erosion, shoreline recession, sand drift, inundation, stormwater erosion and slope & cliff instability. Each of these hazard types has been assessed and a range of management responses identified.



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A total of 17 sites with potential cliff and slope instability hazards were identified through the 2004 Coastline Hazard definition Study. The slope and cliff instability hazards relating to private properties may restrict future development of the site. Remediation works at two sites have already been completed.

The remediation of hazards identified on public land is the responsibility of Council who has gained external funding to conduct further geotechnical assessments as recommended within the original CHDS. Once completed the additional geotechnical assessments will enable Council to prioritise remediation based on the level of risk posed to both life and property by individual hazards.

The predicted loss of beach width for Manly Cove West Beach over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 2 to 4 metres. The current width of the beach, measured a mean sea level is approximately 20 metres

For Manly Cove East Beach the predicted loss of beach width over the next 20 to 50 years due to sediment loss in severe storms and Greenhouse sea level rise is, conservatively, in the order of 5 to 10 metres. The current width of the beach, measured at mean sea level, is zero to approximately 15 metres.

The Sydney Coastal Councils Group has assessed the vulnerability of the SCCG region and its' member Councils to climate change. Manly Council possesses a moderate degree of vulnerability to climate change relative to other Councils. However, due to its coastlines and coastal development, vulnerability to sea-level rise and coastal hazards was assessed to be particularly high. In addition, stormwater management may become a challenge in the future due to development and projected increases in future rainfall. The vulnerability of the coastline and the paucity of natural landscapes suggest the Councils' natural ecosystems have a low resilience to the effects of climate change.

7.1

Reduce to an acceptable level, the risk of damage as a result of beach erosion and shoreline recession

During storms, large waves, elevated water levels and strong winds can cause severe erosion to sandy beaches. The erosion is measured in terms of the volume of sand transported offshore or in terms of the landward movement of a significant beach feature. Manly Cove experienced damage to coastal infrastructure during the 1974 storms and is likely to experience further damage into the future.

Council has assessed the structural stability of coastal infrastructure, including the history of storm events and there impacts. It is essential that ongoing monitoring of seawalls, access and foreshore structures be undertaken to ensure early identification of potential damage and development of appropriate remedial actions.

Indicative Management Options:

7.1.1 Develop and implement a natural shoreline and shoreline structure monitoring program for Manly Cove East and West Beaches

7.1.2 Revise the assessment of coastline hazards based on the findings of the monitoring program

7.1.3 Should the risk of damage to the existing seawall due to the effects of beach erosion and recession in the future become unacceptable, evaluate and implement the available management options

7.2

To ensure the effects of shoreline recession do not adversely impact on beach amenity

Beaches are susceptible to movement and reshaping by combinations of winds, waves and currents. In the public perception, beach visitation has become synonymous with ocean recreation. The high value placed on

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the shorefront for economic and recreational purposes, and more recently environmental considerations, has resulted in great public interest in protecting the shorefront.

Beach Nourishment is a popular alternative to harden shore protection systems. It involves deliberately enlarging the width and height of a beach through the application of dredged material without the addition of hard structures to the beach.

The history of shore protection is marked by “hard” structures that were intended to have long service lifetimes. These measures have included bulkheads, seawalls, breakwaters, revetments, jetties and groins. Hard structures are used less often today because of problems related to restricted beach access, enhanced erosion, and cost of maintenance. The method of choice has evolved towards beach fill with periodic renourishment. This approach is popular largely because it preserves the beach resource and occasionally serves as a response to criticism about the use of hard structures.

The current width of Manly Cove West Beach, measured at mean sea level, is approximately 20 m. This beach has shown a recession rate of about 0.05 m/yr which would mean that the beach would reduce in width by 2 to 4 m over a period of 20 to 50 years respectively. On the other hand, Manly Cove East Beach currently has a width, measured at mean sea level, of approximately 15 m. This beach has an increase in sand volumes over a limited study period, primarily due to artificial nourishment. As these are popular beaches, it is necessary to monitor recession due both to storms and sea level rise.

Indicative Management Options:

- 7.2.1** *Review the results of the beach profile surveys and assess implications for recreational beach amenity*
- 7.2.2** *Should the impact of shoreline recession on beach amenity become unacceptable investigate options to reinstate the beach to the western end of Manly Cove East Beach*

7.3	To ensure future development is compatible with the erosion and recession hazard

Environmental planning options provide measures to ensure protection of coastal land and restriction of development in hazardous sites, as well as encouragement of development in areas not subject to hazards so that hazards are avoided or minimised.

The underlying principle with these options is to recognise the environmental processes operating on the coast and “design with nature”, ie to ensure development is sited so that hazards are avoided. Alternatively, where this is difficult to achieve because of existing development constraints, the principle involves enacting policies to ensure development is carefully designed in or withdrawn from hazardous sites, in an equitable manner, so that hazards are minimised or avoided.

Indicative Management Options:

- 7.3.1** *Control new development so that it is appropriately sited and is not adversely affected by the erosion and recession hazard over a suitable planning timeframe (minimum 50 years)*
- 7.3.2** *Ensure any redevelopment and public facilities are compatible with the erosion and recession hazard and do not adversely affect coastal processes*
- 7.3.3** *Develop guidelines for the construction and maintenance of structures located within areas subjected to coastal hazards.*

7.4	To ensure any protective works minimise impact on beach amenity and access, and where

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practical improve amenity and access

A variety of coastal protection measures can be used to enhance or preserve beach amenity and to protect coastal developments at risk of erosion or recession. These include seawalls, groynes and beach nourishment. To be effective, the type of protection must be compatible with coastal processes at the site. Information is required concerning the magnitude and mechanisms of existing longshore sediment transport, together with likely long term shoreline changes from erosion, accretion or recession. A detailed understanding of coastal processes and hazards is essential to the successful design, construction and operation of coastal protection works.

Protection works have the potential to impact on areas outside those being protected. Therefore any proposal for protection works must take account of the wider implications and consider the impact in a whole embayment or region, as well as the marine environment.

Indicative Management Options:

7.4.1 *Design any future stabilisation works to minimise impact on coastal processes, amnd where practical improve existing amenity and access.*

7.5

To reduce to an acceptable level, the risk to property and risk to life as a result of slope and cliff instability

A Hazard Definition Study was conducted in November 2003 for the section of foreshore between Delwood Beach and Manly Point. The purpose of the investigation was to identify, among others, potential slope and cliff instability hazards and the likely consequences should a hazard occur.

The slope and cliff instability hazards relating to private properties may restrict future development of the site. Council has formally notified a number of private property owners that their properties may be potentially affected by specific hazards identified through the CHDS process. This was done in the form of a letter to each owner notifying the nature of the hazard, the extent (if known), any recommendations from the CHDS and that a copy of the report is available upon request. Concurrently hazard information will also be recorded on 149 Certificates for those properties affected.

The remediation of hazards identified on public land is the responsibility of Council who has gained external funding to conduct further geotechnical assessments as recommended within the original CHDS. Once completed the additional geotechnical assessments will enable Council to prioritise remediation based on the level of risk posed to both life and property by individual hazards.

The main potential geotechnical hazards identified within the study area can be summarised as follows:

- a) localised erosion of undercuts and overhangs with subsequent rock falls from parts of the cliffline;
- b) toppling (*or forward rotation*) of blocks/overhangs from the top part of the cliffline.

A total of 17 sites with potential cliff and slope instability hazards were identified through the 2004 Coastline Hazard definition Study. The slope and cliff instability hazards relating to private properties may restrict future development of the site. Remediation works at two privately owned sites have already been completed.

Indicative Management Options:

7.5.1 *Continue the staged mitigation of cliff and slope instability on public lands based upon the level of risk posed to life and /or property and in line with recommendations of the Davis Marina to Manly Point CHDS*

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7.5.2 Reissue notifications to private property owners of identified coastal hazards potentially affecting their land and a reminder the information has been recorded on the properties S.149 Certificate

7.6

To reduce to an acceptable level, the risk to property and infrastructure resulting from Sea Level Rise

It is well accepted now that global sea level rise is occurring and, while variations to the degree of sea level rise are likely, sea level rise will impact upon the Manly Cove study area. However, the extent of such impacts at specific locations is not currently known. Increased sea level rise will mean that specific foreshores and intertidal areas may be permanently or intermittently inundated. This is likely to have some flow on effects on a variety of human based infrastructure, to existing vegetative communities, coastal/estuarine morphology. It will also allow for tides to propagate up and thereby affect existing salinity regimes, which will have impacts on existing vegetative communities. During flood events the ocean surge levels may also be heightened, potentially increasing flood levels and extent.

Sea level rise, combined with a combination of ocean swell entering the Harbour during storm events and local wind conditions generating wind waves from the south-south-west direction are likely to increase the likelihood of inundation and/or wave overtopping of the Manly Cove seawall.

The Coastline Hazard Definition study identifies that from calculations and available photography, that the seawalls crest level and adjacent esplanade path level along Manly Cove Beaches is below the limit of wave run-up in severe storms. Any raise to the seawall is, however, considered both impractical and undesirable from an aesthetic point of view. The potential for wave overtopping does need to be taken into consideration in the design of drainage systems behind the seawall.

Potential impacts can, at present, be addressed through appropriate forward planning. Hence, future development and redevelopment at foreshores need to accommodate potential risks. This is particularly pertinent to foreshore structures such as seawalls, boat ramps, swimming enclosures.

Indicative Management Options:

7.6.1 Adopt an adaptive risk-based approach to managing sea level rise impacts

7.6.2 Work with regional, state and federal bodies to ensure consistent adaptation planning

7.6.3 Encourage appropriate development on land projected to be at risk from sea level rise

7.6.4 Work within the emergency management frameworks identified in Local Emergency Management systems during times of floods and storms

7.7

Promote understanding of the likely environmental, social and economic impacts of climate change on Manly Cove

The general public needs and has been requesting better and consistent information about sea level rise and its potential impacts. Additionally councils require consistent messages and communication tools for engaging residents about coastal sustainability and climate change vulnerabilities.

The development of tools and strategies for a wide range of audiences would ensure this is done consistently and appropriately. The NSW Government has been requested to develop centrally available education tools and engagement strategies for a wide range of audiences that can be utilised for raising public awareness of the impacts and management strategies associated with sea level rise.



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In 2008, Manly Council also commissioned an independent analysis of the likely impacts of Climate Change on the Manly LGA and to set an appropriate range of response measures for implementation. In order to affect the measures identified in the Report, Council proposed for a special climate change levy, which failed to receive community support in a poll conducted with 2008 local government election. The costs associated with proactive management of climate change are significant and will require community involvement in the decision making process. Appropriate decisions will require broad community understanding of the issues.

Indicative Management Options:

- 7.7.1** *Continue to provide updated information to the public about climate change including sea level rise and its impacts*
- 7.7.2** *Incorporate latest climate change information into management decisions*
- 7.7.3** *Promote climate change partnerships through co-operative approaches by Government, individuals, industry, business and community groups*

7.8

Limit and reduce the greenhouse gas emissions in the Manly LGA

Climate change has been confirmed as our greatest environmental threat, and international debate has shifted from the science of global warming to the policies that may contain and manage it. Many of those policies are leading to new technologies and opportunities for business, employment and fulfilment – a low emissions economy that holds new possibilities for energy, transport, communication and the home (Manly Council, 2006).

The *Manly Sustainability Strategy: For Today and Future Generations* (2006) is Council's plan to ensure that we as a community protect and maintain that way of life, partly for our own enjoyment but more importantly for the enjoyment of generations to come. It is Manly Council's road map for the management of our natural resources, giving us detailed direction for the way forward. The Strategy sets targets for the reduction of local greenhouse emissions with the overall objective that Manly generates zero net Greenhouse gas emissions. More specifically, that community Greenhouse Gas emission is reduced by 25% by 2010 (reduction on 1996 figures) and Council greenhouse gas emissions reduction of 50% by 2010 (on 1996 figures).

Indicative Management Options:

- 7.8.1** *Encourage the use of passive and local transport within and from the study area*
- 7.8.2** *Ensure public facilities are fitted with energy efficient lighting and energy fittings and devices*
- 7.8.3** *Encourage the use of energy efficient devices in commercial and residential buildings*

7.9

Reduce water consumption within the study area

Drought conditions experienced across eastern Australia in the years preceding the development of this report, combined with a greater demand on resources from an increasing population, have seriously depleted the water supplies on which Sydney depends. In response to restrictions placed on the use of mains water, there has been a significant interest amongst the community in accessing and using alternate water sources.

Stormwater harvesting and re-use within Manly Cove may also contribute to reductions in pollution and scour of the beach profile. Sustainable groundwater utilisation is another means of supplementing water supply for irrigation of parks and gardens and cleaning purposes.

Indicative Management Options:

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- 7.9.1** *Ensure public toilet, shower, bubbler and tap facilities within Manly Cove are fitted with water efficient systems*
- 7.9.2** *Repair damaged or malfunctioning public water systems, including leaks, within the study area*
- 7.9.3** *Investigate opportunities for stormwater harvesting and reuse to supplement water use*

Waste Management

8.0 - Promote and facilitate sustainable waste management in Manly Cove

Despite the presence of a range of rubbish bins within the Manly Cove study area, litter, both from harbour and land based activities, presents a continuing issue for the management and aesthetic quality of the Manly Cove study area. The high level of human activity on the harbour and surrounding urban areas contributes to an undesirably large amount of litter accumulating on harbour beaches.

Community consultation, and visual observations following rainfall, confirmed the extent of the problem. The Manly Council Waste Management Committee have for many years campaigned for waste avoidance and minimisation, particularly within the commercial sector. Part of this campaign included writing to take away food outlets, especially those located at Manly Wharf, requesting the implementation of waste avoidance measures such as biodegradable packaging be introduced.

In addition, some outlets have been approached in person to remind management of their responsibility regarding the management of waste and reminding them of their own environmental care statements within corporate handbooks and reports. There are many waste bins are located at Manly Wharf area.

Sample Map: Bin Locations



Further problems arise when people leave waste, namely leftover food items on picnic tables and in open space areas. Birds, namely seagulls and pigeons, swoop to collect the food, scattering plastic and paper debris. Smaller pieces of litter are often collected in the birds' beaks and discarded elsewhere, generally over the water to be washed back onto the sandy beaches of Manly Cove.

The Manly Waste Committee expresses concerns about the effects of removing bins from Ferries, including waste overboard and the increased litter pressure on Manly in October 2004. Formal correspondence was sent



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to seek a response from Sydney Ferries on methods for addressing the problems, including announcements on the Ferries. Sydney Ferries now supply garbage bags at points of disembarking for waste disposal and placed 240L garbage bins close to the exits on board.

The Waste Committee and Clean Up Australia (CUA) day groups have advised that there is significant underwater litter around Manly Cove. Ecodivers and CUA have collected 105kg of rubbish on 2009 CUA day, including significant amounts of plastic bags, cigarette butts and drinking straws at Manly Cove. Council has requested Wharf Management for installation of additional cigarette butt bins.

Identified sources of litter in the Manly Cove study area include:

- food/drink containers, cigarette butts, paper, plastic bags etc, carelessly/intentionally deposited or left behind unawares after picnics, barbecues and general usage of the area;
- rubbish thrown from vehicles and boats;
- boat users dumping litter while moored around the Manly Cove embayment;
- illegal dumping of rubbish;
- organic litter accumulating in roadside gutters;
- building sites without adequate litter controls;
- full bins allowing litter to blow away;
- uncollected dog faeces;
- waste material washed onto the beaches from outside sources.

8.1

To reduce waste while maximising re-use and recycling in the Manly Cove study area

The Manly Cove DCP (1996) provides controls for waste management within the study area through the following objectives:

- All pedestrian areas shall be adequately provided with clearly labelled compartmented waste receptacles to allow for self sorting of recyclable waste products i.e. glass bottles, PET bottles, cans and biodegradable materials such as food waste.
- All containers for take away food must be made of biodegradable material.
- Where seating is provided in or adjacent to food shops, all meals for consumption in the premises shall be served on returnable plates, cups and cutlery.
- A garbage storage area must be provided in a suitable location and of a size and design acceptable to Council. Contact should be made with the Trade Waste Office of Sydney Water to discuss the requirements for liquid trade waste disposal.
- No waste water is to be discharged into the waters of Manly Cove.

A comprehensive study of the Public Bins at Manly Cove and elsewhere is currently being conducted in order to improve maintenance of facilities and reduce recycling contamination rates etc.

Indicative Management Options:

- 8.1.1 Continue to conduct and support community and business education programs to avoid litter production at source**
- 8.1.2 Ensure adequate recycling facilities are provided in public areas and encourage responsible disposal of litter within the study area**
- 8.1.2 Carry out a litter survey of Manly Cove to assess litter types, sources and volumes entering Manly Cove (waste)**



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8.2

To minimise risk to beach users and marine fauna from beach and marine waste while maintaining natural ecosystems

Litter accumulation on Manly Cove beaches has been identified as a major concern to the community, resulting in Council applying a defined beach cleaning regime in an attempt to enhance beach amenity. Weather conditions are known to contribute to the degree of waste on Manly Cove beaches, with south and south westerly winds pushing water borne pollution, possibly from as far as the city and eastern suburbs, across the harbour and onto Manly Cove. The waste may pose risks to human health and marine fauna, including Manly's endangered Little Penguin population.

Indicative Management Options:

- 8.2.1 Continue to operate the existing beach raking regime and remove gross pollutants from Manly Cove beaches**
- 8.2.2 Conduct litter audit to determine sources of rubbish to inform treatment and education programs**
- 8.2.3 Encourage NSW Maritime to improve its water-based litter and debris cleaning regime**

Access & Traffic Management

9.0 - To provide an environment at Manly Cove that is accessible to all people

Discussions with Council's Access Officer, feedback received during community consultation and a review of existing facilities within the Manly Cove area highlighted that the study area provides varying degrees of accessibility.

With Manly Cove, and more specifically Manly Wharf, acting as a major tourist and commuter link, this section of the study area provides safe, well maintained and lit access for a variety of users. However, there are a number of areas which have been identified as requiring improvement in order to meet the standard set by the Access DCP and to meet community needs.

It must be noted that Council discourages access to the foreshore around Manly Point due to the area being designated as critical habitat for the Little Penguin population and the potential risk posed from cliff and slope instability. For further information on access refer to **Appendix C**.

9.1

To improve and control access for pedestrians, cyclists, water based recreation and servicing vehicles, minimising conflicts and negative impacts

Pedestrian Accessibility

Manly Cove is part of an expanding network of pedestrian walks which form part of the Manly Scenic Walkway. Council adopted a Development Control Plan for Access in 1996 which incorporates the Manly Access Policy. The aim of the Policy is "to adopt and implement objectives and strategies which will enable Manly Council to provide an environment that is accessible to all people including those with disabilities". This is now being reviewed.

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A high standard of access is provided in the areas adjacent to Manly Wharf including the bus interchange and toward Manly Corso. However, the quality of such access decreases at each end of the study area with a number of specific concerns raised during community consultation, including:

- The movement of pedestrians between Manly Corso and the Wharf interchange is considered by many to be poorly organised. The concept of an underground pathway to transfer pedestrians underneath East/West Esplanade was supported by a number of respondents during consultation.
- There is a need for the provision of improved beach access at the site identified as the curved set of stairs to the eastern side of Manly Wharf. Coastal processes, coupled with the redevelopment of Manly Wharf have resulted in the beach sediment levels dropping to a level which makes it difficult for users to access the beach. Improvements to beach access at the eastern side of Manly Wharf were being investigated during the development of this Study.

Vehicular Access

Council's Manly Cove DCP recognises that, in general, access for the purpose of loading and parking is difficult within the study area. Parking facilities are only provided where there is direct access to a roadway. Access driveways are not permitted at ground level across East or West Esplanade Reserves. All parking is provided below the ground floor level of any building. Parking structures below mean high water mark are also not permitted outside the footprint of the ground floor of any building and must be screened from view from the water. Where it is impractical to provide on-street parking a contribution towards the provision of parking in the Town Centre shall be required.

There is currently a lack of parking available for residents and patrons of the 'boating precinct' in east Manly Cove. This issue has been ongoing, with a 2 hour time limit placed on non-resident vehicles to discourage long-term parking in this location (Spackman & Mossop, 2005).

Traffic congestion was also considered to be an issue for many who provided feedback during the consultation process.

Bike Access

A shared path currently exists between Federation Point and Manly Yacht Club and extended to skiff Club, providing safe off-road access for cyclists via a footpath shared with pedestrians. At two locations along this route cyclists are required to dismount due to an increased potential for accidents with pedestrians. These include the ramp adjacent to Manly Art Gallery, due to limited path width and the steep and curving layout of the path and the Wharf Forecourt, due to significant pedestrian volumes travelling perpendicular to the path of cyclists.

The use of bicycles is encouraged as an alternative mode of transport with bike racks provided in a number of locations at Manly Wharf and adjacent to the study area. During 2007, Council opened a new secure bike storage facility in the Whistler Street car park which can accommodate up to 72 bikes.

Despite the many positives associated with bike use, many people highlighted the need to impose tighter controls on their movement, particularly in areas where there is high pedestrian activity.

Boating Access

There is currently a lack of public wharf facilities within Manly Cove. Prior to the current lease agreement, recreational vessels were able to use Manly Wharf for transfer of passengers and goods in a safe user-friendly location. However, vessels are now charged at premium rates to utilize Manly Wharf regardless of the time they are berthed. This issue has been raised by numerous groups and individuals during the consultation process, including the Little Manly and Fairlight Precincts. Manly Wharf is currently used by a number of commercial operators.



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A number of formalised jetties are located along the eastern foreshore in the "Club Precinct" between Stuart and Osborne Streets, however these are exclusively utilised by members of the various clubs and not for general use by the public. The eastern jetty of the Manly Wharf development is leased for use by a variety of commercial operators.

The lack of public wharf facilities within the study area results in vessels having to beach themselves. This activity has the potential to increase conflicts between (and potentially the safety of) beach users, particularly during peak summer and holiday periods.

Indicative Management Options:

- 9.1.1 *Encourage NSW Maritime lessees to improve beach access and public amenity immediately east of the Manly Wharf development***
- 9.1.2 *Raise awareness and understanding of disability issues through research, information, consultation and education programmes involving the community, professionals, Council members and Council staff***
- 9.1.3 *Investigate the feasibility of constructing an underground pedestrian pathway to link Manly Wharf with the Corso***

Crime Prevention & Safety

10.0 - To provide public areas in which patrons feel and are safe

Law and order, crime and justice issues are significant concerns for most urban communities. Fear of and incidence of crime stifles the participation of residents in community life and undermines their well being. It can disrupt the effective functioning of the community, damage social harmony and generate tensions which lead to further crime, major costs and significant human suffering amongst victims, perpetrators and their families.

In early 1999 Manly Council, at the instigation of the Manly Community Safety Committee, was successful in obtaining a two year grant from the NSW Attorney General's Department under the Safer Towns and Cities program. This funding has allowed Council to employ a Crime Prevention Co-ordinator to develop a Crime Prevention Plan and has provided funds to implement some strategies.

Whilst the Manly LGA is a relatively safe place to be and currently holds a safe reputation for visitors it is important that this perception is maintained as safety is a paramount consideration for tourists, when choosing a destination.

Compared with many other parts of Sydney, the Manly LGA is considered to be generally safe in respect of violence, personal safety and crime in general. This is born out both statistically and in terms of local community perceptions. The exception to this is the area of Manly Corso and its immediate environs. The unique nature of this heavily used meeting place, with its five hotels and nightclubs, one hundred plus restaurants/food outlets and associated late night social activities, has been identified by police and the community as a problem location, particularly at night time with alcohol seen as a major contributor to the problem.

A core objective for the NSW Maritime Authority is to promote safety on all navigable waters. NSW Maritime is responsible for educating users on boating safety through the issue of licences, educational programs and by establishing and promoting user groups, licensing commercial vessels and operators, maintaining navigation aids and signs, and licensing on-water events.



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NSW Maritime produces a Safe Boating Handbook NSW, which details safety and environment protection legislation effective in NSW. For safety and natural resource conservation reasons a 4 Knot zone is in place for waters up to 100metres offshore of the Manly Cove foreshore.

Council is well placed to address issues of crime prevention and community safety. It is close to the community and influences many of the things that matter to how people live. Council decisions and actions in planning, environment, urban design, and welfare provision, all have an impact on community safety.

10.1

To control and minimise crime and inappropriate behaviour in the study area

Most of the crime in the Manly Council area is concentrated in a relatively small area, that is, the Manly town centre. Across the whole of the northern beaches – the most reports of crime of all types occur in the Manly CBD. This CBD area, which encompasses the Corso and Manly Wharf, is a crime hotspot. The Manly Local Government Area has higher incidents of crime in all categories than either Warringah or Pittwater Council areas.

Based on consultation undertaken during the development of the Manly Cove CMP, the following crime and safety issues were identified as being of concern:

- Breach of speed restrictions by commuter vessels and impacts on foreshore activities;
- Drink spiking
- Improper disposal of rubbish by commuters and users of Manly Cove;
- Public consumption of alcohol particularly in East Esplanade Reserve where loutish, disorderly and offensive behaviour by groups is often reported;
- Camping in East Esplanade Reserve;
- Walking of dogs off-leash and its impact upon the safety of humans and Little Penguins;
- Potential for injury via rubbish accumulating on beach (i.e. broken glass, needle stick injury);
- Risk posed by boating activity including beaching of vessels in popular swimming areas and potential for collision between non-motorised and motorised vessels (inc ferries);
- Loud noise from Manly Wharf Hotel and Manly 16 Foot Skiff Club.
- Unacceptable behaviour of patrons leaving the Manly Wharf Hotel from 7pm onwards such as public urination, breaking of glass and other antisocial behaviour;
- Access to Manly Cove East Beach from Manly Wharf is considered unsafe.

