



Sydney Harbour Coastal Zone Management Plan Scoping Study

Sydney Coastal Councils Group
Sydney Harbour Scoping Study
Literature and Data Review - Management and Use of
Sydney Harbour

June 2015



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Executive Summary

This report documents a review of existing literature and data relevant to the management of Sydney Harbour, downstream of Clarke's Point, Birchgrove, to provide background information to the development of a Sydney Harbour Coastal Zone Management Plan (CZMP).

The existing management of Sydney Harbour is multi-layered, with numerous agencies and government departments playing overlapping roles in its governance as follows:

- 9 Federal government agencies;
- 17 State government agencies spread across 13 departments;
- 6 local governments; and
- 2 statutory Corporations.

Amongst these agencies and other stakeholders, there appears to be debate over whether the legislative definition of "coastal zone" applies to Sydney Harbour, as the literature does not provide clear guidance on this matter. Confirmation of the legislative definition of the 'coastal zone' for Sydney Harbour is a key output of the CZMP process.

Local government coastal management planning within the Manly area has been completed; CZMP technical studies have commenced in Mosman and Woollahra. No coastal specific management planning was identified for North Shore, Leichhardt or the City of Sydney, although numerous other plans address various aspects relevant to coastal management. This may reflect the local and historically heavily modified and developed nature of the shoreline, as well as the historically fragmented approach to coastal management.

Coastal risks and hazards have been inconsistently dealt with throughout the study area, in particular with respect to projected sea level rise and extreme storm events. Whilst inundation information is available, very little other data was made available for review, although it is likely that it exists. Consistency of assumptions and the modelling approach between the datasets is expected to be a major issue.

Faecal contamination and stormwater inputs are the major factors affecting water and sediment quality within the Harbour. Regular monitoring programs have identified gradual improvements, particularly in water quality, but the recording of high levels of contaminants immediately after rainfall events indicates that breaching of the stormwater network is still occurring.

The historical loss of habitat and direct and indirect impacts from Harbour users continue to affect the ecological values of the Harbour, including three Threatened Ecological Communities and one Endangered population.

Key values attributed to the Harbour by users include access to the Harbour for active and passive recreation, views, and improvements to water quality. These users represent a broad section of the community, and have widely varying levels of influence. Retention and improvement of these values would be well regarded by the community. Consideration needs to be given as to how sensitive cultural heritage sites are addressed by a CZMP.

Further data collection activities are recommended, in particular detailed discussions with multiple parts of stakeholder organisations in order to capture additional relevant and available documentation and data that is expected to exist but was not made available for consideration in this review.

Sydney Harbour – summary of issues, gaps and recommendations identified in the literature and data review

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
Management	General confusion on who has management responsibilities as a result of the multitude and complexity of legislation and policies applying to Sydney Harbour	Information on the direct or indirect funding of maintenance activities affecting the management, health and amenity of Sydney Harbour, particularly as a result of local government actions	Develop a summary document that details all relevant coastal policies and plans, to be used as a basis for a detailed discussion between affected stakeholders on how confusion over governance can best be managed or addressed. This may be addressed through the current coastal reform process
	Inconsistent application of coastal policy as a result of reliance on local government for implementation		Investigate why different and inconsistent provisions have been adopted in Local Environmental Plans Develop an understanding of the extent to which Australian and state government policy on coastal management is translated into decision making at local levels Develop an understanding of how coastal policy is being interpreted and the relative weight it is given in decision making, particularly at the local government level
	Long timeframes for policy or legislative change		Identify how the time lag between important issues being identified at a national and or state level and change to regulation at a local level can be reduced
	Lack of coordination between levels of government and geographic responsibilities		

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
	Confusion over the definition of “coastal zone”		Resolve the confusion over whether the Coastal Zone, and by inference Coastal Protection Zones, apply to Sydney Harbour
	Lack of access to historical information held by agencies and organisations	Additional information is likely to be held by key stakeholders.	Hold detailed face to face discussions with multiple parts of key stakeholders to identify and access additional literature and data
Coastal Management Plans	<p>Inconsistent coverage in planning documents of coastal management issues such as:</p> <ul style="list-style-type: none"> • Access • Amenity • Aquatic/Inter-tidal Habitat Conservation & Management • Beach Erosion & Sedimentation • Bushland/Terrestrial Habitat Conservation & Management • Community Involvement • Community, Recreational & Commercial Use • Coordination between Authorities • Crime Prevention & Safety • Foreshore Development • Geodiversity • Hazards & Risks including Climate Change • Heritage Conservation & Management • Monitoring • Public & Foreshore Infrastructure & Facilities • Tourism & Promotion • Traffic Management • Waste Management • Water Quality & Pollution 	No specific CZMP’s are in place for the Sydney Harbour frontage of Warringah, Willoughby, Ku-ring-gai, Mosman, North Sydney, Land Cove, Leichhardt, Sydney and Woollahra local government areas. CZMP’s only in place within Sydney Harbour for Manly Council foreshore areas.	For future stages of the Sydney Harbour CZMP project, broker an agreement between stakeholders to resolve administrative, consistency and content issues, particularly when considering existing CZMP content for a Harbour-wide CZMP

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
	Inconsistent priorities and consideration of management issues		Identify actions for management approaches for heavily modified shorelines
	Inconsistent consideration of ownership of lands to be covered by CZMP		Broker an agreement between stakeholders on which lands are to be covered by a CZMP for Sydney Harbour, and how connectivity and consistency between adjacent local government areas will be addressed
Coastal Risks and Hazards	Differing priorities between Councils Differing approaches to management Lack of agreement by stakeholders on study outcomes and scale applicability Integration with other programs such as floodplain risk assessments and water quality improvement plans		Utilise the CZMP process as a vehicle to unite stakeholders and collaboratively identify the outcomes the CZMP is to achieve.
	Uncertainty as to the content, status and implementation of the NSW Stage II coastal reforms		Liaise with OEH regarding the coastal reform process currently being undertaken by the NSW Government to ensure that the future assessment of coastal risks meets or exceeds the requirements of the NSW State Government
	High implementation costs		Assess funding availability and the feasibility of the overall project
	Lack of direction and agreement on sea level rise benchmarks		Broker an agreement on sea level rise planning benchmarks by all councils covered by a Sydney Harbour CZMP

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
	Data is not readily available or compiled.	<p>Comprehensive, current, Harbour-wide data sets for:</p> <ul style="list-style-type: none"> • Aerial imagery • Cadastral layers • Land use and zoning information • Environmental mapping • Land survey data • Bathymetry • Wave, wind and tide data • Rainfall and flood level data • SLR benchmarks • Details of foreshore treatment measures such as seawalls • Details of foreshore assets 	<p>Reassess the available datasets, in light of the project requirements</p> <p>Estimate the costs required to infill gaps and compile a comprehensive dataset</p>
Water and Sediment Quality	<p>Runoff and stormwater contaminant loads, including faecal contamination and marine debris</p> <p>Cumulative impacts.</p> <p>Climate change.</p> <p>Non-indigenous species.</p>	<p>In undertaking the literature review, a clear understanding of the relative contribution of the various catchments, and the actions currently underway to intercept or manage contaminants before they reach the Harbour was not able to be determined. Additional gaps were identified in the SIMS literature review (Hedge et al. 2013):</p> <ul style="list-style-type: none"> • There have been no circulation modelling studies of the study area which investigate the interactions between the EAC offshore, coastal waters and circulation within the Sydney Harbour estuary itself (Hedge et al. 	<p>Assess how various waterway managers are dealing with the management of contaminants into the Harbour and develop a consistent approach for a CZMP.</p> <p>Develop a large-scale process-based biogeochemical modelling system for the Sydney Harbour to provide invaluable information to scientists and managers on nutrient and contamination pathways.</p> <p>Utilise genetic investigation techniques to provide evidence of NIS status and origin to assist in determining</p>

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
		<p>2013).</p> <ul style="list-style-type: none"> <li>• Much of the literature collated on stressors/threats to the study area concentrate on these stressors in isolation rather than a cumulative impact assessment or consideration of stressor interaction (Hedge et al. 2013). Recent evidence for example, suggests that the effects of nutrients and metals may be synergistic; leading to the prediction that nutrient enrichment in the study area may actually be masking stronger effects of meal contamination (Hedge et al. 2013). <li>• Climate change, specifically how the predicted changes to rainfall patterns, temperature and sea level changes will affect the current water and sediment quality characteristics within the study area. One key area identified by Hedge et al. (2013) is the synergistic impacts of global climate change and the 	<p>management measures to control NIS within the study area.</p> <p>Identify the manner in which stormwater is delivered to the Sydney estuary and its ultimate fate to provide invaluable information to waterway managers.</p> <p>Determine sources of point source pollution affecting the water and sediment quality of the study area, and what role these have on determining the spatial distribution of contamination.</p> <p>Analyse water and sediments across the study area to determine the importance of emerging contaminants and their pathways into the Harbour.</p> <p>Investigate the linkages between water quality and planktonic organisms, which is particularly important for areas of the Harbour which are slower to flush such as the inner parts of Port Jackson.</p> <p>Investigate the projected influence of climate change on water and sediment quality.</p>

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
		<p>documented contamination status of the sediments within the study area.</p> <ul style="list-style-type: none"> • The ecological and economic impacts of Non-indigenous species (NIS) in the study area, including the impact of regional transport patterns of recreational vessels (or coastal trading vessels) on the risk of NIS in the study area (Hedge et al. 2013). • Soft bottom sediment habitats were identified as one of the least studied in Sydney Harbour by Hedge et al. (2013). No comprehensive surveys of soft bottom benthic communities have been undertaken (Hedge et al. 2013) • The impacts of emerging contaminants on natural systems are a globally recognised knowledge gap of concern (Barnes et al. 2008, Philips et al. 2010 in Hedge et al. 2013) and apply to the study area due to the nature of contaminant pathways present 	

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
		<p>in the Harbour.</p> <ul style="list-style-type: none"> • Emerging contaminants such as nanoparticles and micro plastics have not been assessed in the study area. Additional knowledge gaps also exist concerning the feasibility of restoration of degraded systems within contaminated environments (Hedge et al. 2013) • Non-point source pollutant inputs to the study area from urban run-off and stormwater drains were also identified as a knowledge gap by Hedge et al. (2013) • There are knowledge gaps present in the direct or indirect effects of the delivery of nutrients and contaminants to open water or benthic biota within the study area. Typically strong linkages have been made between water quality and planktonic organisms but this has not been well studied in Sydney Harbour (Hedge et al. 2013). Climate change may exacerbate the processes 	

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
		<p>involved in run-off, contamination and nutrient delivery to the study area and as such this linkage requires further investigation.</p> <ul style="list-style-type: none"> • There are no studies on the causal effects of nutrient enrichment on the ecology of Sydney Harbour. Reducing nutrient inputs requires a better understanding of the relative sources. 	
Ecological Values	<p>Anthropogenic threats that have the potential to impact the ecological values of Sydney Harbour include:</p> <ul style="list-style-type: none"> • Coastal development; • Loss of natural riparian habitat; • Resource extraction; • Shipping and boating; • Pollution; • Invasive species; and • Climate change 	<ul style="list-style-type: none"> • Most of the literature on sediment quality within the study area focusses on the spatial patterns of chemical contamination. Few publications were identified as concentrating on the ecology and/or biology of soft bottom habitats as part of the review undertaken by Hedge et al. (2013). • Climate change. The current state of knowledge around climate change impacts to the study area relies on studies conducted in similar estuaries or on similar suites of species found within the study area. 	<p>Address the recommended actions in the SIMS literature review in light of any connectivity to key management issues to be addressed by the CZMP as identified above. Examples of recommendations put forwards in the SIMS literature review (Hedge et al. 2013) include:</p> <ol style="list-style-type: none"> 1. Improved modelling tools to investigate the impacts of climate change within the study area 2. Investigation into local fishing effort which would assist in facilitating understanding the localised risk within the Harbour which will then inform future spatial based management plans 3. More studies designed to

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
		<p>There is a large gap in understanding of how climate change stressors will impact on ecosystems in and adjacent to the study area (Hedge et al. 2013).</p> <ul style="list-style-type: none"> • Paucity of studies which have examined the effects of habitat modification on soft sediment infauna within the study area (Hedge et al. 2013). • As identified by Hedge et al. (2013), further studies on ecological patterns and processes on the natural shores in the study area (rocky intertidal assemblages in particular). • There is a significant knowledge gap relating to the ecological and biochemical importance of materials and biota exchanged through the entrance to the Harbour, as they relate to open water/pelagic ecosystems (Hedge et al. 2013). • There are no Harbour-wide management strategies for mangroves, seagrass and 	<p>determine the effects of habitat modification on ecological patterns and processes of soft sediment assemblages</p> <ol style="list-style-type: none"> 4. Genetic investigation techniques to provide evidence of NIS status and origin to assist in determining management measures to control NIS within the study area 5. Development of a Harbour-wide management strategy for mangroves, seagrass and saltmarsh ecosystems. 6. Further investigation into the diversity of bottom sediments in the study area which includes the iconic sandy beaches to the east of the Harbour Bridge, to increase the limited pool of knowledge regarding this habitat type in the study area. 7. Further investigation into the state of, and processes involved in, rocky intertidal assemblages within the Harbour. 8. Circulation modelling which investigates the interactions between the EAC offshore, coastal waters and the circulation within the Sydney Harbour estuary itself.

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
		<p>saltmarsh ecosystems in the study area Hedge et al. (2013).</p> <ul style="list-style-type: none"> • How design changes and engineering solutions can be used to enhance diversity amongst sub tidal artificial environments (Hedge et al. 2013). • Further research into the effects of recreational fishing on the ecological values present in the study area. The last major assessment was undertaken in 2008 (Hedge et al. 2013). Additional information is also required on the impacts of organic pollutants on food webs, including human consumption of fish caught in the Harbour. 	
Human Use and Values	Large number and diversity of competing users Projected growth in demand	Limited identification of local user groups and their interests within each local government area	Identify user groups and their interests as part of consultation and engagement activities. Assess impacts of increasing demand over time
		Limited input from some key user groups into Literature Review	Consult, one-on-one, including meetings with multiple parts of larger organisations

Topic Area	Key Management Issues	Significant Gaps	Recommendations for Further Work
	Sensitivity of indigenous heritage sites to public disclosure	Identification of key coastal sites	Resolve confidentiality issues to ensure key coastal indigenous areas are either protected or are not adversely impacted by a CZMP
	Identification and prioritisation of which heritage sites should be included in a CZMP	Large amount of information available in hard copy only or not readily available	Compile relevant knowledge and data
	Confirmation of community values specific to Sydney Harbour	Limited documentation clearly detailing community values as they relate to the Harbour	Compile unpublished values information, already gathered by local government Assess the values of Sydney Harbour in light of the findings of the 2014 Marine Estate Management Authority survey

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Appendices

Appendix A - Results from EPBC Protected Matters Search and BioNet Wildlife Atlas

Appendix B - Summary of Data Sets Identified

1. Introduction

This project seeks to lay the foundations for a comprehensive and integrated coastal zone management plan (CZMP) for Sydney Harbour. Led by the Sydney Coastal Councils Group (SCCG), the project scopes Sydney Harbour's values, risks, usage and management issues to underpin a strategic and integrated management plan for Sydney Harbour to protect, enhance, maintain and restore this valuable asset.

The NSW Government provides guidance on the form, content and certification process for a coastal zone management plan under the *Coastal Protection Act 1979* in "Guidelines for Preparing Coastal Zone Management Plans" (OEH, 2013a). These guidelines set out the Coastal Management Principles to be considered, as shown in Figure 1-1. The compilation and review of information in this current document contributes towards Principle 4 – "Base decisions on the best available information and reasonable practice".

This report is a joint report between GHD and the SCCG. This document has been prepared with financial assistance from the New South Wales Government through the Office of Environment and Heritage but does not necessarily represent the opinions of the NSW Government or the Office of Environment and Heritage.

1.1 Purpose of this Report

GHD has been engaged to prepare the scoping study for the CZMP for Sydney Harbour. The scoping study proposes to investigate the development of a CZMP which would seek to address key coastal hazards and priority management issues associated with the Harbour foreshores downstream of Clarke's Point, Birchgrove.

This phase of the project is the preparation of a desktop review of existing literature and data. It is intended that this document will provide a resource of background reference material during the anticipated future preparation of a Sydney Harbour CZMP.

Future phases of the project will:

- identify, document, analyse and prioritise the issues that should be addressed and managed on a whole-of-system basis when dealing with coastal zone management for Sydney Harbour; and
- identify and evaluate potential management actions (considering social, economic and environmental factors) to address Sydney Harbour's management issues.

1.2 Scope

The reporting for this phase of the project is centred on the following scope.

- Investigate, catalogue, evaluate, synthesise and summarise published literature, grey literature and data related to:
 - management and use of the Harbour (including past, present and emerging management issues and priorities); and
 - matters to be addressed in a CZMP for the Harbour including matters that can inform management actions to address usage and priority management issues.
- Consider material:
 - identified by the Advisory Committee
 - contained in the Reference List (including reference lists etc., in individual documents)

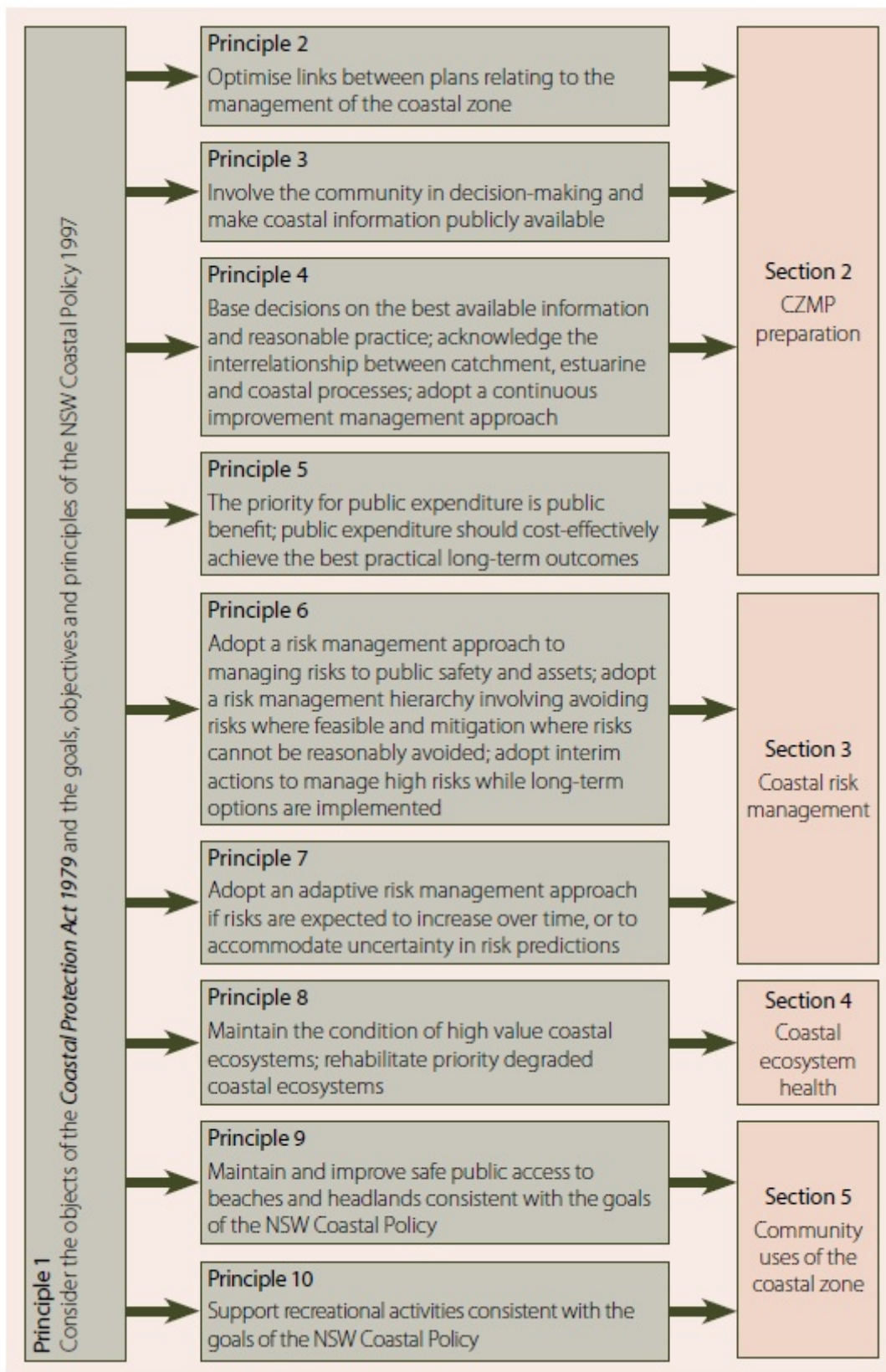


Figure 1-1 Coastal Management Principles (OEH, 2013a)

- provided by or on behalf of Local Land Services (formerly Hawkesbury-Nepean Catchment Management Authority) in relation to its Sydney Harbour Catchment Water Quality Improvement Program
- Enter all source material into a referencing software program such as Mendeley.
- Include a table of all literature and data referenced by key information.

1.3 Study Area

The study area (as illustrated in Figure 1-2) for this review was specified in the project brief as the portion of Sydney Harbour incorporating the area downstream of Clarke's Point, Birchgrove to Sydney Heads, including:

- Port Jackson;
- Middle Harbour;
- Parramatta River;
- Hunters Hill;
- Yulrubin Park, Birchgrove; and
- All local government areas abutting Sydney Harbour (to the extent that they are within the Study Area):
 - Ku-ring-gai
 - Lane Cove
 - Leichhardt
 - Manly
 - Mosman
 - North Sydney
 - Sydney
 - Warringah
 - Willoughby
 - Woollahra



Figure 1-2 Study area extent illustrating coastal zone to the confluence of the Parramatta River and Lane Cove River¹

¹ © 2011. GHD and NSW LPI

It is noted that upstream of this area there are already two coastal zone management plans in place:

- Lane Cove River Coastal Zone Management Plan (BMT WBM, 2012a)
- Parramatta River Estuary Coastal Zone Management Plan, Final Draft (Cardno Lawson Treloar, 2012)

As part of this review consideration of existing management plans in place for various sections of the shoreline within the study area is provided.

1.4 Approach to Data Assembly

Literature investigated for consideration in the review and scoping study included internal reports, surveys, briefing notes, memoranda, studies, manuscripts, metadata etc. directly or indirectly relevant to the management of Sydney Harbour.

This information has been assembled in a number of different ways and phases as follows:

- An initial reference list provided by the Sydney Coastal Councils Group.
- An internet search of typical keywords expected to be associated with the management of Sydney Harbour to locate publicly available documents (see below).
- A targeted online survey sent to key stakeholders, and consequent follow up, seeking details of reference material held or known to them, and an indication of the priority management issues for that organisation to be captured by a CZMP.
- Reference lists contained in material collected in the above activities.
- A workshop with key stakeholders held in April 2014.

The internet search identified accessible information in the public domain. As part of the development of a CZMP, it is possible that there is additional unpublished information which may be obtained from face to face interviews with stakeholders. Internet searches were conducted on local and State government websites (particularly in instances where there was known information sources), specific organisations such as The Sydney Institute of Marine Science (SIMS) and the Centre for Research on Ecological Impacts of Coastal Cities, as well as through search engines such as Google and Bing using keywords linked to Sydney Harbour, such as:

- | | | |
|--------------------------------|-----------------------------------|--|
| • Aboriginal Heritage | • Coves and beaches | • Events |
| • Benthic ecology | • Cruise ship industry | • Federal government environment funding |
| • Biodiversity | • Defence land Sydney Harbour | • Fishing |
| • Boat users | • Defence installations | • Garden Island management plan |
| • Botanic Gardens | • Development Control Plan | • Grants program |
| • Catchment management | • Environment Protection Licence | • Harbour fund |
| • Climate change adaptation | • Environmental improvement grant | • Harbour management |
| • Coastal Hazard Study | • Erosion | • Harbour trust fund |
| • Coastal Zone Management Plan | • Estuary management | • Harbour use |
| • Cockatoo Island | | • Headland Barangaroo |

- Jetties and boat ramps
- Legislation review
- Local Environmental Plan/Study
- Local Government Act
- Marine ecology
- Maritime heritage
- Masterplan
- Metropolitan Urban Development Program
- Overflow strategy
- Pollution reduction program
- Ports and/or shipping
- Recreation (on water and foreshore)
- Recreational users study
- Redevelopment/ Residential/ Commercial development
- Regional Environmental Plan
- Roles and responsibilities
- Sea baths
- Seagrass
- Sea level rise
- Seawalls
- Sediment quality
- Sharing Sydney Harbour Access Program
- State Environmental Planning Policy
- Stormwater management
- Strategic plan
- Sustainable water strategy
- Sydney colony heritage
- Sydney Ferries management plan/study
- Sydney Harbour Federation Trust
- Sydney Harbour Foreshore Authority
- Telecommunications
- Tourism
- Transport
- Ultimo Pyrmont strategy
- View study
- Water quality
- Waterways policy
- Wet weather abatement strategy
- White paper on foreshore/ harbour/ catchment management

It should be noted that other organisations are also currently preparing significant studies of relevance to the management of Sydney Harbour.

SIMS has recently finalised a comprehensive scientific review of Sydney Harbour, with the intent of identifying critical gaps in scientific understanding that could be prioritised for research and/or funding.

In addition, Mosman and Woollahra Councils have both embarked on technical studies to support the preparation of coastal zone management plans for their local government areas.