Indicative Management Options:

10.1.1 Control and minimise the impacts of human and companion animal activity upon Little penguin and seahorse populations of Manly Cove

10.1.2 Address issues associated with antisocial behaviour adjacent to Manly Wharf and in Manly Cove east

10.1.3 Encourage the community to report crime or antisocial behaviour to Police or Council Rangers

10.1.4 Ensure public access within Manly Cove is appropriately lit

Aesthetic & Landscape Character

11.0 - To maintain and enhance the aesthetic appeal of Manly Cove

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Quality of life is intimately connected to how land is developed and used. But how those uses are designed can be even more important and will have a lasting effect on the Manly Coves appearance and function. Commercial and residential development can have an adverse impact on visual resources if not properly designed. This is particularly true for such features as architecture, signage, lighting, parking and landscaping. Well-designed development projects can be enjoyed by residents for 100 years or more. But when done poorly, they can diminish quality of life and damage the economic fabric of the community. The design of development projects, therefore, is a matter of public concern.

11.1

To reduce the adverse impacts of features which detract from the visual quality of Manly Cove

Design standards are one of the most effective tools available to assist Council in retaining its aesthetic qualities and historic character. The design standards illustrate preferred building design and site layout for commercial projects and major developments in Manly Cove. New development should be designed to fit into the natural surroundings rather than becoming a dominant element of the landscape. Architectural standards should be used to ensure architectural quality and compatibility with local styles.

For non-residential development, the standards additionally establish requirements for scale of activity, access, and setbacks, and should illustrate signage, lighting, pedestrian/bicycle circulation, and the preferred location of parking lots to ensure that a proposed project is in harmony with adjacent properties and enhances the visual environment.

The *Manly Cove Development Control Plan 1996* determines what uses are appropriate in the different areas of the study area. The Manly Cove DCP aims:

- To preserve and enhance the amenity of Manly Cove including public places and areas visible from public places or from the navigable waters of Sydney and North Harbours.
- To provide for maximum public visual and scenic quality to the harbour front and to avoid as much as possible private, exclusive use.
- To provide and enhance efficient transport facilities while recognising that the wharf and its connection to The Corso act as a gateway to Manly so that all development must be of a high visual quality and have regard to its visual impact on the shoreline and adjacent reserves.
- To ensure that all development in Manly Cove is complementary to and does not detract from the shoreline and adjacent reserves in Manly Cove.
- To retain all of the existing beach frontage for aquatic and recreational activities.
- To make optimum use of the Manly Pavilion precinct while still retaining its existing character.
- To retain the existing character of the boat club precinct at the southwestern end of Manly Cove while seeking to increase public usage.
- To conserve and enhance the environmental heritage of Manly Cove and its foreshores.

Indicative Management Options:

11.1.1 Ensure all new development complies with the landscape provisions of Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 and the Sydney Harbour Foreshores and Waterways Area Development Control Plan 2005

11.1.2 Ensure signage is appropriately designed, positioned and sized to ensure minimal impact on visual character of Manly Cove

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Recreational Activities & User Groups

12.0 - To provide for the continuing, enjoyable and sustainable use of Manly Cove for a range of user groups

Manly is identified as a place to visit and is a location that supports a host of activities suitable for day tripping and for lengthy stays. It is important to recognise that the features of Manly are different and unique.

Water recreation is one of the key points in this regard. Manly's beachside and harbour side location is its major natural resource which offers recreation opportunities of local, regional and national significance (Manly Cove DCP, 1996).

While serving as a major transport and commuter access point, the Manly Cove study area also provides opportunities for a wide range of water and land-based recreational activities. The most popular activities identified during community consultation and through visual observations occurring within the Manly Cove study area are identified and briefly described in the following section. Those issues which require further description (due to potential impact upon the surrounding environment) are covered in more detail in separate sections of this report.

Community consultation survey results highlighted that 80% of people surveyed considered the ability to undertake recreational activities as being of importance to them. The most popular activities identified during community consultation included walking/jogging, swimming, passive recreation, Picnic/BBQ and Snorkelling/SCUBA diving.

The impact of recreational activities upon the environment is exacerbated through the high visitor numbers observed within Manly Cove. However, the hardened and managed nature of the promenade and parklands minimises these impacts for much of the study area. Most effects will be indirect - such as litter impacts upon aquatic and terrestrial species, sunscreen dispersal and its impact upon local water quality/aquatic organisms, damage to rock platforms, fuel and pollutant discharge from motorised craft, minor recreational fishing impacts and resource usage and energy implications of the study areas role as a major tourist destination.

12.1

To minimise conflicts between differing recreational and commercial activities within Manly Cove

The high visitor numbers also result in a number of conflicts between recreational groups. Issues relating to recreational use of the study area that warrant consideration in the preparation and implementation of the Manly Cove Coastline Management Plan include:

- Potential safety of swimmers through recreational boat movement - power boats are often observed moving in close proximity to swimmers while "beaching" vessels in Manly Cove;
- Potential conflict between kayakers/non-motorised vessels with Ferry and Fast ferry movements due to the minimal warning provided when commuter vessels leave Manly Wharf in a southerly direction;
- Impact of Skiff sailboat rigging activities upon the general use of East Esplanade Reserve. While this activity has been ongoing for many years and contributes to the historic use of Manly Cove, rigging during weekend competition often results in East Esplanade Reserve being dominated by one use and undesirable for many users. is particularly evident during summer weekends;
- Boat wakes created as a result of Fast ferry movement from Manly Wharf results in disruption and safety issues for water-based recreation activities in the eastern 'boating precinct'. The impacts are particularly evident for Sailability activities.



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- Conflicts between cyclists and other users continue despite cycling being currently banned in Esplanade Park. Prohibition is advised by 'No Bicycle' stencils on the path surface at each entry, on the footpath, and on pole signs.
- Conflicts between pedestrians and traffic are common due to the high pedestrian and traffic movements between Manly Cove and Manly Corso;
- Concerns relating to conflicts between companion animals and other users - conflicts may now decrease following the declaration of the area between Federation Point and Manly Wharf as a (Little Penguin) Wildlife Protection Area. Specific controls apply to the control of dogs with dog walkers now required to ensure dogs are kept on-leash at all times within this section of East Esplanade Reserve;
- A number of general concerns have been expressed regarding diver use of the area. These have predominantly been related to pre- and post-dive land-based use of West Esplanade reserve as opposed to any problems with the actual dive activities or impact on biodiversity and habitat. One concern relates to congregation of divers and their equipment in the boat launching area and on the beach.
- Despite the activity being prohibited on Manly Wharf the activities of recreational fishers often result in negative impacts upon the amenity of the area for visitors, residents and commuters through improper disposal of waste and potential for injury through fishing practices.
- Sand quality and coverage is a critical determinant of visitor satisfaction on Manly Cove beaches. Substantial long-term reductions in sand area, or sand quality, would adversely impact upon visitors' enjoyment of the area.
- Visitor use of Manly Cove may be negatively impacted in terms of exacerbated crowding and user conflicts should there be any further reduction in beach sand volumes. This would particularly be the case for Manly Cove east beach which may benefit (from a user and aesthetic perspective) from a beach nourishment exercise.
- Access to the beach zone for people with disabilities or mobility challenges is poor at present and could be improved.
- High usage levels will require that Council continue in the routine high quality maintenance and periodic refurbishment of the landscape works and visitor facilities across the study area in order to maintain current amenity and enjoyment levels.
- Visitors' use and enjoyment of the beach will need to be balanced with the amenity of local residents/neighbours in the area's future development and management.

Indicative Management Options:

- 12.1.1 *Ensure all passive recreational activities are able to continue within Manly Cove in a sustainable and harmonious manner***
- 12.1.2 *Work with Sydney Ferries and NSW Maritime to minimise conflicts between ferries and water based recreational activities***
- 12.1.3 *Support and promote environmentally friendly recreationally sustainable activities***
- 12.1.4 *Support and promote sustainable recreational fishing***
- 12.1.5 *Continue to educate boat users and organization on their potential impact upon the marine environment***

Geodiversity

13.0 - Conserve the significant geodiversity elements of the area's coastline



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Manly's geodiversity is an important element of our natural environment. This concept covers the whole range of natural earth materials and processes. It includes the rocks, landforms, streams, beaches, soils, sediments and groundwater features.

While the principal rock outcropping in Manly is Hawkesbury Sandstone, it is by no means uniform, and a range of sedimentary structures in the rock can be seen in the cliffs along Marine Parade and at other localities. Some structures such as joints, faults and shear zones cut through the sandstone and guide landform development. They may also constrain development and present geological hazards.

Features include cliffs, rock platforms, waterfalls, the terraced nature of sandstone hillslopes, springs, hanging swamps, and a great range of small landforms. While much of Manly has been modified, significant examples of large and small-scale landforms remain, all of which need to be identified and appropriately managed. In recent years developments in the technology of earthmoving and rock excavation have the potential to destroy valuable landscape elements of geodiversity.

13.1

To protect and conserve the important elements of Manly's geodiversity through raising awareness, considering its values in all planning and management and integrating with biodiversity and cultural heritage management

Despite Manly Cove being heavily modified through urban development, the area shows a rich geodiversity, including sandstone cliffs, sandy beaches, rocky intertidal and remnants of the original stream (now piped). Much of this natural landscape provides important habitat for the Little penguin. It also contains significant aboriginal heritage value. As such it is essential to ensure that future development appropriately considers geoheritage values.

Indicative Management Options:

13.1.1 Undertake a comprehensive assessment of geoheritage values of Manly LGA

13.1.2 Ensure that geoheritage issues are considered during development assessment processes

Heritage Conservation & Management

14.0 - Ensure that all Aboriginal and European (cultural and natural) heritage sites within the study area are preserved and protected

Manly Cove is rich in its cultural heritage, including indigenous heritage, natural heritage, and the built heritage representing the historic development of the Manly Local Government Area. The community and Council seek to preserve items of heritage significance and encourage sensitive management and conservation of heritage items both within public and private ownership.

14.1

Ensure that sites of Aboriginal heritage are protected and appropriately maintained

The natural environment of the Manly Cove study area would have been well suited to occupation by Aboriginal people. The area was rich in resources and the variety of plant and animal species, both terrestrial and aquatic would have been highly utilised by Aboriginal people.

Aboriginal places and objects are important part of the rich heritage of Manly and are of great significance to Aboriginal communities, providing links to culture, environment and knowledge. The oldest Aboriginal site known in the Manly LGA is dated to about 4100 years before present. European development has had a great

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impact on Aboriginal heritage in these areas. It is important to protect and conserve these places for future generations. Coastal and foreshore areas are generally considered to have very high potential for Aboriginal sites. Sites can be found immediately above the tidal zone, on slopes above foreshore areas, and on ridge tops.

The Manly Cove study area provided shelter in all weather conditions in the various bays and valleys, with the extensive sandstone outcrops providing an abundance of overhangs and caves. There was also an abundance of food resources and fresh water, as evidenced by the many and extensive middens that can be found throughout. In excess of 1500 Aboriginal middens have been recorded along the coast, primarily as open sites (Sullivan 1988). Many middens are situated in rock shelters, reflective of relative abundance of cavernous overhangs to the shoreline. Middens are observed to be of varying size and length. Mounded middens are also found on the south coast. Estuarine shell fish species comprise approximately 50% of the shell in middens along the coast. Oyster is the dominant shell fish throughout the deposit. Most midden sites are within 200 meters of a water supply.

However, due to potential sensitivities in mapping specific sites and locations of Aboriginal significance, maps and detailed descriptions have not been included in this report. It is likely that further sites will be present in areas that have not been surveyed or where they are not visible at the surface. Aboriginal sites are vulnerable to many of the same processes that affect other assets, such as encroachments, development and earthworks, pedestrian traffic, graffiti and so on.

Based on landscapes or physical setting, the likely range of cultural evidence associated with the landscape and the landscape history, AHO & MC (2006) has identified Esplanade Park as exhibiting high potential area to find further Aboriginal sites. Issues relating to indigenous heritage that warrant consideration in the preparation and implementation of a Coastline Management Plan for Manly Cove include:

- The active involvement of Aboriginal people and organisations in the management of indigenous cultural heritage. The Metropolitan Local Aboriginal Land Council and Aboriginal Heritage Office (Sydney North) should be consulted and involved in the management and knowledge delivery of Aboriginal cultural sites/values throughout Manly Cove;
- A range of Aboriginal sites were previously identified throughout Manly Cove, and unknown/unrecorded sites may still be found within the study area. The possibility for the existence of unknown/unrecorded Aboriginal sites warrants consideration in the development assessment process;
- Tangible Aboriginal objects and sites are protected by legislation. Any objects and sites located within the study area, including those uncovered during development or management works, will require appropriate protection and management;

The areas Aboriginal history, heritage, sites and contemporary associations/significance are all of interest to residents and visitors.

Indicative Management Options:

14.1.1 Continue to undertake consultation with the Aboriginal Heritage Office, Metropolitan Local Aboriginal Land Council, DECCW and other local Aboriginal groups in regard to the management of cultural heritage site management

14.1.2 Undertake a Heritage Impact Assessment prior to proceeding with works that may impact on any Aboriginal heritage items within the study area

14.2	Ensure that all sites of non-indigenous heritage are protected under the relevant legislation and in Council planning instruments

Manly is rich in built heritage representing the historic development of the Manly Local Government Area (LGA). The community and Council seek to preserve the Manly LGA heritage and encourage sensitive management and conservation of heritage items both within public and private ownership. Retention and enhancement of the environmental integrity of the Manly Cove study area was also an important management recommendation identified in the community consultation process.



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There are a significant number of European built heritage items and areas within the bounds of the study area (Table 9.4.2). These sites should be protected according to their level of significance. Many sites are already listed in Manly Council's LEP, Energy Australia Heritage Register and Sydney Regional Environmental Plan. It is important that due care is taken to avoid damage to known cultural sites and sites that may be culturally significant.

Several identified sites of historic heritage significance occur within or adjacent to the study area. These sites are of different levels of significance and are afforded varying degrees of legislative protection. The impact of any proposed works on the heritage values of these places must in all cases be identified and fully considered in the planning and development process.

Indicative Management Options:

- 14.2.1 *Prepare a Heritage Management Plan to identify detailed management measures to protect and maintain built heritage***
- 14.2.2 *Undertake a Heritage Impact Assessment prior to proceeding with works that may impact on any Non-Indigenous heritage items within the study area***

13. PRELIMINARY ASSESSMENT OF MANAGEMENT OPTIONS

All identified management options are investigated through an open and transparent evaluation process. The aim of this process is to enable the Harbour Foreshore and Coastline Management Committee to choose the particular combination of management responses that best meet the vision, goals and objectives set for the study area. The evaluation process, thus, reflect the emerging principle of 'community right to know'. This expresses the community's right to access all information that may affect their quality of life. It acknowledges community demands for more information and increased transparency in decision-making.

13.1 EVALUATION CRITERIA

Options are evaluated according to explicit criteria that reflect a wide range of social, economic, environmental and financial considerations. The most favorable options are those that best satisfy the criteria. The following criteria are used for evaluation management options.

- **Sustainability:** the option is consistent with the principles of ecologically sustainable development (ESD) and other relevant principles.
- **Consistency with vision and goals:** the option promotes achievement of adopted goals and objectives.
- **Likely impacts:** the social, economic and environmental impacts are acceptable to the community.
- **Public domain:** the option protects or enhances the public domain, particularly, the public's right to access and enjoy foreshore reserves, beaches, waterways and the estuary
- **Cultural:** the option respects and promotes the cultural, social or spiritual value of coastal environment
- **Acceptable risk:** the level of risk to life, property and the environment is accessible
- **Indicative Cost-benefit:** the cost-benefit of the option is positive and is superior to alternative options
- **Financial:** the option can be adequately finances, both initially and in the long-term
- **Legal and regulatory:** the option is compatible with legal and regulatory constrains, including land tenure issues and approvals by Commonwealth and state agencies
- **Community support:** the community understands and supports the option.

A preferred management option is the option that best meets the evaluation criteria. It may include a number of actions.

13.2 PRIORITISATION OF MANAGEMENT OPTIONS

The prioritisation process is an important step in focusing activities and funding towards addressing those issues which will potentially provide benefit. Typically the highest priorities for implementation are those, which have the greatest potential to bring about required change within the study area.

The process of prioritising the management options is complex. The reasons for this include:

- There are many different aspects of the study area which can be improved, and it can be difficult to determine whether commercial benefits are more important than ecosystem benefits, etc; and
- The likely level of benefit of some strategies is difficult to estimate. This is often a function of how easy or how well implemented the objective is.

Prioritisation is based on the relative importance of the objectives to the general community of Manly Cove study area, stakeholders and users of the area, to the various statutory bodies responsible for coastal management. Prioritisation of management options will be carried out during Plan preparation stage.





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Table 13.1: Evaluation of indicative Management Options

Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
1.0 Aquatic / Intertidal Habitat Conservation & Management											
Goal: Restore and maintain a healthy and diverse mix of aquatic and intertidal habitats that will maintain and improve biodiversity and ecological functions of Manly Cove											
1.1.1 Continue to work with other stakeholders in the provision of marine focussed educational events	High	Yes	+++	N/A	+++	Yes	N/A	N/A	N/A	N/A	+++
1.1.2 Encourage the establishment of a community-based seagrass monitoring program to provide reliable data on any change to the distribution or health of seagrass in Manly Cove.	High	Yes	+++	++	+++	Yes	N/A	N/A	High	++	+++
1.1.3 Involve the community and user groups in the management planning process to ensure outcomes build public knowledge and meet community expectations	High	Yes	+	N/A	+++	Yes	N/A	N/A	N/A	N/A	+++
1.2.1 Pursue a submitted proposal to DECCW seeking the extension of the boundary of North Harbour Aquatic Reserve to include Manly Cove (Little Manly Cove and North Harbour).	N/A	Yes	N/A	N/A	+++	Yes	N/A	N/A	N/A	N/A	+++
1.2.2 Continue work with DECC to manage Little penguin Critical Habitat, the Wildlife Protection Area at Federation Point and known nesting sites in line with the Recovery Plan.	Medium	Yes	N/A	N/A	+++	Yes	N/A	N/A	Medium	+	++
1.2.3 Protect and enhance marine/intertidal habitats within and adjacent to Manly Cove	Medium	Yes	++	N/A	+++	Yes	++	+	Medium	++	+++
1.3.1 Minimise the impact that recreational fishing activities have on the intertidal and marine ecology, through education and regulation	Medium	Yes	N/A	+	+++	Yes	++	+	Medium	+	+++
1.3.2 Minimise the impact of diver/snorkeller activities and routine maintenance upon the colony of seahorses known to colonise the Manly Cove netted swimming enclosure.	Medium	Yes	+	N/A	+++	Yes	+	++	N/A	+	+++



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
2.0 Boating, Maritime Operations & Facilities											
Goal: To achieve the highest level of environmental protection and safety for maritime operations within Manly Cove											
2.1.1 To encourage boat user groups to play a role in educating the boating community on best practice	High	Yes	N/A	+	++	Yes	+	N/A	N/A	++	++
2.1.2 Encourage the boating community to report marine pest sightings	Medium	Yes	N/A	N/A	++	Yes	N/A	N/A	N/A	N/A	N/A
2.1.3 Ensure Manly Council Rangers are aware of Spill Response Procedures for both on-water and off-water incidents	Medium	Yes	N/A	N/A	++	Yes	N/A	N/A	N/A	N/A	N/A
2.2.1 Encourage compliance with NSW Maritime boating regulations	High	Yes	+++	++	++	Yes	N/A	N/A	Medium	N/A	+++
2.2.2 Sustainably manage the extent to which commercial operators access and use the Manly Cove embayment	Medium	Yes	N/A	N/A	N/A	Yes	N/A	N/A	Medium	N/A	++
2.2.3 Investigate the feasibility for the installation of a ‘ferry underway’ warning system for passive waterway users	High	Yes	+++	++	++	Yes	N/A	N/A	High	++	++
2.2.4 Ensure skiff rigging and storage activity does not negatively impact other usersof East Esplanade Reserve	Medium	Yes	++	++	++	Yes	++	N/A	++	++	++
2.3.1 Work with NSW Maritime and organisations in the boating precinct to investigate the feasibility of providing public wharf facilities in Manly Cove	High	Yes	+++	+++	+	Yes	N/A	++	+++	+	+++
2.3.2 Encourage NSW Maritime, I&I NSW and mooring users to install seagrass friendly moorings throughout Manly Cove	High	Yes	N/A	++	+++	Yes	N/A	++	++	+	+++
2.3.3 Encourage and support the provision of safe, accessible boating facilities in Manly Cove	Medium	Yes	++	N/A	++	Yes	N/A	+	N/A	++	+++



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
3.0 Enhancement of Public Facilities, Infrastructure & Signage											
Goal: Public facilities, infrastructure and signage are upgraded and maintained to facilitate improved social amenity											
3.1.1 Investigate the feasibility of installing water conservation measures in the West Esplanade toilet facility	Medium	Yes	+++	+	+	Yes	++	N/A	Medium	++	+++
3.1.2 Investigate the upgrading of seating and picnicking facilities within East and West Esplanade Reserves	High	Yes	+++	++	++	Yes	++	N/A	High	+	+++
3.1.3 Ensure the netted swimming enclosure is maintained to ensure protection to users and in line with legislative requirements	Medium	Yes	N/A	N/A	+++	Yes	N/A	N/A	Medium	+	++
3.1.4 Investigate the feasibility of constructing a diving/swimming pontoon within the Manly Cove netted swimming enclosure.	Low	Yes	++	++	--	Yes	N/A	High	Medium	--	++
3.2.1 Undertake review of existing compliance signage which meets Councils legislative requirements	Medium	Yes	++	++	+	Yes	++	Low	Medium	++	++
3.2.2 Replace damaged and/or missing signage in line with findings of signage audit	Medium	Yes	+	++	+	Yes	++	High	High	++	??
3.2.3 To reduce negative impacts upon visual character of Manly Cove through signage consolidation	Medium	Yes	++	++	+	Yes	++	Medium	Medium	+	++
3.2.4 Upgrade signage and protective measures in relation to Little Penguin activity and compliance issues	High	Yes	+	+	+++	Yes	N/A	Low	Medium	++	++
4.0 Marine Sediment & Water Quality											
Goal: To ensure water and marine sediment quality meets the community's expectations and falls within acceptable standards suitable for fishing and swimming											
4.1.1 Identify point sources of pollution within the study area and assess feasibility of installing suitable treatment measures	Medium	Yes	N/A	+	++	Yes	N/A	Low	Medium	++	++
4.1.2 Evaluate the effectiveness of stormwater	N/A	Yes	N/A	+	+	Yes	N/A	Low	Medium	++	++



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
improvement actions undertaken within Manly Cove											
4.1.3 Identify and implement opportunities for stormwater treatment, harvesting and reuse within Manly Cove	Medium	Yes	N/A	+	+	Yes	N/A	Medium	Medium	+	++
4.1.4 Develop a greater understanding of sediment quality and processes to guide future management responses with regard to the impact on the marine environment	Medium	Yes	N/A	N/A	+	Yes	N/A	N/A	N/A	N/A	N/A
4.1.5 Formulate a comprehensive Stormwater Management Plan for Manly LGA encompassing the study area	High	Yes	N/A	+	++	Yes	N/A	N/A	High	++	N/A
4.2.1 Continue to liaise with Sydney Water to ensure that all sewage overflows (and pumping stations) operate within established licensing requirements	High	Yes	N/A	N/A	++	Yes	N/A	N/A	N/A	N/A	N/A
4.2.2 Continue to liaise with Sydney Water to ensure that sewage infrastructure operates within design capacity	Medium	Yes	N/A	N/A	+	Yes	N/A	N/A	N/A	N/A	N/A
4.2.3 Encourage property owners to undertake CCTV inspections of their properties sewerage systems and ensure they are adequately maintained.	Low	Yes	N/A	-	++	Yes	N/A	Medium	N/A	N/A	+
4.2.4 Identify and promptly repair sewage leaks from Council facilities	High	Yes	+++	++	+++	Yes	N/A	Low	Medium	++	+++
4.3.1 Undertake a comprehensive study on the Manly Cove aquifer to identify recharge volumes and to ensure sustainable extraction rates	High	Yes	N/A	+	+++	Yes	N/A	Low	Medium	N/A	N/A
4.3.2 Monitor council bores for salinity and other parameters to ensure extraction does not lead to contamination	High	Yes	N/A	N/A	++	Yes	N/A	Low	N/A	N/A	N/A
4.3.3 Ensure Council staff working with or assessing groundwater issues are familiar with the SCCG	High	Yes	N/A	N/A	++	Yes	N/A	N/A	N/A	N/A	N/A



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
Groundwater Management Handbook 2006.											
4.3.4 Develop fact sheets outlining the typical occurrence, behaviour and characteristics of groundwater for distribution to community and building/ construction operators	Mediu m	Yes	++	N/A	+++	Yes	N/A	N/A	Medium	++	++
5.0 Air Quality & Noise											
<i>Goal: To ensure air quality and noise levels meet community expectations and fall within acceptable standards</i>											
5.1.1 Encourage residents to report incinerator use and illegal backyard burning activity in the study area	++	Yes	+++	N/A	+	No	N/A	High	N/A	N/A	++
5.1.2 Encourage Sydney Water to find a solution to alleviate problems associated with odours created by the sludge truck movements from North Head Sewage Treatment Plant.	+++	Yes	++	++	+++	Yes	N/A	Mediu m	N/A	++	++
5.2.1 Encourage local residents, through the Community Precinct system, to report all excessive or unreasonable noise pollution to either Manly Council or Police	+++	Yes	N/A	+	+++	Yes	N/A	Mediu m	++	++	+
6.0 Terrestrial Ecology											
<i>Goal: To conserve and enhance the integrity and diversity of indigenous terrestrial flora and fauna, and their ecosystems</i>											
6.1.1 Maintain remnant vegetation on Manly Point to enhance Critical Habitat for the Little penguin population	N/A	Yes	++	N/A	N/A	Yes	N/A	++	N/A	N/A	++
6.1.2 Encourage planting of low dense clumping native flora species on private and public lands to provide improved potential foraging and nesting habitat for the Long-nosed bandicoot	High	Yes	++	N/A	++	Yes	+++	None	+	++	++
6.1.3 Encourage the planting of native flora species which provide habitat for the vulnerable Grey-headed flying fox	High	Yes	++	N/A	+++	Yes	N/A	None	Medium	+	++
6.1.4 Ensure that Council's Street Tree Planting Program	High	Yes	++	++	+++	Yes	++	None	High	++	+++



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
results in the planting of appropriate native species											
6.1.5 Facilitate the construction of retractable barriers and appropriate signage to protect Little penguins adjacent to Manly Wharf	High	Yes	++	N/A	+++	Yes	N/A	Low	N/A	N/A	+++
6.2.1 Continue to provide community education in line with actions identified in the Manly Little Penguin Recovery Plan and Draft Long-nosed bandicoot Recovery Plan.	High	Yes	+++	N/A	+++	Yes	++	Low	N/A	N/A	+++
6.2.2 Encourage community participation in Bushcare activities within the study area	High	Yes	++	+++	+++	Yes	N/A	None	++	++	+++
7.0 Coastal Hazards & Climate Change											
<i>Goal: Assess, monitor and mitigate risks from coastline hazards and climate change</i>											
7.1.1 Develop and implement a natural shoreline and shoreline structure monitoring program for Manly Cove East and West Beaches	Low	Yes	N/A	++	++	Yes	N/A	None	Medium	++	++
7.1.2 Revise the assessment of coastline hazards based on the findings of the monitoring program	Medium	Yes	N/A	N/A	++	Yes	N/A	None	N/A	N/A	+
7.1.3 Should the risk of damage to the existing seawall due to the effects of beach erosion and recession in the future become unacceptable, evaluate and implement the available management options	Medium	Yes	N/A	+++	++	Yes	N/A	High	+++	++	++
7.2.1 Review the results of the beach profile surveys and assess implications for recreational beach amenity	High	Yes	++	+++	++	Yes	+	None	N/A	N/A	++
7.2.2 Should the impact of shoreline recession on beach amenity become unacceptable investigate options to reinstate the beach to the western end of Manly Cove East Beach	Medium	Yes	++	+++	++	Yes	+	High	Medium	++	++
7.3.1 Control new development so that it is appropriately sited and is not adversely affected by the erosion and	Medium	Yes	N/A	N/A	+	Yes	N/A	None	N/A	N/A	N/A



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
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recession hazard over a suitable planning timeframe (<i>minimum 50 years</i>)											
7.3.2 Ensure any redevelopment and public facilities are compatible with the erosion and recession hazard and do not adversely affect coastal processes	Mediu m	Yes	N/A	N/A	+	Yes	N/A	None	N/A	N/A	N/A
7.3.3 Develop guidelines for the construction and maintenance of structures located within areas subjected to coastal hazards.	Mediu m	Yes	N/A	N/A	+	Yes	N/A	None	N/A	N/A	N/A
7.4.1 Design any future stabilisation works to minimise impact on coastal processes, amnd where practical improve existing amenity and access.	Mediu m	Yes	N/A	N/A	+	Yes	N/A	None	N/A	N/A	N/A
7.5.1 Continue the staged mitigation of cliff and slope instability on public lands based upon the level of risk posed to life and /or property and in line with recommendations of the Davis Marina to Manly Point CHDS	Mediu m	Yes	++	++	+	Yes	N/A	High	++	+	++
7.5.2 Reissue notifications to private property owners of identified coastal hazards potentially affecting their land and a reminder the information has been recorded on the properties S.149 Certificate	Mediu m	Yes	++	N/A	N/A	Yes	N/A	None	N/A	N/A	+
7.6.1 Adopt an adaptive risk-based approach to managing sea level rise impacts	Mediu m	Yes	N/A	N/A	++	Yes	N/A	None	N/A	N/A	++
7.6.2 Work with regional, state and federal bodies to ensure consistent adaptation planning	High	Yes	N/A	N/A	+++	Yes	N/A	None	N/A	N/A	+++
7.6.3 Encourage appropriate development on land projected to be at risk from sea level rise.	Mediu m	Yes	++	++	++	Yes	N/A	Mediu m	Medium	N/A	++
7.6.4 Work within the emergency management frameworks identified in Local Emergency Management	Mediu m	Yes	++	+++	++	Yes	N/A	Low	High	+	++



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
systems during times of floods and storms											
7.7.1 Continue to provide updated information to the public about climate change including sea level rise and their impacts	High	Yes	++	N/A	++	Yes	++	None	N/A	N/A	+++
7.7.2 Incorporate latest climate change information into management decisions	High	Yes	++	++	++	Yes	N/A	None	Medium	N/A	+++
7.7.3 Promote climate change partnerships through co-operative approaches by Government, individuals, industry, business and community groups	High	Yes	N/A	++	++	Yes	++	None	N/A	N/A	+++
7.8.1 Encourage the use of passive and local transport within and from the study area.	Medium	Yes	++	++	+	Yes	N/A	None	High	++	+++
7.8.2 Ensure public facilities are fitted with energy efficient lighting and energy fittings and devices	High	Yes	++	++	++	Yes	++	Low	Medium	++	+++
7.8.3 Encourage the use of energy efficient devices in commercial and residential buildings	High	Yes	++	++	++	Yes	++	Low	Medium	++	+++
7.9.1 Ensure public toilet, shower, bubbler and tap facilities within Manly Cove are fitted with water efficient systems	High	Yes	++	++	++	Yes	++	Low	Medium	++	+++
7.9.2 Repair damaged or malfunctioning public water systems, including leaks, within the study area	High	Yes	+	++	++	Yes	++	None	High	+++	+++
7.9.3 Investigate opportunities for stormwater harvesting and reuse to supplement water use	High	Yes	++	++	++	Yes	++	Medium	Medium	++	+++
8.0 Waste Management											
<i>Goal: Promote and facilitate sustainable waste management in Manly Cove</i>											
8.1.1 Continue to conduct and support community and	N/A	Yes	++	N/A	N/A	Yes	N/A	++	N/A	N/A	++



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
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business education programs to avoid litter production at source											
8.1.2 Ensure adequate recycling facilities are provided in public areas and encourage responsible disposal of litter within the study area	High	Yes	++	N/A	++	Yes	+++	None	+	++	++
8.1.3 Carry out a litter survey of Manly Cove to assess litter types, sources and volumes entering Manly Cove	High	Yes	+++	++	++	Yes	+++	Low	++	+	++
8.2.1 Continue to operate the existing beach raking regime and remove gross pollutants from Manly Cove beaches	High	Yes	++	++	++	Yes	++	Low	Medium	++	+++
8.2.2 Conduct litter audit to determine sources of rubbish to inform treatment and education programs	High	Yes	++	++	++	Yes	++	None	Medium	++	++
8.2.3 Encourage NSW Maritime to improve its water-based litter and debris cleaning regime	N/A	Yes	+	++	+++	Yes	++	Low	High	++	++
9.0 Access & Traffic Management											
<i>Goal: To provide an environment at Manly Cove that is accessible to all people</i>											
9.1.1 Encourage NSW Maritime lessees to improve beach access and public amenity immediately east of the Manly Wharf development	High	Yes	++	N/A	++	Yes	+	None	N/A	+	++
9.1.2 Raise awareness and understanding of disability issues through research, information, consultation and education programmes involving the community, professionals, Council members and Council staff.	High	Yes	+++	N/A	N/A	Yes	++	None	N/A	++	+++
9.1.3 Investigate the feasibility of constructing an underground pedestrian pathway/over bridge to link Manly Wharf with The Corso	Medium	Yes	++	++	+	Yes	+	High	Medium	++	+++
10.0 Crime Prevention & Safety											



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
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Goal: To provide public areas in which patrons feel and are safe											
10.1.1 Control and minimise the impacts of human and companion animal activity upon Little penguin and seahorse populations of Manly Cove	Mediu m	Yes	++	N/A	++	Yes	+	None	N/A	+	++
10.1.2 Address issues associated with antisocial behaviour adjacent to Manly Wharf and in Manly Cove east.	Mediu m	Yes	+++	++	N/A	Yes	+	None	N/A	+	+++
10.1.3 Encourage the community to report crime or antisocial behaviour to Police or Council Rangers.	Mediu m	Yes	+++	++	N/A	Yes	+	None	N/A	+	+++
10.1.4 Ensure public access within Manly Cove is appropriately lit.	Mediu m	Yes	+++	++	N/A	Yes	+	None	N/A	+	+++
11.0 Aesthetic & Landscape Character											
Goal: To maintain and enhance the aesthetic appeal of Manly Cove											
11.1.1 Ensure all new development complies with the landscape provisions of Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 and the Sydney Harbour Foreshores and Waterways Area Development Control Plan 2005	Mediu m	Yes	+	++	+++	Yes	N/A	None	N/A	N/A	+
11.1.2 Ensure signage is appropriately designed, positioned and sized to ensure minimal impact on visual character of Manly Cove	High	Yes	N/A	N/A	+	Yes	N/A	None	N/A	N/A	+
12.0 Recreational Activities & User Groups											
Goal: To provide for the continuing, enjoyable and sustainable use of Manly Cove for a range of user groups											
12.1.1 Ensure all passive recreational activities are able to continue within Manly Cove in a sustainable and harmonious manner	High	Yes	+++	N/A	N/A	Yes	++	None	N/A	++	+++
12.1.2 Work with Sydney Ferries and NSW Maritime to minimise conflicts between ferries and water based	Mediu m	Yes	+++	N/A	++	Yes	N/A	None	N/A	++	++



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
recreational activities											
12.1.3 Support and promote environmentally friendly recreationally sustainable activities	High	Yes	+++	N/A	++	Yes	++	None	Medium	++	+++
12.1.4 Support and promote sustainable recreational fishing	High	Yes	+++	++	++	Yes	++	None	Medium	++	+++
12.1.5 Continue to educate boat users and organization on their potential impact upon the marine environment	High	Yes	+++	++	++	Yes	++	None	Medium	++	+++
13.0 Geodiversity											
<i>Goal: Conserve the significant geodiversity elements of the area's coastline</i>											
13.1.1 Undertake a comprehensive assessment of geoheritage values of Manly LGA	High	Yes	N/A	N/A	+++	Yes	++	None	N/A	+	N/A
13.1.2 Ensure that geoheritage issues are considered during development assessment processes	High	Yes	N/A	N/A	+++	Yes	++	None	N/A	+	N/A
14.0 Heritage Conservation & Management											
<i>Goal: Ensure that all Aboriginal and European (cultural and natural) heritage sites within the study area are preserved and protected</i>											
14.1.1 Continue to undertake consultation with the Aboriginal Heritage Office, Metropolitan Local Aboriginal Land Council, DECC and other local Aboriginal groups in regard to the management of cultural heritage site management.	High	Yes	N/A	N/A	++	Yes	++	None	N/A	+	N/A
14.1.2 Undertake a Heritage Impact Assessment prior to proceeding with works that may impact on any heruitage items within the study area.	N/A	Yes	N/A	N/A	+++	Yes	+	None	N/A	+	++
14.2.1 Prepare a Heritage Management Plan to identify detailed management measures to protect and maintain built heritage.	N/A	Yes	N/A	N/A	+++	Yes	++	None	N/A	+	N/A



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Management Options	Sustain-ability	Consistency with goals/ objectives	Likely Impact			Public Domain	Cultural	Risks	Indicative cost-benefit	Financial acceptability	Community Support
			Social	Economic	Environ-mental						
14.2.2 Undertake a Heritage Impact Assessment prior to proceeding with works that may impact on any heritage items within the study area.	N/A	Yes	N/A	N/A	+++	Yes	+	None	N/A	+	++

14. REFERENCES

- AGO. 2007. *Living With Climate Change: An Overview of Potential Climate Change Impacts on Australia*, online, cited 6/2/08, Australian Greenhouse Office. www.greenhouse.gov.au/impacts/overview/index.html
- AHO & MC. 2006. *Manly Council: Aboriginal Potential Areas Report 2006*. Aboriginal Heritage Office & Manly Council.
- AHO & MC. 2006. *Manly Council: Aboriginal Site Management Report 2006, Volumes 1 and 2*. Aboriginal Heritage Office & Manly Council.
- AHO. 2008. *Aboriginal Heritage*, online, cited 15/04/08, Aboriginal Heritage Office. www.Aboriginalheritage.org.
- ANZECC 2000. *Australian and New Zealand Guidelines for Fresh & Marine Water Quality*. National Water quality Management Strategy. Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
- Australian Museum, *Full Fact Sheet List*, online, cited 16/01/07, www.amonline.net.au/factsheets/
- Bates BC, SP Charles, F Chiew, K Harle, M Howden, M Kirby, M Peel, R Suppiah, L Siriwardena, NR Viney and PH Whetton. 2003. *Climate Change Projections and the Effects on Water Yield and Water Demand for the Australian Capital Territory*. Consultancy report for ACT Electricity and Water.
- Beare S and A Heaney 2002. *Climate Change and Water Resources in the Murray Darling Basin, Australia: Impacts and Adaptation*. ABARE Conference Paper 02.11, 33 pp.
- Brunn P. 1983. *Review of Conditions for Uses of the Brunn Rule of Erosion*. Coastal Engineering 7: 78-99.
- Bulleri F, MG Chapman and AJ Underwood. 2005. *Intertidal assemblages on seawalls and vertical rocky shores in Sydney Harbour, Australia*. Austral Ecology (2005) 30, 655–667)
- Chapman GA. & Murphy CL. 1989. *Soils Landscapes of the Sydney 1:100,000 sheet*. Soil Conservation Service of NSW, Sydney.
- Chapman MG & F Bulleri. 2003. *Intertidal seawalls: new features of landscape in intertidal environments*. Landscape and Urban Planning, Vol. 62, pp. 159-172
- Cowell PJ, BG Thom, RA Jones, CH Everts, and D Simanovic 2006. *Management of Uncertainty in Predicting Climate-Change Impacts on Beaches*, Journal of Coastal Research, 22, 232-245.
- CSIRO. 2006. *Climate change scenarios for initial assessment of risk in accordance with risk management guidance*. Prepared for Australian Greenhouse Office, May 2006.
- CSIRO. 2007. *Climate Change in the Sydney Metropolitan Catchments*. Prepared for the NSW Government, May 2006.
- Currie J, S Garnett, J Ingram and K Snickers 2007. *Modelling the impact of potential sea level rise on Aboriginal heritage sites along the foreshore of Middle Harbour*. Thesis for the Division of Environmental and Life Sciences, Macquarie University. pp 64.
- DECCW. 1994. *Coastal Resource Atlas for Oil Spills in Port Jackson*. Environmental Protection Agency (now DECC). pp 40, July 1994.

MANLY COVE COASTLINE MANAGEMENT STUDY

- DECCW. 2007. *Practical Consideration of Climate Change: Floodplain Risk Management Guideline*, NSW Department of Environment and Climate Change.
- DECCW. 2008. *Beachwatch & Harbour Watch State of the Beaches 2006-2007*, online, cited 03/01/08, Department of Environment & Climate Change. <http://www.environment.nsw.gov.au/beach/Reportannbw0607.htm>
- DECCW. 2008a. *Annual Report 2007-08. Coastal, estuary and floodplain management programs* (online cited 29 Jan 2009) http://www.environment.nsw.gov.au/resources/whoweare/deccar0708sec2_08424.pdf
- DECCW. 2008b. *Annual Report 2006-07. Protecting and restoring coastal environments* (online cited 17 Mar 2008) <http://www.environment.nsw.gov.au/resources/whoweare/deccar07235ch4pt2.pdf>
- DECCW 2009a. *Draft Coastal Risk Management Guide: Incorporating sea level rise benchmarks in coastal risk assessments*, NSW Department of Environment, Climate Change and Water, October 2009.
- DECCW 2009b. *Draft Flood Risk Management Guide: Incorporating sea level rise benchmarks in flood risk assessments*, NSW Department of Environment, Climate Change and Water, October 2009.
- DECCW 2009c. *Derivation of the NSW Government's sea level rise planning benchmarks – Technical Note*, NSW Department of Environment, Climate Change and Water, October 2009.
- DoEH. 2006. *National Cooperative Approach to Integrated Coastal Zone Management: Framework & Implementation Plan*, Natural Resource Management Ministerial Council. Department of Environment and Heritage, Australian Government, Canberra. 55 pp.
- Edgar G. 2001, *Australian Marine Habitats in Temperate Waters*, Reed New Holland, Sydney
- Fairweather PG and RJ Henry. 2003. *To clean or not to clean? Ecologically sensitive management of wrack deposits on sandy beaches?*, *Ecological Management and Restoration*, Notes and Abstracts, vol. 4, no. 3, December 2003, pp. 227-228.
- Farrell T, N Farmer, Q Espey, G Giles and GD Jones. 2008. *0.91 Metres and beyond: Lake Macquarie's response to sea level rise preparedness and planning*. Lake Macquarie City Council. Paper presented at the 17th NSW Coastal Conference, Wollongong.
- Foley D. 2001. *Repossession of our Spirit: Traditional Owners of Northern Sydney*. Aboriginal History Inc., Canberra.
- Foster DN, AD Gordon & NV Lawson. 1975. *The Storms of May-June 1974, Sydney, N.S.W.* Paper presented at the 2nd Australian Conference on Coastal & Ocean Engineering, 1-11pp.
- Galloway MJ. 2005a. *Stormwater Pollutant Concentrations and the Success of Current Treatment Trains in three Urban Sub-catchments in Sydney, Australia*. Research Thesis, UNSW.
- Galloway MJ. 2005b. *Pollutant Loads in Stormwater From Urban Sub-catchments*. Literature Review, UNSW.
- Hassall and Associates. 1998. *Climatic Change Scenarios and Managing the Scarce Water Resources of the Macquarie River*. Australian Greenhouse Office. Hassall and Associates, New South Wales Department of Land and Water Conservation, New South Wales National Parks and Wildlife Service, and CSIRO Atmospheric Research, Canberra, Australia, 113 pp.

MANLY COVE COASTLINE MANAGEMENT STUDY

- Hennessy K, C Page, K McInnes, R. Jones, J Bathols, D Collins and D Jones. 2004. *Climate Change in New South Wales. Part 1. Past Climate Variability and Projected Changes in Average Climate*. Consultancy report for the New South Wales Greenhouse Office by CSIRO and the Australian Bureau of Meteorology.
- Hennessy K, C Page, K McInnes, R. Jones, J Bathols, D Collins and D Jones. 2004. *Climate Change in New South Wales. Part 2. Projected Changes in Climate Extremes*. Consultancy report for the New South Wales Greenhouse Office by CSIRO and the Australian Bureau of Meteorology.
- Hennessy, Kevin, Macadam, Ian, Whetton, Penny, CSIRO Marine & Atmospheric Research, 2006, *Climate Change Scenarios for Initial Assessment of Risk in Accordance with Risk Management Guidance*, Australian Greenhouse Office, Department of Environment and Heritage, Australian Government, Canberra
- I&I NSW. 2001. *NSW Estuary General Fishery Management Strategy: Assessment of Impacts on Heritage and Indigenous Issues*, Umwelt (Australia) Pty Ltd. for Industry & Investment NSW, September 2001.
- I&I NSW. 2002. *Survey of Recreational Fishing in New South Wales*. <http://www.dpi.nsw.gov.au/fisheries/recreational/publications/general/Survey-of-Recreational-Fishing-in-New-South-Wales.pdf>.
- I&I NSW. 2006, *Fish Habitat Protection Plan No 2: Seagrasses*, online, cited 15/01/07, Industry & Investment, NSW. www.fisheries.nsw.gov.au/data/assets/pdf_file/5050/protplan_2.pdf
- I&I NSW. 2006. *Caulerpa taxifolia*, online, cited 13/07/06, Industry & Investment NSW www.fisheries.nsw.gov.au/threatened_species/general/content/fn_caulerpa1.htm
- I&I NSW. 2006. *Intertidal Protected Areas*, online, cited 14/09/06, Industry & Investment NSW www.fisheries.nsw.gov.au/marine_protected_areas/ipa
- I&I NSW. 2006. *Policy & Guidelines – Aquatic Habitat Management and Fish Conservation 1999 Update*, online, cited 14/09/06, Industry & Investment NSW. www.fisheries.nsw.gov.au/aquatic_habitats/aquatic_habitats/policy_and_guidelines
- I&I NSW. 2007. *Recreational Fishing*, online, cited 19/2/07, Industry & Investment NSW. <http://www.fisheries.nsw.gov.au/recreational>
- I&I NSW. 2008. *Fishing in Sydney Harbour*, online, cited 15/4/08, Industry & Investment NSW <http://www.dpi.nsw.gov.au/fisheries/recreational/sydney-closure>
- I&I NSW, 2009, *NSW Control Plan for the Noxious Marine Alga Caulerpa taxifolia*, Industry & Investment NSW. August 2009
- IPCC. 2007. *Climate Change 2007: The Physical Science Basis – Summary for Policymakers*, online, cited 5/2/07, Intergovernmental Panel on Climate Change. www.ipcc.ch/SPM2feb07.pdf
- James RJ and G Fairweather. 1996. *Spacial variation of intertidal macrofauna on a sandy ocean beach in Australia*. Estuarine, Coastal and Shelf Science 43, pp81-107
- Jones RN and CM Page. 2001. *Assessing the risk of climate change on the water resources of the Macquarie River catchment*. In: *Integrating Models for Natural Resources Management across Disciplines, issues and scales* (Part 2), MODSIM 2001 International Congress on Modelling and Simulation, [Ghassemi, P., Whetton, P., Little, R., and Littleboy, M. (eds.)], Modelling and Simulation Society of Australia and New Zealand, Canberra, pp. 673-678.



MANLY COVE COASTLINE MANAGEMENT STUDY

- Landscape EJE and C Ludlow, 1994. Survey of Harbour side and Ocean Pools of the Sydney Metropolitan Region, 1994
- Lawson & Treloar. 1988. *Manly Wharf EIS – Coastal Engineering Aspects*. Prepared for Planning Workshop.
- Lawson & Treloar. 2003. *Foreshore Safety and Beach Rehabilitation Manly Cove East – Draft Report*. Prepared for NSW Maritime.
- Living Harbour 2008. Aboriginal People of Coastal Sydney. cited on 08/09/2008. http://www.livingharbour.net/aboriginal/place_names_chart.htm
- Lord, Doug, Watson, Phil, Coates, Bruce, Hanslow, David, 2006, *Coastal Zone Management Planning under the New South Wales Coastal Protection Act (1979)*, Proceedings from NSW Coastal Conference 2006, Coffs Harbour
- MC.1988. *Manly Local Environment Plan (updated December 2008)*, Manly Council
- MC.1996. *Development Control Plan for Manly Cove*, Manly Council
- MC. 1998. *Manly Scenic Walkway Plan of Management*, Manly Council
- MC. 2004. *Manly Social Plan 2004-2009* Manly Council, November 2004.
- MC. 2006. *Manly's Sustainability Strategy 2006: For Today and Future Generations*. Manly Council, 127pp.
- MC. 2006. *Surfing the Future: A Vision for the Manly Local Government Area for 2025*, Manly Council, Manly
- MC. 2009. Manly Council, 2007, *LEP, DCP's + Policies*, online, cited 16/04/2009, Manly Council www.manly.nsw.gov.au/sp/PlanningDocs.aspx?PageID=518
- MC. 2009. *Manly Management Plan 2009-2012*. Manly Council, June 2009.
- McDougall B. 2008. Harbour Fish Poisoning Young. Daily Telegraph, 08 May 2008.
- McInnes KL, I Macadam, et al. 2007. Projected changes in climatological forcing conditions for coastal erosion in NSW. Coasts and Ports 2007 Conference. Crown Promenade, Melbourne.
- McLoughlin L. 2000. *Shaping Sydney Harbour: sedimentation, dredging and reclamation 1788-1990's*, Australian Geographer, 31(2): 183-208
- McMichael AJ, RE Woodruff, P Whetton, K Hennessy, N Nicholls, S Hales. 2003. *Human Health and Climate Change in Oceania: A Risk Assessment*. Commonwealth Department of Health and Ageing, Canberra, Australia.
- MHL. 1997a. *East Manly Cove Coastal Engineering Study – Stage 2, Options Report*. Manly Hydraulics Laboratory. Prepared for NSW Maritime, November 1997.
- MHL. 1997b. *East Manly Cove Coastal Engineering Study*. Manly Hydraulics Laboratory. Prepared for NSW Maritime, July 1997.