2. Sydney Harbour Management

2.1 Summary

2.1.1 Key Findings

The governance and policy framework for Sydney Harbour is complex and shared between three levels of government: Federal, State and Local. Local and State government planning, policy and funding decisions are largely responsible for coastal zone management. In most strategic and statutory planning processes the protection and enhancement of the coastal zone is one of a number of factors for consideration. There is a clear role for coastal zone management plans to articulate the objectives and management strategies so that these can be considered clearly in planning and decision making frameworks.

At the local government level, GHD's assessment of the coastal zone protection issues included in local environmental plans highlights that there is a significant difference between councils that administer part of Sydney Harbour's coastal zone. The Manly local government area includes the most comprehensive range of factors relating to the coastal zone in their local environmental plan. There is potential to strengthen consideration of the coastal zone as instruments are updated for each local government area.

Cockatoo Island is not part of any local government area. Local government based CZMP's would not automatically apply to this island or others with the same governance status.

GHD's research identified that there is a limited amount of State government funding available for direct and proactive improvement and management of the coastal zone throughout NSW. The amount of funding is variable and is assessed on a project by project basis. The development and redevelopment of land and provision of infrastructure in the coastal zone provide opportunities for site by site and project by project improvements by way of developer contributions, planning agreements or conditions of consent. However, a strategic framework is required to coordinate and guide these decisions to gain Harbour wide improvement.

Coastal protection mechanisms do not appear to be universally well understood in plans reviewed during this project. There is potential for education about the definition of the coastal zone and coastal protection zones respectively.

2.1.2 Facts and figures

The existing management of Sydney Harbour is multi-layered, with numerous agencies and government departments playing a role in its governance as follows:

- 9 Federal government agencies
- 17 State government agencies spread across 13 departments
- 6 local governments
- 4 peak local government organisations
- 2 statutory state government owned corporations

The legislative framework is complex and includes:

- International law and treaties implemented through National and State legislation
- 3 Commonwealth Acts
- 15 State government Acts

- 6 local environmental plans with varying degrees of emphasis on coastal protection
- 8 State Environmental Planning Policies
- A Sydney Harbour Regional Environmental Plan

2.1.3 Issues

Strategic and statutory planning responsibilities for the Harbour are shared between state and local government. The Department of Environment and Planning and Roads and Maritime Services both have roles in the development approval process applicable to coastal and marine areas. Other state agencies are required to be consulted during the development approval process.

The National Cooperative Approach to Integrated Coastal Zone Management has limitations with the structure, responsibility for implementation and lack of funding having been criticised in a previous review (House Standing Committee on Climate Change, Water, Environment and the Arts, 2009).

Local government Community Strategic Plans are prepared and reviewed periodically (every 5 to 10 years) but on a different cycle to the review of local environmental plans (timeframes not set) and with no direct policy and reform pathway linking them.

Other strategic plans and frameworks exist including the Sydney Coastal Councils Catchment Management Strategy and the Catchment Blueprint, but these have no formal reporting or review mechanisms.

Funding sources for coastal protection are limited but include the estuary management and floodplain management programs.

2.1.4 Gaps

Gaps in relation to governance are the time lag between important issues being identified at a national and or state level and the commensurate change to regulation at a local level. Without action oriented policy and suitable resources, key issues identified for action will be ignored or delayed to a point where they become difficult to implement.

Very little information is available on the direct or indirect funding of maintenance activities affecting the management, health and amenity of Sydney Harbour, particularly as a result of local government actions.

2.1.5 Recommendations

1. Key coastal policies and plans should be clearly described in a summary document for Sydney Harbour;
2. An assessment should be made of the extent to which Australian and state government policy on coastal management is translated into decision making at local levels;
3. Local environmental plans for Sydney Harbour should be reviewed for consistency and comprehensiveness in relation to coastal zone management provisions;
4. The definition of and key policy and planning mechanisms for coastal zone management should be clearly documented and widely shared with policy makers and planners.
5. Sources of funding for coastal zone protection and improvement need to be explored in more detail with a focus on gaps in the funding process.
6. To tap into unpublished literature a more detailed information assembly process be adopted, involving face to face interviews with multiple parts of stakeholder organisations.

2.2 Governance

The current governance arrangements in place for Sydney Harbour are complex, involving a range of agencies and stakeholders. This section identifies and documents the roles and responsibilities of various agencies with roles in governance and summarises key reports addressing governance of the coastal zone.

2.2.1 Roles and Responsibilities

Table 2-1 Governance roles and responsibilities within Sydney Harbour

Agency or organisation	Responsibility
Federal Government	
Australian Customs and Border Protection Service	<p>Australian Customs and Border Protection Service (ACBPS) manage the security and integrity of Australia's borders.</p> <p>The service works with other government and international agencies, in particular the Australian Federal Police, the Department of Agriculture, the Department of Immigration and Border Protection and the Department of Defence, to detect and deter unlawful movement of goods and people across the border.</p> <p>Border Protection Command (BPC) is Australia's lead maritime law enforcement agency. It brings together officers from the Australian Customs and Border Protection Service (ACBPS) and the Australian Defence Force (ADF) as a joint multi-agency taskforce to identify and respond to illegal activity in Australia's Maritime Jurisdiction (AMJ).</p>
Australian Maritime Safety Authority (AMSA)	<p>AMSA's role is to:</p> <ul style="list-style-type: none"> • promote maritime safety and protection of the marine environment • prevent and combat ship-sourced pollution in the marine environment • provide infrastructure to support safe navigation in Australian waters • provide a national search and rescue service to the maritime and aviation sectors. • Coordinates with Roads and Maritime Services for local implementation of responsibilities.
Council of Australian Governments (COAG), through the COAG Select Committee on Climate Change	<p>Develop Australian policy position on coastal policy in consultation with states and territories when directed by government.</p> <p>Note: COAG will operate within the frame of reference set by the Australian government in December 2013. The philosophy expressed that States "should get on with delivering on their responsibilities, with appropriate accountability and without unnecessary interference from the Commonwealth." (COAG Communique, 13 December 2013).</p> <p>COAG replaced its 22 Standing Councils, Select Councils and governance fora with a set of eight Councils. This revoked the Standing Council on Environment and Water. Work is currently underway to resolve how its existing work will be managed in future.</p>

Agency or organisation	Responsibility
Department of Agriculture (containing operations of the former Australian Quarantine Inspection Service – AQIS)	<p>The Department administers all biosecurity threats and associated quarantine services. It is responsible for the monitoring of all vessels scheduled to enter and leave Australian waters, including Sydney Harbour. Quarantine threats include the introduction of pests and diseases from the vessel itself (e.g. insects on board), vessel waste as well as live animal and plant material being introduced through ports. The department is responsible for regulating and monitoring key activities in preserving Australia’s quarantine status, including:</p> <ul style="list-style-type: none"> • Conditions for the release of cargo containers at wharves or terminals • Self Assessed Clearance Cargo regulation • Transshipments (Transshipments shipments from overseas that pass through Australia to an overseas destination) • Quarantine reporting of cruise, navy, livestock, barge and live vessels.
Department of Defence	<p>Operates the following defence facilities on Sydney Harbour:</p> <ul style="list-style-type: none"> • HMAS Kuttabul – Garden Island • HMAS Penguin – Balmoral • HMAS Watson – South Head • HMAS Waterhen – Waverton <p>Prepare Plans of Management for Defence Lands</p>
Department of the Environment	<p>Designs and implements Australian Government policies and programmes to protect and conserve the environment, water and heritage and promote climate action.</p> <p>Administers the EPBC Act (refer legislation section).</p>
National Resource Management Ministerial Council (NRMMC)	<p>Developed Natural Resources and Climate Change policies and programs.</p> <p>See note above. Publications still accessible.</p>
NRMMC and its Marine and Coastal Committee (MACC), and Intergovernmental Coastal Advisory Group (ICAG)	<p>Administered the National Cooperative Approach to Integrated Coastal Zone Management: Framework and Implementation Plan.</p> <p>See note above.</p>
Sydney Harbour Federation Trust	<p>The Sydney Harbour Federation Trust is a self-funded agency created by the Australian Government responsible for vision planning and management of Sydney Harbour. Tasked with:</p> <ul style="list-style-type: none"> • Ensuring that management of Trust land contributes to enhancing the amenity of the Sydney Harbour region • Protecting, conserving and interpreting the environmental and heritage values of Trust land • Maximising public access to Trust land • Establishing and managing suitable Trust land as a park on behalf of the Commonwealth
State Government	
Barangaroo Delivery Authority	<p>Manages the city waterfront development at Barangaroo and to deliver world class benchmarks in urban design, public domain and sustainability.</p>
Department of Planning and Environment	<p>State government planning agency responsible for developing and administering state government planning policies, planning instruments and initiatives. Includes the Office of Environment and Heritage.</p> <p>Administers and reforms the <i>Environmental Planning and Assessment Act 1979</i>.</p>

Agency or organisation	Responsibility
Department of Planning and Environment, Division of Local Government	Responsible for local government across NSW. The Division's organisational purpose is "To strengthen the Local Government Sector" and its organisational outcome is "Successful councils engaging and supporting their communities". The Division has a policy, legislative, investigative and program focus in matters ranging from Local Government finance, infrastructure, governance, performance, collaboration and community engagement.
Department of Planning and Environment, Office of Environment and Heritage	Under its coastal zone management program, the OEH aims to reduce the impact of coastal hazards and maintain the ecological health of our estuaries while accommodating population growth. OEH works collaboratively with local government. Administers the Coastal Protection Act 1979.
Department of Primary Industries, Fisheries NSW	Fisheries NSW is responsible for ensuring that fish stocks are conserved and key fish habitat is protected. It is responsible for ensuring the sustainable management of commercial, recreational and Aboriginal cultural fishing, aquaculture, aquatic habitat and biodiversity, and marine protected areas within NSW, including North Harbour Aquatic Reserve in Sydney Harbour.
Department of Primary Industries, Office of Water	Responsible for the management of the State's surface water and groundwater resources through: <ul style="list-style-type: none"> • water planning and implementation of interstate programs • surface water and groundwater management • water licensing and compliance • water information and modelling • science and evaluation • policy and regulation of local water utilities • provision of legal advice on water matters to the government
Department of Trade and Investment, Crown Lands	The administrator for Crown land above the Mean High Water Mark (MHW) within the Sydney Harbour catchment area, and below the MHW to the 3 nautical mile limit (i.e. the bed of the ocean) off of Sydney Harbour. The majority of Crown reserves are managed by Local Government either through appointment as trust managers or by devolvement under the Local Government Act. Crown Lands approve jetties and other domestic waterfront structures on estuaries not covered by Roads and Maritime Services.
Department of Trade and Investment, Regional Development Australia – NSW	The Department manages the Regional Development Australia (RDA) – NSW network. This consists of 14 committees tasked with providing government input about regional issues that impact on economic development and local environments. The RDA Sydney network aims to advance sustainable economic development and social equity within the Sydney's regions. The work of RDA Sydney is guided by the need to create employment growth within a sustainable and socially just mindset. The RDA uses networking, catalysing and brokering of projects, serving as a knowledge base around issues facing Sydney, and advising government to achieve its goals.
Department of Transport NSW	Responsible for planning, program administration, policy, regulation, procuring transport services, infrastructure and freight. Transport operators are responsible for operations.

Agency or organisation	Responsibility
Environment Protection Authority	<p>The primary environmental regulator for NSW. EPA regulates activities that could have an impact on the health of the NSW environment and its people.</p> <p>Uses a combination of tools, services and programs including education, licensing and approvals, economic mechanisms like trading schemes, partnerships and collaborations with community and business organisations, scientific and social research, compliance audits, monitoring programs and information services.</p> <p>Administers the <i>Protection of the Environment Operations Act 1997</i>. This includes enforcement powers and duties. Refer to the legislation section of this report for more information.</p>
Land and Property Information (NSW)	<p>Land and Property Information collects, collates and integrates public and private property information for NSW, including land titles, associated plans and dealings, valuation and mapping and spatial information through aerial imagery.</p> <p>This information is used by the community, business and government for a variety of purposes such as land management, conveyancing, property development, investment, local planning and economic & social development.</p>
Local Land Services (LLS) (formerly Hawkesbury Nepean Catchment Management Authority (HNCMA))	<p>HNCMA was a statutory authority with a board that reported directly to the Minister for Primary Industries. The Sydney Metropolitan Catchment Management Authority was recently merged with the HNCMA. These are now part of LLS.</p> <p>LLS has eleven regions, each of which is accountable for delivering services that add value to local industries, enhance natural resources, protects industries from pests and disease and help communities respond to emergencies like flood, fire and drought.</p> <p>Local Boards headed by local Chairs work closely with farmers, landholders and communities. Each region will develop operational management plans that will prioritise service delivery on a regional basis, reflecting regional priorities.</p>
National Parks and Wildlife Service	<p>Administers national parks within NSW including Sydney Harbour National Park and Garigal National Park with frontage to Sydney Harbour. Sites include:</p> <ul style="list-style-type: none"> • North Head • Dobroyd Head • Georges Head • Bradleys Head • Fort Denison • Goat Island • Rodd Island • Cadmans Cottage • Clark Island • Shark Island • Obelisk Beach • Nielson Park • South Head • Davidson Park - Roseville
NSW Coastal Panel	<p>Provides advice to the Minister administering the <i>Coastal Protection Act 1979</i> and to local councils. Review draft coastal zone management plans. Provides consent for applications for sea walls, beach nourishment and other works in areas not covered by a CZMP.</p>

Agency or organisation	Responsibility
Roads and Maritime Services	<p>Represents the State as landowner and regulator of the bed of Sydney Harbour and its tributaries, and other key locations. Within these areas RMS regulates maritime activities, and Roads is responsible for leasing domestic waterfront facilities in Sydney Harbour and its tributaries.</p> <p>The NSW Maritime Division (Maritime) is responsible for marine safety, regulation of commercial and recreational boating. Maritime administers the following Acts and associated Regulations:</p> <ul style="list-style-type: none"> • <i>Ports and Maritime Administration Act 1995</i> • <i>Marine Safety Act 1998</i> • <i>Maritime Services Act 1935</i> • <i>Navigation Act 1901</i> • <i>Marine Safety Legislation (Lakes Hume and Mulwala) Act 2001</i> • <i>Marine Pollution Act 1987</i> • <i>Maritime also has particular responsibilities under:</i> • <i>Environmental Planning and Assessment Act 1979</i> • <i>Protection of the Environment Operations Act 1997</i> • <i>Passenger Transport Act 1990</i>
Sydney Harbour Foreshore Authority	<p>Sydney Harbour Foreshore Authority owns and manages some of the State's most significant assets, including The Rocks and Darling Harbour.</p> <p>The Authority seeks to preserve and enhance the inter-generational value of the State, heritage and cultural assets it manages.</p> <p>SHFA also owns sites at White Bay Power Station, Rozelle Rail Yards and Ballast Point and manages other major waterfront assets around Sydney Harbour on behalf of other NSW Government agencies.</p>
Sydney Ports Corporation	<p>The Sydney Ports Corporation is responsible for the operation, management and development of seaport facilities within Sydney Harbour. The main functions of the corporation are to:</p> <p>Manage and develop port functions for existing and future commercial trade requirements</p> <p>Manage navigational, pilotage, security, safety and emergency response needs for commercial shipping</p> <p>Monitor, schedule and regulate daily vessel movements within Sydney Harbour</p>
Sydney Water Corporation	<p>Delivers water, wastewater and some stormwater services to Sydney, the Blue Mountains and the Illawarra. Operates systems and invests in improvements to water and wastewater management.</p>
Treasury	<p>Assists the NSW government to establish and implement the State budget and provide funding to government agencies and programs.</p>
Local Government	
Sydney Coastal Councils Group (Botany Bay, Hornsby, Leichhardt, Manly, Mosman, North Sydney, Pittwater, Randwick, Rockdale, Sutherland, Sydney, Warringah, Waverley, Willoughby and Woollahra)	<p>To promote cooperation between, and coordination of actions by Member Councils on issues of regional significance concerning the sustainable management of the urban coastal environment.</p>
Southern Sydney Metropolitan Regional Organisation of Councils	<p>Undertakes projects that cross council boundaries to achieve results that will contribute to the sustainability of member councils and their communities.</p>

Agency or organisation	Responsibility
Northern Sydney Metropolitan Organisation of Councils	Provides strong local government leadership; to work co-operatively for the benefit of the Northern Sydney region; and to effectively advocate on agreed regional positions and priorities.
Local Government and Shires Association	Represents the interests of local governments in policy development and reform.
Local government areas administering lands on Sydney Harbour	Each council is an independent, statutory corporation responsible for administering the local government area over which it has jurisdiction. In relation to coastal zone management in Sydney, councils have responsibility for land use planning and development approval, provision of stormwater services, regulation of pollution, open space management, waste collection and disposal and other related functions. Councils are responsible for implementing a suite of legislation as outlined in the section on legal and policy frameworks within this report.

2.2.2 Project Context – National Approach to Coastal Zone Management

The Australian government’s Standing Committee on Climate Change, Water, Environment and the Arts examined Coastal Zone Management in 2009. The Committee’s final report noted that State and territory governments were largely responsible for Coastal zone planning and management. However, local governments are the day-to-day decision makers. The role of local government was recognised as significant in the report:

“... in many instances local governments are at the forefront of coastal zone planning and management.”

The Australian Government retains “an important influence on coastal environmental policy and planning through the *Environment Protection and Biodiversity Conservation Act 1999*.” State and Australian policy can also be facilitated through “national government councils, such as COAG.”

State governments are primarily responsible for areas up to three nautical miles out from the territorial sea baseline. The Standing Committee report noted:

“The Heads of Agreement on Commonwealth and State Roles and Responsibilities for the Environment, signed in 1997 by COAG and representatives of local governments, sets out Commonwealth and state responsibilities in the coastal zone as follows:

Commonwealth responsibility involves meeting obligations contained in international agreements and in Commonwealth legislation in relation to waters outside those waters under State control pursuant to the Offshore Constitutional Settlement, except where formal Commonwealth/State management arrangements are in place (e.g. specific fisheries) or where waters are under Commonwealth direct management (e.g. the Great Barrier Reef Marine Park). The Commonwealth has responsibility for control of sea dumping in Australian waters.

Commonwealth interest involves co-operation with the States to develop strategic approaches to ensure the management and protection of Australia’s marine and coastal environment.”

The Australian Government’s role in coastal zone management is articulated in the National Cooperative Approach to Integrated Coastal Zone Management Framework and Implementation Plan 2006. The Standing Committee found that this Plan had limitations including:

- “the lack of a definitive structure at a national level to support its delivery
- the lack of funding attached to the framework

- the lack of clarity regarding where responsibility lay for its implementation and lack of accountability in reporting and timeframes:”

The standing committee identified 12 key challenges in relation to governance of the coastal zone as follows:

- involvement by the national government
- definition of roles and responsibilities for each different level of government
- improved cooperation and coordination action across jurisdictions
- need for a regional strategic approach
- better integration in environmental management of socioeconomic elements
- new governmental arrangements to encompass climate change impacts
- stakeholder involvement and community engagement, education and awareness
- improved coastal zone land use planning and population planning
- improved capacity building and resources
- improved communication and information
- a reduction in institutional complexity across jurisdictions
- improved monitoring and reporting

The review of governance concluded by recommending that an “Intergovernmental Agreement on the Coastal Zone should be developed and agreed through COAG.” (House Standing Committee on Climate Change, Water, Environment and the Arts, 2009).

The then Australian government’s response to the recommendations of the committee included an intention to develop a national coastal adaptation agenda through COAG. This agenda is still to be developed.

COAG operates within the frame of reference set by the Australian government in December 2013. The philosophy expressed that States “should get on with delivering on their responsibilities, with appropriate accountability and without unnecessary interference from the Commonwealth.” (COAG Communique, 13 December 2013).

COAG replaced its 22 Standing Councils, Select Councils and governance fora with a set of eight Councils. This revoked the Standing Council on Environment and Water. Work is currently underway to resolve how its existing work will be managed in future.

The efforts by Federal, state and local governments to address coastal zone management in a coordinated way highlight that appropriate inter-governmental cooperation on this issue is important. There is a need to identify clearly the respective roles and responsibilities of different levels of government and ensure that there are no gaps in regulation.

The development of a CZMP for Sydney Harbour directly addresses some of the key challenges identified by the Standing Committee, in particular by improving cooperation and coordination across various local governments and other land managers, and providing a regional strategic approach to coastal zone management.

2.3 Legal/Policy

The primary legislative instruments pertaining to management of the Harbour are detailed alphabetically below:

2.3.1 Federal Legislation

Australian Maritime Safety Authority Act 1990

The Australian Maritime Safety Authority (AMSA) is established by the *Australian Maritime Safety Authority Act 1990*. AMSA coordinates maritime safety including environmental management and the prevention of pollution. AMSA “coordinates a national pollution prevention and response strategy to protect Australia's marine environment from pollution caused by shipping and related activities”.

Australia has adopted several international conventions, formulated by the International Maritime Organization (IMO), dealing specifically with ship related marine pollution matters.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the Australian government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance.

On Sydney Harbour the Act protects items of world and national heritage significance including:

- Cockatoo Island
- Old Government House
- Sydney Opera House

It also protects threatened species including for example Eastern Suburbs Banksia scrub that occurs on North Head.

Protection of the Sea (Prevention of Pollution from Ships) Act 1983

This legislation gives effect to the international conventions adopted by Australia.

2.3.2 State Legislation

Coastal Protection Act 1979

The *Coastal Protection Act 1979* is the primary legislation relating to coastal management in New South Wales. The Act includes requirements for Ministerial concurrence for certain developments in the coastal zone, and for the preparation of coastal zone management plans by local government authorities. The *Coastal Protection Act 1979* declares the Coastal Zone.

The Act was amended by the *Coastal Protection and Other Legislation Amendment Act 2010* and the *Coastal Protection Amendment Act 2012*. Amendments included provisions allowing landowners to temporarily place sand or sandbags as temporary coastal protection works in coastal erosion-prone areas. The amendments are supported by the *Coastal Protection Regulation 2011*.

The key ways in which the Coastal Protection Act has effect are:

1. Through the land use planning process where coastal protection should be a key consideration in the development of regional and local plans and in determination of development applications; and
2. enabling the development of coastal zone management plans to provide a coordinated and consistent approach to coastal zone management.

The NSW Coastal Panel is a statutory authority under Part 2A of the Act, with membership comprising local government and public authority nominees.

The panel provides expert advice to the Minister administering the Act and to local councils. The Minister may also refer draft coastal zone management plans to the panel for review. Under Division 25 of Part 3 of the Infrastructure State Environmental Planning Policy (SEPP), the Coastal Panel has statutory roles in relation to coastal protection works on the open coast or at the entrance to estuaries. In addition, public authorities proposing new works must notify the panel before carrying out these works and take the panel's response into consideration. This role does not apply where the proposed works are in an area subject to a coastal zone management plan or in relation to emergency coastal protection works.

On 13 November 2014 the Minister for the Environment, The Hon. Rob Stokes, MP announced that as part of the Stage Two Coastal Reform, the *Coastal Protection Act 1979* will be replaced with new coastal management legislation - a proposed new Coastal Management Act.

The Coastal Protection Act is supported by a number of policies and tools:

Coastal Protection Package

The NSW Government introduced a Coastal Protection Package in 2001. This package aims to protect the State's beaches, headlands and other coastal features. The package includes:

- a ministerial direction for coastal protection - issued under section 117(2) of the *Environmental Planning and Assessment Act 1979*
- NSW Coastal Policy
- State Environmental Planning Policy No. 71 - Coastal Protection
- State Environmental Planning Policy (Major Development) 2005, which identifies coastal development that will need approval from the Minister for Planning.
- Comprehensive Coastal Assessment Toolkit

The NSW Coastal Zone was extended to the greater metropolitan region on 18 November 2005 and mapping showing the Coastal Protection Zone is available. However, in the Sydney Harbour area, the Coastal Protection Zone is limited to the oceanic frontages and selected coastal creeks of Manly and Woollahra Councils only (Department of Planning and Environment, 2014). The Coastal Protection Zone does not apply within Sydney Harbour. There appears to be interchangeable use of the terms "Coastal Zone" and "Coastal Protection Zone", with workshop participants expressing confusion over the definition of the NSW Coastal Zone.

State Environmental Planning Policy No. 71 - Coastal Protection aims to ensure that:

- development in the NSW coastal zone is appropriate and suitably located;
- there is a consistent and strategic approach to coastal planning and management; and
- there is a clear development assessment framework for the Coastal Zone.

The Comprehensive Coastal Assessment toolkit provides information to support local councils, government agencies and others undertaking strategic land use planning. The toolkit was a whole-of-government initiative developed over three years and was released in 2007. It identified, analysed and assessed data and information on the physical, biological, social and economic values of the State's coastline. This baseline data was made available for use by planning agencies to prepare multi-criteria analysis of planning schemes or development proposals.

This toolkit is defined by the Northern and Southern NSW coastline, excluding coastline between Shellharbour and Port Stephens. Despite not directly including Sydney Harbour it contains key information and methodologies which can be leveraged in the development of a Coastal Zone Management Plan. The toolkit includes an integrated decision framework guide which outlines the development of land use planning options whilst recognising the constraints and implications that proposed activities will have. A guidebook on social impact assessment as well as modelling on the economic-ecological interactions in catchment areas have been produced from the toolkit, both of which can be used to guide a CZMP for Sydney Harbour.

Coastal Lands Protection Scheme

The Coastal Lands Protection Scheme is used to bring significant coastal lands into public ownership. It also provides for their long term management and care. The Department of Planning and Environment administers the Scheme which receives an annual budget allocation of \$3 million for acquisitions.

Coastal Design Guidelines

The Minister for Planning issued a Direction under section 117 of the *Environmental Planning and Assessment Act 1979* to all local councils in the coastal zone regarding the Coastal Design Guidelines 2003. In preparing a draft local environmental plan, councils are required to include provisions that give effect to and are consistent with the Coastal Design Guidelines, unless the inconsistency is justified by an environmental study or strategy.

NSW Sea Level Rise Policy

The NSW Sea Level Rise Policy Statement 2009 statement aimed to promote an adaptive risk based approach to managing the impacts of sea level rise; encourage appropriate development; and provide emergency management and community support and up to date information. The statement relied on review of local and state planning instruments to have an impact on land use planning decisions. Since September 2012, the policy is no longer NSW Government policy, and individual Councils now decide how to incorporate projected sea level rise into their planning documents and decisions. This has led to confusion and inconsistency between adjoining Councils over the levels adopted or approach to managing this issue. To support member Councils, the NSW Sydney Coastal Councils Group undertook a Mapping and Responding to Coastal Inundation Project to assist local councils in planning and managing responses to sea level rise and coastal inundation by mapping present day and future inundation hazards for the entire Sydney region (Dall'Osso and Dominey-Hoes, 2013; Dall'Osso et al, 2013; Dall'Osso et al 2014; SCCG, 2013).

There appear to have been concerted attempts to introduce and improve coastal policy but the administration of coastal management policy is still complex (EDO, 2011). There is no published information readily available about the efficacy of the existing legislation and policy; however comments received from stakeholders during the workshops indicate that there is still significant confusion and this is a key area for further investigation.

Crown Lands Act 1989

This Act seeks to manage Crown Land for the benefit of the people of New South Wales by providing for:

- a. a proper assessment of Crown land;
- b. the management of Crown land;
- c. the proper development and conservation of Crown land;
- d. the regulation of the conditions under which Crown land is permitted to be occupied, used, sold, leased, licensed or otherwise dealt with;

- e. the reservation or dedication of Crown land for public purposes and the management and use of the reserved or dedicated land; and
- f. the collection, recording and dissemination of information in relation to Crown land.

Activities and structures on Crown Land (including submerged lands) are regulated under this Act.

Environmental Planning and Assessment Act 1979

This Act provides a framework for the New South Wales planning and development assessment system. This system governs planning and decision making in relation to land zoning and development. State and local planning instruments operate within this framework. A table at the end of this section outlines the key planning instruments for Sydney Harbour.

Fisheries Management Act 1994

The *Fisheries Management Act 1994* aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. The sustainable management of commercial, recreational, Aboriginal cultural fishing and aquaculture activities is covered under this Act.

The Act includes measures to protect key fish habitat and aquatic reserves, and lists threatened species of freshwater fish, aquatic invertebrate and macroinvertebrate species, endangered populations and aquatic ecological communities and key threatening processes.

Habitat Protection Plans have been created to implement some of these measures. Fish Habitat Plan No 1 provides broad direction on the protection of fish habitats throughout the State, relating to dredging and reclamation activities, fish passage requirements, the protection of mangroves, seagrasses and other marine vegetation, and the importance of snags.

Heritage Act 1977

The *Heritage Act 1977* identifies and protects heritage items, and is administered by the Heritage Division of the OEH. Any development that would impact on an item listed on the State Heritage Register requires approval from the Heritage Council under Section 60 of the Act.

Marine Pollution Act 2012

The *Marine Pollution Act 2012* regulates the pollution of the marine environment by oil and other noxious substances. The Act incorporates provisions in the International Convention for the Prevention of Pollution from Ships 1973 (known as MARPOL) and prevents the discharge of harmful packaged substances, sewage and garbage into certain waters.

Maritime Services Act 1935

The *Maritime Services Act 1935* enabled the then Maritime Services Board to carry out a range of functions related to the construction and operation of maritime facilities and services. These responsibilities have now transferred to Roads and Maritime Services.

The Act is subject to the *Ports and Maritime Administration Act 1995*. This Act established Sydney Ports Corporation as a statutory state owned corporation. The objectives of Sydney Ports in summary are to:

- a. be a successful business including having regard to the interests of the community;
- b. promote and facilitate trade through its port facilities;
- c. ensure that its port safety functions are carried out properly;
- d. promote and facilitate a competitive commercial environment in port operations; and

- e. improve productivity and efficiency in its ports and the port-related supply chain.

The *Management of Waters and Waterside Lands Regulation 1972* is administered by Roads and Maritime Services and regulates structures and waterside activities.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* promotes and regulates the management of National Parks and historic sites or places of cultural value within the landscape and the conservation of certain fauna, native plants and Aboriginal objects and places.

The *National Parks and Wildlife Act 1974* provides the basis for legal protection and management of Aboriginal sites in NSW. All Aboriginal objects within NSW are protected under Part 6 of the Act. The Department of Planning and Environment, Office of Environment and Heritage (OEH) is responsible for implementing the Aboriginal heritage provisions in the *National Parks and Wildlife Act 1974*.

Ports and Maritime Administration Act 1995

The *Ports and Maritime Administration Act 1995* and the *Ports and Maritime Administration Regulations* identify the boundaries of the Port of Sydney Harbour and the port safety functions that the Sydney Ports Corporation is required to conduct within those boundaries.

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is the key piece of environment protection legislation administered by the Environment Protection Authority (EPA). The key features of the Act are:

Protection of the environment policies (PEPs)

PEPs are instruments that enable the EPA to set environmental standards, goals, protocols and guidelines. They provide both the framework for State government decisions that affect the environment and the vehicle for adopting Australia-wide environment protection measures.

Integrated environment protection licensing

The POEO Act provides a single licensing arrangement for air, water and noise pollution and waste management. Integration of EPA licensing with the development approval procedures under the *Environmental Planning and Assessment Act 1979* provides for public participation in the environmental assessment of activities that may be licensed by the EPA.

Regulation of scheduled and non-scheduled activities

The EPA regulates scheduled activities including the following with the potential to affect the coastal zone:

- Aquaculture and mariculture
- Brewing and distilling
- Cement or lime works
- Chemical production
- Chemical storage
- Concrete works
- Contaminated soil or groundwater treatment
- Extractive activities
- Helicopter-related activities

- Marinas and boat repairs
- Petroleum and fuel production
- Printing, packaging and visual communications
- Railway systems activities
- Road construction
- Sewage treatment including systems
- Shipping in bulk including the operation of wharves
- Various waste management activities including transport of waste

The Act also enables the EPA to issue environment protection notices including clean-up notices, prevention notices and prohibition notices.

Section 148(8) of the Act provides a duty to notify 'relevant authorities' of pollution incidents where material harm to the environment is caused or threatened.

Sydney Harbour Federation Trust Act 2001

The Sydney Harbour Federation Trust was established by the 2001 Act. It was formed to manage surplus defence lands on Sydney Harbour Foreshores. The Trust has responsibility for lands including the former Defence lands at Middle Head–Georges Head and Chowder Bay in Mosman; the North Head former School of Artillery; Macquarie Lightstation near South Head; Woolwich Dock and Parklands; Cockatoo and Snapper Islands; and the former Marine Biological Station at Watsons Bay. The objectives of the Trust are:

- a. to ensure that management of Trust land contributes to enhancing the amenity of the Sydney Harbour region;
- b. to protect, conserve and interpret the environmental and heritage values of Trust land;
- c. to maximise public access to Trust land;
- d. to establish and manage suitable Trust land as a park on behalf of the Commonwealth as the national government;
- e. to co-operate with other Commonwealth bodies that have a connection with any Harbour land in managing that land;
- f. to co-operate with New South Wales, affected councils and the community in furthering the above objects.

Sydney Water Act 1994

Sydney Water Corporation is a Statutory State Owned Corporation created by the *Sydney Water Act 1994*. It replaced the former Water Board. Sydney Water has three equal principal objectives that can be summarised as:

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

Sydney Water is responsible for delivering water, wastewater and some stormwater services within Sydney including within the Sydney Harbour catchment. Sydney Water's operations are regulated by the EPA. Sydney Water's wastewater systems operate under the terms of Environment Protection Licences issued under the *Protection of the Environment Operations Act 1997*.

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) provides legal status for biota of conservation significance in NSW. The Act aims to, *inter alia*, 'conserve biological diversity and promote ecologically sustainable development'. It provides for:

- The listing of 'threatened species, populations and ecological communities' (threatened biota) with endangered species, populations and communities listed under Schedule 1,
- 'Critically endangered' species and communities listed under Schedule 1A, vulnerable species and communities listed under Schedule 2;
- The listing of 'Key Threatening Processes' (KTPs) (under Schedule 3);
- The preparation and implementation of Recovery Plans and Threat Abatement Plans; and
- Requirements or otherwise for the preparation of Species Impact Statement (SIS).

The TSC Act lists a number of factors to be taken into account in deciding whether there is likely to be a significant impact on threatened species, populations or ecological communities or their habitats. A Species Impact Statement is required when it is determined by the assessment of significance (undertaken in accordance with Section 5A of the EP&A Act) that there is likely to be a significant impact on a threatened species, population or ecological community.

In December 2014, Byron *et al.* (2014) reported on its review of the *Threatened Species Conservation Act 1995* (as well as the *Native Vegetation Act 2003*, and *Nature Conservation Trust Act 2001*, and parts of the *National Parks and Wildlife Act 1974*). Amongst other things, the report recommends repealing the *Threatened Species Conservation Act 1995* and parts of the *National Parks and Wildlife Act 1974 Act* and reconstituting elements of them in a new 'Biodiversity Conservation Act'.

Water Act 1912

The *Water Act 1912* came into force at the turn of the last century. This Act is being progressively phased out and replaced by the *Water Management Act 2000*, but some provisions are still in force.

Water Management Act 2000

The *Water Management Act 2000* provides a statutory framework for managing water in NSW. It recognises the need to protect the health of rivers and groundwater systems and associated wetlands, floodplains, estuaries.

Under the terms of the Act the State has the rights to the control, use and flow of:

- a. all water in rivers, lakes and aquifers;
- b. all water conserved by any works that are under the control or management of the Minister; and
- c. all water occurring naturally on or below the surface of the ground.

The Act is administered by the Department of Primary Industries (DPI), Office of Water.

Water sharing plans are being developed progressively by interagency panels led by the Department of Primary Industries. These plans aim to protect the health of rivers and groundwater. They establish rules for sharing water between the environmental needs of a river or aquifer and water users, and also between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation.

Water sharing plans for the Greater Metropolitan Region Groundwater and Unregulated River Water Sources were commenced in 2011. These include "Southern Sydney Harbour".

Audit of Sea Level Rise, Coastal Erosion and Inundation Legislation and Policy

An audit of legislation and policy relevant to the coast, erosion and inundation was undertaken by the Environmental Defenders Office (EDO, 2011). The audit examined legislation and policy from all States of Australia, and selected international locations. A key recommendation of this report was the need to review the ad-hoc framework and multiple layers in which erosion and inundation of the coast are managed, a similar review may also be beneficial in identifying the multitude of overlaps of regulation of activities that contribute to or are affected by these issues.

The audit also indicates that these issues are not new, and that many previous inquiries have identified these issues, yet the matter still appears to be some way from resolution. These issues also affect other States and Territories; EDO (2011) particularly recommends that emergency response related issues are best integrated at a Federal level.

Until these legislative and policy overlaps for managing the coast are agreed and resolved, key stakeholders will continue to express concerns over the practical implementation of a whole of Harbour CZMP. It is understood that reforms to coastal policy and legislation arrangements are currently underway (additional details are provided in Section 4.4. No details of what the reforms comprise have been provided for use in this study.

2.3.3 Planning Instruments

Table 2-2 Planning instruments affecting Sydney Harbour

Instrument	Role
Local	
Local environmental plans – all local councils managing land adjacent to Sydney Harbour	Regulates development permitted without consent, with consent and prohibited. Includes development standards
Development Control Plans – made by local councils under the terms of local environmental plans	Provides more specific guidance on development
State	
<i>State Environmental Planning Policies</i>	
State and Regional Development	Identifies development that is State significant development or infrastructure, and confers functions on joint regional planning panels to determine development applications.
Urban Renewal	Establishes the process for identifying and assessing sites for urban renewal.
Infrastructure	Planning regime for assessing infrastructure proposals.
Temporary structures	Regulates the construction of temporary structures
Former SEPP 56 Sydney Harbour Foreshores and Tributaries	Repealed by SEPP (Major Projects) Amendment (Luna Park Site) Policy 2005
Major Development	Defines developments that are major projects to be assessed under Part 3A (now repealed) of the <i>Environmental Planning and Assessment Act 1979</i> and determined by the Minister for Planning. It also provides planning provisions for State significant sites.
71 – Coastal Protection	Ensures that development in the NSW coastal zone is appropriate and suitably located.

Instrument	Role
	Provides a consistent and strategic approach to coastal planning and management and to ensure there is a clear development assessment framework for the coastal zone. Does not include Sydney Harbour.
33 – Hazardous and Offensive Development	Defines these industries and enables decisions to approve or refuse a development to be based on the merit of proposal.
<i>Sydney Regional Environmental Plan</i>	
Sydney Regional Environmental Plan (SREP) 26 for Sydney Harbour	The Harbour REP consolidates, replaces or amends a number of planning instruments applying to the Harbour. The REP provides an improved and clearer planning framework to achieve better environmental outcomes for the Harbour and its catchment. It consolidates and replaces the following instruments: Sydney Regional Environmental Plan No. 22 – 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).

This table outlines the multitude of instruments that need to be considered in the development of a Coastal Zone Management Plan. Other planning instruments and environmental legislation do not apply to the Harbour such as SEPP 14 Coastal Wetlands and the Native Vegetation Act. A recommendation for further work is the preparation of a detailed matrix indicating all instruments and environmental legislation that apply to Sydney Harbour, as there may be particular provisions within instruments that exclude parts of Sydney Harbour due to the way coastal areas are defined, and the state of flux of coastal management in general. This is a significant issue for management of the area in a consistent fashion.

While SREP 26 consolidates key considerations for the Harbour it is not the sole instrument for the coastal zone within the Harbour. There are further opportunities to reform and simplify planning and environmental controls as they apply to the Harbour.

2.3.4 Local Environmental Plans

Local environmental plans for all NSW Councils are published on the NSW legislation website. Standard provisions for common issues have been developed by NSW Planning and Environment, with individual Councils choosing which provisions they include or modify. A summary of the provisions relevant to coastal management is provided in Table 2-3.

It is noted that only Manly Council contains provisions for development within the “Coastal Zone”,

Another inconsistency occurs with foreshore building line provisions. Whilst Mosman, Lane Cove, Sydney and Woollahra Councils use the “Foreshore building line” clause to regulate development, the equivalent provisions for Manly, North Sydney and Leichhardt Councils are included for interpretation in other clauses such as “Limited development on foreshore area”.

Table 2-3 Coastal management provisions in Local Environmental Plans

Planning Clause	Manly	Ku-ring-gai	Willoughby	Mosman	North Sydney	Lane Cove	Leichhardt	Sydney	Woollahra ²
Development within the coastal zone	✓								
Development below mean high water mark	✓		✓	✓	✓	✓	✓	✓	
Stormwater management	✓						✓		✓
Riparian land and watercourses	✓	✓ ³				✓ ³			
Natural watercourses				✓					
Foreshore scenic protection area	✓								✓
Scenic protection				✓					
Limited development on foreshore area	✓		✓		✓		✓		
Development on the foreshore must ensure access							✓	✓	
Foreshore building line				✓		✓		✓	✓
Site specific provisions								✓	

2.4 Strategy

A number of organisations and agencies have produced strategic plans for land and activities under their control. This section summarises key plans and strategies that have the potential to affect Sydney Harbour.

Whilst the CZMP will not deliver actions in its own right, it will be an important plan to underpin planning strategy, decision making and investment plans.

2.4.1 Sydney Harbour National Park Plan of Management – Office of Environment and Heritage

Sydney Harbour National Park covers 393 hectares of headlands, beaches and islands in and around Sydney Harbour. The plan of management describes the aspects of Sydney Harbour valued from a national park perspective. It identifies eight key desired outcomes as follows:

1. Conserve the natural values of the park
2. Celebrate and nurture contemporary and traditional Aboriginal culture

² Woollahra Council's current adopted LEP is from 1995; the 2013 LEP is in draft form and is expected to be adopted in late 2014. The Woollahra provisions have therefore been aligned with the closest current terminology used for other recent LEPs.

³ LEP contains provisions, but they do not apply within the study area.

3. Celebrate the historic heritage values of the park
4. Provide enriching and memorable experiences in the park
5. Improved access to the park for all
6. Strengthen and create partnerships
7. Robust management of the park is sustained
8. Contribute to the goal of easy and safe transport to and within the park

The plan identifies key projects to achieve these desired outcomes. Precincts are identified and issues that pose a threat to the park are summarised within the plan. This plan also notes the interdependence with other agencies and a need for high degree of cooperation.

2.4.2 Sydney Regional Coastal Management Strategy – SCCG

The Sydney Coastal Councils Group (SCCG) released the Sydney Regional Coastal Management Strategy (SRCMS) in 1998. The aim of the Strategy was to protect and conserve terrestrial and marine ecosystems in the study area, through the implementation of identified sustainable coastal planning and management practices. The study area comprised the local government areas from Pittwater to Sutherland inclusive, and the adjacent marine waters within three nautical miles (5.5 km) of the coastline. The Strategy contained 6 key themes, 42 strategic actions and 148 indicators. The key themes were:

1. Water cycle management
2. Nature conservation
3. Public access
4. Role of government
5. Climate change
6. Cultural heritage

A 2001 review of progress in implementing the SRCMS found good progress in relation to Water Cycle Management and Natural Conservation. Reasonable progress was found to have been achieved in the programs of Public Access and the Role of Government. It is unclear whether the SRCMS is still funded or is being actively implemented by coastal councils.

2.4.3 Sydney Harbour Catchment Blueprint – Department of Land and Water Conservation

Sydney Harbour Catchment Blueprint was released in 2003 by the then Department of Land and Water Conservation. The Blueprint established the strategic direction for the management of natural resources in the catchment. The Blueprint aimed to guide the actions of government and set priorities for the investment of natural resource management funds over a 10 year horizon. The plan was provided without any direct responsibility to organisations to implement its recommendations, however having held the status of government policy, it served as an influential document for a range of state based natural resource management agencies. The term of the plan expired in 2013. The guiding principles established in the Blueprint serve as an influential legacy for the future Coastal Zone Management Plan of Sydney Harbour.

2.4.4 Local Government Strategic Plans

Each LGA with access to Sydney Harbour has produced a strategic plan. The key aspects relevant to Sydney Harbour are summarised for this study.

City of Sydney - The City's Sustainable Sydney 2030 plan incorporates strategic objectives into actionable steps to make Sydney 'green, global and connected'. Key to this is reconnecting residents and the workforce to the waterfront. This is to be achieved through plans to:

- Improve active transport (especially by walking and cycling)
- Undertake waterfront renewal projects
- Implement street improvements to connect waterfront villages

North Sydney – Council has prepared a water based recreation needs study and a foreshore access strategy. The strategy considers 10 precincts within the council area that serve as access points to important foreshore areas, focussing on three aspects:

- Existing access systems – including pedestrian tracks, stairs and safety rails
- Pressures for access – including challenging topography for disabled persons
- Opportunities for improved access – such as way-finding signage for public identification of foreshore access areas

Accordingly, the strategy is driven by the vision *“To promote and improve access links to the North Sydney foreshore for the local and wider community from both the land and the water to continue sustainable use and enjoyment of Sydney Harbour as a unique waterfront environment.”*

Ku-ring-gai Council Community Strategic Plan 2030 – Kur-ring-gai Council has a frontage on Middle Harbour, with most of this included in Garigal National Park. Relevant provisions include the enhancement and protection of natural areas and waterways, and a reduction in vulnerability to the impacts of climate change and extreme weather events.

Lane Cove 2025 Community Strategic Plan – The majority of Lane Cove's Harbour frontage is on the Lane Cove River, however a small section extends into Gore Cove where it meets the boundary of the North Sydney Council area. The Strategic Plan considers this Harbour area as river frontage. Key aspects of relevance to the management of their foreshore areas are the condition of the waterways, bushland regeneration and maintenance of high water quality standards.

Leichhardt 2025+ – Council's plan seeks to “promote and develop Leichhardt as a sustainable, liveable and connected community”. Strategies linked to the Harbour comprise:

- Maximising community access to the waterfront
- Retrofitting the built environment for the protection of waterways and the natural environment
- Reducing water pollution
- Managing flooding risks

Manly Community Strategic Plan – Beyond 2021 – This plan identifies key environmental goals focused on preserving and protecting biodiversity for future generations. Strategies linked to the management of the Harbour foreshore within Manly include:

- Implementing management actions in relevant coastal management plans
- Completing an estuary hazard study for the Clontarf/Bantry Bay area
- Implementing Sandy Bay, North Harbour and Ellery's Punt Reserve Landscape Masterplans
- Development of a Water Sensitive Urban Design Stormwater Plan
- Development of an asset management plan for foreshore structures

These activities are supported by the Harbour Foreshores and Coastline Management Special Advisory Committee.

MOSPLAN 2013–2023 – This plan outlines the vision for Mosman's future with a strong focus on economic, social and environmental sustainability. Various activities that will impact upon the management of Harbour areas outlined in the plan include:

- Contributing to the Sydney Harbour Federation Trust Management Plan Review
- Improving areas of foreshore path-based access
- Preserving and enhancing the biodiversity of beaches and the marine environment on both public and private land
- Improvement of water quality through the Harbourwatch program

Warringah Community Strategic Plan 2023 – This plan includes community objectives for a Healthy Environment recognising the importance of the health of beaches, foreshores and waterways. The plan outlines key activities and programs for parks, reserves and foreshores such as:

- Review of the Coastal Lands Plan of Management
- Foreshore renewal of key beaches and amenity areas
- Promoting the importance of sustainable living practises to help achieve foreshore management goals

Willoughby City Strategy 2013-2029 – Willoughby Council has nearly 20 km of Harbour foreshore, split between the Lane Cove River and Middle Harbour. Much of the Middle Harbour frontage is covered by bushland reserves, and the actions from the plan relevant to CZMP development focus on the conservation and maintenance of these areas, whilst still providing access to foreshore open space and recreational facilities.

Woollahra 2025 – This plan identifies the strengths and natural assets which characterise the 16km of Harbour foreshore within the Woollahra council locality. Anticipated challenges to future Harbour management are identified, including as aging foreshore infrastructure which will need to be updated in order to preserve the amenity and management of the area's natural assets. A key focus of the plan is to adopt 'a healthy environment' which is connected with the strategy to support clean, healthy waterways within immediate Harbour areas. Stormwater management plans.

In the past, Councils and Sydney Water produced management plans for stormwater systems draining to Sydney Harbour. The quality, quantity and velocity of stormwater have the potential to affect the Harbour. These plans articulate how stormwater systems will be managed and improved, identifying key objectives which relate to ecological sustainability, management considerations over various timeframes (short, medium, long run), and key issues facing stormwater management from a social and environmental perspective.

Stormwater management plans articulate an implementation strategy that applies within the LGA, in conjunction with estimated costs of activities, such as ensuring litter traps on major drain networks. Continued water quality monitoring is an integral component of these plans, as is continual revision to ensure that objectives are being met in line with environmental and social needs.

Within the study area, the provisions of most stormwater management plans have now been incorporated into Local Environmental Plans and are not separately published on local government web sites. Monitoring results are provided via either Beachwatch (official water quality monitoring) or Streamwatch (volunteer water quality monitoring). Beachwatch uses the National Health and Medical Research Council's Guidelines for Managing Risks in Recreational Waters (NHMRC, 2008).

2.4.5 Sydney Harbour Foreshore Authority

In May 2011, the Minister for Planning and Infrastructure announced that the Bays Precinct Taskforce would be reconvened to provide the NSW Government strategic advice on the land use issues within the Precinct and a framework for delivery.

The Bays Precinct (the Precinct) comprises the 94 hectares of the waterways of four connected bays west of Darling Harbour (Johnstons, White, Rozelle and Blackwattle Bays) and 80 hectares of adjoining and largely Government owned land.

The Taskforce made key recommendations in 2012 including regarding the following:

- Retaining public ownership of key sites
- Retaining and strengthening the planning framework including retaining Sydney Regional Environmental Plan
- Controls on leases
- Specific recommendations about each key precinct
- Traffic and transport
- Development opportunities
- Waterways use and management

In order to advance the Taskforce recommendations, the Bays Precinct Implementation Committee was established in 2013. This committee contains representatives from organisations including:

- Sydney Harbour Foreshore Authority
- Sydney Ports
- Government Property NSW
- Roads and Maritime Services, Maritime Division
- Transport for NSW

Various projects have subsequently been initiated to implement the Taskforce recommendations. In July 2014 the NSW Government announced the comprehensive redevelopment of the Bays Precinct, to be led by UrbanGrowth NSW (NSW Government, 2014d).

2.4.6 Sydney Harbour Federation Trust

The Sydney Harbour Federation Trust (SHFT) is responsible for vision planning and management of key Sydney Harbour sites such as Cockatoo Island, Neutral Bay and Georges Heights and aims to integrate the function of these sites into the life of the wider city. The Trust recognises the importance of environmental sustainability, guided by the principals in the *Environment Protection and Biodiversity Conservation Act (1999)* as well as a focus on preserving local heritage.

A Comprehensive Plan for the Harbour sites managed by the SHFT was approved by the then Federal Minister for Environment and Heritage in 2003. The plan sets out the Trust's vision for the sites under its control. The Comprehensive Plan requires that the Trust has prepares more detailed management plans for specific precincts, places or buildings. Plans have been prepared for Cockatoo Island (SHFT, 2007a; 2010).

The 2010 Cockatoo Island Management Plan notes that the island is not part of any local government area. On this basis, local government based Coastal Zone Management Plans would not automatically apply to Cockatoo Island or others with the same governance status.