MANLY COVE COASTLINE MANAGEMENT STUDY

- MHL. 2002. *East Manly Cove Beach Management Options Scoping Study – Draft Report*. Manly Hydraulics Laboratory. Prepared for NSW Maritime, June 2002.
- Minnery JR and DI Smith. 1996. *Climate change, flooding and urban infrastructure*. In: *Greenhouse: Coping with Climate Change* [Bouma, W.J., G.I. Pearman, and M.R. Manning (eds.)]. CSIRO Publishing, Collingwood, Victoria, Australia, pp. 235-247.
- MLAMC. 2003. *Correspondence to Manly Council dated 18 March 2003*. Metropolitan Local Aboriginal Land Council.
- Moreira J. 2006. *Patterns of occurrence of grazing molluscs on sandstone and concrete seawalls in Sydney Harbour (Australia)*. Molluscan Research 26(1):51-60
- Natural Resource Management Ministerial Council, 2006, *National Cooperative Approach to Integrated Coastal Zone Management – Framework and Implementation Plan*, Australian Government, Department of Environment and Heritage, Canberra
- NHMRC 2008. *Guidelines for Managing Risks in Recreational Waters*. National Health and Medical Research Council, Australian Government Publishing Service, Canberra.
- Nikolov A. 2005. *Manly Council's Accessible Parks & Reserves*. Manly Council, September 2005.
- NSW Department of Natural Resources, *Acid Sulphate Soil*, online, cited 05/10/06, <http://www.dnr.nsw.gov.au/soils/sulfate.shtml>
- NSW Department of Natural Resources, *Estuaries in NSW*, online, cited 11/09/06, www.dnr.nsw.gov.au/estuaries
- NSW DoP. 2004. *Boat Storage Policy for Sydney Harbour*, NSW Department of Planning, Sydney
- NSW DoP. 2005. *Sydney Harbour Catchment: Sydney Regional Environment Plan*, NSW Government Department of Planning.
- NSW DoP. 2005. *Sydney Harbour Foreshores and Waterways Area: Development Control Plan*, NSW Department of Planning.
- NSW DoP. 2009. *Draft NSW Coastal Planning Guideline – Adapting to Sea Level Rise*, NSW Department of Planning October 2009.
- NSW Government, 1992, *Estuary Management Manual*, NSW Government
- NSW Government. 1990. *Coastline Management Manual*, NSW Government, September 1990.
- NSW Government. 2009. *NSW Sea Level Rise Policy Statement*, NSW Government, October 2009.
- NSW Maritime, 2006, *Moorings in the Manly LGA*, unpublished
- NSW Maritime, *Boating Handbook*, online, cited 2/1/2007, www.maritime.nsw.gov.au/sbh.html
- NSW Maritime, *Boating Map For Port Jackson – Sydney, Middle And North Harbours*, online, cited 14/09/06, www.maritime.nsw.gov.au/maps.html#sydney



MANLY COVE COASTLINE MANAGEMENT STUDY

- Osborn A. 2008. *Geology of Manly: Change, Cause and Perspective through Geological Time*. Manly Environmental Centre.
- PBP, 1999, *Northern Beaches Stormwater Management Plan*, Patterson, Britton & Partners for Warringah, Manly & Pittwater Councils, July 1999.
- PBP, 2004, *Davis Marina to Manly Point Coastline Hazard Definition Study*, Patterson, Britton & Partners Manly Council, Manly
- PIA. 2004. *Sustainable Regional and Urban Communities Adapting to Climate Change: Issues Paper*. Planning Institute of Australia, Queensland Division, Brisbane, 88 pp.
- Piorewicz J. 2002. *Proceedings of the Public Workshop "Beach protection: risk and management"*, Yeppoon, 7 February 2002, online, cited 7/2/07, www.coastal.crc.org.au/pdf/beach_protection_yeppoon_feb02.pdf
- Preston BL, T Smith, C Brooke, R Gorddard, T Measham, G Withycombe, K McInnes, D Abbs, B Beveridge, and C Morrison. 2008. *Mapping Climate Change Vulnerability in the Sydney Coastal Councils Group*. Prepared for the Sydney Coastal Councils Group by the CSIRO Climate Adaptation Flagship, Canberra.
- PWD. 1985. *Elevated Ocean Levels – Storms affecting NSW Coast 1880-1980*. Prepared by Blain Bremner & Williams Pty. Ltd. for Public Works Coastal Branch, Public Works Department, Report No. 85041, December 1985.
- SCCG. 2006. *Sydney Coastal Councils Region Groundwater Management Handbook - A Guide for Local Government*, First Edition. Sydney Coastal Councils Group and Groundwater Working Group. Sydney, September.
- Schreider SY, DI Smith and AJ Jakeman. 2000. Climate change impacts on urban flooding. *Climatic Change* 47, 91-115.
- Skelton N, E Donner & P Wong, 2004, *Flora and Fauna of Manly Council's Bushland Reserves*, GIS Environmental Consultants.
- Skelton N, T Gilson, & E Donner. 2002, *Stormwater Impact on Manly Bushland Reserves*, GIS Environmental Consultants, February 2002.
- Smith D. 2008. What Lies Beneath (Sydney Harbour). *Sydney Morning Herald*, 22 May 2008.
- Smith PG. 2006. *A Systems Approach to Integrated Watercycle Science, Action and Institutional Change*. PhD thesis. University of Western Sydney, Richmond, NSW.
- Smith T and Doherty M 2006, 'The suburbanisation of coastal Australia', paper prepared for the 2006 Australia State of the Environment Committee, Department of Environment and Heritage, Canberra, <http://www.deh.gov.au/soe/2006/integrative/coastal/index.html>
- Stevens L. 2008. *Assessment of Impacts of Climate Change on Australia's Physical Infrastructure*. The Australian Academy of Technological Sciences and Engineering (ATSE). July 2008
- Sullivan ME. 1982. *Aboriginal Shell Middens in the Coastal Landscape of New South Wales*, PhD thesis, Australian National University.
- Susan-Moylan-Coombs. 2007. *Northern Sydney Aboriginal Social Plan 2007-2011*. November 2007.



MANLY COVE COASTLINE MANAGEMENT STUDY

- US EPA. 1983. *Results of the Nationwide Urban Runoff Program*. Water Planning Division of U.S. Environmental Protection Agency, United States.
- UWS. 2005, *Sustainable Coastal Tourism for Manly*, Tourism Research for Healthy Futures, University of Western Sydney for Manly Council.
- West G and R.J. Williams. 2008. *A preliminary assessment of the historical, current and future cover of seagrass in the estuary of the Parramatta River*. NSW Department of Primary Industries. February 2008
- Willing & Partners, 1999, *Middle Harbour Catchment Stormwater Management Plan*, Middle Harbour Stormwater Management Committee, Sydney

15. GLOSSARY

Accreted Profile	The profile of a sandy beach that develops in the "calm" periods between major storm events. During such periods, swell waves move sediment from the offshore bar back onto the beach to rebuild the beach form.
Accretion	A build up of sand which may cause or be associated with a seaward movement of the beach profile.
Aeolian Transport	Transport (of sand) by wind.
Bathymetry	Description of the shape of the ocean bed (underwater contours etc.). The measurement of depths of water.
Beach Erosion	The offshore movement of sand from the sub-aerial beach during storms.
Beach Profile	A cross-section of a beach, generally normal to the water line, showing the elevation of the surface relative to some datum. It may also extend some distance offshore.
Benthic ²	Pertaining to the seafloor (or bottom) of a river, coastal waterway, or ocean.
Berm	The relatively flat section of the beach profile between the top of the swash zone and the toe of the erosion escarpment or frontal dune.
Bluff	Vertical or near vertical cliff face (relatively erosion resistant rock) or moderate to steep slope (less erosion resistant rock or soils perched on rock strata).
Breaker Zone	That area of coastal waters where shoaling effects cause swell waves to break. This typically occurs in the shallower waters over an offshore bar.
Breaking Waves	As waves increase in height through the shoaling process, the crest of the wave tends to speed up relative to the rest of the wave. Waves break when the speed of the crest exceeds the speed of advance of wave as a whole. Waves can break in three modes: spilling, surging and plunging.
Breakwater	Structure protecting a shoreline, harbor, anchorage or basin from ocean waves.
Buffer Zone	An appropriately managed and unalienated zone of unconsolidated land between beach and development, within which coastline fluctuations and hazards can be accommodated in order to minimise damage to the development.
Catchment	The area of land which collects and transfers rainwater into a waterway.
Coastal Process	The active forcing functions (waves, winds, currents etc.) and their interaction with and effects on the coastal environment (sediments, beach and cliff erosion etc.)
Coastal Structures	Those structures on the coastline designed to protect and rebuild the coastline and/or enhance coastal amenity and use.
Coastal Zone	The zone affected by coastal processes and its immediate hinterland.
Corridor	Lines of native vegetation connecting separate habitat areas that are essential for maintaining biodiversity. Corridors enable fauna to access larger habitats by

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encouraging mobility between areas. Corridors may also assist native plant species to spread and colonise new areas over time.

Diffraction	The “spreading” of waves into the lee of obstacles such as breakwaters by the transfer of wave energy along wave crests. Diffracted waves are lower in height than the incident waves.
Erosion	The depletion of the land mass by natural forces, such as the reduction of a beach by waves and/or wind. Commonly perceived as the landward movement of an erosion escarpment during storm events.
Erosion Escarpment	A near vertical step formed by wave erosion at the back of a beach. Usually indicates the landward extent of wave incursion during recent storm events.
Estuary (definition 1)	The tidal portions of river mouths, bays and coastal lagoons, irrespective of whether they are dominated by hyper saline, marine or fresh water conditions
Estuary (definition 2)	a semi enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage
Flushing	Exchange of water between an estuary or coastal waterway and the ocean.
Frictional Attenuation	As applied to water waves, the reduction in wave energy as a result of resistant to water particle movement at the sea bed (bottom friction).
Groynes	Low walls built perpendicular to a shoreline to trap longshore sediment. Typically, sediment buildup on the updrift side of a groyne is offset by erosion on the downdrift side.
Intertidal	The environment between the level of high tide and low tide.
Littoral Drift	The sedimentary material which is moved in the littoral zone by waves and currents.
Littoral Transport	The movement of littoral drift.
Littoral Zone	Extends from the onshore dune system to the seaward limit of the offshore zone and possibly beyond.
Longshore Currents	Currents flowing parallel to the shore within the inshore and nearshore zones. Longshore currents are typically caused by waves approaching the beach at an angle. The “feeder” currents to rip cells are another example of longshore currents.
Longshore Transport	Synonymous with LITTORAL TRANSPORT.
Mud	Fine sedimentary material, typically comprising both inorganic (mineral) and organic material.
Nearshore Zone	Coastal waters between the offshore bar and the 60 m depth contour.
Net	With respect to sediment transport is the resultant difference of the volume of transport in all directions, i.e. the time averaged resultant effect.



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Nourishment	The replenishment of a beach with sand. Commonly used to increase the beach width after erosion.
Offshore Bar	Submerged sandbar formed offshore by the process of beach erosion and accretion. Typically, swell waves break on the offshore bar. Also known as longshore bar.
Offshore Zone	Coastal waters to the seaward of the nearshore zone.
Onshore/Offshore Transport	The process whereby sediment is moved onshore and offshore by wave, current and wind action.
Organic Material	Once-living material (typically with high carbon content), mostly of plant origin.
Refraction	The tendency of wave crests to become parallel to bottom contours as waves move into shallower waters. This effect is caused by the shoaling process which slows down waves in shallower waters.
Rip Currents	Concentrated currents flowing back to sea perpendicular to the shoreline. Rip currents are caused by wave action piling up water on the beach. Feeder currents running parallel to the shore (longshore currents) deliver water to the rip current.
Seagrass	Marine flowering plants which generally attach to the substrate with roots.
Seawalls	Walls built parallel to the shoreline to limit shoreline recession.
Sediment Budget	An accounting of the rate of sediment supply from all sources (credits) and the rate of sediment loss to all sinks (debits) from an area of coastline to obtain the net sediment supply/loss.
Sediments	Unconsolidated detrital material consisting of organic and/or inorganic fragments. The composition and textural characteristics (gravel, sand, mud) vary with sediment source (local, fluvial, marine) and the transporting medium.
Semi-diurnal Tide	Tides with a period, or time interval between two successive high or low waters, of about 12.5 hours. Tides along the New South Wales coast are semi-diurnal.
Shoreline Recession	A net long term landward movement of the shoreline caused by a net loss in the sediment budget.
Spilling Waves	The wave crest breaks gradually as the wave travels to the shore. Characterised by the appearance of white water at the crest.
Spring Tide	A tide greater than the mean tidal range. Occurs about every two weeks, when the Moon is full or new.
Storm Bar	An offshore bar formed by sediments eroded from the beach during storm conditions.
Storm Profile	The profile of a sandy beach that develops in response to storm wave attack. Considerable volumes of sediment form the beach berm, the incipient dune and the foredune can be eroded and deposited offshore. The landward limit of the storm profile is typically defined by a backbeach erosion escarpment.

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Storm Surge	The increase in coastal water level caused by the effects of storms. Storm surge consists of two components: the increase in water level caused by the reduction in barometric pressure (barometric setup) and the increase in water level caused by the action of wind blowing over the sea surface (wind setup).
Subaerial	That section of the beach which is above the waterline.
Subaqueous	The portion of the beach profile below the water surface.
Surging Waves	The wave does not "break" but maintains its basic shape as it moves towards the shore, where it surges up the beach. Very little white water is evident before surging waves reach the shore.
Swell	Wind-generated waves that have travelled out of their generating area. Swell characteristically exhibits a more regular shape and longer period than the sea (c.f. SEA).
Swell Waves	Wind waves remote from the area of generation (fetch) having a uniform and orderly appearance characterised by regularly spaced wave crests.
Turbidity	The condition resulting from the presence of suspended particles in the water column which attenuate or reduce light penetration.
Wave Height	The vertical distance between a wave trough and the following wave crest.
Wave Period	The time taken for consecutive wave crests or wave troughs to pass a fixed point.
Wavelength	The distance between consecutive wave crests or wave troughs.
Wind Waves	The waves initially formed by the action of wind blowing over the sea surface. Wind waves are characterised by a range of heights, periods and wavelengths. As they leave the area of generation (fetch), wind waves develop a more ordered and uniform appearance and are referred to as swell or swell waves.



APPENDIX A

Community Consultation

INTRODUCTION

Prior to the commencement of the Coastline Management Study, Council undertook a variety of community consultation events. Open days, which formed the base for community consultation, were widely publicised through the Precinct Community Forums, letter box drops, local media and advertising material.

Consultation commenced during September 2005 with Community Questionnaires distributed to residents attending Councils regular Hill to Headland walking tour. A display was also set up in Manly Cove in conjunction with Manly Councils Marine Environment Expo with the community requested to complete surveys and identify issues to be included in the CMP.

Consultation with the Little Manly, Fairlight, The Corso and Balgowlah Heights Precincts was undertaken through those representatives on the Manly Harbour Foreshores Management Committee, through written correspondence and advertisements in local media.

The responses obtained from the first survey totalled 89 submissions, from which an initial issues report was prepared. The issues raised during initial consultation were then incorporated into the Draft Manly Cove Coastline Management Plan Support Document and in the consideration of management responses within the Draft Manly Cove CMP Action Plan.

The results from the initial community consultation showed 89% of respondents were residents of the Manly area, 10% were day trippers and 1% was holiday maker. The surveyed group indicated that 89% were regular visitors to Manly Cove and 11% did not visit regularly.

Respondents to the questionnaire were asked to indicate the level of importance that they gave to eleven *activities* relevant to Manly Cove (Refer to Figure 3). The results clearly identified the importance of Manly Cove as an exercise haven with walking, jogging and swimming considered the most popular uses for the area. Other more passive activities are also seen as important, along with the use of Manly Cove as a commuter transport hub. Surveys were conducted during a weekend morning and, therefore, it can be assumed that the value of the study area for commuters may well exceed the level indicated.

For those indicating that walking/jogging are important additional comments highlighted the need for adequate footpath and step maintenance along walking routes. Similarly, those who designated swimming of importance were concerned about the maintenance of swimming enclosures (net and bar enclosures).

COMMUNICATIONS ACTIVITIES

Stakeholder Consultation

In order to establish holistic management strategies, land and aquatic areas outside the study area boundaries, which impact on the biophysical or social environment within the boundary, must also be considered in development of the Plan. While Council does not have management responsibilities or jurisdiction for a number of the issues considered in this CMP, Council sought to liaise with relevant state government agencies responsible for each of those issues during the development of the CMP.

It is noted that this Plan may not reflect the complete thoughts, ideas and perspectives of those agencies however Council will seek their endorsement of the Plan and their commitment to its implementation.

Letters were distributed to stakeholders requesting written submissions with feedback provided by a number of key stakeholders. Further feedback was obtained from relevant government agencies via representation on the Harbour Foreshores Management Committee.

Community Consultation

To be successful the Manly Cove Coastal Management Plan must incorporate the knowledge and support of the local community. Council actively involved representatives of the community in the preparation and review of the plan through involvement on the Manly Harbour Foreshores Management Committee, community consultation events as well as via submissions and questionnaires. Public comment received during exhibition was incorporated prior to the plan being finalised and adopted.

Two separate opportunities were utilised for consultation including:

- Hill to Harbour Community Walk Tania Park to Manly Cove (3 September 2005), and;
- 'Boats and Beasties' Marine Environment Workshop East Esplanade (17 September 2005)

A call for community submissions was advertised in the 8 October 2005 Manly Daily and temporary display has been set up in the library foyer which explains the CMP process and encourages community feedback.

A series of poster boards were displayed in the Manly Library Foyer and at community events to encourage additional feedback. The boards described the CMP development process as well as identifying a number of key issues. Copies of the poster display boards are also included in Figures 1 to 5 of this report.

Community Precinct Consultation

Consultation with the Little Manly, Fairlight, The Corso and Balgowlah Heights Precincts was undertaken through those representatives on the Manly Harbour Foreshores management Committee, through written correspondence and advertisements in local media.

Available Precinct committee meeting between 01/01/2004 and 01/01/2007 had issues of concern relating to Manly Cove Coastal Management Plan were integrated into the community consultation. Precincts included Little Manly, The Corso and Fairlight.

Issues relating to Manly Cove identified from Precinct meeting minutes include:

- Penguin protection
- Late night operation of fast food outlets
- Rubbish & Noise from late night goers
- Cleaning of beaches and local area
- Better access for the disabled to reserves and clubs
- No take sanctuaries/better fishing practices for the area
- Protection of Native Wildlife
- Maintenance of swimming enclosures
- Spreading of *Caulerpa taxifolia* and its management
- True extent of seagrass not known
- Water recycling and ocean input reduction
- Improved water waste management
- Better safety

SUMMARY OF RESPONSES

Key Values

A total of 89 questionnaires/community feedback forms were completed and returned during the consultation process. Further details on the questionnaire format and results are provided in at the end of this report. Responses to the questionnaire identified a diverse range of values and provided confirmation of activities and issues of importance within the study area. The most frequent responses to issues included:

- Protection of the aquatic environment (87%),

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- The ability to undertake recreational activities (79%),
- Retaining aesthetic values of the area (77%),
- Protection of the Little Penguin population (77%),
- heritage values (76%); and,
- The provision of waste/recycling facilities (75%).

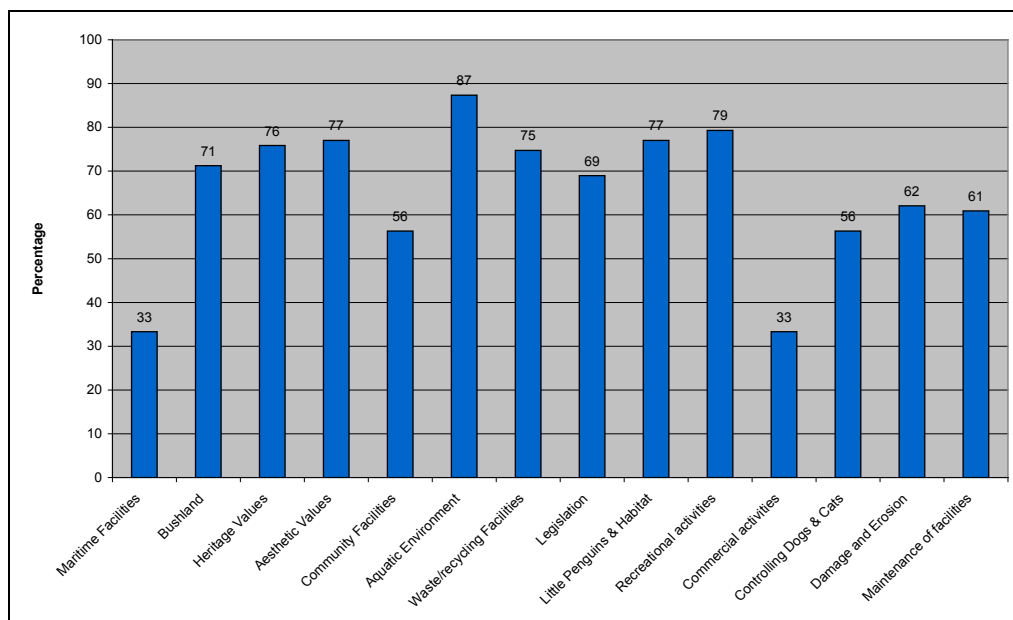


Figure 1 – Issues of importance identified through community consultation

Respondents to the questionnaire were asked to indicate the level of importance that they gave to eleven *activities* undertaken within Manly Cove. The results clearly identified the importance of Manly Cove as an exercise haven with walking, jogging and swimming considered the most popular uses for the area. Other more passive activities are also seen as important, along with the use of Manly Cove as a commuter transport hub. A full summary of specific comments recorded within the questionnaires is provided in Section 4 of this report.

Consultation with the Little Manly, Fairlight, The Corso and Balgowlah Heights Precincts was undertaken through those representatives on the Manly Harbour Foreshores Management Committee, through written correspondence and calls for submissions placed in local media and on the Manly Council Website. Issues raised at Precinct committee meetings were reviewed and integrated into the community consultation process.

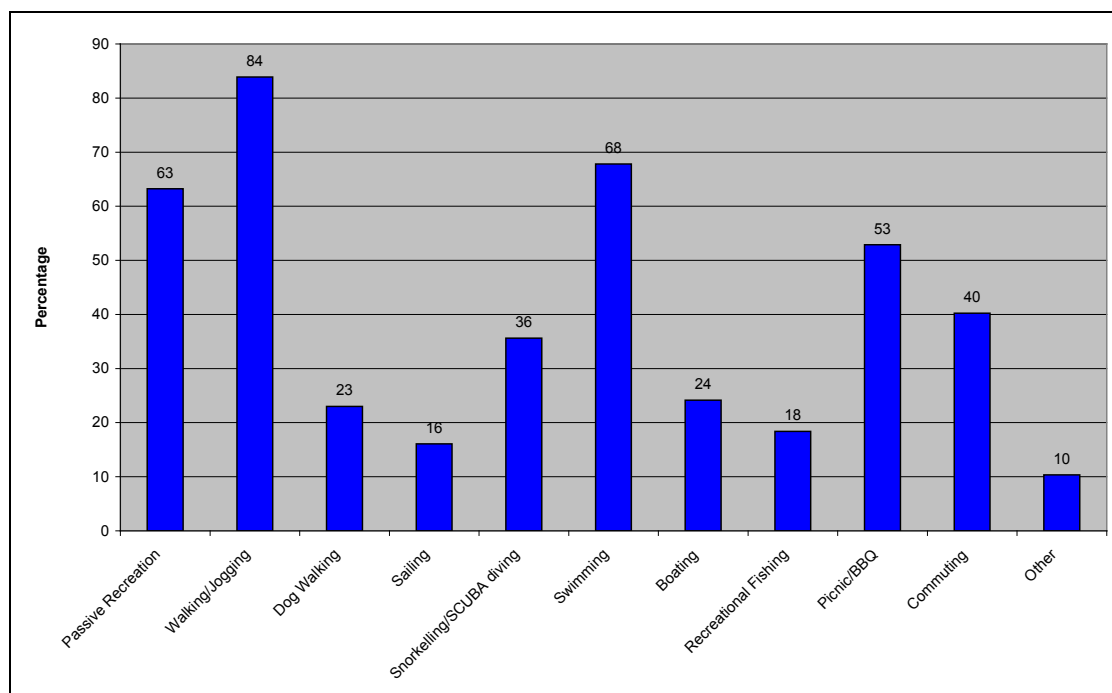


Figure 2 – Activities of importance identified through community consultation

Concerns and Issues

The following Tables provide a summary of the feedback received during the community consultation process:

Table 1 – Issues raised during consultation relating to land ownership, zoning and categorization.

Issue	Comment
Land Zoning	• Stop any future development by development companies • Stop over development • Unrestricted development would pose a threat (e.g. a Marina). • Protecting the area and ensuring things stay pretty much the same • Wildlife and feel of the area needs to be preserved and protected from development areas already present could be neater e.g. wharf, area under manly restaurant. • Over development in relation to hotels to be stopped • Threat of high rise development/stop high rise development (5) • Existing buildings. Structures could be updated. Plastic barrier outside manly wharf hotel is very ugly. • Controlling building on the coastal area. • Manly cove is the gateway to manly for most visitors and commuters. It already has too many high rise developments. More would spoil the area. • As manly cove is an important gateway to manly, I would be absolutely against any more high rise development near the water font. The existing high-rise already detracts from the charm of the area. • Ensure that the present mix and character of the area is respected and bulk and height

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Issue	Comment
	profile is not breached by over development.

Table 2 – Marine related issues raised during community consultation.