Management Plans identify outcomes for the sites desired by the Trust by setting out suitable land uses, new projects, and how the heritage of a site should be interpreted. As at November 2014, Management Plans have been prepared by the Trust for the following sites:

- North Head Sanctuary, Manly (2011)
- the former Marine Biological Station at Watsons Bay (2004)
- Macquarie Lightstation (2007)
- Woolwich Dock (2007)
- Headland Park, Mosman:
 - Lower Georges Heights (2003)
 - The harbourside precinct of Chowder Bay (2003)
 - Markham Close, Georges Heights (2003)
 - Georges Head (2005)
 - Training Command, Georges Heights (2004)
 - Mosman Drill Hall (2006)
 - Middle Head (2014)
 - Georges Heights (2008)

The Sydney Harbour Green Precincts Project is managed by the Trust, an initiative focused on implementing energy and water saving mechanisms at key sites. Bush regeneration is also an important focus of the Trust, having undertaken a variety of programs which have focused on planting and conserving native flora and collecting local seeds for propagation.

2.5 Funding

The NSW Government's Coastal Management Program provides support to local councils to manage the risks from coastal hazards, such as coastal erosion. It also assists to restore degraded coastal habitats and purchase for the State significant coastal lands under the Coastal Lands Protection Scheme. The NSW Government's Estuary Management Program provides support to councils to improve the health of NSW estuaries.

The support provided to councils under these programs includes technical and financial assistance to:

- prepare (or update) coastal zone management plans and associated technical studies (including estuary health and coastal hazard assessments)
- undertake actions to manage the risks associated with coastal hazards and to protect or improve coastal environments and estuary health.

Grant offers are subject to availability of funds for each financial year and statewide priorities. Funding of up to 50% of a project's costs will normally be offered for successful grant applications.

The NSW Government Floodplain Management Program provides financial support to councils and eligible public land managers for the management of flood risk to:

- make informed decisions by preparing floodplain risk management plans and studies;
- implement floodplain risk management plans; and
- provide essential information to the State Emergency Service to enable preparation and implementation of local flood plans for flood emergency response.

Assistance under the program is normally \$2 for every \$1 provided by local councils.

The Sharing Sydney Harbour Access Plan (DIPNR, 2003), provides for annual Access Program grants.

Roads and Maritime Services administered the Better Boating Program to help fund the development of boating infrastructure. This program provided \$2 million annually for boat ramps and other improvements within Sydney Harbour under two components: Sydney Harbour Boat Ramps (nominally \$1.5 million) and Sharing Sydney Harbour Access Program (nominally \$500,000). The latter program was run jointly with the Department of Planning and Infrastructure. From 2014-15, the Better Boating Program was replaced by the NSW Boating Now program. This new program will provide \$14 million annually for 5 years to be allocated in accordance with new Boating Regional Plans throughout NSW (RMS, 2014a).

Local government funding for foreshore areas is generally either project related (e.g. major infrastructure or planning documents), or maintenance related. As funding often covers other matters such as being included in budgets for general parks and gardens maintenance, the amount provided specifically for coastal management is generally not easily identified.

2.6 Key Management Issues

A multitude of legislation including Australian and state acts, planning instruments and local government plans and policies have an impact on the management of Sydney Harbour. The documents considered in this chapter were largely planning instruments and legislation. GHD has drawn conclusions about the content and relationship between these. GHD's review identified that each instrument or act has its own focus and by nature of the individual aims there is potential for conflict. Acts enabling maritime and transport activities have different goals from those that seek to protect the environment. This report identifies some of the common aspects of the goals of these instruments. However, this study in isolation is insufficient to resolve confusion. This current project can contribute towards resolution of these larger issues by identifying contributing issues and recommending priorities for action.

The planning system, primarily administered by local government, is a venue for these tensions to be resolved through the strategic planning and development approval systems. Australian and State governments are focusing on reducing regulation (Department of Premier and Cabinet, 2014) This is at a time when environmental challenges and pressures on the coastal zone are increasing and are placing more importance on the role of local government.

Not all areas to be covered by a CZMP are in local government areas, for example Cockatoo Island. Without specific inclusion, the management of coastal issues on these sites cannot be covered by local government based plans.

GHD observes that the respective time frames for legislative change and review of local planning instruments is a factor that can inhibit the implementation of coastal policy. A coastal zone management plan relies on delivery through secondary mechanisms including for example consideration in the assessment of a development application or review of a planning instrument.

Coordination between levels of government and between geographic areas of responsibilities is a well-documented challenge (Commonwealth of Australia, 2012). Highlighting inconsistencies in coastal zone management issues will assist in focussing on better management of this challenge. As outlined in this study, in particular, the definition of the coastal zone, including in terms of the definition of coastal protection zones, appears to be a source of significant confusion and debate.

Resources to manage the coastal zone and make effective decisions about major proposals are continuing to be put under strain.

2.7 Significant Gaps

Information provided by key stakeholders was reasonably brief and often did not address issues managed by other specialists within their organisation. GHD expects that significantly more, largely unpublished, information is held by those organisations. This applies to each of the topic areas covered in this review.

GHD notes that gaps in relation to governance arise due to the time lag between important issues being identified at a national and or state level and change to regulation at a local level. Without action oriented policy and suitable resources, key issues identified for action will be ignored or unduly delayed.

GHD was unable to find meaningful information is available on the direct or indirect funding of maintenance activities affecting the management, health and amenity of Sydney Harbour, particularly as a result of local government actions.

2.8 Recommendations for Further Work

It is recommended that key coastal policies and plans be clearly described in a summary document for Sydney Harbour. The State government's *Comprehensive Coastal Assessment* did not include Sydney Harbour and is now approaching a decade since release. This document could then form the basis for detailed discussion between affected stakeholders on how confusion over governance can best be managed or addressed, and may be being undertaken as part of the current coastal reform process. This issue needs to be considered as a priority in the development of a Sydney Harbour Coastal Zone Management Plan.

This literature review did not compare and contrast in detail the multiple local environmental plans and policies that apply to Sydney Harbour. Delving into why different provisions have been adopted is a potential area for further investigation. An assessment could also be made of the extent to which Australian and state government policy on coastal management is translated into decision making at local levels. The interpretation of policy and the relative weight it is given in decision making is an area for further consideration.

Local governments, through regional organisations of councils, can assess key governance gaps in relation to the need for state and federal coordination and research and cooperation priorities and seek to influence the state and Australian government COAG agenda.

Coastal protection zones have not been identified within Sydney Harbour, which is contributing to the debate over whether Sydney Harbour is indeed part of the coastal zone. Resolution of this matter is vital for the progress of a Harbour-wide CZMP. Agreement on the definition and extent of the NSW Coastal Zone and Coastal Protection Zones is required.

In order to identify additional, particularly unpublished information held by key stakeholders, it is recommended that a secondary detailed information assembly process be adopted, involving face to face interviews with multiple parts of stakeholder organisations. Issues to be pursued could be targeted on the basis of which aspects are of most concern to stakeholders.

2.9 Data Summary – Sydney Harbour Management

Table 2-4 Sydney Harbour management – summary of data sets identified

Data Requirement	Title	Description	Source/Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Planning Administration	New South Wales State Environmental Planning Policies	New South Wales State Environmental Planning Policies 14, 26, 59 and 71	Department of Planning and Infrastructure	Vector	1980-2012	NSW	Identify areas that, in the opinion of the Minister, is of State or regional environmental planning significance	H	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B3FA0508F-A2F1-4AD1-839A-C406AECAF0D6%7D
Planning Administration	Coastal Protection (State Environmental Planning Policy No. 71) - SEPP 71	Defines the NSW Coastal Zone	Department of Planning and Infrastructure	Vector	n/a	NSW Coastline	Defines the NSW Coastal Zone for use in assessing coastal development applications	H	N	Available	https://sdi.nsw.gov.au/catalog/nrdd/C/Coastal%20Protection%20(State%20Environmental%20Planning%20Policy%20No.%2071)%20-%20SEPP%2071.html
Planning Administration	Planning Region	Administrative boundaries	Department of Planning and Infrastructure	Vector	2012	NSW	To clearly define administrative planning regions that support statewide planning and development	H	N	Planned	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B54DBBF8-6148-4935-844A-0B1486FA288B%7D
Planning Administration	NSW Local Government Area Boundary Map	Local Government Administrative boundaries	Land and Property Information	Vector	2012	NSW	A meaningful administrative subdivision of land	H	N	Ongoing	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B4D7D4F49-56E1-4562-B559-B17AA139D9F5%7D

2.10 Summary of issues, gaps and recommendations

Table 2-5 Sydney Harbour management – summary of issues, gaps and recommendations

Key Management Issues	Significant Gaps	Recommendations for Further Work
General confusion on who has management responsibilities as a result of the multitude and complexity of legislation and policies applying to Sydney Harbour	Information on the direct or indirect funding of maintenance activities affecting the management, health and amenity of Sydney Harbour, particularly as a result of local government actions	Develop a summary document that details all relevant coastal policies and plans, to be used as a basis for a detailed discussion between affected stakeholders on how confusion over governance can best be managed or addressed. This may be addressed through the current coastal reform process
Inconsistent application of coastal policy as a result of reliance on local government for implementation		Investigate why different and inconsistent provisions have been adopted in Local Environmental Plans Develop an understanding of the extent to which Australian and state government policy on coastal management is translated into decision making at local levels Develop an understanding of how coastal policy is being interpreted and the relative weight it is given in decision making, particularly at the local government level
Long timeframes for policy or legislative change		Identify how the time lag between important issues being identified at a national and or state level and change to regulation at a local level can be reduced
Lack of coordination between levels of government and geographic responsibilities		
Confusion over the definition of “coastal zone”		Resolve the confusion over whether the Coastal Zone, and by inference Coastal Protection Zones, apply to Sydney Harbour
Lack of access to historical information held by agencies and organisations	Additional information is likely to be held by key stakeholders.	Hold detailed face to face discussions with multiple parts of key stakeholders to identify and access additional literature and data

3. Coastal Management Plans

3.1 Summary

3.1.1 Key Findings

Coastal management planning is not addressed consistently throughout Sydney Harbour. Within the study area only Manly Council has implemented Coastal Zone Management Plans (CZMP's) for its Sydney Harbour shoreline.

In other local government areas within the study area, a variety of planning documents are used to address a range of coastal management issues. Not all issues are addressed in all areas, and the way the issues are addressed is also variable. This is likely to be reflective of the priority of that particular issue for that community at that point in time, the age of the documents and other policy and guidance available at the time the various documents were prepared.

3.1.2 Facts and Figures

There are five CZMP's in place within the study area, all of which are within the Manly Council local government area. Mosman and Woollahra Councils are currently preparing CZMP's.

The only issue addressed by plans for all local governments in the study area was the recreational and commercial use of the area by the community.

Nearly all local governments included the conservation and management of terrestrial habitat and heritage sites in their plans.

Only four local governments addressed coastal hazards and risks in their planning documents; three provided direction on the management of beach erosion and sedimentation.

3.1.3 Issues

Management of various coastal issues within the remaining local government areas is either addressed in other planning documents such as Park Management Plans (e.g. Lane Cove Council, 2007), actioned through usual Council functions (e.g. Mosman Council, 2013), or not addressed at all. In the majority of plans, the management of coastal issues is included as a secondary concern, rather than being the focus of the document (e.g. NSW National Parks and Wildlife Service, 2013).

There is inconsistency between Councils over which coastal management issues are addressed. To some extent this is reflective of the physical attributes of the shoreline, as the maintenance of natural coastal processes such as sediment transport are not addressed by planning documents in areas dominated by seawalls and rock headlands (e.g. COS, 2006).

As the issues addressed by a CZMP are developed through consultation with the wider community, it is not possible to state whether a management issue addressed in one plan but not addressed in another is a gap, as it may be more reflective of the priority of that particular issue for that community at that point in time.

However, whilst many of the issues are consistent, there is inconsistent consideration of that issue between local governments. It is GHD's view that some of this can be attributed to the varying age and purpose of the management documents, and the State government policy and guidance available at the time the documents were prepared.

Coastal hazards and risks, and beach erosion and sedimentation are key management issues typically contained within a CZMP, yet few local governments addressed these issues in their planning (Ku-ring-gai Council, 2013; Mosman Council, 2011; Manly Council, 2010b; Lane Cove Council, 2007; Geomarine, 1997).

3.1.4 Gaps

There are no specific CZMP's within the study area other than within the Manly local government area. It is acknowledged that Mosman and Woollahra Councils are currently preparing CZMP's. Limited foreshore specific information is available for Mosman, Lane Cove, Willoughby and Ku-ring-gai Harbour frontages.

There does not appear to have been a consistent basis for preparation of plans, as the issues addressed in CZMP's and other planning documents reflect the priority issues for that area at that time. It is acknowledged that it would be expected that a Sydney Harbour-wide CZMP would seek to provide consistent consideration of all relevant issues where appropriate.

Some of the management plans cover foreshore land regardless of ownership (e.g. Manly Council, 2004b), whereas other plans only address issues for land which is under the direct management of the organisation who prepared the document.

3.1.5 Recommendations

1. Whilst a Harbour-wide CZMP will resolve the current fractured approach to coastal management planning in the Harbour, development of the document will need to resolve numerous administrative, consistency and content issues. Further detailed discussions with key stakeholders on how best to resolve these issues will be required.
2. Heavy historical urbanisation has changed the nature of many foreshore areas over natural conditions. Actions for management approaches for heavily modified shorelines such as those prevalent in the Leichhardt and Sydney Council areas need to be identified.
3. A consistent approach on which lands are to be covered by a CZMP for Sydney Harbour (public only, or all lands) needs to be determined. Consideration of connectivity and consistency between adjacent local government areas within CZMP's is also required.

3.2 Existing Coastal Zone Management Plans

A number of local government areas have prepared, or are in the process of preparing, CZMP's for their Council area. At the time of compilation of this review, the CZMP's and/or their supporting documentation for Woollahra and Mosman Councils were under preparation and were not available for review.

To date, only Manly Council has prepared CZMP's that cover the entirety of their harbour foreshore areas, preparing detailed Management Plans for coastal areas under its control. There are currently 5 within the Sydney Harbour Study Area, and each management plan is supported by a technical study that provides context for the study, and identifies and quantifies the coastal processes and hazards affecting that area:

- Forty Baskets (2004)
- Little Manly (2004)
- Clontarf/Bantry Bay (2008)
- North Harbour (2010)
- Manly Cove (2011)

Warringah and North Sydney Council's shorelines within the study area are limited to their Middle Harbour frontage. The Warringah Council shoreline within Middle Harbour is contained within Garigal National Park. For North Sydney, an Estuary Management Plan was prepared for Long Bay (Geomarine, 1997). This plan was also supported by an estuary processes study (Willing and Partners, 1996).

Leichhardt and City of Sydney Councils have prepared Plans of Management for various parks in their jurisdiction, including foreshore parks. These plans focus on terrestrial issues such as landscaping and scenic amenity rather than the maintenance of natural processes. There are few, if any, sections of foreshore unprotected by natural rock headlands or coastal structures such as seawalls.

Mosman Council has Plans of Management in place for selected foreshore areas, such as The Spit and Balmoral Beach (Mosman Council, 2011; Phillips Marler, 2010; 2011). In addition, the Council published foreshore building lines as part of its Local Environmental Plan (Mosman Council, 2012).

Woollahra Council's "Foreshore Areas Plan of Management" (WMC, 1996) covers estuarine and oceanic frontages within the Council boundaries. The plan is strongly focussed on terrestrial management within the Council boundary, and the way the community uses foreshore land.

3.3 Other Management Plans

Some of the operational aspects of issues typically covered by CZMP's have been addressed in other planning documents, such as park plans of management and local environmental plans (which include stormwater). These include those contained in Table 3-1. Management of coastal issues on private lands do not generally appear to have been included in CZMP's, but instead are managed through Local Environmental Plans. It is noted that Section 36 of the *Local Government Act 1993* requires Councils to prepare a draft plan of management for all public land classified as community land.

Table 3-1 Non-CZMP documents that implement coastal management actions

Issue	Plan Type	North Sydney	Mosman	Leichhardt	Sydney	Willoughby	Lane Cove	Ku-ring-gai	National Parks	Botanic Gardens	Roads & Maritime Services
Bushland/Terrestrial Habitat Conservation & Management	Park Management Plan Annual Report Riparian Policy	✓	✓	✓		✓	✓	✓	✓		
Hazards & Risks including Climate Change	Floodplain Management Policy				✓	✓	✓	✓		✓	
Amenity	Park Management Plan	✓		✓		✓		✓	✓		
Access	Park Management Plan Boating Safety Plan Annual Report	✓	✓	✓		✓	✓	✓	✓		✓
Community, Recreational & Commercial Use	Park Management Plan Boating Safety Plan	✓		✓		✓		✓	✓		✓
Heritage Conservation & Management	Park Management Plan Annual Report	✓	✓	✓		✓	✓	✓	✓		
Community Involvement	Park Management Plan Boating Safety Plan Annual Report		✓			✓	✓	✓	✓		✓
Coordination between Authorities	Park Management Plan						✓		✓		

Issue	Plan Type	North Sydney	Mosman	Leichhardt	Sydney	Willoughby	Lane Cove	Ku-ring-gai	National Parks	Botanic Gardens	Roads & Maritime Services
Traffic Management	Park Management Plan Boating Safety Plan					✓		✓	✓		✓
Crime Prevention & Safety	Boating Safety Plan			✓		✓		✓			✓
Beach Erosion & Sedimentation	Boating Safety Plan Annual Report		✓					✓			✓
Aquatic/Inter-tidal Habitat Conservation & Management	Boating Safety Plan Annual Report		✓								✓
Monitoring	Monitoring Plan Park Management Plan		✓			✓		✓			

3.4 Key Management Issues

Whilst the issues and proposed management actions are in some cases unique to or sensitive to the local conditions, the issues in the various management plans can be largely grouped as shown in Table 3-2.

Table 3-2 Coastal management issues addressed in local government plans

Planning Issue	Manly	Ku-ring-gai	Willoughby	Mosman	North Sydney	Lane Cove	Leichhardt	Sydney	Woollahra
Access	✓	✓	✓	✓	✓	✓			✓
Amenity	✓			✓			✓	✓	✓
Aquatic/Inter-tidal Habitat Conservation & Management	✓				✓				
Beach Erosion & Sedimentation	✓			✓	✓				
Bushland/Terrestrial Habitat Conservation & Management	✓	✓	✓	✓		✓	✓	✓	✓
Community Involvement		✓	✓			✓			✓
Community, Recreational & Commercial Use	✓	✓	✓	✓	✓	✓	✓	✓	✓
Coordination between Authorities				✓		✓			✓
Crime Prevention & Safety	✓			✓			✓	✓	
Foreshore Development	✓			✓			✓	✓	✓
Geodiversity	✓	✓	✓			✓			
Hazards & Risks including Climate Change	✓	✓		✓		✓			
Heritage Conservation & Management	✓	✓	✓	✓		✓	✓	✓	✓
Monitoring	✓		✓						
Public & Foreshore Infrastructure & Facilities	✓		✓	✓	✓		✓	✓	✓
Tourism & Promotion									✓
Traffic Management	✓	✓	✓	✓					✓
Waste Management	✓		✓	✓					
Water Quality & Pollution	✓	✓	✓	✓	✓	✓			✓

This table illustrates the inconsistent manner in which coastal planning and management issues are currently addressed by local government with Sydney Harbour frontage.

The only issue addressed by all local governments was the use of coastal areas for recreational and commercial purposes. Nearly all local governments included planning for the conservation of heritage and terrestrial habitats in coastal areas.

Coastal hazards and risks, and beach erosion and sedimentation are management issues typically contained within a CZMP, yet few local governments have addressed these issues in their planning (Ku-ring-gai Council, 2013; Mosman Council, 2011; Manly Council, 2010b; Lane Cove Council, 2007; Geomarine, 1997).

As the issues addressed by a CZMP are developed through consultation with the wider community, it is not possible to state whether a management issue addressed in one plan but not addressed in another is a gap, as it may be more reflective of the priority of that particular issue for that community at that point in time. However, whilst many of the issues are consistent, there is not consistent consideration of that issue between local governments. Some of this can be attributed to the varying age and purpose of the management documents, and the State government policy and guidance available at the time the various documents were prepared.

3.5 Significant Gaps

GHD identified that specific CZMP's have not been prepared for the Sydney Harbour frontage of Warringah, Mosman, North Sydney, Leichhardt, Sydney and Woollahra local government areas. It is acknowledged that Mosman and Woollahra Councils have commenced CZMP planning processes within the last 2 years, and that a draft CZMP has been released for Warringah's ocean frontage beaches (Warringah Council, 2014). This issue would be addressed through the preparation of a Harbour-wide CZMP.

Limited foreshore specific information is available for Mosman, Lane Cove, Willoughby and Ku-ring-gai Harbour frontages, and the focus appears to have been on the protection of bushland within some of these areas (Ku-ring-gai Council, 2013; Lane Cove Council, 2007; Willoughby City Council, 2013).

As previously mentioned, issues addressed in CZMP's reflect the priority issues for that area at that time. It is acknowledged that it would be expected that a Sydney Harbour-wide CZMP would seek to provide consistent consideration of all relevant issues where appropriate.

Some of the management plans cover foreshore land regardless of ownership (e.g. Manly Council, 2004b), whereas other plans only address issues for land which is under the direct management of the organisation who prepared the document.

3.6 Recommendations for Further Work

It is acknowledged that this literature and data review will inform a scoping study to identify the next steps for the development of a CZMP for Sydney Harbour. Whilst a Harbour-wide CZMP will resolve the current fractured approach to coastal management planning in the Harbour, development of the document will need to resolve numerous administrative, consistency and content issues as outlined in this document. Further detailed discussions with key stakeholders on how best to resolve these issues will be required.

Heavy historical urbanisation has changed the nature of many foreshore areas over natural conditions. Actions for management approaches for non-natural (i.e. heavily modified) shorelines such as those prevalent in the Leichhardt and Sydney Council areas need to be identified.

A consistent approach on which lands are to be covered by a CZMP for Sydney Harbour (public only, or all lands) needs to be determined. Consideration of connectivity and consistency between adjacent local government areas within CZMP's is also required.

3.7 Data Summary – Coastal Management Plans

Table 3-3 Coastal management plans – summary of data sets identified

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Infrastructure	Estuary Foreshore Structures	Data on the location of licensed foreshore structures	Office of Environment and Heritage	Locations	2009	NSW	To assess and better manage the health of natural resources across the State	M	N	Ongoing	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B3F2B8EFF-CD19-438A-9D23-BA5A0A3BE68E%7D

3.8 Summary of issues, gaps and recommendations

Table 3-4 Coastal management plans – summary of issues, gaps and recommendations

Key Management Issues	Significant Gaps	Recommendations for Further Work
<p>Inconsistent coverage in planning documents of coastal management issues such as:</p> <ul style="list-style-type: none"> • Access • Amenity • Aquatic/Inter-tidal Habitat Conservation & Management • Beach Erosion & Sedimentation • Bushland/Terrestrial Habitat Conservation & Management • Community Involvement • Community, Recreational & Commercial Use • Coordination between Authorities • Crime Prevention & Safety • Foreshore Development 	<p>No specific CZMP's are in place for the Sydney Harbour frontage of Warringah, Willoughby, Ku-ring-gai, Mosman, North Sydney, Land Cove, Leichhardt, Sydney and Woollahra local government areas. CZMP's only in place within Sydney Harbour for Manly Council foreshore areas.</p>	<p>For future stages of the Sydney Harbour CZMP project, broker an agreement between stakeholders to resolve administrative, consistency and content issues, particularly when considering existing CZMP content for a Harbour-wide CZMP</p>

Key Management Issues	Significant Gaps	Recommendations for Further Work
<ul style="list-style-type: none"> • Geodiversity • Hazards & Risks including Climate Change • Heritage Conservation & Management • Monitoring • Public & Foreshore Infrastructure & Facilities • Tourism & Promotion • Traffic Management • Waste Management • Water Quality & Pollution 		
Inconsistent priorities and consideration of management issues		Identify actions for management approaches for heavily modified shorelines
Inconsistent consideration of ownership of lands to be covered by CZMP		Broker an agreement between stakeholders on which lands are to be covered by a CZMP for Sydney Harbour, and how connectivity and consistency between adjacent local government areas will be addressed

4. Coastal Risks and Hazards

4.1 Summary

4.1.1 Key Findings

The management of coastal risks and hazards within NSW is primarily covered by the *Coastal Protection Act 1979*, as well as supporting legislation and guideline documents. Guidelines for the assessment of coastal risks are described in *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013a).

Recent risk assessments for Sydney Harbour foreshores have been undertaken as part of supporting studies to inform the preparation of CZMP's, including those still in preparation. This work has been completed through the NSW State Government's Coastal Zone Management Program. The majority of these previous risk assessments focused on the assessment of hazards as a result of coastal inundation of the Sydney Harbour foreshore.

Despite the intensity of development on many of the cliffs and steep slopes adjacent to the foreshore, limited investigations have been undertaken into cliff/slope stability as part of these coastal risk assessments.

In addition, flooding studies completed by councils such as Leichhardt, Manly and Mosman considered tidal and wave inundation from Sydney Harbour due to the intrinsic link between the Harbour and the floodplains of the local government areas. These flooding studies have been completed under the NSW State Government's Floodplain Management Program.