Issue	Comment
Aquatic Habitat and Flora	dominance of introduced species More native fauna and flora
Aquatic fauna	Protection of threatened species. Areas for endangered species Conservation of penguins
Conservation Management	• Overuse of environment • Protection of threatened species and marine life (3) • Marine Sanctuaries • Make this area an aquatic reserve. • Areas on the beach for walking dogs with responsible owners more dog bins and plastic bags. • Please protect our penguins and maintain bush land and wildlife corridors. • Maintenance of the seawall around the perimeter of the foreshore and the preservation and planting of suitable bushland vegetation is a priority.
Maritime Operations	• Unrestricted development would pose a threat (e.g. a Marina). • Consultation with NSW maritime re. boating related issues if any • Allow marine operators to continue operate. • (Manly launch club) consideration should be given to providing public boarding and landing for recreational vessels in the cove. Our club and possibly others are sometimes used mistakenly by the public without authorization and this has caused some issues in the past.
Boating	Protecting waterways Address commercial boat usage Multi mooring of boats Mooring past Collins point prohibited Wash from vessels Plastic bags from boating people Speed limits for boats when entering the cove The main threat is the ferries and jet cat pollution, not allow any moored private boats They both emit pollution and oils (2) • With the cleanliness of water the main ingredient for the protection of the threatened species and for the enjoyment of swimming on the harbour beaches more policy of boating activities is necessary.

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Issue	Comment
	Boats kept out, Extended storage of staff anchoring vessels
Sediment Processes	Address erosion issues (beach) (3) Beach sand erosion and high strong walls to protect us from high seas More frequents sand doctoring etc

Table 3 - Interconnected issues raised during community consultation.F

Issue	Comment
User Groups	Keeping the beach for all
Fisheries & Fishing	• Over fishing issues (2) • Fishing rules enforced (2) • Ban fishing off manly point and gas works, patrolling of area especially summer months • Fishing of undersized fish
Boating facilities and organizations	• As discussed the Dinghies are dangerous and unsightly, providing stocker fees? • Leave manly 16ft skiff club as it is • Boats kept out, • Would like to see speed limit for boats slowed, especially larger vessels (particularly Jet cat) to mitigate damage to sea walls. Particularly important at low tide when water level allows build-up of waves • Slow jetcat/ferry speed (3) • Matilda style cat has minimal effect of wake and waves, as do the river cats. Jet cat skippers are coming in too fast, causing damage to all. • Multiple mooring still happens at Collins flat
Water Cycle Management	Need to address pollution (20) Water Quality (storm water/sewerage treatment/control). (11) Protecting waterways Storm water drainage (East Esplanade). Keeping the beach litter free Better sewage facilities/control Improvement in pollutant traps and drainage (Eastern Hills) Keeping it clean, enjoying the clean water to swim. beach cleaning (quite well done), Storm water contour Better traps for catching storm water pollution Diverting storm water drainage somewhere other than the ocean • Immediate clean up of manly cove after storms, clean up of sea bed at least once a year

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Issue	Comment
	about 30 from shoreline at low tide to beach (lots of glass etc where children swim). - Boats should be forced to dump all toilet activities on return to marinas. Not to be released into the water. Any oil spills should be heavily penalized. - During southerly squalls, an awful amount of jetsam and washes up or hangs in the water for a long time and ruins the aesthetics of the area. Is it possible to have a timely process to scour the beach and the immediate waterfront? - Has any analysis of the storm water on flow on East Esplanade been done? How safe swimming near it?
Air Quality & Noise	- noise associated with licensed premises at manly wharf - Control the Rosella's as they are very noisy, particularly in the early hours. - Noise pollution (3) from eastern club precinct.
Climate Change	- global warming - Rising ocean level - Global warming means rising ocean levels. It would be very short sighted to allow any new developments at sea level. - In view of the prediction of a significant rise in the level of the ocean due to global warming it would be unwise for any government body to allow further development in the manly CDB or other low rise area.

Table 4 – Terrestrial based issues raised during community consultation.

Issue	Comments
Terrestrial Flora	More native flora in the area
Terrestrial Fauna	Protection of threatened species (2). Areas for endangered species. Include Seaforth; please do something about the birds!
Manly Scenic Walkway	I really enjoy the interesting talks given on the stunning coastline and the walks and lunch given.
Landscape Masterplan	Maintaining Natural beauty
View Maintenance	- Maintenance of natural beauty of the cove - More up market commercial/retail areas but low key - Keeping the land clean
Conservation Management	Address dog control - It would be good to have a dedicated area to bring my dog along the beach. Of course you should clean up any mess when leaving. - Dog walking is very important and I enjoy the beautiful scenery - Conservation of wildlife at Collins point - Education for residents and visitors (3) - Bush land corridors

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Issue	Comments
Terrestrial Flora	More native flora in the area
	Keeping the land clean Education of our local community Changing the balance and level of use. Recognition of the diversity of activities in manly cove.
Heritage	- Heritage values of area visual and aesthetic values of the area - Wildlife and feel of the area needs to be preserved and protected from development areas already present could be neater e.g. wharf, area under manly restaurant. - To maintain its natural and friendly atmosphere - The existing qualities that make manly a tourist attraction and unique, should be maintained, vegetation, buildings, beach, boat housing etc. - For many years I have been outspoken regarding the rebuilding of our harbour pool walkway from the wharf to the pier restaurant. This area historically took care of 50% per ferry load of visitors during the warmer seasons. From May 1974 I began patrols on the manly beach (for manly surf club) for 15 years. Entire ferry loads would and so continue up the corso towards the beach. Containing the population within two beaches had a dramatic effect (positive) on all areas of concern. - Beautiful and historical area needs to be looked after carefully in the context of a lot of public use. - Manly seems to exist more for tourists than residents now. Commercial interests would power and resident's interests are shelved. They manly cove area is a lovely one for walking, picnicking, etc and should remain as such. No new developments. - As manly cove is an important gateway to manly, I would be absolutely against any more high rise development near the water font. The existing high-rise already detracts from the charm of the area. - Preserving and maintaining heritage features. - We (manly launch club) are keen to see the preservation of as much natural landscape and heritage items as possible whilst allowing for legitimate use of the land and waterways.
Access	- Tourist Numbers controlled (2) - another pedestrian crossing near top burner St. - The section of the walk from east esplanade (the road) down to the east esplanade park paths needs a great deal of improvement. - The area that is relevant to the members of sailability manly is the very short part of the walkway that runs along the East Esplanade waterfront from the lower part of the walkway to the top section of manly yacht club, or in the opposite direction. - Locating at pedestrian crossings a very visible sign for cyclists to "dismount" before using crossing. Too often you observe cyclists approaching and crossing busy roads at unsafe/dangerous speeds without dismounting. - Very important, no skateboard riding between exit from ferry and the corso.
Traffic	Address ferry issues



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Issue	Comments
Terrestrial Flora	More native flora in the area
Management	• Levels of use restrict to walkways. • Motor traffic management /reduction(6) • Control of bicycles this is a problem endemic on manly. I believe there re road rules for bicycles bit no one seems to know them. Could they be published in the manly daily? • Roadway in front of hotel improved and pathway delineated. Launching ramps should be doubled with to allow for breakdowns and speed of launching. Present arrangements show self interest and are invalid. Parking will always be limited. • Motor traffic is badly organized at manly cove. An underpass for ferry commuters would solve the problem. • As a resident and council rate payer, I do not want any more tourists in the area, in fact I would prefer less tourists and commercial events. • If the CMP includes traffic management, then the interchange at the manly ferry wharf should be improved, both for though traffic from the "caiten hill" and access to buses. Although expensive an under poll is probably the solution.
Infrastructure	• maintaining balance between preservation and recreation • More community activities • Child friendly activities • Seating and lighting and toilets • Build bike jump park • more shade • I'm sure in summer people would appreciate it if there was a water bubbler or a tap. In summer especially there are a lot of thirsty people around. • Boardwalk back • More BBQ tables and kids recreation areas • More community activities e.g. short courses in Horticulture, soil management and improvement • Wharf important for tourist • Better supervision in public access areas where restricting of certain activities exist e.g. cycling, skate boarding, roller blading. • Improve bathroom near the art gallery • A kid's playground. • More tables and seats north sides of ferry terminal on grassed areas and seating (trenches) on jetty facing enclosed swimming pool. • Attention to steps and footpath. • Is fine how it is • Good night time lighting • I think it's a great manly wharf has cleaned up with new restaurants, bars and cafes, this



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Issue	Comments
Terrestrial Flora	More native flora in the area
	is all good as long as no foreshore damage to the environment is made. • Upgrade manly wharf to be a world class tourist destination and facility with shops, restaurants etc e.g. Fisherman's Wharf in San Francisco. • Maintain current amenities and the environment • BBQ's at Delwood beach and seating, Wentworth St and Victoria Pde attractive but ash burner st needs upgrading. • As a long term resident of manly and new at Harbord- I would like to see the reconstruction of the bridge and the diving areas returned to the manly pool area. With changing sheds and toilets available it would bring more people to manly to enjoy the foreshores. • I have always rejected the loss of the walkway. Fixed swimming enclosure
Interpretation & Signage	• Care along beach sections and inclusion of educational statues, posters & material, to inform people about natural heritage. • Signage at wharf to little manly etc
Safety & Crime Prevention	• Further development vs. preservation/prevent further change/keeping manly safe • Drink spiking, introduce 24hr licenses for hotels • Glass on the beach (child was cut) • Enforcement of rules (re. multi mooring of boats, over fishing), ban fishing from manly point • Heavier on the spot fines for littering. • More visits by council rangers. • At the eastern end of manly cove (near manly yacht club) there is frequently a group who use the parkland as a day and evening drinking spot- Isn't this an alcohol free zone? In any event they are sometimes disorderly and always an embarrassment
Waste Management	• Address litter issues • Increasing volume of litter including alcoholic drink bottles (enforcement of more waste bins) • More garbage bins (8) • Empty bins more often (3) • Improvements in GPT, other waste tools • Glass clean up • More public recycling facilities • Plastic reduction • Incentives to shop to give "friendly bags" rather sell for profit • Heavier on the spot fines for littering. • Since pub on wharf, too much broken glass on beach



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Issue	Comments
Terrestrial Flora	More native flora in the area
	• Litter from McDonalds at the wharf to be minimized.



APPENDIX B

SPECIES LISTS

Table B1 – Fishes of Sydney Harbour

Common name	Scientific name	Common name	Scientific name
Amberjack	<i>Seriola dumerili</i>	Mackerel Tuna	<i>Euthynnus affinis</i>
Arrow Dartgoby	<i>Ptereleotris evides</i>	Magpie Morwong	<i>Cheilodactylus gibbosus</i>
Australian anchovy	<i>Engraulis australis</i>	Mangrove Jack	<i>Lutjanus argentimaculatus</i>
Australian Angelshark	<i>Squatina australis</i>	Manta Ray	<i>Manta birostris</i>
Australian Bandfish	<i>Cepola australis</i>	Manyband Sole	<i>Zebrias scalaris</i>
Australian Bonito	<i>Sarda australis</i>	Many-host Cling-Goby	<i>Pleurosicya mossambica</i>
Australian Damsel	<i>Pomacentrus australis</i>	Maori Wrasse	<i>Ophthalmolepis lineolatus</i>
Australian Herring	<i>Arripis georgianus</i>	Maray	<i>Etrumeus teres</i>
Australian Mado	<i>Atypichthys strigatus</i>	Marble Dragonet	<i>Neosynchiropus ocellatus</i>
Australian Pilchard	<i>Sardinops sagax</i>	Marbled Flathead	<i>Platycephalus marmoratus</i>
Australian Rainbow Wrasse	<i>Suezichthys devisi</i>	Messmate Fish	<i>Echiodon rendahli</i>
Australian Smelt	<i>Retropinna semoni</i>	Milkfish	<i>Chanos chanos</i>
Axilspot Hogfish	<i>Bodianus axillaris</i>	Mimic Leatherjacket	<i>Paraluteres prionurus</i>
banded bellowsfish	<i>Centriscoops humerosus</i>	Miracle Threefin	<i>Enneapterygius mirabilis</i>
Banded Morwong	<i>Cheilodactylus spectabilis</i>	Mirrorwing Flyingfish	<i>Hirundichthys speculiger</i>
Banded Rockcod	<i>Epinephelus ergastularius</i>	Moon Wrasse	<i>Thalassoma lunare</i>
Banded Scat	<i>Selenotoca multifasciata</i>	Moorish Idol	<i>Zanclus cornutus</i>
Banded Seaperch	<i>Hypoplectrodes nigroruber</i>	Mosaic Leatherjacket	<i>Eubalichthys mosaicus</i>
Barracouta	<i>Thyrstites atun</i>	Moses Perch	<i>Lutjanus russelli</i>
Barred Longtom	<i>Ablennes hians</i>	Mother-of-Pearl Pipefish (P)	<i>Vanacampus margaritifer</i>
Barred Soapfish	<i>Diploprion bifasciatum</i>	Mud Flathead	<i>Ambiserrula jugosa</i>
Barred Threefin	<i>Brachynectes fasciatus</i>	Mulloway	<i>Argyrosomus japonicus</i>
Bar-tailed Goatfish	<i>Upeneus tragula</i>	Nannygai	<i>Centroberyx affinis</i>
Bastard Red Cod	<i>Pseudophycis breviuscula</i>	Narrow-Banded Sergeant Major	<i>Abudefduf bengalensis</i>
Bastard Trumpeter	<i>Latridopsis forsteri</i>	Narrow-banded Sole	<i>Aseraggodes macleayanus</i>
Beaked Coralfish	<i>Chelmon rostratus</i>	Narrow-barred Spanish Mackerel	<i>Scomberomorus commerson</i>
Beaked Salmon	<i>Gonorynchus greyi</i>	Nebulous Wrasse	<i>Halichoeres nebulosus</i>
Bearded Rock Cod	<i>Pseudophycis barbata</i>	Numbfish	<i>Hypnos monopterygium</i>
Beardie	<i>Lotella rhacina</i>	Oarfish	<i>Regalecus glesne</i>
Bicolour Goatfish	<i>Parupeneus barberinoides</i>	Ocean Jacket	<i>Nelussetta ayraudi</i>
Bigbelly Seahorse (P)	<i>Hippocampus abdominalis</i>	Ocellate Butterflyfish	<i>Parachaetodon ocellatus</i>
Bigeye Trevally	<i>Caranx sexfasciatus</i>	Ogilby's Hardyhead	<i>Atherinomorus vaigiensis</i>
Bigscale Scalyfin	<i>Parma oligolepis</i>	Ogilby's weedfish	<i>Heteroclinus heptaeolus</i>
Bigscale Soldierfish	<i>Myripristis berndti</i>	Old Wife	<i>Enoplosus armatus</i>
Bigtooth Twin-spot Flounder	<i>Pseudorhombus duplici-cellatus</i>	One-spot Puller	<i>Chromis hypsilepis</i>
Black Kingfish	<i>Rachycentron canadum</i>	Orangeband Surgeonfish	<i>Acanthurus olivaceus</i>
Black Leopard-Wrasse	<i>Macropharyngodon negrosensis</i>	Orangebar Threefin	<i>Ceratobregma helenae</i>
Black Rockcod (V)	<i>Epinephelus daemeli</i>	Orangeline Cardinalfish	<i>Apogon cyanosoma</i>
Black Sole	<i>Brachirus nigra</i>	Orange-line Wrasse	<i>Halichoeres hartzfeldi</i>
Black Spinefoot	<i>Siganus fuscescens</i>	Orangelined Wirrah	<i>Acanthistius paxtoni</i>
Black Triggerfish	<i>Sufflamen chrysopteron</i>	Ornate Ghostpipefish (P)	<i>Solenostomus paradoxus</i>
Blackback Butterflyfish	<i>Chaetodon melannotus</i>	Ornate Wobbegong	<i>Orectolobus ornatus</i>
Blackbanded Seaperch	<i>Hypoplectrodes annulatus</i>	Oxeye Herring	<i>Megalops cyprinoides</i>
Blackhead Leatherjacket	<i>Pervagor melanocephalus</i>	Oyster Blenny	<i>Omobranchus anolius</i>
Black-head Threefin	<i>Enneapterygius larsonae</i>	Pacific Blue-eye	<i>Pseudomugil signifer</i>

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Common name	Scientific name	Common name	Scientific name
Black-lined Sleeper Goby	<i>Valenciennaea helsdingenii</i>	Pacific Rockcod	<i>Trachypoma macracanthus</i>
Blackmargin Dartfish	<i>Parioglossus marginalis</i>	Painted Lizardfish	<i>Trachinocephalus myops</i>
Blackmargin Maori Wrasse	<i>Oxycheilinus nigromarginatus</i>	Painted Rainbow Wrasse	<i>Suezichthys arquatus</i>
Blackspot Boarfish	<i>Zanclistius elevatus</i>	Painted Stinkfish	<i>Eocallionymus papilio</i>
Black-spot Goatfish	<i>Parupeneus spilurus</i>	Painted Sweetlips	<i>Diagramma pictum</i>
Blackspot Gurnard	<i>Lepidotrigla umbrosa</i>	Peacock Rockskipper	<i>Istiblennius meleagris</i>
Black-spot Mangrove-goby	<i>Mugilogobius stigmaticus</i>	Peacock Sole	<i>Pardachirus pavoninus</i>
Blackspot Snapper	<i>Lutjanus fulviflamma</i>	Pearl Perch	<i>Glaucosoma scapulare</i>
Black-spotted Porcupinefish	<i>Diodon hystrix</i>	Pennantfish	<i>Alectis ciliaris</i>
Black-spotted Wrasse	<i>Austrolabrus maculatus</i>	Piano Fangblenny	<i>Plagiotremus tapeinosoma</i>
Blacktail Snapper	<i>Lutjanus fulvus</i>	Pigfish	<i>Bodianus unimaculatus</i>
Black-tipped Bullseye	<i>Pempheris affinis</i>	Pike	<i>Sphyræna novaehollandiae</i>
Black-tipped Fusilier	<i>Pterocaesio digramma</i>	Pilotfish	<i>Naucrates ductor</i>
Blindshark	<i>Brachaelurus waddi</i>	Pineapplefish	<i>Cleidopus gloriamaris</i>
Blotched Hawkfish	<i>Cirrhitichthys aprinus</i>	pink clingfish	<i>Aspasmogaster costatus</i>
Blue Angelfish	<i>Pomacanthus semicirculatus</i>	Pink-banded Grubfish	<i>Parapercis nebulosa</i>
Blue Damsel	<i>Pomacentrus coelestis</i>	Pinkbreast Siphonfish	<i>Siphamia roseigaster</i>
Blue Groper	<i>Achoerodus viridis</i>	Pink-lined Wrasse	<i>Coris dorsomacula</i>
Blue Mackerel	<i>Scomber australasicus</i>	Port Jackson glassfish	<i>Ambassis jacksoniensis</i>
Blue Morwong	<i>Nemadactylus douglasii</i>	Port Jackson Shark	<i>Heterodontus portusjacksoni</i>
Blue Sprat	<i>Spratelloides robustus</i>	Premature Floater	<i>Schindleria praematura</i>
Blue Warehou	<i>Seriotelele brama</i>	Purple Flying Gurnard	<i>Dactyloptena orientalis</i>
Blue-barred Parrotfish	<i>Scarus ghobban</i>	Purple Rockcod	<i>Epinephelus cyanopodus</i>
Bluebottle-fish	<i>Nomeus gronovii</i>	Purple Tuskfish	<i>Choerodon cephalotes</i>
Bluefish	<i>Girella cyanea</i>	Pygmy Scorpionfish	<i>Scorpaenodes scaber</i>
Blue-lined Goatfish	<i>Upeneichthys lineatus</i>	Queensland Yellowtail Angelfish	<i>Chaetodontoplus meredithi</i>
Blue-spot Goby	<i>Pseudogobius sp 9</i>	Raccoon Butterflyfish	<i>Chaetodon lunula</i>
Blue-spotted Parrotfish	<i>Leptoscarus vaigiensis</i>	Ragged-finned Firefish	<i>Pterois antennata</i>
Bluestripe Seaperch	<i>Lutjanus kasmira</i>	Rainbow Cale	<i>Odax acriptilus</i>
Bluestriped Fangblenny	<i>Plagiotremus rhinorhynchus</i>	Rainbow Monocle-bream	<i>Scolopsis monogramma</i>
Bluntheaded Wrasse	<i>Thalassoma amblycephalum</i>	Red Firefish	<i>Pterois volitans</i>
Bony Flyingfish	<i>Hirundichthys oxycephalus</i>	Red Gurnard	<i>Chelidonichthys kumu</i>
Bridled Goby	<i>Arenigobius bifrenatus</i>	Red Morwong	<i>Cheilodactylus fuscus</i>
Bridled Leatherjacket	<i>Acanthaluteres spilomelanurus</i>	Red Pipefish (P)	<i>Notiocampus ruber</i>
Bridled Monocle Bream	<i>Scolopsis bilineatus</i>	Red Rockcod	<i>Scorpaena cardinalis</i>
Bridled Triggerfish	<i>Sufflamen fraenatum</i>	Redbanded Grubfish	<i>Parapercis binivirgata</i>
Broadhead Goosefish	<i>Lophiomus setigerus</i>	Redspot Wrasse	<i>Stethojulis bandanensis</i>
Broadnosed Sevengill Shark	<i>Notorynchus cepedianus</i>	Remora	<i>Remora remora</i>
Broadstripe Cardinalfish	<i>Apogon angustatus</i>	Ribbonfish	<i>Trachipterus arawatae</i>
Brokenline Wrasse	<i>Stethojulis interrupta</i>	Ring-scale Triplefin	<i>Enneapterygius atrogulare</i>
Bronze Whaler	<i>Carcharhinus brachyurus</i>	River Garfish	<i>Hyporhamphus regularis</i>
Brown Sabretooth Blenny	<i>Petroscirtes lupus</i>	Robust Ghost Pipefish (P)	<i>Solenostomus cyanopterus</i>
Brown Sweetlips	<i>Plectorhinchus gibbosus</i>	Rock Blackfish	<i>Girella elevata</i>
Bull Shark	<i>Carcharhinus leucas</i>	Rock Cale	<i>Aplodactylus lophodon</i>
Bullrout	<i>Notesthes robusta</i>	Rock Flathead	<i>Thysanophrys cirronasus</i>
Butterfly Perch	<i>Caesioperca lepidoptera</i>	rosy perch	<i>Callanthias allporti</i>

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Common name	Scientific name	Common name	Scientific name
Capricorn Cardinalfish	<i>Apogon capricornis</i>	Rosy Weedfish	<i>Heteroclinus roseus</i>
Carp	<i>Cyprinus carpio</i>	Rotund Blenny	<i>Omobranchus rotundiceps</i>
Checkerboard Wrasse	<i>Halichoeres hortulanus</i>	Rough Flutemouth	<i>Fistularia petimba</i>
Clouded Saury	<i>Saurida nebulosa</i>	Rough Leatherjacket	<i>Scobinichthys granulatus</i>
Coastal Cubehead	<i>Cubiceps whiteleggi</i>	Rough-head Dragonet	<i>Repomucenus limiceps</i>
Cockatoo Waspfish	<i>Ablabys taenianotus</i>	Roundbelly Cowfish	<i>Lactoria diaphana</i>
Cockerel Wrasse	<i>Pteragogus enneacanthus</i>	Roundsnout Gurnard	<i>Lepidotrigla mulhali</i>
Cocos Frillgoby	<i>Bathygobius cocosensis</i>	Ruby Cardinalfish	<i>Apogon coccineus</i>
Comb Wrasse	<i>Coris picta</i>	Saddled Puffer	<i>Canthigaster valentini</i>
Common Bullseye	<i>Pempheris multiradiata</i>	Sailfin Goby	<i>Nesogobius pulchellus</i>
Common Dolphinfish	<i>Coryphaena hippurus</i>	Samson fish	<i>Seriola hippos</i>
Common Galaxias	<i>Galaxias maculatus</i>	Sand Flathead	<i>Platycephalus bassensis</i>
Common Jack Mackerel	<i>Trachurus declivis</i>	Sand Mullet	<i>Myxus elongatus</i>
common name unknown	<i>Gymnothorax kidako</i>	Sand Whiting	<i>Sillago ciliata</i>
Common Pike Eel	<i>Muraenesox bagio</i>	Sandy Sprat	<i>Hyperlophus vittatus</i>
Common Saury	<i>Saurida tumbil</i>	Sandyback Stingaree	<i>Urolophus bucculentus</i>
Common Sawshark	<i>Pristiophorus cirratus</i>	Sargassum Anglerfish	<i>Histrio histrio</i>
Common Shore-eel	<i>Alabes dorsalis</i>	Sawtail Surgeonfish	<i>Prionurus microlepidotus</i>
Common Silverbiddy	<i>Gerres subfasciatus</i>	Saw-tooth Moray	<i>Gymnothorax prionodon</i>
Common Stingaree	<i>Trygonoptera testacea</i>	Sawtooth Pipefish (P)	<i>Maroubra perserrata</i>
Common Stinkfish	<i>Foetorepus calauropomus</i>	Scalloped Hammerhead	<i>Sphyrna lewini</i>
Common Threefin	<i>Trinorfolkia clarkei</i>	Scalytail Toadfish	<i>Torquigener squamicauda</i>
Common Toadfish	<i>Tetractenos hamiltoni</i>	School Mackerel	<i>Scomberomorus queenslandicus</i>
Convict Surgeonfish	<i>Acanthurus triostegus</i>	School Shark	<i>Galeorhinus galeus</i>
Coral Sea Gregory	<i>Stegastes gascoynei</i>	Schooling Bannerfish	<i>Heniochus diphreutes</i>
Cottonmouth Trevally	<i>Uraspis secunda</i>	Scissortail Sergeant	<i>Abudefduf sexfasciatus</i>
Cox's Gudgeon	<i>Gobiomorphus coxii</i>	Scribbled Leatherjacket	<i>Aluterus scripta</i>
Crescent Perch	<i>Terapon jarbua</i>	Scribbled Rockcod	<i>Epinephelus undulatostratus</i>
Crested Flounder	<i>Lophonectes gallus</i>	Scribbled Wrasse	<i>Anampses geographicus</i>
Crested Horn shark	<i>Heterodontus galeatus</i>	Sea Mullet	<i>Mugil cephalus</i>
Crested Oyster Goby	<i>Cryptocentroides gobioides</i>	Seagrass Ghost-goby	<i>Pleurosicya bilobata</i>
Crested Pipefish (P)	<i>Histiogamphelus briggsii</i>	Senator Wrasse	<i>Pictilabrus laticlavius</i>
Crested Weedfish	<i>Cristiceps australis</i>	Sergeant Baker	<i>Aulopus purpurissatus</i>
Crimsonband Wrasse	<i>Notolabrus gymnogenis</i>	Serpent Eel	<i>Ophisurus serpens</i>
Crowned Puffer	<i>Canthigaster coronata</i>	Sharpnose Grubfish	<i>Parapercis cylindrica</i>
Darkbar Flyingfish	<i>Cypselurus hexazona</i>	Shortfin Eel	<i>Anguilla australis</i>
Dash-dot Goatfish	<i>Parupeneus barberinus</i>	Shortfin Worm Eel	<i>Scolecenchelys australis</i>
Diamond Wrasse	<i>Anampses caeruleopunctatus</i>	Shorthead Lamprey	<i>Mordacia mordax</i>
Diamondfish	<i>Monodactylus argenteus</i>	Shorthead Worm Eel	<i>Scolecenchelys breviceps</i>
Diamondscale Goatfish	<i>Parupeneus ciliatus</i>	Shoulder-spot Sandgoby	<i>Gnatholepis anjerensis</i>
Doublesaddle Butterflyfish	<i>Chaetodon ulietensis</i>	Shoulderspot Wrasse	<i>Leptojulis cyanopleura</i>
Dusky Butterflyfish	<i>Chaetodon flavirostris</i>	Sieve-patterned Moray	<i>Gymnothorax cribroris</i>
Dusky Flathead	<i>Platycephalus fuscus</i>	Silver Sweep	<i>Scorpius lineolata</i>
Dusky Morwong	<i>Dactylophora nigricans</i>	Silver Toadfish	<i>Lagocephalus scleratus</i>
Dusky Shark	<i>Carcharhinus obscurus</i>	Silver Trevally	<i>Pseudocaranx dentex</i>
Dusky Wrasse	<i>Halichoeres marginatus</i>	Silverline Cardinalfish	<i>Apogon hartzfeldi</i>