4.1.2 Facts and Figures

Key facts and figures relating to the coastal risks and hazards of Sydney Harbour are as follows:

- Harbour area covers 5,255 hectares (RMS, 2014b)
- 317 km of foreshore (RMS, 2014b)
- 52 beaches (Outer Harbour – East of the bridge) (Short, 2007)
- Over 25 swimming sites (OEH, 2014)
- Key foreshore assets:
 - Sydney Opera House
 - Kirribilli House
 - Barangaroo
 - Harbour Bridge Infrastructure
 - Sydney Harbour National Park
 - Garden Island Naval Base
 - Fort Denison
 - Circular Quay and Darling Harbour Transport Hubs
 - Numerous Marinas and Yacht Clubs
 - Royal Botanical Gardens
 - White Bay Port Infrastructure
 - Gore Cove Refinery

- Eight islands, comprising:
 - Fort Denison
 - Shark Island
 - Clark Island
 - Rodd Island
 - Spectacle Island
 - Snapper Island
 - Goat Island
 - Cockatoo Island

4.1.3 Issues

Upon consideration of the information reviewed, the key management issues associated with coastal risk are:

- Differing priorities between councils
- Differing approaches between councils
- Lack of detailed outcomes and specific actions generated by previous study
- Inconsistent integration with other programs
- Data availability and consistency;
- The high cost of implementation
- Uncertainty regarding coastal reforms
- The absence of agreed sea level rise benchmarks.

4.1.4 Gaps

In order to consider the minimum criteria for assessing the extent of coastal hazards as specified by the NSW Government, an extensive dataset would be required for the study area.

Whilst much of this information is held by local and state government, comprehensive data sets do not generally exist. Significant resources would be required to source and compile this information such that a detailed assessment of coastal risks could be undertaken. Very little information on these datasets was identified by stakeholders as part of this literature review.

4.1.5 Recommendations

1. Stakeholder Liaison with OEH regarding the coastal reform process currently being undertaken by the NSW Government. This would ensure that the future assessment of coastal risks meets or exceeds the requirements of the NSW State Government.
2. Discussions are undertaken with project partners to confirm the specific outcomes of the CZMP, which will significantly influence the overall scale of the studies required to deliver the ultimate Plan.

4.2 Coastal Risk Assessment in NSW

The management of coastal risks and hazards within NSW is primarily covered by the *Coastal Protection Act 1979*, as well as supporting legislation and guideline documents. A more detailed discussion of the legislation relation to management of the coastal zone is provided in Section 2.3.

Guidelines for the assessment of coastal risks have been prepared by the Office of Environment and Heritage (OEH), and are described in *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013a). These guidelines were amended in 2013 to reflect the NSW Government's withdrawal of its sea level rise policy (refer Section 2.3.2). Figure 4-1 shows the minimum requirements for assessing coastal risks as outlined in the guidelines.

The guidelines also outline the minimum criteria for assessing the extent of coastal hazards which are provided in Table 4-1. It is noted that in addition to these risks, the guidelines also state that consideration may also be given to the following risks:

- Rock fishing
- Beach safety
- Sand drift
- Stormwater outlets onto beaches
- Tsunami impacts

Table 4-1 Minimum assessment criteria for coastal hazards (OEH, 2013a)

Hazard	Minimum assessment criteria
Beach erosion	Storm bite due to a beach erosion event with an average recurrence interval (ARI) of approximately 100 years plus an allowance for reduced building foundation capacity
Shoreline recession	Estimated recession due to sediment budget deficit and projected sea level rise*
Coastal lake or watercourse entrance instability	Qualitative assessment of entrance dynamics based on historical records*
Coastal inundation (including estuaries)	Estimate of wave run-up level and overtopping of dunes resulting from an extreme ocean storm event*
Coastal cliff or slope instability	Slope stability assessment; see Australian Geomechanics Society (2007)*
Tidal inundation (including estuaries)	Estimate of areas inundated from still water levels with a 50 or 100-year ARI*
Erosion within estuaries caused by tidal waters, including the interaction of those waters with catchment floodwaters	Estimate of estuary foreshore erosion due to physical processes and flood events

* assess under current conditions and projected future conditions.

Minimum requirements: coastal risks

A CZMP which addresses coastal risks should include:

- a description of:
 - coastal processes within the plan's area, to a level of detail sufficient to inform decision-making
 - the nature and extent of risks to public safety and built assets from coastal hazards
 - projected climate change impacts on risks from coastal hazards (section 55C(f) of the *Coastal Protection Act 1979*), based on council's adopted sea level rise projections or range of projections. Councils should consider adopting projections that are widely accepted by competent scientific opinion.
 - suitable locations where landowners could construct coastal protection works (provided they pay for the maintenance of the works and manage any off-site impacts), subject to the requirements of the *Environmental Planning and Assessment Act 1979*, and
 - property risk and response categories for all properties located in coastal hazard areas
- proposed actions in the implementation schedule to manage current and projected future risks from coastal hazards, including risks in an estuary from coastal hazards. Actions are to focus on managing the highest risks (section 55C(d) and (e) of the *Coastal Protection Act 1979*)
- where the plan proposes the construction of coastal protection works (other than temporary coastal protection works) that are to be funded by the council or a private landowner or both, the proposed arrangements for the adequate maintenance of the works and for managing associated impacts of such works (section 55C(g) of the *Coastal Protection Act 1979*), and
- an emergency action subplan, which is to describe:
 - intended emergency actions to be carried out during periods of beach erosion such as coastal protection works for property or asset protection, other than matters dealt with in any plan made under the *State Emergency and Rescue Management Act 1989* relating to emergency response (sections 55C(b) and (g) of the *Coastal Protection Act 1979*)
 - any site-specific requirements for landowner temporary coastal protection works, and
 - the consultation carried out with the owners of land affected by a subplan.

Figure 4-1 Minimum requirements for assessing coastal risks (OEH, 2013a)

4.3 Coastal Risk Assessment within Sydney Harbour

Recent risk assessments for Sydney Harbour foreshores have been undertaken as part of supporting studies to inform the preparation of CZMP's, including those still in preparation. This work has been completed through the NSW State Government's Coastal Zone Management Program.

Whilst ocean swell does penetrate into Sydney Harbour, in accordance with wave theory the swell is attenuated it propagates upstream into shallower and more sheltered water (Dean and Dalrymple, 1991). It is therefore important to note that the majority of foreshore lining Sydney Harbour is not directly exposed to open ocean swells and the Harbour is generally considered to be a less dynamic environment than the open coast. As a result, the types of coastal hazards, as well as the likelihood and consequences of the risks arising from these hazards differ from those typically encountered within other local government areas along the NSW ocean coastline.

More specifically, the majority of previous risk assessments completed for Sydney Harbour have focused on the assessment of hazards from coastal inundation of the foreshore. This includes high resolution hydrodynamic modelling by the CSIRO in 2012 of inundation under current climate, extreme event and sea level rise projections commissioned by the SCCG on behalf of its member councils (Leitch, 2012).

In addition, flooding studies completed by councils such as Leichhardt, Manly and Mosman have considered tidal and wave inundation from Sydney Harbour due to the intrinsic link between the Harbour and the floodplains of the local government areas. These flooding studies have been completed under the NSW State Government’s Floodplain Management Program.

Assessment of isolated areas of coastal erosion within Sydney Harbour has been generally addressed on a case by case basis, rather than through a single study and plan of management.

Consideration of the stability of cliffs and other steep slopes adjacent to the foreshore is also important for many Harbour stakeholders, particularly in light of the intensity of development on many of these slopes, views and recreational opportunities afforded by these vantage points. The Australian Geomechanics Society guideline (Australian Geomechanics Society, 2007) assists decision makers, land use planners, geotechnical professionals and project managers in dealing with projects involving these slopes. Only Manly Council’s Coastal Management Plans include consideration of geodiversity and cliff/slope stability (Manly Council, 2012a).

Table 4-2 provides a list of the Councils that have completed council-wide coastal hazard studies. As shown in Table 4-2, CZMP’s have recently been prepared for the sections of Sydney Harbour foreshore adjacent to the Parramatta and Lane Cove Rivers, immediately upstream of the study area for this scoping study.

Table 4-2 Coastal hazard studies within Sydney Harbour by Council

Council	Status	Relevant Studies
Ashfield Municipal Council	Completed	Parramatta River Estuary Processes Study October 2010 AECOM Parramatta River Estuary – Coastal Hazard Assessment 2013 Cardno Parramatta River Estuary Coastal Zone Management Plan 2012 Cardno
Auburn Council	Completed	Parramatta River Estuary Processes Study October 2010 AECOM Parramatta River Estuary – Coastal Hazard Assessment 2013 Cardno Parramatta River Estuary Coastal Zone Management Plan 2012 Cardno

Council	Status	Relevant Studies
Canada Bay City Council	Completed	Catchment to Cove - Stormwater and Biodiversity 2008 Parramatta River Estuary Processes Study October 2010 AECOM Parramatta River Estuary – Coastal Hazard Assessment 2013 Cardno Parramatta River Estuary Coastal Zone Management Plan 2012 Cardno
Hunters Hill Municipal Council	Completed	Lane Cove River Coastal Zone Management Plan July 2013 WBM BMT Parramatta River Estuary Processes Study October 2010 AECOM Parramatta River Estuary – Coastal Hazard Assessment 2013 Cardno Parramatta River Estuary Coastal Zone Management Plan 2012 Cardno
Ku-ring-gai Council	Not completed	N/A
Lane Cove Municipal Council	Completed	Lane Cove River Coastal Zone Management Plan July 2013 WBM BMT
Leichhardt Municipal Council	Completed	Parramatta River Estuary Processes Study October 2010 AECOM Parramatta River Estuary – Coastal Hazard Assessment 2013 Cardno Parramatta River Estuary Coastal Zone Management Plan 2012 Cardno Estuarine Planning Levels Study April 2010 Cardno Flood Risk Management Strategy and Plan underway
Manly Council	Completed	Forty Baskets Coastline Management Plan Little Manly Coastline Management Plan 2004 North Harbour Coastline Hazard Definition Study April 2004 North Harbour Coastline Management Study March 2009 North Harbour Coastline Management Plan March 2010 Manly Cove Coastal Zone Management Plan Clontarf / Bantry Bay Data Compilation & Estuary Processes Study August, 2007 Manly Council Clontarf / Bantry Bay Estuary Management Study November 2007 Manly Council Clontarf / Bantry Bay Estuary Management Plan May 2008 Manly Council Manly LGA Flood Study (underway)
Mosman Municipal Council	In progress	Mosman Coastal Zone Management Plan (underway) Mosman LGA Flood Study (underway)
North Sydney Council	Limited studies	Long Bay Middle Harbour Data Compilation Study June 1994 NSW Public Works Long Bay Estuary Management Study April 1997 Geomarine Long Bay Estuary Management Plan November 1997 Geomarine

Council	Status	Relevant Studies
Parramatta City Council	Completed	Parramatta River Estuary Data Compilation And Review Study July 2008 Cardno Parramatta River Estuary Processes Study October 2010 AECOM Parramatta River Estuary – Coastal Hazard Assessment 2013 Cardno Parramatta River Estuary Coastal Zone Management Plan 2012 Cardno
Ryde City Council	Completed	Lane Cove River Coastal Zone Management Plan July 2013 WBM BMT Parramatta River Estuary – Coastal Hazard Assessment 2013 Cardno Parramatta River Estuary Coastal Zone Management Plan 2012 Cardno
Sydney Coastal Councils Group ⁴	Completed	Modelling and Mapping of Coastal Inundation under Future Sea Level Rise December 2011 SCCG, CSIRO Incorporating Coastal Inundation & Sea Level Rise into Local and Regional Planning Responses July 2012 SCCG, CSIRO Supporting Local Government to communicate coastal inundation October 2012 SCCG CSIRO
Sydney City Council	Not completed	Blackwattle Bay catchment area flood study draft report WMA Water Sept 2012 Rushcutters Bay catchment area flood study draft report WMA Water June 2013 Woolloomooloo catchment area flood study draft report WMA Water July 2013
Warringah Council ⁵	Not completed	CZMP completed for Collaroy-Narrabeen Beach and Fishermans Beach
Willoughby City Council	Completed	Lane Cove River Coastal Zone Management Plan July 2013 WBM BMT
Woollahra Municipal Council	In progress	Woollahra CZMP (in progress) Watsons Bay Updated Flood Study 2013 Cardno Rushcutters Bay Flood Study 2007 Webb McKeown and Associates Double Bay Catchment Flood Study 2008 Bewsher Rose Bay Floodplain Risk and Management Study 2013 Dewar and Richards

⁴ Sydney Coastal Councils Group study considered lands managed by Botany Bay City Council, Hornsby Shire Council, Leichhardt Municipal Council, Manly Council, Mosman Municipal Council, North Sydney Council, Pittwater Shire Council, Randwick City Council, Rockdale Shire Council, Sydney City Council, Warringah Council, Waverley Shire Council, Willoughby City Council and Woollahra Municipal Council.

⁵ Warringah Shire Council does not own or manage any foreshore lands adjacent to Sydney Harbour.

It is important to note that some of the councils in the study area have already taken steps to investigate the coastal hazards and priority management issues associated with their sections of the Harbour foreshore. In particular, Manly Council has completed a number of hazard definition studies and prepared CZMP's for much of the northern foreshore of Middle Harbour Manly Council. (2009a,b; 2012a,c). In addition, Woollahra and Mosman Councils have commenced preparation of council-wide CZMP's which include the risk assessment of coastal hazards. These two CZMP's are still at the technical hazard studies stage (WMC, 2013b), (Mosman Council, 2005).

4.4 Key Management Issues

Upon consideration of the information reviewed, the key management issues associated with coastal risk have been identified and are summarised in Table 4-3.

Table 4-3 Key coastal risk management issues

Issue	Description
Differing priorities	<p>In some cases, the assessment of coastal risks may not be considered a high priority by some councils surrounding Sydney Harbour. This may be due to the relatively small percentage of land affected by coastal hazards or low level of perceived risk.</p> <p>In contrast, councils such as Mosman have a proportionally long length of coastline, iconic beaches, high ecological habitat values and important transport infrastructure in close proximity to potential coastal hazards.</p> <p>The priority assigned to completion of a risk assessment will vary between LGA's. Consequently, securing buy-in from all councils will require significant consultation as well as careful scoping and implementation of the CZMP.</p>
Differing approaches	<p>Some councils may prefer to manage foreshore issues on a case by case basis, in response to environmental, safety, social, political and economic issues at a local level.</p> <p>The completion of a single integrated project may constrain the management approaches available to councils.</p>
Study outcomes	<p>Previous studies such as those completed for the Parramatta and Lane Cove Rivers were completed to facilitate broader planning and assessment outcomes. Due to limitations of the available data and assumptions made in the assessment process, these studies did not allow application of the results on a small-scale basis (e.g. assessment of individual lots).</p> <p>The agreed outcomes for the CZMP will inform the level of investigations necessary to deliver these.</p>
Integration with other programs	<p>The results of a coastal risk assessment would need to be considered against similar flooding risk assessments completed through the Floodplain Management Program.</p> <p>It should be noted that the relative importance of the links between these risk assessments varies between councils. For example, flooding studies completed by councils such as Leichhardt, Manly and Mosman have considered tidal and wave inundation from Sydney Harbour due to the intrinsic link between the Harbour and the floodplains of these local government areas.</p> <p>Integration will also be required with other planning programs such as Local Land Services' Sydney Harbour Catchment Water Quality Improvement Plan, and other smaller risk related projects.</p>
Coastal reforms	<p>The NSW Government is currently conducting a two-stage coastal reform process in order to address community concerns about coastal management arrangements in NSW.</p> <p>Stage I of the NSW Government's coastal management reforms is now</p>

Issue	Description
	<p>largely complete.</p> <p>Stage II of the reforms covers the following three key areas:</p> <ul style="list-style-type: none"> • establishing a simpler and more integrated legal and policy framework for coastal management • providing improved guidance and technical advice to councils, while enabling and supporting local decision making • identifying potential funding options, particularly to implement coastal asset management strategies. <p>Liaison with state government representatives would be required throughout the study to ensure that the work undertaken is in accordance with the Stage II reforms.</p>
Implementation costs	<p>The completion of a single integrated project would offer cost savings through economy of scale and greater efficiency.</p> <p>However a project of this scale would require a large implementation cost to cover the investigation of coastal risks and development of appropriate management measures over a long length of complex foreshore.</p> <p>The approach to funding such as study would require careful consideration.</p>
Data availability	<p>The land immediately adjacent to the foreshores of Sydney Harbour includes a wide variety of landowners, including residential and commercial as well as local, state and federal government bodies.</p> <p>Securing access to these foreshore areas and existing datasets will require extensive liaison with a large number of land owners and lessees.</p> <p>Compilation of the required dataset will require merging of a large number of different datasets from a variety of sources.</p>
Sea level rise benchmarks	<p>It should also be acknowledged that as part of their coastal reforms, the NSW Government no longer recommends state-wide sea level rise benchmarks for use by local councils. This approach aims to allow councils to consider local conditions when assessing future hazards. Accordingly agreement on sea level rise planning benchmarks could be advanced through a Sydney Harbour CZMP.</p>

4.5 Significant Gaps

In order to consider the minimum criteria for assessing the extent of coastal hazards outlined in Table 4-1, an extensive dataset would be required for the study area, including the following:

- Aerial imagery
- Cadastral layers
- Land use and zoning information
- Environmental mapping
- Land survey data
- Bathymetry
- Wave, wind and tide data
- Rainfall and flood level data
- SLR benchmarks
- Details of foreshore treatment measures such as seawalls
- Details of foreshore assets

Whilst much of this information is held by local and state government, comprehensive data sets do not generally exist. Significant resources would be required to source and compile this information such that a detailed assessment of coastal risks could be undertaken. Very little information on these datasets was identified by stakeholders as part of this literature review.

It is likely that some individual datasets will be outdated which could affect the extent to which the combine dataset could be utilised.

Consequently, it is expected that infilling of the dataset would be required to enable a comprehensive assessment of the minimum criteria for coastal hazards outlined in Table 4-1.

4.6 Recommendations for Further Work

In order to allow an accurate appraisal of the issues associated with a coastal risk assessment for Sydney Harbour and to facilitate the delivery of a valuable scoping study document, the following tasks are recommended in the short term:

- Continued liaison with OEH regarding the coastal reform process currently being undertaken by the NSW Government. This would ensure that the future assessment of coastal risks meets or exceeds the requirements of the NSW State Government.
- Discussion with stakeholders to develop the specific outcomes of the CZMP. In particular, it will be necessary to define the manner in which the CZMP is to be utilised. For example, a plan similar to the Parramatta River CZMP could be prepared to facilitate broader planning and assessment outcomes. Alternatively, a more in-depth study could be undertaken in order to prepare a CZMP that could be applied on a small-scale basis, allowing assessment of individual lots, such as that currently under preparation for Mosman Council.

The specific outcomes of the CZMP will significantly influence the overall scale of the studies required to deliver the Plan. Depending on these outcomes, additional work may include:

- Agreement on sea level rise planning benchmarks by all councils covered by a Sydney Harbour CZMP.
- Reassessment of the available datasets, in light of the project requirements.
- Estimate the costs required to infill gaps and compile a comprehensive dataset.
- Assess funding availability and the feasibility of the overall project.

4.7 Data Summary – Coastal Risks and Hazards

Table 4-4 Coastal risks and hazards – summary of data sets identified

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Offshore Wave Climate	Sydney Waverider Buoy Data	Directional wave data since 3rd March 1992. Non-directional wave data since 17th July 1987.	MHL	Wave Height (Hsig & Hmax), Wave Period (Tz & Tp) and Wave Direction	Various	Long Reef	Defines offshore wave climate	H	N	Available	http://new.mhl.nsw.gov.au/data/realtime/wave/WaveDataCollection
Bathymetry	National Digital Elevation Model	Medium resolution dataset to provide elevation and depth data	Geoscience Australia	Elevations and Depths	Various	Australia	Regional scale depth and elevation usage	H	N	Under review	http://www.anzlic.gov.au/foundation_spatial_data_framework/elevation_and_depth
Bathymetry	N/A	Hydrographic Survey recorded by SPC	SPC	Points files, xyz, ASCII	Various	Sydney Harbour (part)	Defines seabed levels	H	N	Available	http://wavewindtide.sydneyports.com.au/wave/weather_original.asp
Topography	Sydney Heads 1:25000 Scale Geopdf Topographic Map		Land and Property Information	Map	1970-2011	Eastern Sydney Harbour	Emergency services	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B57A50E30-61A8-4AA1-A6C1-4BD0D9A2CA20%7D Note: also available in TIFF format
Landform	New South Wales DTDB Landform Theme	Digital terrain model	Land and Property Information	Elevations	2012	NSW	NSW wide DTM	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7BC09B0C21-34D0-4215-AED4-A8D7D08E7BED%7D
Water Level Data	N/A	Sydney Harbour (Fort Denison) Tides	SPC	Elevations	Various	Fort Denison	Defines water levels	H	N	Available	http://wavewindtide.sydneyports.com.au/wave/weather_original.asp

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Extreme Water Levels	N/A	Modelling and Mapping of Coastal Inundation Under Future Sea Level Rise	SCCG & CSIRO	Maps and elevations	Various	Sydney Harbour	Defines extreme water levels	H	N	Available	http://www.sydneycostalouncils.com.au/Project/Mapping_and_Responding_to_Coastal_Inundation
Extreme Water Levels	Tsunami inundation	Inundation layers from Tsunami events of varying return periods	University of Sydney (?)	Maps and elevations (?)	Unknown	Unknown	Defines extreme water levels	M	N	Unknown	Not publicly available. Held by University of Sydney (?)
Wind Data	N/A	Sydney Harbour (Fort Denison) Winds	SPC	Wind Speeds	Various	Fort Denison	Defines wind speeds	H	N	Available	http://wavewindtide.sydneyports.com.au/wave/weather_original.asp
Aerial Imagery	N/A	Vertical and oblique aerial photography since 1928	Geoscience Australia	Various	Various	Australia	Identify change	H	N	Available	http://www.ga.gov.au/scientific-topics/earth-obs/accessing-satellite-imagery/aerial-photography
Aerial Imagery	Sydney 50cm Orthorectified Imagery	Standard Colour Orthorectified Mosaic with ground sample distance of 50cm	Land and Property Information	Standard Colour Orthorectified Mosaic	2007-2008	Sydney	Identify change	H	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B8D5D4D53-6BFE-402B-9ECB-49BB738F59FF%7D
Sediment Samples	Coastal CRC Sediment Data	Sediment samples were collected by the Coastal CRC during August 2003	Geoscience Australia	Various	2003	Sydney Harbour	Identify Sediment Properties	M	N	Available	http://www.ozcoasts.gov.au/geom_geol/web3d/sydney.jsp
Catchment	Water	Hydrology features	Geoscience Australia	Catchment boundaries	Various (to 2011)	Australia	Interaction with coastal risks and hazards	L	N	Available	http://www.ga.gov.au/metadata-gateway/metadata/record/gcat_73078

4.8 Summary of issues, gaps and recommendations

Table 4-5 Coastal risks and hazards – summary of issues, gaps and recommendations

Key Management Issues	Significant Gaps	Recommendations for Further Work
Differing priorities between Councils	Comprehensive, current, Harbour-wide data sets for: <ul style="list-style-type: none"> • Aerial imagery • Cadastral layers • Land use and zoning information • Environmental mapping • Land survey data • Bathymetry • Wave, wind and tide data • Rainfall and flood level data • SLR benchmarks • Details of foreshore treatment measures such as seawalls • Details of foreshore assets 	Liaise with OEH regarding the coastal reform process currently being undertaken by the NSW Government to ensure that the future assessment of coastal risks meets or exceeds the requirements of the NSW State Government
Differing approaches to management		Utilise the CZMP process as a vehicle to unite stakeholders and collaboratively identify the outcomes the CZMP is to achieve.
Lack of agreement by stakeholders on study outcomes and scale applicability		Broker an agreement on sea level rise planning benchmarks by all councils covered by a Sydney Harbour CZMP
Integration with other programs such as floodplain risk assessments and water quality improvement plans		Reassess the available datasets, in light of the project requirements
High implementation costs		Estimate the costs required to infill gaps and compile a comprehensive dataset
Data is not readily available or compiled.		Assess funding availability and the feasibility of the overall project
Uncertainty as to the content, status and implementation of the NSW Stage II coastal reforms		
Agreement on sea level rise benchmarks		

5. Water and Sediment Quality

5.1 Summary

5.1.1 Key Findings

Sydney estuaries have been subject to substantial anthropogenic inputs from widespread urbanisation and development (Alquezar et al., 2006a; Hatje et al., 2001). Urban and industrialised run off has been particularly prevalent from sources such as power stations, lead and zinc smelters, sewerage works, refineries, manufacturing and agricultural practices (Alquezar et al., 2006b; Birch, 1996; DPI 2014a; Irvine and Birch, 1998; McCready et al., 2000), as well as stormwater pollution associated with general urban development (LLS, 2014c).

Water and sediment have the potential to act as a sink for contaminants entering estuarine environments, leading to prolonged contamination (Alquezar et al., 2006a) and subsequent biological and ecological impacts. These include elevated concentrations of contaminants within the tissues of marine organisms (Kirby, Maher and Harasti, 2001; Kirby, Maher and Krikowa, 2001), alterations of the biology and physiology of marine organisms (Alquezar et al., 2006a,b) and ultimately issues relating to human health from the consumption of contaminated animal tissues or ingestion of affected waters (DPI, 2014d).

In response to ongoing health concerns, long term monitoring programs were established to monitor bacterial levels and water quality parameters within Sydney Harbour. Results from these programs indicate there has been a gradual improvement in water quality over time (DEH, 1990; OEH, 2013b); however it is noted that rainfall events are often the trigger for beaches becoming susceptible to faecal contamination (DEH, 2011).