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Common name	Scientific name	Common name	Scientific name
Dwarf Hawkfish	<i>Cirrhitichthys falco</i>	Silverside Weedfish	<i>Cristiceps argyropleura</i>
Dwarf Lionfish	<i>Dendrochirus brachypterus</i>	Silverstreak Wrasse	<i>Stethojulis strigiventer</i>
Eastern Australian Salmon	<i>Arripis trutta</i>	Six-spine Leatherjacket	<i>Meuschenia freycineti</i>
Eastern Blue Devil	<i>Paraplesiops bleekeri</i>	Skipjack Tuna	<i>Katsuwonus pelamis</i>
Eastern Blue-spotted Flathead	<i>Platycephalus caeruleopunctatus</i>	Slender Flounder	<i>Pseudorhombus tenuirastrum</i>
Eastern Cleaner-clingfish	<i>Cochleocephalus orientalis</i>	Slender Longtom	<i>Strongylura leiura</i>
Eastern Conger	<i>Conger wilsoni</i>	Slender Rainbow Wrasse	<i>Suezichthys gracilis</i>
Eastern Fiddler Ray	<i>Trygonorrhina sp a</i>	Slender Roughy	<i>Optivus agastos</i>
Eastern Frogfish	<i>Batrachomoeus dubius</i>	Slender Sandburrer	<i>Creedia haswelli</i>
Eastern Gambusia	<i>Gambusia holbrooki</i>	Slender Seamothe (P)	<i>Pegasus volitans</i>
Eastern Gobbleguts	<i>Vincentia novaeollandiae</i>	Slender Suckerfish	<i>Echeneis naucrates</i>
Eastern Hulafish	<i>Trachinops taeniatus</i>	Slimy Cuskeel	<i>Brosomphyciops pautzkei</i>
Eastern Jumping Blenny	<i>Lepidoblennius haplodactylus</i>	Small-head Sole	<i>Soleichthys microcephalus</i>
Eastern King Wrasse	<i>Coris sandeyeri</i>	Smallmouth Hardyhead	<i>Atherinosoma microstoma</i>
Eastern Longfin-goby	<i>Favonigobius lentiginosus</i>	Small-scale Bullseye	<i>Pempheris compressa</i>
Eastern Pomfred	<i>Schuettea scalaripinnis</i>	Smallscale Hardyhead	<i>Atherinason hepsetoides</i>
Eastern School Whiting	<i>Sillago flindersi</i>	Smallspot Dart	<i>Trachinotus bailloni</i>
Eastern Sea Garfish	<i>Hyporhamphus australis</i>	Smalltooth Flounder	<i>Pseudorhombus jenynsii</i>
Eastern Shovelnose Ray	<i>Aptychotrema rostrata</i>	Smooth Flutemouth	<i>Fistularia commersonii</i>
Eastern Smooth Boxfish	<i>Anoplocapros inermis</i>	Smooth Golden Pufferfish	<i>Lagocephalus inermis</i>
Eastern Stargazer	<i>Kathetostoma laeue</i>	Smooth Hammerhead	<i>Sphyrna zygaena</i>
Eastern Striped Trumpeter	<i>Pelates sexlineatus</i>	Smooth Stingray	<i>Dasyatis brevicaudata</i>
Eastern Talma	<i>Chelmonops truncatus</i>	Smooth Toadfish	<i>Tetractenos glaber</i>
Eastern Wirrah	<i>Acanthistius ocellatus</i>	Snakeskin Wrasse	<i>Eupetrichthys angustipes</i>
Eastern Yellow Blindfish	<i>Dermatopsis macrodon</i>	Snapper	<i>Pagrus auratus</i>
Elegant Wrasse	<i>Anampses elegans</i>	Snubnose Dart	<i>Trachinotus blochii</i>
Elephantfish	<i>Callorhynchus milii</i>	snubnose Garfish	<i>Arrhamphus sclerolepis</i>
Empire Gudgeon	<i>Hypseleotris compressa</i>	Southern Conger	<i>Conger verreauxi</i>
Epulette Shark	<i>Hemiscyllium ocellatum</i>	Southern Demoiselle	<i>Chrysiptera notialis</i>
Estuary Catfish	<i>Cnidoglanis macrocephalus</i>	Southern Eagle Ray	<i>Myliobatis australis</i>
Estuary Perch	<i>Macquaria colonorum</i>	Southern Fanfish	<i>Pteraclis velifera</i>
Estuary Perchlet	<i>Ambassis marianus</i>	Southern Peacock Sole	<i>Pardachirus hedleyi</i>
Estuary Stingray	<i>Dasyatis fluviorum</i>	Southern Pygmy Leatherjacket	<i>Brachaluteres jacksonianus</i>
Exquisite Sandgoby	<i>Favonigobius exquisitus</i>	Southern Red Scorpionfish	<i>Scorpaena papillosus</i>
Eye Gurnard	<i>Lepidotrigla argus</i>	Southern Roughy	<i>Trachichthys australis</i>
Eyestripe Surgeonfish	<i>Acanthurus dussumieri</i>	Southern Silver Drummer	<i>Kyphosus sydneyanus</i>
False Cleanerfish	<i>Aspidontus taeniatus</i>	Southern Smiler	<i>Opistognathus jacksoniensis</i>
False Fusilier	<i>Paracaesio xanthura</i>	Southern Sprat	<i>Herklotsichthys castelnaui</i>
False Kelpfish	<i>Sebastiscus marmoratus</i>	Spangled emperor	<i>Lethrinus nebulosus</i>
Fan-bellied Leatherjacket	<i>Monacanthus chinensis</i>	Sparse Eviota	<i>Eviota sparsa</i>
Fantail Mullet	<i>Valamugil georgii</i>	Spikey Dogfish	<i>Squalus megalops</i>
Fine-spotted Wrasse	<i>Cirrhitilabrus punctatus</i>	Spineless Toadfish	<i>Torquigener perlevis</i>
Finny Scad	<i>Megalaspis cordyla</i>	Spiny Gurnard	<i>Lepidotrigla papilio</i>
Firetailed Gudgeon	<i>Hypseleotris galii</i>	Spiny Pipehorse (P)	<i>Solegnathus spinosissimus</i>
Fisons Flounder	<i>Amoglossus fisoni</i>	Spinyeye Cardinalfish	<i>Apogon fraenatus</i>
Five-line Snapper	<i>Lutjanus quinquelineatus</i>	Spinytooth Parrotfish	<i>Calotomus spinidens</i>

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Common name	Scientific name	Common name	Scientific name
Five-lined Cardinalfish	<i>Cheilodipterus quinquelineatus</i>	Spot-tail wide-eye Flounder	<i>Engyproson grandisquama</i>
Flag-tail Flathead	<i>Platycephalus arenarius</i>	Spotted Bigeye	<i>Priacanthus macracanthus</i>
Flat-backed Mangrove-goby	<i>Mugilogobius platynotus</i>	Spotted Butterfish	<i>Scatophagus argus</i>
Flathead Goby	<i>Callogobius depressus</i>	Spotted Dragonet	<i>Repomucenus calcaratus</i>
Flathead Gudgeon	<i>Philypnodon grandiceps</i>	Spotted Grubfish	<i>Paraperca ramsayi</i>
Flathead Sandfish	<i>Lesueurina platycephala</i>	Spotted Pipefish (P)	<i>Stigmatopora argus</i>
Flat-tail Mullet	<i>Liza argentea</i>	Spotted Sawtail	<i>Prionurus maculatus</i>
Fortescue	<i>Centropogon australis</i>	Spotted Wobbegong	<i>Orectolobus maculatus</i>
Fourline Cardinalfish	<i>Apogon doederleini</i>	Starck's Demoiselle	<i>Chrysiptera starcki</i>
Foxfish	<i>Bodianus frenchii</i>	Starry Goby	<i>Asterropteryx semipunctatus</i>
Freckled Porcupinefish	<i>Diodon holocanthus</i>	Starry Pufferfish	<i>Arothron stellatus</i>
Freshwater Catfish	<i>Tandanus tandanus</i>	Starry Toadfish	<i>Arothron firmamentum</i>
Freshwater Herring	<i>Potamalosa richmondia</i>	Stars and Stripes Leatherjacket	<i>Meuschenia venusta</i>
Frigate Mackerel	<i>Auxis thazard</i>	Stars and Stripes Toadfish	<i>Arothron hispidus</i>
Fringed Stargazer	<i>Ichthyoscopus barbatus</i>	Stick Pipefish (P)	<i>Trachyrhamphus bicoarctatus</i>
Frostfish	<i>Lepidopus caudatus</i>	Stout Longtom	<i>Tylosurus gaviatoides</i>
Gelatinous Cardinalfish	<i>Pseudamia gelatinosa</i>	Stout Whiting	<i>Sillago robusta</i>
Giant Anglerfish	<i>Antennarius commersoni</i>	Striped Anglerfish	<i>Antennarius striatus</i>
Giant Boarfish	<i>Paristiopterus labiosus</i>	Striped Cardinalfish	<i>Apogon fasciatus</i>
Giant Herring	<i>Elops hawaiiensis</i>	Striped Catfish	<i>Plotosus lineatus</i>
Giant Sea Catfish	<i>Arius thalassinus</i>	Striped Cleaner Wrasse	<i>Labroides dimidiatus</i>
Giant Squirrelfish	<i>Ostichthys japonicus</i>	Striped Gudgeon	<i>Gobiomorphus australis</i>
Giant Trevally	<i>Caranx ignobilis</i>	Striped Sandgoby	<i>Acentrogobius pflaumii</i>
Girdled Parma	<i>Parma unifasciata</i>	Striped Seapike	<i>Sphyræna obtusata</i>
Girdled Pipefish (P)	<i>Festucalex cinctus</i>	Stripey	<i>Microcanthus strigatus</i>
Girdled Reef-goby	<i>Priolepis cincta</i>	Surge Demoiselle	<i>Chrysiptera brownriggii</i>
Glassgoby	<i>Gobiopterus semivestitus</i>	Sweetlip Emperor	<i>Lethrinus miniatus</i>
Glassy Sprat	<i>Hyperlophus translucidus</i>	Sydney Cardinalfish	<i>Apogon limenus</i>
Goblinfish	<i>Glyptauchen panduratus</i>	Sydney Scorpionfish	<i>Scorpaenopsis insperatus</i>
Goldband Fusilier	<i>Caesio caerulaurea</i>	Sydney Skate	<i>Dipturus australis</i>
Golden Weedfish	<i>Cristiceps aurantiacus</i>	Tailor	<i>Pomatomus saltatrix</i>
Goldfish	<i>Carassius auratus</i>	Tallfin Flyingfish	<i>Cheilopogon pinnatibarbatus</i>
Goldlined Wrasse	<i>Coris aurilineata</i>	Tamar Goby	<i>Afurcagobius tamarensis</i>
Goldspot Pigfish	<i>Bodianus perditio</i>	Tarwhine	<i>Rhabdosargus sarba</i>
Gold-spotted Sweetlips	<i>Plectorhinchus flavomaculatus</i>	Tasmanian Blenny	<i>Parablennius tasmanianus</i>
Grass Whiting	<i>Haletta semifasciata</i>	Tasmanian clingfish	<i>Aspasmogaster tasmaniensis</i>
Green Moray	<i>Gymnothorax prasinus</i>	Tasmanian numbfish	<i>Narcine tasmaniensis</i>
Green Sawfish	<i>Pristis zijsron</i>	Tasselled Leatherjacket	<i>Chaetodermis penicilligera</i>
Greenback Stingaree	<i>Urolophus viridis</i>	Teira Batfish	<i>Platax teira</i>
Greeneye Dartgoby	<i>Ptereleotris microlepis</i>	Temperate Scad	<i>Decapterus muroadsi</i>
Grey Nurse Shark (E)	<i>Carcharias taurus</i>	Teraglin	<i>Atractoscion aequidens</i>
Grey Spotted Catshark	<i>Asymbolus analis</i>	Theodore's Threadfin-bream	<i>Nemipterus theodorei</i>
Gulf Damsel	<i>Pristotis obtusirostris</i>	Thicklip Trevally	<i>Carangoides orthogrammus</i>
Gummy Shark	<i>Mustelus antarcticus</i>	Thicklip Wrasse	<i>Hemigymnus melapterus</i>
Günther's Butterflyfish	<i>Chaetodon guentheri</i>	Thorny-back Cowfish	<i>Lactoria fornasini</i>
Gunther's wrasse	<i>Pseudolabrus guentheri</i>	Threadfin Butterflyfish	<i>Chaetodon auriga</i>

Table B1 – Fishes of Sydney Harbour

Common name	Scientific name	Common name	Scientific name
Hairy Pipefish (P)	<i>Urocampus carinirostris</i>	Threadfin Emperor	<i>Lethrinus genivittatus</i>
Halfband Cardinalfish	<i>Apogon semiornatus</i>	Threadfin Leatherjacket	<i>Paramonacanthus filicauda</i>
Halfband Snake Eel	<i>Malvoliophis pinguis</i>	Threadfin Reef-goby	<i>Priolepis nuchifasciata</i>
Half-banded Seaperch	<i>Hypoplectrodes maccullochi</i>	Thread-tail Dartgoby	<i>Ptereleotris hanae</i>
Half-bridled Goby	<i>Arenigobius frenatus</i>	Threeband Demoiselle	<i>Chrysiptera tricineta</i>
Half-scale Sandburrer	<i>Creedia partimsquamigera</i>	Three-bar Porcupinefish	<i>Dicotylichthys punctulatus</i>
Halstead's Toadfish	<i>Reicheltia halsteadii</i>	Three-by-two Garfish	<i>Hemiramphus robustus</i>
Hasselt's Flaphead Goby	<i>Callogobius hasseltii</i>	Three-spot Dascyllus	<i>Dascyllus trimaculatus</i>
Herring Cale	<i>Odax cyanomelas</i>	Tiger Cardinalfish	<i>Cheilodipterus macrodon</i>
Highfin Toadfish	<i>Torquigener altipinnis</i>	Tiger Flathead	<i>Platycephalus richardsoni</i>
Hoese's Sandgoby	<i>Istigobius hoesei</i>	Tiger Pipefish (P)	<i>Filicampus tigris</i>
Horned Blenny	<i>Parablennius intermedius</i>	Tiger Shark	<i>Galeocerdo cuvier</i>
Hussar	<i>Lutjanus adetii</i>	Tommyfish	<i>Limnichthys fasciatus</i>
Immaculate Damsel	<i>Mecaenichthys immaculatus</i>	Toothbrush Leatherjacket	<i>Acanthaluteres vittiger</i>
Indo-Pacific sergeant	<i>Abudefduf vaiensis</i>	Trident Goby	<i>Tridentiger trigonocephalus</i>
Jameson's Seaperch	<i>Hypoplectrodes jamesoni</i>	Tripletail	<i>Lobotes surinamensis</i>
Javelin Pipefish (P)	<i>Lissocampus runa</i>	Trumpeter Whiting	<i>Sillago maculata</i>
John Dory	<i>Zeus faber</i>	Turretfish	<i>Tetrosomus reipublicae</i>
Keel-head Razorfish	<i>Xyrichtys jacksonensis</i>	Two-eye Cardinalfish	<i>Apogon nigripinnis</i>
Kelpfish	<i>Chironemus marmoratus</i>	Two-spine Angelfish	<i>Centropyge bispinosa</i>
keyhole angelfish	<i>Centropyge tibicen</i>	Twospot Maori Wrasse	<i>Oxycheilinus bimaculatus</i>
King Gar	<i>Scomberesox saurus</i>	Twotone Wrasse	<i>Halichoeres prosopoeion</i>
Klein's Butterflyfish	<i>Chaetodon kleinii</i>	Unicorn Leatherjacket	<i>Aluterus monoceros</i>
Kreff's Frillgoby	<i>Bathygobius krefftii</i>	Upside Down Pipefish (P)	<i>Heraldia nocturna</i>
Kuiter's Goby	<i>Valenciennesa immaculata</i>	Variegated Lizardfish	<i>Synodus variegatus</i>
Kuiter's Wrasse	<i>Macropharyngodon kuiteri</i>	Velvetfish	<i>Aploactisoma milesii</i>
Lance Blenny	<i>Aspidontus dussumieri</i>	Waite's Seapike	<i>Sphyrna waitii</i>
Largehead Hairtail	<i>Trichiurus lepturus</i>	Ward's Damsel	<i>Pomacentrus wardi</i>
Largemouth Goby	<i>Redigobius macrostoma</i>	Weedy Seadragon (P)	<i>Phyllopteryx taeniolatus</i>
Largenose Weedfish	<i>Heteroclinus nasutus</i>	Weeping Toado	<i>Torquigener pleurogramma</i>
Largescale Saury	<i>Saurida undosquamis</i>	White Shark (V)	<i>Carcharodon carcharias</i>
Largespotted Herring	<i>Herklotsichthys koningsbergeri</i>	White-barred Goby	<i>Amblygobius phalaena</i>
Large-tooth Flounder	<i>Pseudorhombus arsius</i>	White-Ear	<i>Parma microlepis</i>
Latchet	<i>Pterygotrigla polyommata</i>	Whitelegg's Weedfish	<i>Heteroclinus whiteleggii</i>
Leaf Scorpionfish	<i>Taenianotus triacanthus</i>	Whitelined Eviota	<i>Eviota albolineata</i>
Leaping Bonito	<i>Cybiosarda elegans</i>	White's Seahorse (P)	<i>Hippocampus whitei</i>
Lemon Tongue-sole	<i>Paraplagusia bilineata</i>	Whitespotted Guitarfish	<i>Rhynchobatus australiae</i>
Leopard Shark	<i>Stegostoma fasciatum</i>	Whitetail Angelfish	<i>Centropyge flavicauda</i>
Lesser Moray	<i>Gymnothorax minor</i>	Wide-body Pipefish (P)	<i>Stigmatopora nigra</i>
Little Conger	<i>Gnathophip longicaudatus</i>	Woods Siphonfish	<i>Siphania cephalotes</i>
Little Dragonfish	<i>Eurypegasus draconis</i>	Yellow Boxfish	<i>Ostracion cubicus</i>
Little Weed Whiting	<i>Neodax balteatus</i>	Yellow Tang	<i>Zebrosoma flavescens</i>
Long Green Wrasse	<i>Pseudojuloides elongatus</i>	Yellowback Bream	<i>Dentex tumifrons</i>
Longfin Bannerfish	<i>Heniochus acuminatus</i>	Yellow-back Puller	<i>Chromis nitida</i>
Longfinned Eel	<i>Anguilla reinhardtii</i>	Yellowband Fusilier	<i>Pterocaesio chrysozona</i>
Long-finned Perch	<i>Caprodon longimanus</i>	Yellowwedge Lyretail	<i>Variola louti</i>

MANLY COVE COASTLINE MANAGEMENT STUDY

Table B1 – Fishes of Sydney Harbour

Common name	Scientific name	Common name	Scientific name
Long-finned Pike	<i>Dinolestes lewini</i>	Yellowfin Bream	<i>Acanthopagrus australis</i>
Longhorn Cowfish	<i>Lactoria cornuta</i>	Yellowfin Goby	<i>Acanthogobius flavimanus</i>
Longsnout Flounder	<i>Ammotretis rostratus</i>	Yellowfin Pigfish	<i>Bodianus flavipinnis</i>
Longspine Flathead	<i>Platycephalus longispinis</i>	Yellow-finned Leatherjacket	<i>Meuschenia trachylepis</i>
Longtail Catfish	<i>Euristhmus lepturus</i>	Yellow-striped Leatherjacket	<i>Meuschenia flavolineata</i>
Lowe's Leatherjacket	<i>Paramonacanthus lowei</i>	Yellowtail Demoiselle	<i>Neopomacentrus azysron</i>
Luculentus Wrasse	<i>Pseudolabrus luculentus</i>	Yellowtail Kingfish	<i>Seriola lalandi</i>
Luderick	<i>Girella tricuspidata</i>	Yellowtail Scad	<i>Trachurus novaezelandiae</i>
Lyre-tail Hawkfish	<i>Cyprinocirrhites polyactis</i>	Zebra Lionfish	<i>Dendrochirus zebra</i>
		Zebra Sole	<i>Zebrias quagga</i>
		Zebrafish	<i>Girella zebra</i>
		Zig-zag Ponyfish	<i>Leiognathus moretoniensis</i>
P = Protected Species V = Vulnerable E = Endangered Species Fisheries Management Act, 2004			
Source: Australian Museum, 2007			

Table B2 – Other Marine Fauna Species Recorded in Sydney Harbour

Common Name	Scientific Name	Where Observed	Source of Information
Australian Fur Seal (V1)	<i>Arctocephalus pusillus doriferus</i>	Sydney Harbour	Australian Museum, 2007
Blue Swimmer Crab	<i>Portunus pelagicus</i>	Manly Wharf	Scott Machar*
Bottlenose Dolphin	<i>Tursiops truncatus</i>	Sydney Harbour	Australian Museum, 2007
Common Dolphin	<i>Delphinus delphis</i>	Sydney Harbour	Australian Museum, 2007
Crab-eater Seal	<i>Lobodon carcinophagus</i>	Sydney Harbour	Australian Museum, 2007
Dugong (E1)	<i>Dugong dugon</i>	Sydney Harbour	Australian Museum, 2007
Green Turtle	<i>Chelonia Mydas</i>	Sydney Harbour	Australian Museum, 2007
Humpback Whale (V1)	<i>Megaptera novaeangliae</i>	Sydney Harbour	Scott Machar*
Leatherback Turtle	<i>Dermochelys Coriacea</i>	Sydney Harbour	Australian Museum, 2007
Leopard Seal	<i>Hydrurga leptonyx</i>	Sydney Harbour	Australian Museum, 2007
Loggerhead Turtle	<i>Caretta Caretta</i>	Sydney Harbour	Australian Museum, 2007
Pygmy Sperm Whale	<i>Kogia breviceps</i>	Sydney Harbour	Australian Museum, 2007
Risso's Dolphin	<i>Grampus griseus</i>	Sydney Harbour	Australian Museum, 2007
Southern Calamari	<i>Sepioteuthis australis</i>	Adjacent to Balmoral Beach	Scott Machar*
Southern Elephant Seal	<i>Mirounga leonina</i>	Sydney Harbour	Australian Museum, 2007
Sperm Whale (V1)	<i>Physeter macrocephalus</i>	Sydney Harbour	Australian Museum, 2007
Spotted Dolphin	<i>Stenella attenuata</i>	Sydney Harbour	Australian Museum, 2007
Yellow-bellied Sea Snake	<i>Pelamis platurus</i>	Sydney Harbour	Australian Museum, 2007
E1 = Endangered Species, NSW Threatened Species Conservation Act, 1995			
V1 = Vulnerable Species, NSW Threatened Species Conservation Act, 1995			
* = species observed by Manly Council Natural Resources Branch staff			