5.1.2 Facts and Figures

Some relevant facts and figures broadly relating to water and sediment quality in the study area are listed as follows:

- Sydney catchment is small and highly urbanised (86%) which results in rapid run-off during high precipitation events (Beck and Birch, 2012, in Hedge et al., 2013).
- Harbour salinity is generally in the order of 35 psu. At the Harbour mouth this can be reduced to about 30 psu in the top water layers (4 m) after very heavy rain (Hedge et al 2013).
- Tides in the Harbour are semi diurnal and reverse every six hours. Towards the Harbour entrance, tidal velocities can be as high as 0.25 m/s (Hedge et al., 2013).
- Ten kilometres offshore at the 100 m isobath, oceanic temperatures range between 12 °C and 25 °C in February (Hedge et al., 2013). Temperatures are more mixed in winter ranging between 16 °C and 20 °C in June.
- Rainfall in the Sydney catchment is characterised by dry conditions, punctuated by infrequent, high-precipitation events (rainfall > 50 mm per day).
- Most of the contamination present in the study area results from a combination of historical inputs that remain in the sediments and some current sources of input such as stormwater (Birch and McCready, 2009 in Hedge et al., 2013).
- The highest contamination concentrations are generally restricted to the bedded embayments and decrease markedly seaward in the Harbour (Roberts et al., 2008; Davis and Birch, 2010, 2011; in Hedge et al., 2013).

- Freshwater inflows deliver over 90% of Total Suspended Solids and metals during high river flow. Conversely base flow conditions deliver high levels of nutrients to the study area (Hedge et al. 2013).
- Modelling of overflows and discharges to the study area suggest that historically, sewage has contributed just over 50% of the Total Nitrogen and Total Phosphorus Loads (Hedge et al. 2013).

5.1.3 Issues

The primary issues around water and sediment quality are faecal contamination, particularly after rainfall events, stormwater contaminant input from estuary catchments (DEH, 2014e), as well as the interconnected and aged nature of the water infrastructure present in and adjacent to the Harbour, which may be contributing phosphorus and nitrogen contamination to the Harbour (Hedge et al., 2013).

The contamination status of the study area has been well characterised, with literature reviewed by Hedge et al. (2013) highlighting the extensive metal contamination present in the sediment coupled with the presence of non-metallic contaminants such as organohaline pesticides and polycyclic aromatic hydrocarbons. Emerging contaminants such as microplastics and nanoparticles have not been assessed within the Harbour. Over 50% of the sediment in the study area exceeds the Interim Sediment Guideline concentrations for Lead and 100% of the sediment exceeds trigger values that prompt further investigation of the activities that may disturb the sediment (Hedge et al., 2013).

High turbidity and nutrient loading into the Sydney catchment has the ability to adversely affect water quality in the study area. Delivery of Total Suspended Solids into the Harbour affects the quantity and quality of light available for photosynthesis (Hedge et al., 2013) whilst the enrichment of estuaries via nutrient input stimulates plant growth (eutrophication) and disrupts the balance between the production and metabolism of organic matter, sometimes leading to decreased ecological function (Cloern, 2001 in Hedge et al., 2013).

Predicated changes to the East Australian Current (EAC) due to climate change may have implications for water flows on the continental shelf and tidal exchange in the study area (Hedge et al., 2013).

5.1.4 Gaps

Based on key management issues identified in the SIMS report (2014) the following literature gaps have been identified as they relate to water and sediment quality:

- There have been no circulation modelling studies of the study area which investigate the interactions between the EAC offshore, coastal waters and circulation within the Sydney Harbour estuary itself (Hedge et al., 2013).
- Much of the literature collated on stressors/threats to the study area concentrate on these stressors in isolation rather than a cumulative impact assessment or consideration of stressor interaction (Hedge et al., 2013). Recent evidence for example, suggests that the effects of nutrients and metals may be synergistic; leading to the prediction that nutrient enrichment in the study area may actually be masking stronger effects of metal contamination (Hedge et al., 2013).
- Climate change, specifically how the predicted changes to rainfall patterns, temperature and sea level changes will affect the current water and sediment quality characteristics within the study area. One key area identified by Hedge et al., (2013) is the synergistic impacts of global climate change and the documented contamination status of the sediments within the study area.

- The ecological and economic impacts of NIS in the study area, including the impact of regional transport patterns of recreational vessels (or coastal trading vessels) on the risk of NIS in the study area (Hedge et al., 2013).
- Soft bottom sediment habitats were identified as one of the least studied in Sydney Harbour by Hedge et al. (2013). No comprehensive surveys of soft bottom benthic communities have been undertaken (Hedge et al., 2013)
- The impacts of emerging contaminants on natural systems are a globally recognised knowledge gap of concern (Barnes et al., 2008, Philips et al., 2010 (both cited but not referenced) in Hedge et al., 2013) and apply to the study area due to the nature of contaminant pathways present in the Harbour.
- Emerging contaminants such as nanoparticles and micro plastics have not been assessed in the study area. Additional knowledge gaps also exist concerning the feasibility of restoration of degraded systems within contaminated environments (Hedge et al., 2013)
- Non-point source pollutant inputs to the study area from urban run-off and stormwater drains were also identified as a knowledge gap by Hedge et al. (2013)
- There are knowledge gaps present in the direct or indirect effects of the delivery of nutrients and contaminants to open water or benthic biota within the study area. Typically strong linkages have been made between water quality and planktonic organisms but this has not been well studied in Sydney Harbour (Hedge et al., 2013). Climate change may exacerbate the processes involved in run-off, contamination and nutrient delivery to the study area and as such this linkage requires further investigation.
- There are no studies on the causal effects of nutrient enrichment on the ecology of Sydney Harbour. Reducing nutrient inputs requires a better understanding of the relative sources, and
- In undertaking the literature review, a clear understanding of the relative contribution of the various catchments, and the actions currently underway to intercept or manage contaminants before they reach the Harbour was not able to be determined.

5.1.5 Recommendations

An assessment of how various waterway managers are dealing with the management of contaminants into the Harbour would be beneficial to develop a consistent approach for a CZMP. Identification of any additional recommended actions from the SIMS study should be undertaken, and if relevant incorporated into the CZMP. Examples of recommendations put forward in the SIMS literature review (Hedge et al., 2013) include:

1. Development of a large-scale process-based biogeochemical modelling system for the Sydney Harbour to provide invaluable information to scientists and managers on nutrient and contamination pathways.
2. Genetic investigation techniques to provide evidence of NIS status and origin to assist in determining management measures to control NIS within the study area.
3. Information into the manner in which stormwater is delivered to the Sydney estuary and its ultimate fate would provide invaluable information to waterway managers.
4. Investigations to determine sources of point source pollution affecting the water and sediment quality of the study area, and what role these have on determining the spatial distribution of contamination.

5. Further analysis of water and sediments across the study area to determine the importance of emerging contaminants and their pathways into the Harbour.
6. Further investigations into the linkages between water quality and planktonic organisms, which is particularly important for areas of the Harbour which are slower to flush such as the inner parts of Port Jackson.

5.2 Historical Influences

Since European settlement, Sydney estuaries have been subject to substantial anthropogenic inputs from widespread urbanisation and development (Alquezar et al., 2006a; Hatje et al., 2001). Urban and industrialised run off has been particularly prevalent from sources such as power stations, lead and zinc smelters, sewerage works, refineries, manufacturing and agricultural practices (Alquezar et al., 2006b; Birch, 1996; DPI 2014a; Irvine and Birch, 1998; McCready et al., 2000). As each of these has its own contamination 'footprint', the distribution of contaminants within Sydney Harbour is not uniform. For example, the Parramatta River contains a high concentration of metals due to its proximity to previously operated refineries and metal smelters (Irvine and Birch, 1998).

In more recent years, stormwater pollution associated with general urban development has become a focus for catchment management authorities and their stakeholders, resulting in projects such as Local Lands Services' Sydney Harbour Catchment Water Quality Improvement Plan (LLS, 2014c) (formerly being undertaken under the name of Sydney Metropolitan Councils Catchment Management Authority).

5.3 Flow on Impacts

The waters and sediments within Sydney Harbour act as a medium where contaminants can be found over prolonged periods of time. This is particularly true for sediments, as they act as a sink for contamination which can persist for decades (Alquezar et al., 2006a). Prolonged contamination of estuarine environments, including those that abut Sydney Harbour, can lead to a number of biological and ecological impacts. These include elevated concentrations of contaminants within the tissues of marine organisms (Kirby, Maher and Harasti, 2001; Kirby, Maher and Krikowa, 2001), alterations of the biology and physiology of marine organisms (Alquezar et al., 2006a, 2006b) and ultimately issues relating to human health from the consumption of contaminated animal tissues or ingestion of affected waters (DPI, 2014d). Within Sydney Harbour, the presence of dioxins within the body tissues of marine organisms led to a ban of commercial fishing in 2006 (DPI, 2014d). Additionally, due to the high level of dioxins in marine organisms, the Department of Primary Industries recommends that recreational fishers not consume fish caught upstream of the Sydney Harbour bridge, and that the consumption of fish caught downstream of the bridge be limited to 150 g per month (DPI, 2014d).

5.4 Current Status and Monitoring

In response to ongoing health concerns, long term monitoring programs were established to monitor bacterial levels and water quality parameters within Sydney Harbour. These programs include the Beachwatch program, established in 1989, and the Harbourwatch program, established in 1994 (OEH, 2013b). Both programs are now known as Beachwatch, and aim to characterise annual water quality objectives (e.g. faecal coliforms) in comparison to national guidelines, such as the Australian and New Zealand Environment and Conservation Council Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000)

Results from long-term monitoring indicate there has been a gradual improvement in water quality over time (Department of Environment and Heritage, 1990; OEH, 2013b). However, in many cases results are skewed by the amount of rainfall or runoff, with rainfall events triggering beaches becoming susceptible to faecal contamination (DEH, 2011).

Specific Councils were directed to develop Stormwater Management Plans under Section 12 of the *Protection of the Environment Administration Act 1991*. All Harbour Councils within the study area were included in this direction, and the content of these plans have been incorporated into or reflected in other planning documents such as Local Environmental Plans, Development Control Plans and policies. This work was supported by the now defunct Stormwater Trust.

Modelling of stormwater pollutants for use in planning and program development forms a critical part of the Sydney Harbour Catchment Water Quality Improvement Plan (LLS, 2014c).

Water quality objectives published by the Department of Environment and Heritage (DEH, 2006) appear to have been in place for nearly a decade. It is not clear whether these objectives are regularly reviewed.

Sediments within Sydney Harbour have demonstrated elevated concentrations of metals in surface sediments (Birch, 1996; Birch et al., 1996; Irvine and Birch, 1998). For example, Zinc and Copper were found to be 48 and 108 times greater than estimated pre-European levels within the surface sediments of estuaries that feed into Sydney Harbour (Irvine and Birch, 1998). These elevated concentrations are typically associated with point sources from historic industrial practices, including smelting. A similar result was witnessed in the nearby Hawkesbury River; sediment sampling revealed that contamination sources were typically associated with point sources such as marinas and berths (URS, 2006).

Ongoing monitoring of contamination is also being investigated to determine the link between potential contamination and ecosystem health within Sydney Harbour as part of a multi-disciplinary study (Sydney Institute of Marine Science, 2014). Information generated from a number of studies currently being completed under this program are predicted to improve knowledge of the current state of sediment contamination and the possible flow on effects this is having within the wider marine ecosystem of Sydney Harbour.

5.5 Key Management Issues

The primary issues around water and sediment quality are faecal contamination, particularly after rainfall events, and contaminant loads from catchments supplying the estuary (stormwater) (DEH, 2014e). These issues impact on the Harbour's ecological values and recreational use.

5.6 Significant Gaps

In reviewing the literature presented above, a clear understanding of the relative contribution of the various catchments, and the actions currently underway to intercept or manage contaminants before they reach the Harbour was not able to be determined.

Based on key management issues identified in the SIMS report (2014) the following gaps have been identified as they relate to water and sediment quality:

- There have been no circulation modelling studies of the study area which investigate the interactions between the EAC offshore, coastal waters and circulation within the Sydney Harbour estuary itself (Hedge et al., 2013).
- Much of the literature collated on stressors/threats to the study area concentrate on these stressors in isolation rather than a cumulative impact assessment or consideration of stressor interaction (Hedge et al., 2013). Recent evidence for example, suggests that the effects of nutrients and metals may be synergistic; leading to the prediction that nutrient enrichment in the study area may actually be masking stronger effects of metal contamination (Hedge et al., 2013).
- Climate change, specifically how the predicted changes to rainfall patterns, temperature and sea level changes will affect the current water and sediment quality characteristics

within the study area. One key area identified by Hedge et al. (2013) is the synergistic impacts of global climate change and the documented contamination status of the sediments within the study area.

- The ecological and economic impacts of Non-Indigenous Species (NIS) in the study area, including the impact of regional transport patterns of recreational vessels (or coastal trading vessels) on the risk of NIS in the study area (Hedge et al., 2013).
- Soft bottom sediment habitats were identified as one of the least studied in Sydney Harbour by Hedge et al. (2013). No comprehensive surveys of soft bottom benthic communities have been undertaken (Hedge et al., 2013)
- The impacts of emerging contaminants on natural systems are a globally recognised knowledge gap of concern (Barnes et al., 2008, Philips et al., 2010 (both cited but not referenced) in Hedge et al., 2013) and apply to the study area due to the nature of contaminant pathways present in the Harbour.
- Emerging contaminants such as nanoparticles and micro plastics have not been assessed in the study area. Additional knowledge gaps also exist concerning the feasibility of restoration of degraded systems within contaminated environments (Hedge et al., 2013)
- Non-point source pollutant inputs to the study area from urban run-off and stormwater drains were also identified as a knowledge gap by Hedge et al. (2013)
- There are knowledge gaps present in the direct or indirect effects of the delivery of nutrients and contaminants to open water or benthic biota within the study area. Typically strong linkages have been made between water quality and planktonic organisms but this has not been well studied in Sydney Harbour (Hedge et al., 2013). Climate change may exacerbate the processes involved in run-off, contamination and nutrient delivery to the study area and as such this linkage requires further investigation.
- There are no studies on the causal effects of nutrient enrichment on the ecology of Sydney Harbour. Reducing nutrient inputs requires a better understanding of the relative sources.

5.7 Recommendations for Further Work

An assessment of how various waterway managers are dealing with the management of contaminants into the Harbour would be beneficial to develop a consistent approach for a CZMP. Identification of any additional recommended actions from the SIMS study should be undertaken, and if relevant incorporated into the CZMP. Examples of recommendations put forward in the SIMS literature review (Hedge et al., 2013) include:

1. Further research in Sydney Harbour can provide invaluable information to scientists and managers globally on nutrient and contamination pathways.
2. Genetic investigation techniques to provide evidence of NIS status and origin to assist in determining management measures to control NIS within the study area.
3. Information into the manner in which stormwater is delivered to the Sydney estuary and its ultimate fate would provide invaluable information to waterway managers.
4. Investigations to determine sources of point source pollution affecting the water and sediment quality of the study area, and what role these have on determining the spatial distribution of contamination.
5. Analysis of water and sediments across the study area to determine the importance of emerging contaminants and their pathways into the Harbour.

6. Investigations into the linkages between water quality and planktonic organisms, which is particularly important for areas of the Harbour which are slower to flush such as the inner parts of Port Jackson.

5.8 Data Summary – Water and Sediment Quality

Table 5-1 Water and sediment quality – summary of data sets identified

Data Requirement	Title	Description	Source/Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Sediment Samples	Coastal CRC Sediment Data	Sediment samples were collected by the Coastal CRC during August 2003	Geoscience Australia	Various	2003	Sydney Harbour	Identify Sediment Properties	M	N	Available	http://www.ozcoasts.gov.au/geom_geol/web3d/sydney.jsp
Water quality	Beachwatch Programs	Daily water pollution forecasts, annual reporting	NSW Department of Environment and Heritage	Water quality and metocean data	Annual reports 1989-current	Sydney Harbour (and greater region)	Predict likelihood of bacterial contamination at swimming sites in Sydney Harbour	M	Y	Available	http://www.environment.nsw.gov.au/eachapp/SydneyBulletin.aspx?NoMobile

5.9 Summary of issues, gaps and recommendations

Table 5-2 Water and sediment quality – summary of issues, gaps and recommendations

Key Management Issues	Significant Gaps	Recommendations for Further Work
Stormwater contaminant loads, including faecal contamination.	<p>In undertaking the literature review, a clear understanding of the relative contribution of the various catchments, and the actions currently underway to intercept or manage contaminants before they reach the Harbour was not able to be determined. Additional gaps were identified in the SIMS literature review (Hedge et al., 2013):</p> <ul style="list-style-type: none"> There have been no circulation modelling studies of the study area which investigate the interactions between the EAC offshore, 	<p>Assess how various waterway managers are dealing with the management of contaminants into the Harbour and develop a consistent approach for a CZMP.</p> <p>Develop a large-scale process-based biogeochemical modelling system for the Sydney Harbour to provide invaluable information to scientists and managers on nutrient and contamination pathways.</p> <p>Utilise genetic investigation techniques to provide evidence of NIS status and origin to assist in</p>

Key Management Issues	Significant Gaps	Recommendations for Further Work
	<p>coastal waters and circulation within the Sydney Harbour estuary itself (Hedge et al., 2013).</p> <ul style="list-style-type: none"> • Much of the literature collated on stressors/threats to the study area concentrate on these stressors in isolation rather than a cumulative impact assessment or consideration of stressor interaction (Hedge et al., 2013). Recent evidence for example, suggests that the effects of nutrients and metals may be synergistic; leading to the prediction that nutrient enrichment in the study area may actually be masking stronger effects of meal contamination (Hedge et al., 2013). • Climate change, specifically how the predicted changes to rainfall patterns, temperature and sea level changes will affect the current water and sediment quality characteristics within the study area. One key area identified by Hedge et al. (2013) is the synergistic impacts of global climate change and the documented contamination status of the sediments within the study area. • The ecological and economic impacts of Non-indigenous species (NIS) in the study area, including the impact of regional transport patterns of recreational vessels (or coastal trading vessels) on the risk of NIS in 	<p>determining management measures to control NIS within the study area.</p> <p>Identify the manner in which stormwater is delivered to the Sydney estuary and its ultimate fate to provide invaluable information to waterway managers.</p> <p>Determine sources of point source pollution affecting the water and sediment quality of the study area, and what role these have on determining the spatial distribution of contamination.</p> <p>Analyse water and sediments across the study area to determine the importance of emerging contaminants and their pathways into the Harbour.</p> <p>Investigate the linkages between water quality and planktonic organisms, which is particularly important for areas of the Harbour which are slower to flush such as the inner parts of Port Jackson.</p> <p>Investigate the projected influence of climate change on water and sediment quality.</p>

Key Management Issues	Significant Gaps	Recommendations for Further Work
	<p>the study area (Hedge et al., 2013).</p> <ul style="list-style-type: none"> • Soft bottom sediment habitats were identified as one of the least studied in Sydney Harbour by Hedge et al. (2013). No comprehensive surveys of soft bottom benthic communities have been undertaken (Hedge et al., 2013) • The impacts of emerging contaminants on natural systems are a globally recognised knowledge gap of concern (Barnes et al., 2008, Philips et al., 2010 in Hedge et al., 2013) and apply to the study area due to the nature of contaminant pathways present in the Harbour. • Emerging contaminants such as nanoparticles and micro plastics have not been assessed in the study area. Additional knowledge gaps also exist concerning the feasibility of restoration of degraded systems within contaminated environments (Hedge et al., 2013) • Non-point source pollutant inputs to the study area from urban run-off and stormwater drains were also identified as a knowledge gap by Hedge et al. (2013) • There are knowledge gaps present in the direct or indirect effects of the delivery of nutrients and contaminants to open water or benthic biota within the study area. Typically strong linkages have been made between 	

Key Management Issues	Significant Gaps	Recommendations for Further Work
	<p>water quality and planktonic organisms but this has not been well studied in Sydney Harbour (Hedge et al., 2013). Climate change may exacerbate the processes involved in run-off, contamination and nutrient delivery to the study area and as such this linkage requires further investigation.</p> <ul style="list-style-type: none"> • There are no studies on the causal effects of nutrient enrichment on the ecology of Sydney Harbour. Reducing nutrient inputs requires a better understanding of the relative sources. 	

6. Ecological Values

6.1 Summary

6.1.1 Key Findings

Habitats within Sydney Harbour include seagrass communities, mangrove habitats, rocky reefs, macroalgal communities, open water/semi-pelagic environments and large expanses of soft-sediment benthic environments (Sydney Institute of Marine Science, 2013). These habitats support a range of marine flora and fauna species including plankton, infaunal and epifaunal invertebrates (e.g. polychaetes, molluscs, crustaceans, echinoderms), birds (marine and shorebirds), marine reptiles, marine mammals, fish, sharks, and marine plants.

6.1.2 Facts and Figures

There are two protected marine areas of relevance to the study area:

- Sydney Harbour National Park (DEH, 2014e)
- North Harbour Aquatic Reserve (DPI, 2014b)

Database searches indicate a number a threatened species and/or populations have the potential to occur within the marine, intertidal and riparian habitats of Sydney Harbour. These species may inhabit Sydney Harbour on a temporary or permanent basis for the purposes of foraging, dispersal, migration, sheltering/ resting and breeding, and include:

- Three Threatened Ecological Communities
- One Endangered population
- Four marine mammals
- Five marine reptiles
- Three fishes
- Six sharks
- 27 birds

Over 586 species of fish are found in Sydney Harbour (Hedge et al., 2013).

Habitats considered particularly important for threatened populations include the Manly area within the North Harbour Aquatic Reserve as this area supports the only breeding colony of little penguin (*Eudyptula minor*) in NSW and is listed as critical habitat for the species (DECC, 2007b). The Harbour houses endangered populations of the seagrass *Posidonia australis*, which are restricted to Middle Cove, Rose Bay, Watson's Bat and the North Harbour area (DPI, 2012b). In addition to providing habitat for threatened species, Sydney Harbour also supports species listed as Migratory and Marine under the Commonwealth EPBC Act. These species include marine mammals, marine turtles, sharks, marine birds and shorebirds.

6.1.3 Issues

Anthropogenic threats that have the potential to impact habitats and protected species within Sydney Harbour include:

- Coastal development/habitat modification. Over 50% of the shoreline has been replaced by artificial structures, and almost 77 km of the original 322 km shoreline has been removed due to reclamation and infilling (Hedge et al., 2013)

- Loss of natural riparian habitat
- Resource extraction
- Shipping and boating
- Pollution: Invasive species. Non-Indigenous Species (NIS) and novel species have been identified as an issue impacting on the overall ecosystem within the study area
- Climate change. Sydney Harbour is located in a region known to be warming faster than the global average, and a 3°C rise in ocean temperature off Sydney Harbour is expected by 2070 (Hedge et al., 2013). Sea level rise of 1.7 mm a year is not predicted to impact mangrove habitats; however it is likely to diminish saltmarsh habitats. Increased storm activities are likely to place coastal infrastructure under greater threat. Harbour barrier habitats such as mangroves and seagrasses will become more important for infrastructure protection (Hedge et al., 2013)

Ongoing active management of these activities is required for the protection of the ecological values of Sydney Harbour.

6.1.4 Gaps

- Most of the literature on sediment quality within the study area focusses on the spatial patterns of chemical contamination. Few publications were identified as concentrating on the ecology and/or biology of soft bottom habitats as part of the review undertaken by Hedge et al. (2013).
- Climate change. The current state of knowledge around climate change impacts to the study area relies on studies conducted in similar estuaries or on similar suites of species found within the study area. There is a large gap in understanding of how climate change stressors will impact on ecosystems in and adjacent to the study area (Hedge et al., 2013).
- Paucity of studies which have examined the effects of habitat modification on soft sediment infauna within the study area (Hedge et al., 2013).
- As identified by Hedge et al. (2013), further studies on ecological patterns and processes on the natural shores in the study area (rocky intertidal assemblages in particular).
- There is a significant knowledge gap relating to the ecological and biochemical importance of materials and biota exchanged through the entrance to the Harbour, as they relate to open water/pelagic ecosystems (Hedge et al., 2013).
- There are no Harbour-wide management strategies for mangroves, seagrass and saltmarsh ecosystems in the study area Hedge et al. (2013).
- How design changes and engineering solutions can be used to enhance diversity amongst sub tidal artificial environments (Hedge et al., 2013).
- Further research into the effects of recreational fishing on the ecological values present in the study area. The last major assessment was undertaken in 2008 (Hedge et al., 2013). Additional information is also required on the impacts of organic pollutants on food webs, including human consumption of fish caught in the Harbour.

6.1.5 Recommendations

The identification of recommended actions coming from the SIMS literature review should be undertaken in light of any connectivity to key management issues to be addressed by the CZMP as identified above. Examples of recommendations put forwards in the SIMS literature review (Hedge et al., 2013) include:

1. Improved modelling tools to investigate the impacts of climate change within the study area
2. Investigation into local fishing effort which would assist in facilitating understanding the localised risk within the Harbour which will then inform future spatial based management plans
3. Studies to determine the effects of habitat modification on ecological patterns and processes of soft sediment assemblages
4. Genetic investigation techniques to provide evidence of NIS status and origin to assist in determining management measures to control NIS within the study area
5. Development of a Harbour-wide management strategy for mangroves, seagrass and saltmarsh ecosystems.
6. Further investigation into the diversity of bottom sediments in the study area which includes the iconic sandy beaches to the east of the Harbour Bridge, to increase the limited pool of knowledge regarding this habitat type in the study area.
7. Further investigation into the state of, and processes involved in, rocky intertidal assemblages within the Harbour.
8. Circulation modelling which investigates the interactions between the EAC offshore, coastal waters and the circulation within the Sydney Harbour estuary itself.

6.2 Overview

The ecological values of Sydney Harbour are linked to the wide range of habitats found within the study area (refer to Section 1.3). This is particularly true of estuarine and marine environments, as the Harbour includes seagrass communities, mangrove habitats, rocky reefs, macroalgal communities, open water/semi-pelagic environments and large expanses of soft-sediment benthic environments (Sydney Institute of Marine Science, 2013). Such diversity of habitats in turn supports a high diversity of flora and fauna (Hutchings et al., 2013), including commercially and recreationally important species of fish (e.g. yellowtail kingfish (*Seriola lalandi*) and a variety of crustaceans.

As well as harvested species, Sydney Harbour also houses a number of endangered populations, such as the little penguin (*Eudyptula minor*) (DECC, 2007b) and the seagrass *Posidonia australis* (DPI, 2012b). The presence of these species, coupled with their limited distribution within Sydney Harbour, has resulted in the formation of important habitat areas. Such areas were developed to both encourage the continual occupancy of the species' within the Harbour and increase their ability to overcome anthropogenic disturbances.

6.3 Sydney Harbour Habitats and Species

Sydney Harbour provides suitable habitat for a range of marine flora and fauna species including: plankton, infaunal and epifaunal invertebrates (e.g. polychaetes, molluscs, crustaceans, echinoderms), birds (marine and shorebirds), marine reptiles, marine mammals, fish, sharks, and marine plants. In a recent study conducted by the Australian Museum (Hutchings et al., 2013), Sydney Harbour was found to support double to triple the number of crustacean, molluscs, polychaetes, echinoderms and fish species than the neighbouring Hawkesbury River, Botany Bay and Port Hacking. The high species richness of Sydney Harbour has been attributed to the high diversity of habitats within the area and the significant tidal flushing that occurs (Hutchings et al., 2013). Key habitats include the riparian habitats within the estuary and catchment margins and a wide range of intertidal and subtidal habitats.

6.3.1 Riparian Habitats

Mapping of riparian habitats was undertaken throughout the extent of Sydney Harbour and estuaries that feed into the Harbour (Allen et al., 2007). This process was necessary to identify the changes in riparian habitat over time and assess the current distribution of this habitat type. Results from the study demonstrated that the riparian vegetation within 40 m of the Sydney Harbour mean high water mark has been influenced by human development (Allen et al., 2007). Habitats have been cleared and urbanised such that turf/man made hard structures, gardens/weeds or unvegetated areas account for a total of 63% of the riparian environment, inclusive of protected areas (Allen et al., 2007). The islands and foreshore areas located within the Sydney Harbour National Park support the largest areas of intact native vegetation communities. Coastal sandstone gully forest on foreshore slopes is the most abundant vegetation community within Sydney Harbour inclusive of protected areas, accounting for 12.3% of the total area (Allen et al., 2007). The riparian habitat within 40 m of the Sydney Harbour mean high water mark provides habitat resources for a range of terrestrial and marine species including three Endangered Ecological Communities (refer to Section 6.6).

6.3.2 Intertidal and Subtidal Habitats

The intertidal and subtidal habitats of Sydney Harbour include:

- Rocky reefs
- Soft sediments

- Saltmarshes
- Seagrasses
- Mangroves
- Open water
- Macroalgae

Of the above habitats, studies suggest rocky reefs house the highest diversity of marine life within the Harbour. For example, of the 575 known species of fish within Sydney Harbour, 60 % inhabit subtidal rocky reefs (Sydney Institute of Marine Science, 2013). Intertidal and subtidal rocky reefs also support a range of macroalgae species, which in turn provide a food source for herbivorous organisms and encourage the settlement of mobile and sessile invertebrates such as sponges, bryozoans, molluscs and crustaceans (Sydney Institute of Marine Science, 2013). Rocky reef environments are likely to form suitable habitat for a variety of protected pipe fishes (Syngnathidae). Additionally, aggregations of the critically endangered grey nurse shark (*Carcharias taurus*) are known from rocky reef areas along the New South Wales coastline (refer to Section 6.6).

Seagrasses, mangroves and saltmarshes are known to occur within Sydney Harbour, particularly from Middle Harbour and the mouth of the Parramatta River (Kelleway et al., 2007; SMCMA, 2008; West and Williams, 2008). These habitats are economically and ecologically important as they provide permanent or temporary habitats for a wide range of species, such as the juvenile age classes of commercially and recreationally important species, such as fish (e.g. yellowfin bream *Acanthopagrus australis*) and crustaceans (e.g. blue swimmer crab *Portunus pelagicus* and a variety of prawns) (Davie, 2011; Kelleway et al., 2007; West and Williams, 2008).

Of the estuarine and marine habitats within Sydney Harbour, the open water habitat comprises the largest area, accounting for over 50 km², or roughly ten times the area of rocky reefs, mangroves and intertidal flats reefs (Sydney Institute of Marine Science, 2013). The species that inhabit the open water environment range from planktonic organisms to large bodied megafauna, such as marine mammals, reptiles and sharks. The protected humpbacked whale (*Megaptera novaeangliae*) and southern right whale (*Eubalaena australis*) are known visitors to Sydney Harbour (DEC, 2005; refer to Section 6.6).

A large proportion of the estuarine benthic environment within Sydney Harbour is soft sediment (West and Williams, 2008). Although the Sydney Institute of Marine Science (SIMS) identifies this habitat type as being poorly studied in comparison to habitats such as rocky reefs, species records have identified 308 species of worms, 118 echinoderms, 1375 molluscs and 672 crustaceans within and in proximity to the soft bottom benthic environments of the area (Sydney Institute of Marine Science, 2013). Soft-bottom habitats can provide high value services for the maintenance of marine ecosystems as they house a high abundance and diversity of lower trophic level organisms, such as infaunal invertebrates (Davie, 2011; Langlois et al., 2005; Thrush, 1999). Although such habitats are understudied in Sydney Harbour, it is likely they serve a similar ecological role to those observed for other estuaries and coastal areas.

6.4 Ecosystem Health

The NSW Department of Environment and Heritage undertook State of the Catchment reporting in 2010 (DEH, 2010). This included a combined assessment of marine health indicators in the Sydney Metropolitan and Hawkesbury-Nepean regions. Indicators that were assessed included:

- Extent of marine protected areas
- Algal blooms

- Rocky reef biota including:
 - Large habitat-forming algae
 - Abundances of sea urchins, abalone and lobsters
 - Commercial catches of reef fish in demersal fish traps
- Beachwatch, a measure of bacteria at ocean beaches to indicate sewage contamination and/or presence of waterborne pathogens

Results of the assessment (Table 6-1) indicate that there was no change in ecosystem health in the five to ten years preceding the reporting. Publication of a comprehensive literature review by SIMS of the “physical structure, the biological diversity and human threats” of Sydney Harbour is imminent. It is expected that this research will more thoroughly identify the current status of the health of Sydney Harbour.

Table 6-1 Indicator ratings and trends in resource condition for marine waters in the Sydney Metropolitan and Hawkesbury-Nepean regions (from DEH, 2010)

Indicator	Condition	Trend*	Data confidence
Marine protected areas		↔	H
Algal blooms		?	L
Rocky reef biota		↔	M
• Macroalgae		↓	M
• Eastern rock lobster		↔	H
• Commercial reef fish		↔	H
• Purple sea urchin		↔	M
• Abalone		↔	M
Beachwatch		↔	H

Key

	Very good	↑ Improving	H High
	Good	↔ No change	M Medium
	Fair	↓ Declining	L Low
	Poor	? Unknown	
	Very Poor	* trend typically related to the previous 5-10 years	
	No data		

6.5 Marine Protected Areas

The NSW system of marine protected areas comprises multi-use marine parks, aquatic reserves, national parks and reserves with marine components. There are two protected marine areas of relevance to the study area:

- Sydney Harbour National Park (DEH, 2014e)
- North Harbour Aquatic Reserve (DPI, 2014b)

6.5.1 Sydney Harbour National Park

Declared in 1975, Sydney Harbour National Park protects a number of islands and foreshore areas of Sydney Harbour (DEH, 2014e), including:

- Clark Island
- Shark Island
- Goat Island
- Fort Denison
- North Head
- South Head
- Middle Head and Georges Head
- Dobroyd Head
- Bradleys Head
- Neilsen Park

Protected within this National Park is a diverse range of terrestrial, riparian and intertidal species, which assist in maintaining the integrity of the marine values of the Harbour.

6.5.2 North Harbour Aquatic Reserve

The North Harbour Aquatic Reserve covers an approximate area of 260 ha, and connects the North Head and Dobroyd Head areas of the Sydney Harbour National Park (Figure 6-1; DPI, 2014a). Habitats within the reserve include intertidal and subtidal rocky reefs and boulder fields, sandy beaches, and expanses of open sandy substrate in depths of up to 20 m (DPI, 2014b). These support seagrass and macroalgal beds, cunjevoi communities, temperate corals and sponges as well as a diverse range of other marine taxa including macro-invertebrates, teleosts, cephalopods and elasmobranchs. The reserve provides critical habitat for endangered populations of little penguin (*Eudyptula minor*), and supports endangered populations of the seagrass *Posidonia australis* (DPI, 2014b).

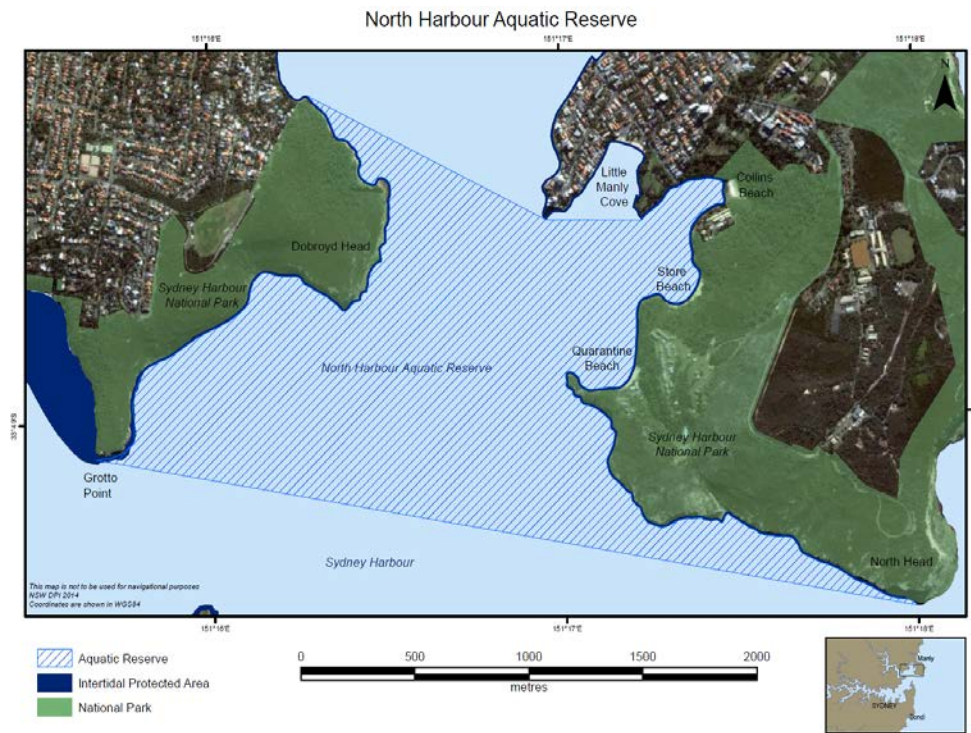


Figure 6-1 North Harbour Aquatic Reserve (from DPI, 2014b)

6.6 Marine Protected Species

A search of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Database (DOE, 2014c) and the NSW BioNet Wildlife Atlas (DEH, 2014c) identified a number of threatened species that have the potential to occur within the marine, intertidal and riparian habitats of Sydney Harbour (Table 6-2). These species are protected under the Commonwealth EPBC Act, the NSW *Threatened Species Conservation Act 1995* (TSC Act), and the NSW *Fisheries Management Act 1994* (FM Act). Species identified included:

- Three Threatened Ecological Communities;
- One Endangered population
- Four marine mammals;
- Five marine reptiles;
- Three fishes;
- Six sharks; and
- 27 birds.

These species may inhabit Sydney Harbour on a temporary or permanent basis for the purposes of foraging, dispersal, migration, sheltering/ resting and breeding. Habitats considered particularly important for threatened populations include the Manly area within the North Harbour Aquatic Reserve as this area supports the only breeding colony of little penguin in NSW and is listed as critical habitat for the species (DECC, 2007b) (Figure 6-2).

Table 6-2 Threatened species predicted to occur in Sydney Harbour

Common name	Scientific name	EPBC Act status	TSC Act status	FM Act status
Threatened Ecological Communities				
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions) (DEH, 2014a)		V	EEC	
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (DEH, 2014d)			EEC	
Sydney Turpentine-Ironbark Forest (DEH, 2013b)		CE		
Endangered populations				
Sydney Harbour population of the seagrass <i>Posidonia australis</i>				E
Marine mammals				
Southern right whale	<i>Eubalaena australis</i>	E, M	E	
Humpback whale	<i>Megaptera novaeangliae</i>	V, M	V	
New Zealand fur-seal	<i>Arctocephalus forsteri</i>		V	
Australian fur seal	<i>Arctocephalus pusillus doriferus</i>		V	
Marine reptiles				
Loggerhead turtle	<i>Caretta caretta</i>	E, M	E	
Leatherback turtle	<i>Dermochelys coriacea</i>	E, M	E	
Green turtle	<i>Chelonia mydas</i>	V, M	V	
Hawksbill turtle	<i>Eretmochelys imbricata</i>	V, M		
Flatback turtle	<i>Natator depressus</i>	V, M		
Fish				
Black rockcod	<i>Epinephelus daemелиi</i>	V		V
Australian grayling	<i>Prototroctes maraena</i>	V		
Southern bluefin tuna	<i>Thunnus maccoyii</i>			E
Sharks				
Grey nurse shark (east coast population)	<i>Carcharias taurus</i>	CE		CE
Great white shark	<i>Carcharodon carcharias</i>	V, M		V
Green sawfish	<i>Pristis zijsron</i>	V		
Whale shark	<i>Rhincodon typus</i>	V, M		
Scalloped hammerhead shark	<i>Sphyrna lewini</i>			E

Common name	Scientific name	EPBC Act status	TSC Act status	FM Act status
Great hammerhead shark	<i>Sphyrna mokarran</i>			V
Birds				
Northern royal albatross	<i>Diomedea epomophora sanfordi</i>	E, M		
Tristan albatross	<i>Diomedea exulans exulans</i>	E, M		
Southern giant-petrel	<i>Macronectes giganteus</i>	E, M	E	
Gould's petrel	<i>Pterodroma leucoptera leucoptera</i>	E, M		
Chatham albatross	<i>Thalassarche eremita</i>	E, M		
Southern royal albatross	<i>Diomedea epomophora epomophora</i>	V, M		
Wandering albatross	<i>Diomedea exulans (sensu lato)</i>	V, M	E	
Antipodean albatross	<i>Diomedea exulans antipodensis</i>	V, M	V	
Gibson's albatross	<i>Diomedea exulans gibsoni</i>	V, M	V	
White-bellied storm-petrel	<i>Fregatta grallaria grallaria</i>	V, M	V	
Northern giant-petrel	<i>Macronectes halli</i>	V, M	V	
Kermadec petrel (western)	<i>Pterodroma neglecta neglecta</i>	V, M	V	
Australian fairy tern	<i>Sternula nereis nereis</i>	V, M		
Buller's albatross	<i>Thalassarche bulleri</i>	V, M		
Shy albatross	<i>Thalassarche cauta cauta</i>	V, M	V	
Salvin's albatross	<i>Thalassarche cauta salvini</i>	V, M		
White-capped albatross	<i>Thalassarche cauta steadi</i>	V, M		
Black-browed albatross	<i>Thalassarche melanophris</i>	V, M	V	
Campbell albatross	<i>Thalassarche melanophris impavida</i>	V, M		
Little penguin	<i>Eudyptula minor</i>		E	
Flesh-footed shearwater	<i>Ardenna carneipes</i>		V	
Eastern osprey	<i>Pandion cristatus</i>		V	
Sooty oystercatcher	<i>Haematopus fuliginosus</i>		V	
Pied oystercatcher	<i>Haematopus longirostris</i>		E	
Lesser sand-plover	<i>Charadrius mongolus</i>	M	V	
Sooty tern	<i>Onychoprion fuscata</i>		V	
Little tern	<i>Sternula albifrons</i>		E	

Notes: EEC: Endangered Ecological Community; CE, Critically Endangered, E: Endangered: V: Vulnerable, M: Migratory



Figure 6-2 Little penguin critical habitat map within Sydney Harbour. Red and green areas represent known habitat areas and yellow areas indicate potential habitat areas (from DECC, 2007b)

As identified in Figure 6-3, Sydney Harbour houses endangered populations of seagrass *Posidonia australis*. The species is endemic to temperate Australian waters, occurring in 20 estuaries along the coastline of NSW (DPI, 2012b). Six of these estuaries, Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie, have suffered significant population declines, resulting in their listing as endangered populations under the FM Act (DPI, 2014c). Within Sydney Harbour, the species distribution is restricted to Middle Cove, Rose Bay, Watson's Bay and the North Harbour area (DPI, 2012b).

In addition to providing habitat for threatened species, Sydney Harbour also supports species listed as Migratory and Marine under the Commonwealth EPBC Act. These species include marine mammals, marine turtles, sharks, marine birds and shorebirds. These species are highly mobile and are likely to occur in the region as transient visitors.

Results of the EPBC Act Protected Matters Database and NSW BioNet Wildlife Atlas searches are provided in Appendix A.

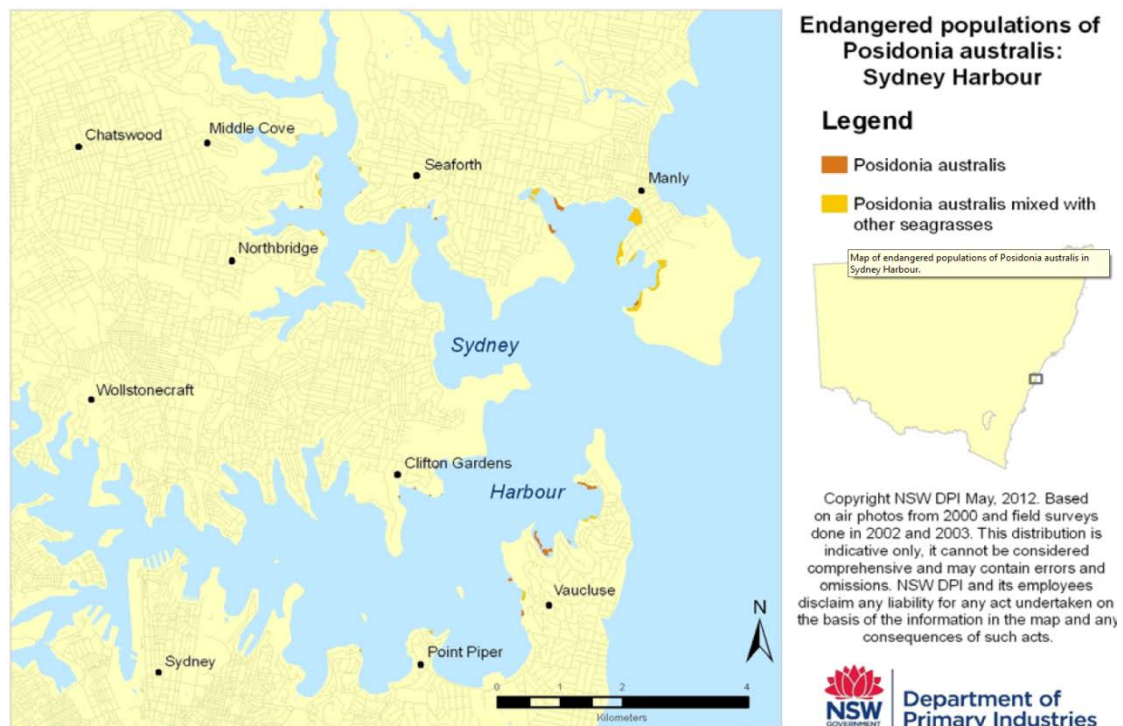


Figure 6-3 Distribution of *Posidonia australis* within Sydney Harbour (from DPI, 2012b)

6.7 Key Management Issues

The historical loss of natural riparian habitat has had subsequent adverse impacts on terrestrial and marine species. This may be partially addressed by restoration of these former habitats where possible. Programs such as Sydney’s Salty Communities (SCCG, 2014) allocate funding secured from the federal government to support the rehabilitation of salt-influenced ecosystems.

In addition to loss of natural riparian habitat there are a number of anthropogenic threats that have the potential to impact habitats and protected species within Sydney Harbour. These include coastal development, resource extraction, shipping and boating, pollution, invasive species, and climate change (Sydney Institute of Marine Science, 2013). Ongoing active management of these activities is required for the protection of habitats that support commercial and recreational fisheries, and protected and endangered species.

6.8 Significant Gaps

- Most of the literature on sediment quality within the study area focusses on the spatial patterns of chemical contamination. Few publications were identified as concentrating on the ecology and/or biology of soft bottom habitats as part of the review undertaken by Hedge et al., (2013).
- Climate change. The current state of knowledge around climate change impacts to the study area relies on studies conducted in similar estuaries or on similar suites of species found within the study area. There is a large gap in understanding of how climate change stressors will impact on ecosystems in and adjacent to the study area (Hedge et al., 2013).
- Paucity of studies which have examined the effects of habitat modification on soft sediment infauna within the study area (Hedge et al., 2013).

- As identified by Hedge et al. (2013), further studies on ecological patterns and processes on the natural shores in the study area (rocky intertidal assemblages in particular).
- There is a significant knowledge gap relating to the ecological and biochemical importance of materials and biota exchanged through the entrance to the Harbour, as they relate to open water/pelagic ecosystems (Hedge et al., 2013).
- There are no Harbour-wide management strategies for mangroves, seagrass and saltmarsh ecosystems in the study area Hedge et al. (2013).
- How design changes and engineering solutions can be used to enhance diversity amongst sub tidal artificial environments (Hedge et al., 2013).
- Further research into the effects of recreational fishing on the ecological values present in the study area. The last major assessment was undertaken in 2008 (Hedge et al., 2013). Additional information is also required on the impacts of organic pollutants on food webs, including human consumption of fish caught in the Harbour.

6.9 Recommendations for Further Work

The identification of recommended actions coming from the SIMS literature review should be undertaken in light of any connectivity to key management issues to be addressed by the CZMP as identified above. Examples of recommendations put forwards in the SIMS literature review (Hedge et al., 2013) include:

1. Improved modelling tools to investigate the impacts of climate change within the study area
2. Investigation into local fishing effort which would assist in facilitating understanding the localised risk within the Harbour which will then inform future spatial based management plans
3. More studies designed to determine the effects of habitat modification on ecological patterns and processes of soft sediment assemblages
4. Genetic investigation techniques to provide evidence of NIS status and origin to assist in determining management measures to control NIS within the study area
5. Development of a Harbour-wide management strategy for mangroves, seagrass and saltmarsh ecosystems.
6. Investigation into the diversity of bottom sediments in the study area which includes the iconic sandy beaches to the east of the Harbour Bridge, to increase the limited pool of knowledge regarding this habitat type in the study area.
7. Investigation into the state of, and processes involved in, rocky intertidal assemblages within the Harbour.
8. Circulation modelling which investigates the interactions between the EAC offshore, coastal waters and the circulation within the Sydney Harbour estuary itself.

6.10 Data Summary – Ecological Values

Table 6-3 Ecological values – summary of data sets identified

Data Requirement	Title	Description	Source/Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
EPBC Act Protected Matters	Protected Matters Search Tool	Identify whether matters relevant to the EPBC Act are likely to occur in area of interest.	Australian Government Department of the Environment	Likelihood of occurrence of EPBC Act protected matters.	n/a	Australia-wide	Predict the likelihood of occurrence of EPBC Act protected matters within a specified search area	H	Y	Available	http://www.environment.gov.au/epbc/pmst/index.html
NSW Wildlife	BioNet	Identify sightings of plants or animals in a particular area	Office of Environment and Heritage	Sightings of plants and animals	n/a	NSW-wide	Report on sightings of plants and animals within a specified search area	H	Y	Available	http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx
Fisheries Management Act protected matters	Threatened species conservation	List of species /communities protected under FM Act	Department of Primary Industries	Status of species/communities protected under the FM Act	n/a	NSW-wide	Identify species/communities listed under the FM Act to manually cross reference habitat requirements against resources available	H	Y	Available	http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current
Vegetation	Sydney Harbour foreshore vegetation	API and ground truthed vegetation mapping of the Sydney Harbour foreshore	Office of Environment and Heritage	Vegetation mapping	2003	Sydney Harbour	Prioritise property-scale management objectives of NSW Maritime	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B97414205-ABE2-4881-BBC5-689E736934B6%7D
Vegetation	The Native Vegetation of the Sydney Metropolitan Area	Digital mapping of the native vegetation communities	Office of Environment and Heritage	Vegetation mapping	2013	Sydney	Provide a single detailed coverage of native vegetation communities in the Sydney metropolitan area using standardised vegetation	M	N	Under Development	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B2CCFE4F6-4743-4597-AAEA-8575A0DF12DA%7D

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
							classification				
Ecology	Nearshore subtidal marine reef systems and soft sediment mapping	Near-shore reef boundaries	Office of Environment and Heritage	Vector	2002-2012	NSW nearshore areas	Regional level marine conservation assessment	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7BB4C0CFF6-D72A-453D-8223-4B710E9B066E%7D

6.11 Summary of issues, gaps and recommendations

Table 6-4 Ecological values – summary of issues, gaps and recommendations

Key Management Issues	Significant Gaps	Recommendations for Further Work
<p>Anthropogenic threats that have the potential to impact the ecological values of Sydney Harbour include:</p> <ul style="list-style-type: none"> • Coastal development; • Loss of natural riparian habitat; • Resource extraction; • Shipping and boating; • Pollution; • Invasive species; and • Climate change 	<ul style="list-style-type: none"> • Most of the literature on sediment quality within the study area focusses on the spatial patterns of chemical contamination. Few publications were identified as concentrating on the ecology and/or biology of soft bottom habitats as part of the review undertaken by Hedge et al. (2013). • Climate change. The current state of knowledge around climate change impacts to the study area relies on studies conducted in similar estuaries or on similar suites of species found within the study area. There is a large gap in understanding of how climate change stressors will impact on ecosystems 	<p>Address the recommended actions in the SIMS literature review in light of any connectivity to key management issues to be addressed by the CZMP as identified above. Examples of recommendations put forwards in the SIMS literature review (Hedge et al. 2013) include:</p> <ol style="list-style-type: none"> 1. Improved modelling tools to investigate the impacts of climate change within the study area 2. Investigation into local fishing effort which would assist in facilitating understanding the localised risk within the Harbour which will then inform future spatial based management plans 3. More studies designed to determine the effects of habitat modification on ecological patterns and processes of soft sediment assemblages

Key Management Issues	Significant Gaps	Recommendations for Further Work
	<p>in and adjacent to the study area (Hedge et al. 2013).</p> <ul style="list-style-type: none"> • Paucity of studies which have examined the effects of habitat modification on soft sediment infauna within the study area (Hedge et al. 2013). • As identified by Hedge et al. (2013), further studies on ecological patterns and processes on the natural shores in the study area (rocky intertidal assemblages in particular). • There is a significant knowledge gap relating to the ecological and biochemical importance of materials and biota exchanged through the entrance to the Harbour, as they relate to open water/pelagic ecosystems (Hedge et al. 2013). • There are no Harbour-wide management strategies for mangroves, seagrass and saltmarsh ecosystems in the study area Hedge et al. (2013). • How design changes and engineering solutions can be used to enhance diversity amongst sub tidal artificial environments (Hedge et al. 2013). • Further research into the effects of recreational fishing on the ecological values present in the study area. The last major assessment was undertaken in 2008 (Hedge 	<ol style="list-style-type: none"> 4. Genetic investigation techniques to provide evidence of NIS status and origin to assist in determining management measures to control NIS within the study area 5. Development of a Harbour-wide management strategy for mangroves, seagrass and saltmarsh ecosystems. 6. Further investigation into the diversity of bottom sediments in the study area which includes the iconic sandy beaches to the east of the Harbour Bridge, to increase the limited pool of knowledge regarding this habitat type in the study area. 7. Further investigation into the state of, and processes involved in, rocky intertidal assemblages within the Harbour. 8. Circulation modelling which investigates the interactions between the EAC offshore, coastal waters and the circulation within the Sydney Harbour estuary itself.