Table B3 – Estuarine Flora Species within the Study Area	
Common Name	Scientific Name
Caulerpa*	<i>Caulerpa taxifolia</i>
Eelgrass	<i>Zostera capricorni</i>
Halophila	<i>Paddleweed</i>
Kelp / Algae	<i>Various / Unknown</i>
Strapweed	<i>Posidonia australis</i>
* Class 1 Noxious Marine Vegetation on Fisheries Management Act, 1994	
Source: DPI, 2006	

Table B4
Port Survey for Introduced Marine Species – Sydney Harbour
Schedule 1 - Target Introduced Pest Species <i>Alexandrium catenella</i> <i>Alexandrium tamarense</i>
Schedule 2 - Marine Species that Pose a Threat to Australia <i>Mytilus galloprovincialis</i>
Schedule 3 - Known or Likely Exotic Marine Species in Australian Waters <i>Euchone limnicola</i> <i>Hydroides elegans</i> <i>Ficopomatus enigmaticus</i> <i>Pseudopolydora paucibranchiata</i> <i>Megabalanus rosa</i> <i>Notomegabalanus algicola</i> <i>Cirolana harfordi</i> <i>Eurylana arcuata</i> <i>Limnoria lignorum</i> <i>Limnoria quadripunctata</i> <i>Limnoria tripunctata</i> <i>Paracerceis sculpta</i> <i>Sphaeroma walkeri</i> <i>Botrylloides leachi</i> <i>Botryllus schlosseri</i> <i>Ciona intestinalis</i> <i>Styela plicata</i> <i>Tridentiger trionocephalus</i> <i>Bugula flabellata</i> <i>Bugula neritina</i> <i>Conopeum tenuissimum</i> <i>Schizoporella unicornis</i> <i>Teredo navalis</i> <i>Theora lubrica</i> <i>Polycera hedgpethi</i> <i>Zeacumantus subcarinatus</i> <i>Caulerpa filiformis</i>
Source: Australian Museum Business Services, 2002

Table B5 – Intertidal Species Within the Study Area	
Common Name or Taxon	Scientific Name
Austrocochlea*	<i>Austrocochlea constricta</i> ³
Barnacle ²	<i>Austrobalanus imperator</i>
Barnacle ²	<i>Balanus variegates / amphitrite</i>
Barnacle ²	<i>Chthamalus antennatus</i>
Barnacle ²	<i>Elminius covertus</i>
Barnacle ²	<i>Ibla quadrivalvis</i>
Barnacle ²	<i>Tesseropora rosea</i>
Barnacle ²	<i>Tetraclitella purpurescens</i>
Bembicium*	<i>Unknown</i>
Chiton ²	<i>Chiton pelliserpentis</i>
Chiton ²	<i>Chiton sp.</i>
Crab ²	<i>Cyclograpsus audouinii</i>
Crab ²	<i>Helograpsus haswellianus</i>
Cunjevoi ¹	<i>Pyura stolonifera</i> ³
Galeolaria*	<i>Galeolaria caespitosa</i> ³
Gastropoda (limpets, slugs, snails) ²	<i>Aplysia sp.</i>
Gastropoda (limpets, slugs, snails) ²	<i>Cf. Agnewia tritoniformis</i>
Gastropoda (limpets, slugs, snails) ²	<i>Austrocochlea concamerata</i>
Gastropoda (limpets, slugs, snails) ²	<i>Austrocochlea porcata</i>
Gastropoda (limpets, slugs, snails) ²	<i>Batillaria australis</i>
Gastropoda (limpets, slugs, snails) ²	<i>Bembicium nanum</i>
Gastropoda (limpets, slugs, snails) ²	<i>Bembicium melanostomum</i>
Gastropoda (limpets, slugs, snails) ²	<i>Cellana tramoserica</i>
Gastropoda (limpets, slugs, snails) ²	<i>Littoraria luteola</i>
Gastropoda (limpets, slugs, snails) ²	<i>Morula marginalba</i>
Gastropoda (limpets, slugs, snails) ²	<i>Nerita atramentosa</i>
Gastropoda (limpets, slugs, snails) ²	<i>Nodilittorina unifasciata</i>
Gastropoda (limpets, slugs, snails) ²	<i>Nodilittorina pyramidalis</i>
Gastropoda (limpets, slugs, snails) ²	<i>Notoacmea</i>
Gastropoda (limpets, slugs, snails) ²	<i>Onchidella/Onchidina</i>
Gastropoda (limpets, slugs, snails) ²	<i>Opisthobranchia sp.1</i>
Gastropoda (limpets, slugs, snails) ²	<i>Opisthobranchia sp. 2</i>
Gastropoda (limpets, slugs, snails) ²	<i>Patelloida</i>
Gastropoda (limpets, slugs, snails) ²	<i>Siphonaria</i>
Gastropoda (limpets, slugs, snails) ²	<i>Umbraculum sinicum</i>
Green Algae*	<i>Unknown</i>
Limpets*	<i>Cellana tramoserica</i> ³
Little Penguin ¹	<i>Eudyptula minor</i>
Marine Worm ²	<i>Galeolaria caespitose</i>
Marine Worm ²	<i>Nereidae</i>
Marine Worm ²	<i>Terebellidae</i>
Marine Worm ²	<i>Polynoidae</i>
Mollusca ²	<i>Crassostrea gigas</i>
Mollusca ²	<i>Lasaea australis</i>

Table B5 – Intertidal Species Within the Study Area	
Common Name or Taxon	Scientific Name
Mollusca ²	<i>Mytilus</i>
Mollusca ²	<i>Saccostrea glomerata</i>
Mollusca ²	<i>Trichomya hirsuta</i>
Morula*	<i>Morula marginalba</i> ³
Mussels*	<i>Unknown</i>
Nerita*	<i>Unknown</i>
Onchidium*	<i>Unknown</i>
Oyster Limpet*	<i>Unknown</i>
Oysters*	<i>Unknown</i>
Pyrazus*	<i>Pyrazus ebeninus</i> ³
Red Algae*	<i>Unknown</i>
Sea Squirt ²	<i>Ascidacea sp.</i>
Sea Squirt ²	<i>Pyura stolonifera</i>
Seastar ²	<i>Patiriella exigua</i>
Slater ²	<i>Cirolana</i>
Slater ²	<i>Ligiidae</i>
Soldier Crab	<i>Mictyris longicarpus</i>
Yabby (Saltwater)	<i>Trypaea australiensis</i>
* species were observed by Sydney Water at monitoring locations at Sugarloaf Bay &/or Quakers Hat Bay (both adjacent to the study area, on the opposite side of Middle Harbour), and are therefore expected to also be present within the study area	
² Species identified in the Spit Bridge Proposed Widening Statement of Environmental Effects, GHD, 2003	
³ Scientific names were obtained through various websites, and are assumed to be the correct scientific names of the species observed by Sydney Water	

Table B6 – Terrestrial Native Fauna Species within the Study Area		
Group	Common Name	Scientific Name
Amphibian	Common Eastern Froglet	<i>Crinia signifera</i>
Amphibian	Brown-striped Frog	<i>Limnodynastes peronii</i>
Amphibian	Red-crowned Toadlet	<i>Pseudophryne australis</i>
Bird	Australian Magpie	<i>Gymnorhina tibicen</i>
Bird	Australian Raven	<i>Corvus coronoides</i>
Bird	Australian Wood Duck	<i>Chenonetta jubata</i>
Bird	Brown Gerygone	<i>Gerygone mouki</i>
Bird	Bush Stone Curlew (T2 & E2)*	<i>Burhinus grallarius</i>
Bird	Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>
Bird	Crested Pigeon	<i>Ocyphaps lophotes</i>
Bird	Crimson Rosella	<i>Platycercus elegans</i>
Bird	Diamond Firetail	<i>Stagonopleura guttata</i>
Bird	Eastern Whipbird	<i>Psophodes olivaceus</i>
Bird	Eastern Yellow Robin	<i>Eopsaltria australis</i>

Table B6 – Terrestrial Native Fauna Species within the Study Area		
Group	Common Name	Scientific Name
Bird	Galah	<i>Cacatua roseicapilla</i>
Bird	Grey Butcherbird	<i>Cracticus torquatus</i>
Bird	Grey Fantail	<i>Rhipidura fuliginosa</i>
Bird	Laughing Kookaburra	<i>Dacelo novaeguineae</i>
Bird	Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>
Bird	Little Wattlebird	<i>Anthochaera chrysoptera</i>
Bird	Magpie-lark	<i>Grallina cyanoleuca</i>
Bird	Masked Lapwing	<i>Vanellus miles</i>
Bird	Noisy Miner	<i>Manorina melanocephala</i>
Bird	Pied Cormorant	<i>Phalacrocorax varius</i>
Bird	Pied Currawong	<i>Strepera graculina</i>
Bird	Rainbow Lorikeet	<i>Trichoglossus haematodus</i>
Bird	Red Wattlebird	<i>Anthochaera carunculata</i>
Bird	Sacred Kingfisher	<i>Todiramphus sanctus</i>
Bird	Silver Gull	<i>Larus novaehollandiae</i>
Bird	Southern Leaf-tailed Gecko	<i>Phyllurus platurus</i>
Bird	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>
Bird	Superb Fairy-wren	<i>Malurus cyaneus</i>
Bird	Tawny Frogmouth	<i>Podargus strigoides</i>
Bird	Variegated Fairy-wren	<i>Malurus lamberti</i>
Bird	Welcome Swallow	<i>Hirundo neoxena</i>
Bird	White-browed Scrubwren	<i>Sericornis frontalis</i>
Bird	Willie Wagtail	<i>Rhipidura leucophrys</i>
Bird	Yellow Thornbill	<i>Acanthiza nana</i>
Mammal	Common Brushtail Possum	<i>Trichosurus vulpecula</i>
Mammal	Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>
Mammal	Grey-headed Flying-fox (T2 & E2)	<i>Pteropus poliocephalus</i>
Mammal	Water Rat	<i>Hydromys chrysogaster</i>
Reptile	Copper-tailed Skink	<i>Ctenotus taeniolatus</i>
Reptile	Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>
Reptile	Eastern Blue-tongued Lizard	<i>Tiliqua scincoides</i>
Reptile	Eastern Water-skink	<i>Eulamprus quoyii</i>
Reptile	Golden Crowned Snake	<i>Cacophis squamulosus</i>
Reptile	Pale-flecked Garden Sunskink	<i>Lampropholis guichenoti</i>
Reptile	Robust Ctenotus	<i>Ctenotus robustus</i>
Reptile	Yellow-bellied Three-toed Skink	<i>Saiphos equalis</i>
Reptile	Weasel Skink	<i>Saproscincus mustelinus</i>
T2 = Vulnerable on Schedule 2, NSW Threatened Species Conservation Act, 1995 E2 = Endangered on Commonwealth Environmental Protection and Biodiversity Conservation Act, 1999		
Source: Skelton et al, 2004 *Sighted recently (August 2008) within the study area		

Table B7 – Terrestrial Exotic Fauna Species within the Study Area		
Group	Common Name	Scientific Name

Table B7 – Terrestrial Exotic Fauna Species within the Study Area		
Group	Common Name	Scientific Name
Bird	Spotted Turtle-Dove	<i>Streptopelia chinensis</i>
Bird	Common Myna	<i>Acridotheres tristis</i>
Bird	Common Starling	<i>Sturnus vulgaris</i>
Bird	House Sparrow	<i>Passer domesticus</i>
Bird	Rock Dove	<i>Columbia livia</i>
Mammal	Black Rat	<i>Rattus rattus</i>
Mammal	Cat	<i>Felis catus</i>
Mammal	Dog	<i>Canis familiaris</i>
Mammal	Rabbit	<i>Oryctolagus cuniculus</i>
Source: Skelton et al, 2004		

Table B8 – Terrestrial Native Flora Species within the Study Area		
Habit	Common Name	Scientific Name
Fern	Batswing Fern	<i>Histiopteris incisa</i>
Fern	Birds Nest Fern	<i>Asplenium australasicum</i>
Fern	Bracken	<i>Pteridium esculentum</i>
Fern	Christella	<i>Christella dentata</i>
Fern	Creeping Shield Fern	<i>Lastreopsis microsora</i>
Fern	False Bracken Fern	<i>Calochlaena dubia</i>
Fern	Giant Club Moss	<i>Lychopodium deuterodensum</i>
Fern	Hares Foot Fern (rare)	<i>Davallia pyxidata</i>
Fern	King Fern	<i>Todea barbara</i>
Fern	Lacy Wedge Fern	<i>Lindsaea microphylla</i>
Fern	Maidenhair Fern	<i>Adiantum aethiopicum</i>
Fern	Pouched Coral Fern	<i>Gleichenia dicarpa</i>
Fern	Screw Fern	<i>Lindsaea linearis</i>
Fern	Straw Tree Fern	<i>Cyathea cooperi</i>
Grass	Basket Grass	<i>Oplismenus aemulus</i>
Grass	Basket Grass	<i>Oplismenus imbecillis</i>
Grass	Blady Grass	<i>Imperata cylindrica var. major</i>
Grass	Common Couch	<i>Cyanodon dactylon</i>
Grass	Indian Cupscale Grass	<i>Sacciolepis indica</i>
Grass	Kangaroo Grass	<i>Themeda australis</i>
Grass	Kikuyu	<i>Pennisetum clandestinum</i>
Grass	Sand Couch	<i>Sporobolus virginicus</i>
Grass	Unknown	<i>Cymbopogon refractus</i>
Grass	Unknown	<i>Danthonia sp.</i>
Grass	Unknown	<i>Eragrostis brownii</i>
Grass	Weeping Grass	<i>Microlaena stipoides var. stipoides</i>
Grass	Wiry Panic	<i>Entolasia stricta</i>
Grass Tree	Broad-leaved Grass Tree	<i>Xanthorrhoea arborea</i>
Grass Tree	Forest Grass Tree	<i>Xanthorrhoea media/resinifera</i>
Grass Tree	Grass Tree	<i>Xanthorrhoea minor ssp. minor</i>
Herb	Bearded Orchid	<i>Calochilus sp.</i>

Table B8 – Terrestrial Native Flora Species within the Study Area		
Habit	Common Name	Scientific Name
Herb	Blue Flax Lily	<i>Dianella caerulea</i>
Herb	Bush Pea	<i>Pultanaea stipularis</i>
Herb	Carrot Tops	<i>Platysace linearifolia</i>
Herb	Centella	<i>Centella asiatica</i>
Herb	Cockspur Flowers	<i>Plectranthus parviflorus</i>
Herb	Common Chloanthos	<i>Chloanthos stoechadis</i>
Herb	Common Stinkweed	<i>Opercularia aspera</i>
Herb	Creeping Christian	<i>Commelina cyanea</i>
Herb	Cup Orchid	<i>Cryptostylis erecta</i>
Herb	Daisy-bush	<i>Olearia tomentosa</i>
Herb	Fish Bones	<i>Lomandra obliqua</i>
Herb	Flannel Flower	<i>Actinotus helianthi</i>
Herb	Geranium	<i>Geranium homeanum</i>
Herb	Germander Raspwort	<i>Gonocarpus teucroides</i>
Herb	Lesser Flannel Flower	<i>Actinotus minor</i>
Herb	Lesser joy weed	<i>Alternanthera denticulata</i>
Herb	Mitre Weed	<i>Mitrasacme polymorpha</i>
Herb	Native Bluebell	<i>Wahlenbergia gracilis</i>
Herb	Native Parsnip	<i>Platysace lanceolata</i>
Herb	Native Violet	<i>Viola hederacea</i>
Herb	Pale Mat-rush	<i>Lomandra glauca</i>
Herb	Pomax	<i>Pomax umbellata</i>
Herb	Spiny-headed Mat-rush	<i>Lomandra longifolia</i>
Herb	Stephenson's Platysace	<i>Platysace stephensonii</i>
Herb	Swamp Lilly	<i>Crinum pedunculatum</i>
Herb	Tongue Orchid	<i>Dendrobium linguiforme</i>
Herb	Tuft Mat-rush	<i>Lomandra brevis</i>
Herb	Unknown	<i>Apium Prostratum</i>
Herb	Unknown	<i>Hydrocotyle peduncularis</i>
Herb	Unknown (rare)	<i>Schelhammera undulate</i>
Herb	Unknown	<i>Veronica plebeia</i>
Herb	Warrigal Greens	<i>Tetragonia tetragonoides</i>
Herb	Wattle Mat-rush	<i>Lomandra filiformis ssp. filiformis</i>
Herb	White Root	<i>Pratia purpurascens</i>
Herb	Wooly Xanthosia	<i>Xanthosia pilosa</i>
Palm	Cabbage Tree Palm	<i>Livistona australis</i>
Rush	Cord Rush	<i>Restio dimorphus</i>
Rush	Cord Rush	<i>Restio tetraphyllus ssp. meiotachyus</i>
Rush	Scale-rush	<i>Lepyrodia scariosa</i>
Rush	Tassel Rush	<i>Restio fastigiatus</i>
Scrambler	Native Raspberry	<i>Rubus parvifolius</i>
Sedge	Bog-rush	<i>Schoenus sp.</i>
Sedge	Carex	<i>Carex sp.</i>
Sedge	Caustis	<i>Caustis pentandra</i>
Sedge	Cut Grass	<i>Gahnia aspera</i>

Table B8 – Terrestrial Native Flora Species within the Study Area		
Habit	Common Name	Scientific Name
Sedge	Cut Grass	<i>Gahnia sp.</i>
Sedge	Cyathochaeta	<i>Cyathochaeta diandra</i>
Sedge	Knobby Club-rush	<i>Isolepis nodosa</i>
Sedge	Rush	<i>Juncus usitatus</i>
Sedge	Unknown	<i>Lepidosperma filiforme</i>
Sedge	Unknown	<i>Ptilothrix deusta</i>
Sedge	Variable Sword Edge	<i>Lepidosperma laterale</i>
Shrub	Ball Honeymyrtle	<i>Melaleuca nodosa</i>
Shrub	Banksia	<i>Banksia oblongifolia</i>
Shrub	Bleeding Heart	<i>Omalanthus populifolius</i>
Shrub	Bossiaea	<i>Bossiaea heterophylla</i>
Shrub	Box-leaved Wax Flower	<i>Eriostemon buxifolius</i> spp. <i>obovatus</i>
Shrub	Breynia	<i>Breynia oblongifolia</i>
Shrub	Bush Pea	<i>Pultenaea elliptica</i>
Shrub	Bushy Needlebush	<i>Hakea sericea</i>
Shrub	Crimson Bottlebrush	<i>Callistemon citrinus</i>
Shrub	Coastal Rosemary	<i>Westringia fruticosa</i>
Shrub	Coastal Tea-tree	<i>Leptospermum laevigatum</i>
Shrub	Coastal Wattle	<i>Acacia longifolia</i> var. <i>sophorae</i>
Shrub	Conesticks	<i>Petrophile pulchella</i>
Shrub	Coral Heath	<i>Epacris microphylla</i> var. <i>microphylla</i>
Shrub	Crinkle Bush	<i>Lomatia silaifolia</i>
Shrub	Crowea	<i>Crowea saligna</i>
Shrub	Dagger Hakea	<i>Hakea teretifolia</i>
Shrub	Darwinia	<i>Darwinia fascicularis</i> spp. <i>fascicularis</i>
Shrub	Dog Rose	<i>Bauera capitata</i>
Shrub	Drumsticks	<i>Isopogan anethifolius</i>
Shrub	Eggs and Bacon	<i>Dillwynia retorta</i>
Shrub	Elderberry Panax	<i>Polyscias sambucifolia</i>
Shrub	Flax-leaved Wattle	<i>Acacia linifolia</i>
Shrub	Fuchsia Heath	<i>Epacris longiflora</i>
Shrub	Grey Spider Flower	<i>Grevillea buxifolia</i> ssp. <i>buxifolia</i>
Shrub	Hairy Zieria	<i>Zieria pilosa</i>
Shrub	Hakea	<i>Hakea gibbosa</i>
Shrub	Heath Leaved Banksia	<i>Banksia ericifolia</i> var. <i>ericifolia</i>
Shrub	Hop Bush	<i>Dodonaea triquetra</i>
Shrub	Lance-leaved Geebung	<i>Persoonia lanceolata</i>
Shrub	Lemon Scented Tea Tree	<i>Leptospermum polygalifolium</i>
Shrub	Mock Olive	<i>Notelaea ovata</i>
Shrub	Mountain Devil	<i>Lambertia formosa</i>
Shrub	Narrow-leaved Bottlebrush	<i>Callistemon linearis</i>
Shrub	Narrow-leaved Geebung	<i>Persoonia linearis</i>
Shrub	Paperbark	<i>Melaleuca hypericifolia</i>
Shrub	Paperbark Tea Tree	<i>Leptospermum trinervium</i>
Shrub	Pink Kunzea	<i>Kunzea ambigua</i>

Table B8 – Terrestrial Native Flora Species within the Study Area		
Habit	Common Name	Scientific Name
Shrub	Pink Spider Flower	<i>Grevillea sericea</i>
Shrub	Prickly Broom-heath	<i>Monotoca scoparia</i>
Shrub	Prickly-leaved Paperbark	<i>Melaleuca styphelioides</i>
Shrub	Prickly Moses	<i>Acacia ulicifolia</i>
Shrub	Red Spider Flower	<i>Grevillea speciosa</i>
Shrub	Rice Flower	<i>Pimelea linifolia</i> ssp. <i>linifolia</i>
Shrub	Sandfly Zieria	<i>Zieria smithii</i>
Shrub	Scrub She-oak	<i>Allocasuarina distyla</i>
Shrub	Small-leaved White Beard	<i>Leucopogon microphyllus</i>
Shrub	Smooth Geebung	<i>Persoonia levis</i>
Shrub	Smooth Parrot-pea	<i>Dillwynia glaberrima</i>
Shrub	Snow Wreath	<i>Woolfsia pungens</i>
Shrub	Stiff Bottlebrush	<i>Callistemon rigidus</i>
Shrub	Sunshine Wattle	<i>Acacia terminalis</i>
Shrub	Swamp Banksia	<i>Banksia robur</i>
Shrub	Swamp Paperbark	<i>Melaleuca ericifolia</i>
Shrub	Sweet Scented Wattle	<i>Acacia suaveolens</i>
Shrub	Sydney Golden Wattle	<i>Acacia longifolia</i>
Shrub	Tick Bush	<i>Kunzea ambigua</i>
Shrub	Twining Guinea Flower	<i>Hibbertia dentata</i>
Shrub	Two-veined Hickory	<i>Acacia binervata</i>
Shrub	Unknown	<i>Hovea</i> sp.
Shrub	Unknown	<i>Omalanthus nutans</i>
Shrub	Unknown	<i>Petrophile sessilis</i>
Shrub	Unknown	<i>Philotheca salsolifolia</i>
Shrub	White Spider Flower	<i>Grevillea linearifolia</i>
Shrub	Willow Bottlebrush	<i>Callistemon salignus</i>
Shrub	Willow-leaved Hakea	<i>Hakea salicifolia</i>
Tree	Bangalay	<i>Eucalyptus botryoides</i>
Tree	Bastard Mahogany	<i>Eucalyptus umbra</i>
Tree	Black She-oak	<i>Allocasuarina littoralis</i>
Tree	Black Wattle	<i>Callicoma serratifolia</i>
Tree	Bloodwood	<i>Corymbia gummifera</i>
Tree	Blueberry Ash	<i>Elaeocarpus reticulatus</i>
Tree	Blue Lillypilly	<i>Syzygium olesum</i>
Tree	Broad-leaved Paperbark	<i>Melaleuca quinquenervia</i>
Tree	Brown Stringy Bark	<i>Eucalyptus capitellata</i>
Tree	Cheese Tree	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>
Tree	Coastal Banksia	<i>Banksia integrifolia</i> ssp. <i>integrifolia</i>
Tree	Dwarf Apple	<i>Angophora hispida</i>
Tree	Hard Leaved Scribbly Gum	<i>Eucalyptus sclerophylla</i>
Tree	Forest She-oak	<i>Allocasuarina torulosa</i>
Tree	Grey Gum	<i>Eucalyptus punctata</i>
Tree	Lily Pilly	<i>Acmena smithii</i>
Tree	Magenta Lillypilly	<i>Syzygium paniculatum</i>

Table B8 – Terrestrial Native Flora Species within the Study Area		
Habit	Common Name	Scientific Name
Tree	Mountain Cedar Wattle	<i>Acacia elata</i>
Tree	Muttonwood	<i>Rapanea variabilis</i>
Tree	NSW Christmas Bush	<i>Ceratopetalum gummiferum</i>
Tree	Old Man Banksia	<i>Banksia serrata</i>
Tree	Parramatta Green Wattle	<i>Acacia parramattensis</i>
Tree	Port Jackson Fig	<i>Ficus rubiginosa</i>
Tree	River Oak	<i>Casuarina cunninghamiana</i>
Tree	Rough-fruit Pittosporum	<i>Pittosporum revolutum</i>
Tree	Scribbly Gum	<i>Eucalyptus haemastoma</i>
Tree	Scrub She-oak	<i>Allocasuarina distyla</i>
Tree	Smooth-barked Apple	<i>Angophora costata</i>
Tree	Spotted Gum	<i>Corymbia maculata</i>
Tree	Swamp Sheoak	<i>Casuarina glauca</i>
Tree	Sweet Pittosporum	<i>Pittosporum undulatum</i>
Tree	Sydney Blue Gum	<i>Eucalyptus saligna</i>
Tree	Sydney Peppermint	<i>Eucalyptus piperita</i>
Tree	Unknown	<i>Angophora Bakeri</i> ssp. <i>bakeri</i>
Tree	Water Gum	<i>Trisaniopsis laurina</i>
Vine	Apple Berry, Dumplings	<i>Billardiera scandens</i>
Vine	Dusky Coral-pea	<i>Kennedia rubicunda</i>
Vine	Golden Guinea Flower	<i>Hibbertia scandens</i>
Vine	Hairy Devil's Twine	<i>Cassytha pubescens</i>
Vine	Lawyer Vine	<i>Smilax australis</i>
Vine	Mistletoe	<i>Amyema congener</i> ssp. <i>congener</i>
Vine	Native Sarsaparilla	<i>Smilax glycyphylla</i>
Vine	Scrambling Lily	<i>Geitonoplesium cymosum</i>
Vine	Smooth Devil's Twine	<i>Cassytha glabella</i>
Vine	Snake Vine	<i>Stephania japonica</i> var. <i>discolor</i>
Vine	Unknown	<i>Marsdenia</i> sp.
Vine	Wombat Berry	<i>Eustrephus latifolius</i>
Vine	Wonga Wonga Vine	<i>Pandorea pandorana</i>
Source: Skelton et al, 2004		

Table B9 - Terrestrial Exotic Flora Species within the Study Area			
Habit	Common Name	Scientific Name	Status
Fern	Fishbone Fern	<i>Nephrolepis cordifolia</i>	
Grass	Buffalo Grass	<i>Stenotaphrum secundatum</i>	
Grass	Giant Reed / Elephant Grass	<i>Arundo donax</i>	Noxious Class 4a
Grass	Kikuyu	<i>Pennisetum clandestinum</i>	
Grass	Palm Grass	<i>Setaria palmifolia</i>	
Grass	Pampas Grass	<i>Cortaderia</i> sp.	Nox W2
Grass	Parramatta Grass	<i>Sporobolus africanus</i>	
Grass	Paspalum	<i>Paspalum dilatatum</i>	
Grass	Rhizomatous Bamboo	<i>Phyllostachys</i> sp.	Noxious Class W4a

Table B9 - Terrestrial Exotic Flora Species within the Study Area

Habit	Common Name	Scientific Name	Status
Grass	Summer Grass	<i>Digitaria sanguinalis</i>	
Grass	Unknown	<i>Paspalum radiatum</i>	
Grass	Veldt Grass	<i>Ehrharta sp.</i>	
Grass	Whiskey Grass	<i>Andropogon virginicus</i>	
Grass	Winter Grass	<i>Poa annua</i>	
Herb	Agapanthus	<i>Agapanthus orientalis</i>	
Herb	American Cactus	<i>Agave americana</i>	
Herb	Asparagus Fern	<i>Asparagus aethiopicus</i>	
Herb	Asthma Weed, Pellitory	<i>Parietaria judaica</i>	Noxious Class W3
Herb	Balsam	<i>Impatiens walleriana</i>	
Herb	Banana	<i>Musa sp.</i>	
Herb	Beefsteak Plant	<i>Acalypha wilkesiana</i>	
Herb	Bindii	<i>Solvia pterosperma</i>	
Herb	Black-berry Nightshade	<i>Solanum nigrum</i>	
Herb	Canna Lily	<i>Canna indica</i>	
Herb	Cast Iron Plant	<i>Aspidistra elatior</i>	
Herb	Climbing Asparagus	<i>Asparagus plumosus</i>	Noxious Class W4c
Herb	Clover	<i>Trifolium sp.</i>	
Herb	Cobbler's Pegs, Pitchforks	<i>Bidens pilosa</i>	
Herb	Coreopsis	<i>Coreopsis lanceolata</i>	
Herb	Creeping Buttercup	<i>Ranunculus repens</i>	
Herb	Crofton Weed	<i>Ageratina adenophora</i>	Nox W3
Herb	Crucifix Orchid	<i>Epidendrum ibaguense</i>	
Herb	Cud Weed	<i>Gnaphalium sp.</i>	
Herb	Dandelion	<i>Teraxacum Officinale</i>	
Herb	Dietes	<i>Dietes sp.</i>	
Herb	Fairy Crassula	<i>Crassula multicava</i>	
Herb	Fennel	<i>Foeniculum vulgare</i>	
Herb	Fire Weed	<i>Senecio madagascariensis</i>	
Herb	Flatweed	<i>Hypochaeris radicata</i>	
Herb	Fleabane	<i>Conyza sp.</i>	
Herb	Freesia	<i>Freesia refracta</i>	
Herb	Gazania	<i>Gazania rigens</i>	
Herb	Ginger	<i>Zingiber officinale</i>	
Herb	Ginger Lily	<i>Hedychium gardnerianum</i>	
Herb	Hydrangea	<i>Hydrangea macrophylla</i>	
Herb	Japanese Knotweed	<i>Polygonum capitatum</i>	
Herb	Kaffir Lily	<i>Clivea miniata</i>	
Herb	Kurnell Curse	<i>Hydrocotyle Bonariensis</i>	
Herb	Lamb's Tongues, Plantain	<i>Plantago lanceolata</i>	
Herb	Mistflower	<i>Ageratina riparia</i>	
Herb	Mother-of-millions	<i>Bryophyllum delagoense</i>	
Herb	Mouse Ear Chick Weed	<i>Cerastium glomeratum</i>	
Herb	New Zealand Christmas Bell	<i>Alstroemeria psittacina</i>	
Herb	New Zealand Flax	<i>Phormium tenax</i>	

Table B9 - Terrestrial Exotic Flora Species within the Study Area

Habit	Common Name	Scientific Name	Status
Herb	Onion Weed	<i>Nothoscordum gracile</i>	
Herb	Ornamental Ginger	<i>Alpinia sp.</i>	
Herb	Paddy's Lucerne	<i>Sida rhombifolia</i>	
Herb	Petty Spurge	<i>Euphorbia peplus</i>	
Herb	Poinsettia	<i>Euphorbia pulcherrima</i>	
Herb	Potato Weed	<i>Galinsoga parviflora</i>	
Herb	Roadside Lilly	<i>Lilium formosum</i>	
Herb	Slender Celery	<i>Ciclospermum leptophyllum</i>	
Herb	Smooth Cats Ear	<i>Hypochaeris glabra</i>	
Herb	Spider Plant	<i>Chlorophytum comosum</i>	
Herb	Swiss Cheese Plant	<i>Monstera deliciosa</i>	
Herb	Taro	<i>Colocasia esculenta</i>	
Herb	Unknown	<i>Senecio milkanioides</i>	
Herb	Wandering Jew	<i>Tradescantia albiflora</i> syn. <i>fluminensis</i>	
Herb	Wild Watsonia, Bugle Lily	<i>Watsonia meriana</i> cv. <i>bulbillifera</i>	
Palm	Canary Island Palm	<i>Phoenix canariensis</i>	
Palm	Cocos Palm, Queen Palm	<i>Syagrus romanzoffiana</i>	
Scrambler	Blackberry	<i>Rubus fruticosus</i>	Noxious Class 4
Shrub	African Olive	<i>Olea europaea</i> ssp. <i>africana</i>	
Shrub	Bird of Paradise	<i>Strelitzia reginae</i>	
Shrub	Boneseed	<i>Chrysanthemoides monilifera</i> spp. <i>monilifera</i>	Nox W3
Shrub	Bottlebrush	<i>Callistemon sp.</i>	
Shrub	Bracelet Honeymyrtle	<i>Melaleuca armillaris</i>	
Shrub	Cassia	<i>Senna floribunda</i>	
Shrub	Cassia / Senna	<i>Senna pendula</i>	Noxious Class 4b
Shrub	Cootamundra Wattle	<i>Acacia baileyana</i>	
Shrub	Cotoneaster	<i>Cotoneaster pannosus</i>	
Shrub	Fleabane	<i>Conyza albida</i>	
Shrub	Golden Wreath Wattle	<i>Acacia saligna</i>	
Shrub	Green Cestrum	<i>Cestrum parqui</i>	Noxious Class W2
Shrub	Hibiscus	<i>Hibiscus sp.</i>	
Shrub	Jade Plant	<i>Portulacaria afra</i>	
Shrub	Lantana	<i>Lantana camara</i>	Noxious Class W2
Shrub	Looking-glass Bush	<i>Coprosma repens</i>	
Shrub	Ochna, Mickey Mouse Plant	<i>Ochna serrulata</i>	Noxious Class 4
Shrub	Oleander	<i>Nerium oleander</i>	
Shrub	Orange Firethorn	<i>Pyracantha angustifolia</i>	
Shrub	Pink Pavonia	<i>Pavonia hastata</i>	
Shrub	Plumbago	<i>Plumbago sp.</i>	
Shrub	Polygala	<i>Polygala myrtifolia</i>	
Shrub	Privet – broad leaved	<i>Ligustrum lucidum</i>	Noxious Class W4b
Shrub	Privet – narrow leaved	<i>Ligustrum sinense</i>	Noxious Class W4b
Shrub	Rhus Tree	<i>Toxicodendron succedaneum</i>	Noxious Class W2
Shrub	Scotch/English Broom	<i>Cytisus scoparius</i>	
Shrub	Silky Oak	<i>Grevillea robusta</i>	

Table B9 - Terrestrial Exotic Flora Species within the Study Area

Habit	Common Name	Scientific Name	Status
Shrub	Snowbell Tree	<i>Viburnum tinus</i>	
Shrub	Tibouchina, Lasiandra	<i>Tibouchina</i> sp.	
Shrub	Umbrella Tree	<i>Brassaia actinophylla</i>	
Shrub	Wild Tobacco Tree	<i>Solanum mauritianum</i>	
Tree	Bauhinia	<i>Bauhinia</i> sp.	
Tree	Black Bean	<i>Castanospermum australe</i>	
Tree	Brush Box	<i>Lophostemon confertus</i>	
Tree	Camphora Laurel	<i>Cinnamomum camphora</i>	
Tree	Climbing Fig	<i>Ficus pumila</i>	
Tree	Coral Tree	<i>Erythrina</i> X <i>sykesii</i>	
Tree	Draceana	<i>Dracaena marginata</i>	
Tree	Flame Tree	<i>Brachychiton acerifolius</i>	
Tree	Grey Box	<i>Eucalyptus moluccana</i>	
Tree	Jacaranda	<i>Jacaranda mimosifolia</i>	
Tree	Liquidamber	<i>Liquidamber orientalis</i>	
Tree	Lombardy Poplar	<i>Populus</i> sp.	
Tree	Morton Bay Fig	<i>Ficus macrophylla</i>	
Tree	Narrow-leaved Pepermint	<i>Eucalyptus nicholii</i>	
Tree	New Zealand Cordyline	<i>Cordyline australis</i>	
Tree	Norfolk Island Pine	<i>Araucaria heterophylla</i>	
Tree	Pine	<i>Pinnus</i> sp.	
Tree	Stonefruit	<i>Prunus</i> sp.	
Tree	Tortured Willow	<i>Salix matsudana</i>	
Tree	Weeping Willow	<i>Salix babylonica</i>	Noxious Class 4
Tree	White Cedar	<i>Melia azedarach</i>	
Tree	White Mulberry	<i>Morus alba</i>	
Tree	Willow Gum	<i>Eucalyptus scoparia</i>	
Vine	Balloon Vine	<i>Cardiospermum grandiflorum</i>	Noxious Class W4c
Vine	Cape Ivy	<i>Delairea odorata</i>	Noxious Class W4d
Vine	Cat's Claw Creeper	<i>Macfadyena unguis-cati</i>	Nox W4c
Vine	English Ivy	<i>Hedera helix</i>	
Vine	Japanese Honeysuckle	<i>Lonicera japonica</i>	
Vine	Madeira Vine	<i>Anredera cordifolia</i>	Noxious Class W4c
Vine	Morning Glory	<i>Ipomea cairica</i>	Noxious Class W4c
Vine	Moth Vine	<i>Araujia sericifera</i>	
Vine	Passionfruit	<i>Passiflora edulis</i>	
Vine	Turkey Rhubarb	<i>Acetosa sagittata</i>	
Vine	Unknown	<i>Cissus rhombifolia</i>	
Vine	Wistaria	<i>Wistaria sinensis</i>	
Source: Skelton et al, 2004			
Status Definitions			
Noxious Class 1	State Prohibited Weeds - The plant must be eradicated from the land and the land must be kept free of the plant.		
Noxious Class 2	Regionally Prohibited Weeds - The plant must be eradicated from the land and the land must be kept free of the plant.		



MANLY COVE COASTLINE MANAGEMENT STUDY

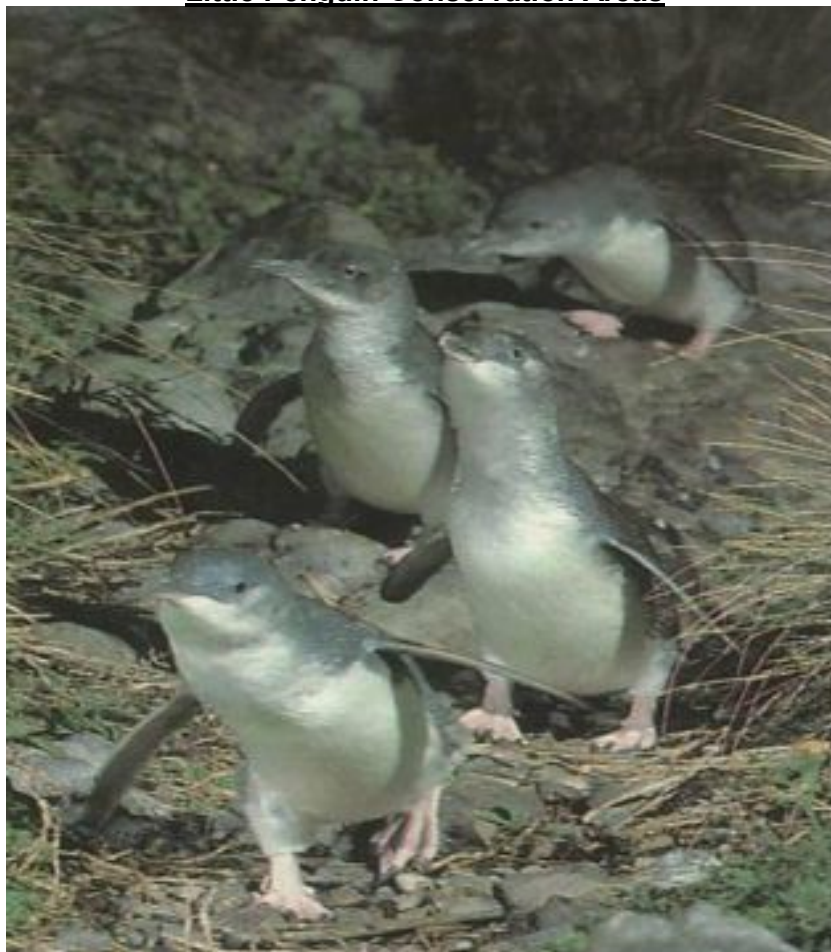
Table B9 - Terrestrial Exotic Flora Species within the Study Area			
Habit	Common Name	Scientific Name	Status
Noxious Class 3	Regionally Controlled Weeds - The plant must be fully and continuously suppressed and destroyed.		
Noxious Class 4	Locally Controlled Weeds - The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.		
Noxious Class 5	Restricted Plants - The requirements in the Noxious Weed Act 1993 for a notifiable weed must be complied with.		



APPENDIX C

Conservation of the Little Penguin Population

Little Penguin Conservation Areas



Manly is home to an endangered population of Little Penguins, which is the only mainland breeding colony of penguins left anywhere in NSW. Made up of only about 60 breeding pairs, this unique bird population is an icon of Manly, surviving in one of the most urbanised areas of Sydney.

The main threats to the population include loss of suitable habitat, attack by dogs and foxes, and disturbance at or near nesting sites and foraging areas. Land clearing practices and development has greatly reduced the amount of native vegetation present. Adapting to their changing environment, a range of nest types are utilised by the penguins including under rocks on the foreshore, under seaside houses, garages, under stairs, in wood piles and under overhanging vegetation.

Other threats to Little Penguins include residential gardening activities (such as removing vegetation that exposes burrows or dumping vegetation or garden clippings), noise and light on the foreshore or on the water (which can delay penguins returning to their burrows or abandon them all together) and pollution (rubbish can tangle, suffocate and injure Little Penguins). In order to provide greater protection to the Little Penguins and their habitat, Critical Habitat was declared by the NSW Government in December 2002.

What is Critical Habitat?

Critical habitat is an area that is critical to the survival of an endangered species, population or community.

The critical habitat area for the Manly penguins was identified based on the biological requirement of the population and the potential impacts of known and/or suspected threats.

The declaration of critical habitat provides greater protection and stricter controls over particular activities in areas crucial to the colony's survival. It is designed to help penguins breed successfully and protect them from disturbance and predators.

The declared critical habitat contains areas we know the penguins use to nest and also travel up to their nests. If it were lost, there is a chance the population would not survive.

Where is Critical Habitat?

The critical habitat includes known and potential rocky foreshore nesting areas, usually in the first 50 metres of water, as well as aquatic areas extending 50 metres into the harbour from the mean high tide mark. There are two areas of critical habitat (refer to maps below):



Area A starts from west of Collins Beach and extends to the northern side of Cannae Point and includes Collins, Store and Quarantine Beaches to the northern side of Cannae Point. On the land, the critical habitat boundary includes ridge top habitat where penguins currently nest and areas of potential nesting habitat.

Area B extents from 11A Oyama Avenue around Manly Point to 26 Addison Road. The land side of the critical habitat boundary includes the area from the mean high watermark, up the rocky foreshore slope to the beginning of the ridgetop in residential areas (ie the rocky foreshore upslope to the boundary of the formed backyard is included as critical habitat, but the backyard and residential area is not included):

The critical habitat also includes the harbour to make it easier for penguins to get to their nesting areas. Parts of this aquatic zone include seagrass beds that are likely to be important feeding areas, especially during the rearing of chicks when Little Penguins are known to seek food closer to their nests.

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The declaration includes the rocky foreshore between the rock platform and the top of the cliff but does not affect flat formed backyard areas used for private activities. For residents who own dogs, the animal is not allowed beyond the flat formed area or onto the rock platform below.



Key: Orange = Critical Habitat A, Yellow = Critical Habitat B, Blue = Potential Critical Habitat

Under the National Parks and Wildlife Act 1974 Section 118C – A person must not, by an act or an omission, do anything that causes damage to critical habitat. For the Little Penguins this means the following restrictions are in place:

- No companion animals (except assistance animals) to protect the penguins from attack.
- No fishing between sunset and sunrise during breeding season (start July to end Feb) to give the penguins a chance to enter and leave their burrows undisturbed.
- No tampering with or damaging Little Penguin nest boxes or burrows, air approaching within 5 metres of a penguin on land – to allow penguins to continue their normal breeding behaviour.
- No anchoring or mooring a vessel in the Little Penguin critical habitat Area A between sunset and sunrise during the breeding season.
- No vessel (other than a non-motorised tender) to enter or remain in the Little Penguin critical habitat Area A between sunset and sunrise during the breeding season.

What is a Wildlife Protection Area?

Due to the high vulnerability of Little Penguins to dog attack and human disturbance and following numerous incidents and concerns from residents a Wildlife Protection Area was declared in May

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2006 in the area of foreshore between Federation Point and Manly Wharf. A number of Penguins are known to nest at this location with evidence to suggest individuals also nest underneath Manly Wharf.



Restrictions now apply and dogs must be on a leash at all times within this location. The area of foreshore in the vicinity of Federation Point has also been declared a dog exclusion zone. Appropriate signage has been developed and erected at various locations throughout the area.

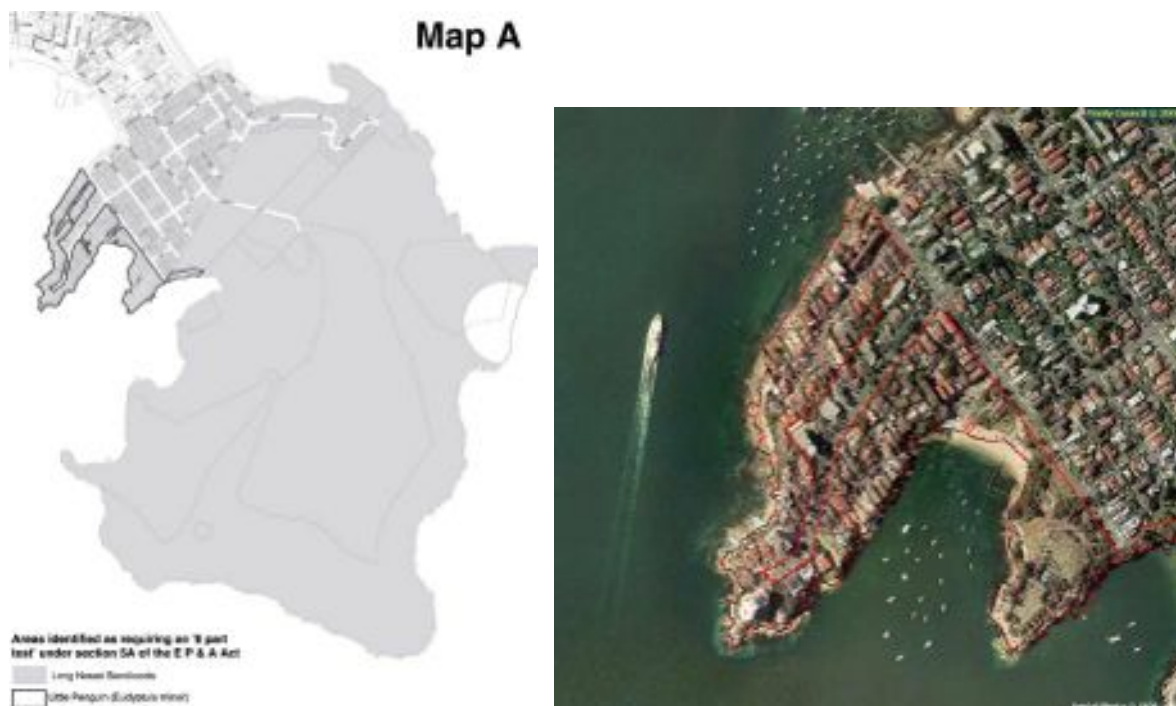
THREATENED SPECIES CONSIDERATIONS – LITTLE PENGUINS

When determining development applications, Council, as the consent authority, must give consideration to both the status of the Little Penguin colony as an endangered population in accordance with the *Environmental Planning and Assessment Act 1979*, and the recent declaration of critical habitat in accordance with the *Threatened Species Conservation Act 1995*.

If you are submitting a development application in the area where a threatened species occurs (refer Map A) you need to address Council's requirements for assessment of the proposal.

An '7 Part Test' must be carried out in accordance with Section 5A of the *EP&A Act 1979* if the subject site is potential habitat for or may impact on an endangered flora or fauna species or population, eg. the Little Penguin and Long-nosed Bandicoot as identified under the *TSC Act 1995*

Areas requiring an '7 Part Test' under section 5A of the EP&A Act for Penguins & Bandicoots



If the proposed works are within the area defined as Critical Habitat for the Little Penguins (refer Map B), or if a Council Officer deems necessary, a Species Impact Statement is required with lodgement.

What is '7-Part Test'?

An '7-Part Test' is a statutory mechanism which allows Council to assess whether a proposed development or activity is likely to have a 'significant effect' on threatened species, populations or ecological communities, or their habitats. It describes and assesses the ecological impact of the proposal on a threatened species or its habitat.

Who prepares the '7-Part test'?

A technical report which addresses the '7-Part Test' must be prepared by a qualified environmental consultant. Details regarding the consultant's qualifications and experience must be included. A list of environmental consultants qualifies to prepare an '7-Part Test' can be found on the Ecological Consultants Association Register website – www.ecansw.org.au

If the environmental consultant or Council finds that a development is likely to have a significant impact then:

- 4 The proposal may be modified by the applicant and the '7-Part Test' revised, such that a significant impact on threatened populations or ecological communities, or their habitats is unlikely.
- 4 A Species Impact Statement (SIS) must be prepared.

Important Note:

Ultimately, it is left to the discretion of Council to determine if a development will have a significant impact on threatened species, populations or ecological communities, or their habitats.

Council may request the applicant submit a Species Impact Statement even if the proponents '7-Part Test' concluded that the development would not have a significant impact.

The proponent's environmental consultant report must provide Council with sufficient information to base its decision otherwise Council must take the precaution of deciding in favour of the environment.

What is a Species Impact Statement (SIS)?

A SIS is a statutory report which provides a more detailed assessment of the site, the proposal, alternatives and impact mitigation measures. It is a means of evaluating a proposal so that potential impacts on threatened species, populations and ecological communities, and their habitats are identified and mitigated, where possible.

Do I need to submit a SIS?

In accordance with Section 77(3)(d1) of the EP&A Act, any development on land that is, or part of, critical habitat must be accompanied by a SIS. A SIS may also be required if the proposed development could potentially impact upon the threatened species or its habitat, or if Council determines that the '7-Part Test' does not provide sufficient information to determine if the development would have a significant impact on the threatened populations or ecological communities, or their habitats.

Who prepares the Species Impact Statement?

The SIS should be prepared by a qualified environmental consultant, and details of the consultants experience and qualifications must be included in the SIS. The cost of preparing an SIS is borne by the applicant or proponent. The content of a SIS is set out in section 110 of the TSC Act.

Prior to the preparation of a SIS, a request for the Director General of the National Parks and Wildlife Service's (NPWS) requirements must be made by the proponent. The request for the Director General's requirements pursuant to Section 111 of the TSC Act must be forwarded to NPWS by the proponent.

Requests for the Director General's requirements should be accompanied by an 7-Part Test and a copy of the development application or request for Part 5 Approval. Written details of the location, nature and scale of the proposal should be included.