Key Management Issues	Significant Gaps	Recommendations for Further Work
	<p>et al. 2013). Additional information is also required on the impacts of organic pollutants on food webs, including human consumption of fish caught in the Harbour.</p>	

7. Human Use and Values

7.1 Summary

7.1.1 Key Findings

Sydney Harbour has high value to a range of user groups, clubs, associations and individuals. The aspirations and values of these users are diverse. Reconciling the disparate objectives of these users is a challenge of preparing a CZMP for Sydney Harbour.

Key values of the Harbour identified by users focussed on access for recreation, appreciation of the natural characteristics, and ongoing sustainable use (Sweeney Research, 2014; Manly Council, 2011).

Activities centred on Sydney Harbour including boating, fishing and Harbour-side recreation form an important part of the NSW and Australian economy. (Destination NSW, 2014) There are competing demands for boat storage, Harbourside recreation and tourism spaces. The Harbour hosts a range of public and private transport facilities which will undergo change and expansion as Sydney continue to grow.

Indigenous communities have a strong connection to Sydney Harbour. Indigenous cultural heritage sites are still located on or close to the Harbour shoreline, and a CZMP will need to sensitively consider any potential impacts on these.

The non-indigenous heritage of Sydney Harbour has been extensively covered (e.g. Stephenson and Kennedy, 1966), and the role of the Harbour in European colonisation well documented. Individual sites for inclusion in a CZMP need to be identified.

7.1.2 Facts and Figures

This study has identified over 50 agencies, organisations and user groups within an interest in Sydney Harbour.

Twenty items of national significance are identified on the Australian Heritage Database either in, or in very close proximity to Sydney Harbour.

The database of Maritime Heritage Sites (DEH, 2014b) contains 171 sites within Sydney Harbour, 154 of which are shipwrecks.

Sydney Harbour was the most visited NSW Marine Estate in 2013/14.

7.1.3 Issues

Former defence sites are an asset and management plans and processes are in place to consider long term uses. Sydney Harbour is a key venue for international, inter-state and intra-state tourism. A variety of recreational opportunities exist on the Harbour foreshore including the Botanic Gardens, zoo, national parks and Harbourside local parks. Opportunities to improve and expand recreation facilities and pedestrian links have been identified in local and State plans.

The ongoing and sensitive preservation/conservation of heritage sites is expected to continue to be a high profile management issue for the community, as will be maintenance of access to the Harbour and retention or improvement of its sustainability.

7.1.4 Gaps

There is limited direct information about the aspirations of user groups specifically in relation to Sydney Harbour. Specific research and broad consultation with stakeholders would be required to report meaningfully on views about the future of Sydney Harbour.

Much of the existing heritage information is not available electronically, or was unavailable for review within this study. Targeted collection of this information for specific sites may be required, depending on how heritage aspects are to be treated in a CZMP.

7.1.5 Recommendations

1. User group and stakeholder consultation must form a key part of the future preparation of a CZMP.
2. Consultation is to include strategies to confirm the current understanding of values held in relation to Sydney Harbour and to address competing objectives and conflicting values. Should the CZMP be tasked to identify key heritage sites for conservation purposes, a separate research project to identify individual sites would be required.

7.2 Users

Sydney Harbour is heavily used for a variety of purposes. It provides a major cultural, recreational, economic and ecological resource for the city, state, nation, and for international visitors and commercial operators. Most literature available on user group aspirations for Sydney Harbour is indirect, i.e. user groups are necessarily focussed on their primary function and do not articulate general policy positions on Sydney Harbour and management of the coastal zone. Readily available information is summarised in this section. It is suggested that direct consultation with user groups about their specific use of Sydney Harbour would be a useful component of a future coastal zone management planning process.

As part of this project, a list of likely stakeholders (and therefore key users) was developed. This list is provided in Table 7-1. It is important to note that this list is not exhaustive, reflects the understanding of users at this point in time, and includes direct and indirect users. These groups are subject to change, either through re-badging, evolution or disbanding. In addition, there will be smaller “area focussed” user groups which provide much of their input into Harbour management issues through local government. Information on this is not always readily accessible as it tends to be buried within project specific or Council-wide strategic documents, or unpublished communications. In addition, many smaller groups are not registered but are informal local groups. Local government is in the best position to identify and consult with the smaller user groups within their local government area not listed in Table 7-1.

The table also includes an indication of the likely influence and resources of each stakeholder/ As development of the CZMP progresses, it is possible that some of these stakeholders may seek to influence the extent to which certain issues are addressed, particularly if there are competing objectives or conflicting values. Those stakeholders identified as having a major influence or extensive resources are expected to be critical to that process.

First and foremost, the key users of Sydney Harbour are the community. Whilst many of the stakeholders listed are involved in decision-making, it is with the intent of facilitating ongoing use of the Harbour for the wider community, such as local government. For example, recreational users would include swimmers, individual sailing clubs and walkers. Ways in which the Harbour is used is provided in the following section.

Impacts for a variety of human uses is generally documented in terms of what the resultant impacts are, such as water quality, habitat disturbance or erosion due to access. One current SIMS study in the Harbour includes an assessment of the level of human activity on the various habitats present (Sydney Institute of Marine Science, 2014).

7.2.1 Cruise Ship Industry

According to Carnival Australia (2011), Sydney Harbour is the major cruise port of Australia because of its natural beauty. Cruise ship passenger numbers are expected to triple to reach one million passengers cruising from Australia by 2020. On this basis the cruise ship industry forecasts that two cruise terminals are required – one west and one east of the Sydney Harbour Bridge (Carnival Australia, 2011).

In 2012 the Australian government reviewed the capacity for Garden Island to accommodate additional commercial cruise ships (Australian Government, 2012). The review found that Garden Island facilities are essentially incompatible with cruise ship access over the long term, except on the existing ad hoc basis.

Of note are the Navy’s comments that:

- Garden Island is central to the Navy’s capacity to provide a maritime force capable of meeting all Government directed operational requirements; and

Table 7-1 Sydney Harbour stakeholders

Stakeholder	Influence	Resources	Likely areas of interest in the use and management of the Harbour																	
Name	Major Moderate Minor	Extensive Moderate Limited	Transport and access	Tourism	Economic development	Residential development	Recreation	Aboriginal Heritage	Non-Aboriginal Heritage	Sea level rise	Coastal erosion	Coastal landscape	Flora and fauna	Water quality	Sea bed	Utility installation	Governance	Funding	Property Values	Public Safety
Federal Government																				
Australian Customs and Border Protection Service	Major	Extensive	*	*	*												*			*
Australian Maritime Safety Authority	Major	Extensive	*	*			*							*	*		*			*
Department of Defence including Navy and Garden Island facility	Minor	Moderate	*							*	*		*	*	*	*				*
Department of the Environment	Major	Extensive						*	*	*	*	*	*	*	*		*	*		
Sydney Harbour Federation Trust	Major	Moderate	*	*		*	*	*	*	*	*	*	*		*			*		
State Government																				
Barangaroo Delivery Authority	Major	Moderate	*	*	*	*	*									*			*	
Department of Education and Communities	Minor	Limited			*	*	*													*
Department of Planning and Environment	Major	Limited	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*		
Department of Primary Industries, Fisheries NSW	Major	Limited		*			*				*		*	*	*		*			*
Department of Trade and Investment	Minor	Limited	*								*	*				*				
Department of Transport	Moderate	Limited	*	*	*		*													*
Destination NSW	Major	Limited	*	*	*		*	*	*		*	*	*	*						*
Environment Protection Authority	Major	Limited												*						
Local Land Services	Moderate	Limited					*	*	*	*	*	*	*	*	*	*				*
Manly Hydraulics Laboratory (MHL)	Minor	Limited								*	*	*								
National Parks and Wildlife Service	Major	Limited		*			*	*	*	*	*	*	*	*	*		*			*
Natural Resources Commission	Minor	Limited			*					*	*	*	*	*	*					
Roads and Maritime Services	Moderate	Moderate	*	*	*	*														
Sydney Harbour Foreshore Authority	Major	Moderate	*	*	*		*			*	*	*	*	*	*					
Sydney Water Corporation	Moderate	Moderate			*	*				*				*		*				
Treasury	Major	Moderate																*		

Stakeholder	Influence	Resources	Likely areas of interest in the use and management of the Harbour																	
Name	Major Moderate Minor	Extensive Moderate Limited	Transport and access	Tourism	Economic development	Residential development	Recreation	Aboriginal Heritage	Non-Aboriginal Heritage	Sea level rise	Coastal erosion	Coastal landscape	Flora and fauna	Water quality	Sea bed	Utility installation	Governance	Funding	Property Values	Public Safety
Local Government within study area																				
Sydney Coastal Councils Group	Major	Moderate	*	*	*		*	*	*	*	*	*	*	*	*					*
Local Government NSW	Moderate	Limited	*	*	*	*	*			*	*	*	*	*						
City of Sydney Council*	Major	Extensive	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Leichhardt Municipal Council	Minor	Limited	*	*	*	*	*										*		*	*
Manly Council	Moderate	Moderate	*	*	*	*	*			*							*		*	*
Mosman Council*	Moderate	Limited	*	*	*	*	*			*							*		*	*
North Sydney Council	Moderate	Limited	*	*	*	*	*			*	*	*	*	*	*	*	*		*	*
Pittwater Council	Moderate	Limited	*	*	*	*	*			*							*		*	*
Warringah Council	Moderate	Limited	*	*	*	*	*			*							*		*	*
Woollahra Council	Moderate	Limited	*	*	*	*	*			*							*		*	*
LGAs upstream of study area adjoining Parramatta River																				
Ashfield Council	Minor	Limited	*	*	*	*	*							*			*		*	*
Canada Bay Council	Minor	Limited	*	*	*	*	*							*			*		*	*
Hunters Hill Council	Minor	Limited	*	*	*	*	*			*							*		*	*
Lane Cove Council	Minor	Limited	*	*	*	*	*			*							*		*	*
Parramatta Council	Minor	Limited	*	*	*	*	*							*			*		*	*
Ryde Council	Minor	Limited	*	*	*	*	*							*			*		*	*

Stakeholder	Influence	Resources	Likely areas of interest in the use and management of the Harbour																	
Name	Major Moderate Minor	Extensive Moderate Limited	Transport and access	Tourism	Economic development	Residential development	Recreation	Aboriginal Heritage	Non-Aboriginal Heritage	Sea level rise	Coastal erosion	Coastal landscape	Flora and fauna	Water quality	Sea bed	Utility installation	Governance	Funding	Property Values	Public Safety
Peak Environment Groups																				
Greenpeace	Major	Moderate								*	*	*	*	*	*			*		
Nature Conservation Council	Moderate	Limited								*	*	*	*	*	*					
Surfrider Foundation	Moderate	Limited								*	*	*		*				*		*
Total Environment Centre	Moderate	Limited								*	*	*	*	*	*			*		
World Wide Fund for Nature (WWF)	Moderate	Moderate								*	*	*	*	*	*			*		
UNSW	Moderate	Moderate								*	*	*								
User Groups																				
Boat owners association	Moderate	Limited	*	*			*			*				*						*
NSW Fishing Clubs Association Incorporated	Moderate	Limited	*	*			*			*				*						*
Rowing NSW	Minor	Limited	*				*			*				*						*
Yachting NSW	Minor	Limited	*	*			*			*	*	*		*						*
Commercial operators																				
Commercial shipping operators	Major	Extensive	*		*					*				*	*					
Cruise ship industry	Major	Extensive	*	*	*		*			*					*					
Harbour and tourist cruise operators	Major	Extensive	*	*	*		*			*	*	*	*	*						*
Sydney Ports	Major	Extensive	*	*	*		*			*				*	*					*

Stakeholder	Influence	Resources	Likely areas of interest in the use and management of the Harbour																	
Name	Major Moderate Minor	Extensive Moderate Limited	Transport and access	Tourism	Economic development	Residential development	Recreation	Aboriginal Heritage	Non-Aboriginal Heritage	Sea level rise	Coastal erosion	Coastal landscape	Flora and fauna	Water quality	Sea bed	Utility installation	Governance	Funding	Property Values	Public Safety
Academic, Scientific and Other Groups																				
Australian Museum	Minor	Limited		*				*	*				*	*						
Environment Defender's Office NSW	Moderate	Limited						*	*	*	*	*	*	*	*					
Macquarie University	Moderate	Moderate								*	*	*								
Sydney Institute of Marine Sciences (SIMS)	Moderate	Limited								*	*	*	*	*	*					
Sydney Opera House	Moderate	Limited		*	*	*	*			*	*	*								
Sydney Royal Botanic Gardens	Moderate	Limited		*									*							
Sydney University	Moderate	Moderate								*	*	*								
Taronga Zoo	Moderate	Limited																		

- there are no circumstances in the foreseeable future where the Navy would be in a position to relinquish its primacy of use at Garden Island.

7.2.2 Former Defence Sites

The Harbour hosts a number of former defence sites, managed by the Sydney Harbour Federation Trust. The sites are:

- HMAS Platypus
- Cockatoo Island
- Woolwich Dock and Parklands
- Snapper Island
- Chowder Bay
- Georges Heights
- Middle Head
- North Head
- Macquarie Lightstation

These sites provide a combination of recreation, commercial development and tourism on Sydney Harbour. Site specific management plans have been prepared for all sites except for Snapper Island (SHFT, 2013).

The Sydney Harbour Federation Trust has managed Cockatoo Island to develop an array of complementary uses and activities, ranging from those which tap into the island's past, such as maritime and related industries, to entirely new uses such as cultural events, short-stay accommodation and restaurants.

Existing buildings and structures have been adaptively reused.

7.2.3 Tourism and Recreation

Tourism Australia has listed Sydney Harbour as one of its "National Landscapes" – a reflection of the outstanding natural and cultural values associated with the Harbour (Tourism Australia, 2014). A number of eco-tourism initiatives to increase the quality of visitation to the Harbour are proposed in line with its value as a National Landscape, including creating the best Harbour walking experience in the world, and developing a world-class conservation program with visitor involvement. These initiatives include projects within the Sydney Harbour National Park as well as within the Harbour itself.

Tourism and visitation statistics for Sydney are published quarterly, however no particular statistics are attributed to the Harbour (Destination NSW, 2014; TTF, 2014).

The unique setting of Sydney Harbour hosts a range of tourism and recreation facilities. Many of these facilities operate under management plans or strategies, which have the potential to enhance or affect the coastal zone. The Tourism and Transport Forum Industry Action Plan identifies key priorities for investment in tourism. In relation to Sydney Harbour the Forum's 2011 submission recommends that the government develops "a Great Harbour Walk linking major attractions around Sydney Harbour in conjunction with the development of the NSW Walking Strategy."

The City of Sydney Released a Tourism Action Plan in 2013. It focuses on actions to recognise Sydney as Australia's premier tourist destination ahead of other Australian capital cities and as a regional leader in the Asia Pacific. Sydney Harbour and its natural and built environment contribute significantly to the attractiveness of Sydney as a tourist destination. A key challenge is to balance the pressure of use with the conservation of coastal attributes of significance.

Individual Councils work closely with their local community to develop tourism and recreation material and plans. However, detailed information does not appear to be widely available on the specific relationship between tourism in the area and the Harbour, possibly as the Harbour is strongly interlinked into other attractors within the area. Other example tourism attractors include ocean frontage in Manly and Woollahra; Taronga Zoo in Mosman, and the central business district/The Rocks/Sydney Opera House/Sydney Harbour Bridge precinct.

Many of these destinations/experiences are included in the following sections.

7.2.4 Royal Botanic Gardens

The Botanic Gardens occupies a prominent site on the Harbour and contributes significantly to the amenity and cultural heritage of the Harbour. The Gardens are managed by the Royal Botanic Gardens and Domain Trust. The Trust's aims "to protect and nourish a much-loved institution so that it can thrive and evolve, and continue to provide the people of Sydney and tourists from around the world with beautiful gardens and parks to enjoy for a further 200 years."

7.2.5 The Rocks and Darling Harbour

The Sydney Harbour Foreshore Authority counts people movements electronically in The Rocks and Darling Harbour. During 2013 the counts were:

The Rocks	14,292,957 (an increase of 2.6% on the previous year)
Darling Harbour	26,630,904 (an increase of 1.9% on the previous year)

7.2.6 Major Cultural and Sporting Events

Sydney Harbour hosts a vast range of cultural and sporting events each year. While each event publishes a program of activities there is limited information about the impact of these events on Sydney Harbour. Key events include:

- New Year's Eve celebrations
- Australia Day celebrations
- Vivid Festival
- Biennale
- Sydney Harbour regatta
- Maritime museum events
- Chinese New Year
- Fleet review
- Sydney to the Gong bike ride
- Sydney Marathon and other running festivals
- Spring Cycle

7.2.7 Swimming and Walking

Sydney Harbour includes a number of scenic swimming locations both natural and constructed including Redleaf Pool, Nielsen Park and Clifton Gardens.

Sydney Harbour is a venue for bush and urban walks. The extensive coastal walking network has been mapped and includes part of the Great North Walk and coastal trails (SCCG, 2007). Spectacular views, remnant bushland and historical features make these walks highly attractive to locals and tourists. Literature about walks includes guides such as *Walking Coastal Sydney*, NPWS information and historical references. Walking user groups would be an important part of future consultation. Demand for access to the Harbour foreshore is in tension with development and the need to conserve critical natural and built heritage.

7.2.8 Boating

In terms of intensity, Sydney Harbour is one of the most important areas for recreational boating in the southern hemisphere (Widmer and Underwood, 2004). In 2003 it was estimated that there were 7,500 boats stored on Sydney Harbour (Widmer and Underwood, 2004). It was also estimated that there were 10,000 mooring berths and 42 marinas in 2003. Several sailing clubs maintain a fleet of thousands of sailing dinghies, and trailable vessels can access the Harbour from public or private boat ramps.

The *Sydney Harbour Boat Storage Strategy* (NSW Government, 2013) noted that Sydney Harbour has approximately 8 per cent of the State's recreational vessels and 20 per cent of the State's commercial vessels.

A range of boating occurs on Sydney Harbour. These include vessels under sail and motorised vessels. Management plans have been developed for some of these, including the *Sydney Harbour Superyacht Guidelines 2011*, *NSW Maritime and Sydney Ports*. Roads and Maritime Services have developed Boating Plans for major waterways throughout NSW; a plan for Sydney Harbour is in draft form. These plans "are a guide to shared use and access to a particular waterway to the benefit of recreational and commercial users alike" (NSW Government, 2014).

The Boating Industry Association's 2012 Annual Report notes that the Association embodies over 90% of the business activity in the retail and light commercial boating industry.

Key statistics on boating access to the Harbour (NSW Government, 2008) include:

- Formal public boat ramps – 15
- Public wharves – 80
- Ferry wharves – 44
- Commercial marinas – 45
- Clubs / sheds for rowing sailing, power boating and fishing – > 40
- Private landing facilities - > 700
- Private mooring licences - 5000

In addition, kayaks are extensively promoted as a unique way to explore the Harbour for residents and visitors alike (e.g. Sydney Harbour Kayaks).

Private marina berths currently accommodate approximately 500 vessels with a further 2000 at commercial marina berths and approximately 1000 at commercial mooring sites. The Maritime Management Centre (MMC) within Transport for NSW (TfNSW) is undertaking a review of the policy and regulatory framework governing the administration of moorings in NSW (Maritime Management Centre, 2014). Issues currently under discussion include improving mooring efficiency, environmental impacts and alternative delivery models.

In addition, MMC, together with Roads and Maritime Services (RMS), is undertaking a state-wide study of existing facilities and safety measures to inform the development of Regional Boating Plans which cover each of the major waterways in NSW.

The Regional Boating Plans will help inform projects to be funded under the new Boating Infrastructure Partnership Program (BIPP) by identifying infrastructure priorities for each region and across the state. The BIPP will replace the successful Better Boating Program and will see more funding made available for the priority projects identified in the Regional Boating Plans.

The study will identify the actions required to enhance the boating experience across NSW by improving boating safety, boat storage and waterway access on major waterways.

It is important to recognise that even though vessel use is largely regulated through licencing and enforcement activities, individual operators are expected to behave responsibly and within the limits of the law. Impacts of irresponsible behaviour include increased boat wash (resulting in erosion, turbidity and habitat loss or damage), direct damage to landscape and habitat, and safety concerns for other Harbour users.

7.2.9 Recreational Fishing

Recreational fishing is a popular pastime and Sydney Harbour provides many opportunities for this activity. A 2012 state wide fishing economic survey was commissioned by Primary Industries to measure expenditure on fishing (ORS, 2013). The survey found that:

- there were approximately 905,048 anglers in NSW
- recreational fishing employs 3,944 people in Sydney alone
- recreational fishers in Sydney spend over \$900M annually on fishing. There is no information about how much of this is spent on fishing in Sydney Harbour.

The Department of Primary Industries noted that:

“Sydney Harbour (Port Jackson) and Sydney's northern beaches (Barrenjoey Head to North Head) provide a wide range of fishing opportunities from beach or jetty fishing” as well as rock and boat fishing and opportunities for anglers. Fishing in Sydney Harbour is regulated by DPI and some areas are closed to recreational fishing.”

Commercial fishing within the Harbour has been banned since 2006, due to elevated levels of dioxins in fish and crustaceans, however, recreational fishing is still supported. The consumption of fish from west of the Sydney Harbour Bridge is not recommended, and dietary advice is provided to guide the consumption of particular fish species (DPI, 2014a; NSW Health, 2006).

7.2.10 Transport

Sydney Ferries

During 2011-12, 14.768 million passengers patronised Sydney Ferry services, by 2013-14 the patronage had grown to 15.977 million passengers (NSW Government, 2014b). Sydney Ferries have been privately operated since 2012.

Sydney Harbour provides key facilities for ferry passengers at Circular Quay and several other locations within the Harbour. These facilities provide a key linkage to different parts of the Harbour less accessible by road and rail and support a variety of economic activities including commuter transport, facilitating employment and tourism.

Port functions

Sydney Ports Corporation is responsible for berth allocation at the following 'common user berths':

- Overseas Passenger Terminal
- White Bay Cruise Terminal
- Glebe Island berths No. 1,2,7 and 8
- White Bay berths No. 2,3,4,5.

Sydney Ports provides key information about these ports within *Sydney Harbour in Port Information for Sydney Harbour and Botany Bay* (SPC, 2014).

Sydney Harbour Bridge

As well as providing train, road, pedestrian and cycle access, Sydney Harbour Bridge is a tourist resource offering Bridge Climb and is a key facility for fireworks displays.

Sydney Harbour Tunnel

The tunnel is a key north south vehicular link complementing the Harbour Bridge.

7.3 Heritage

The Australian Heritage Database identifies 20 items of national significance either in or in very close proximity to Sydney Harbour, covering:

- Military fortifications/defence
- Foreshore Dwellings
- Aesthetics
- Environment
- Indigenous
- European Settlement
- Aquatic Reserve

Due to their age, many of the heritage studies identified in the literature assembly are not available electronically, and due to the limited scope access to review these documents has not been possible. They are however listed in the reference section for further consideration should this be considered to be a priority issue for the project. The following sections therefore provide an overview of the information that was available for review.

7.3.1 Indigenous Heritage

The indigenous history of the Sydney Harbour area has been considered extensively by previous studies, with AMBS (2005) and Attenbrow (1991) providing accounts of the Aboriginal Clans of the Port Jackson area and its catchment.

Indigenous communities have long held a strong connection to Sydney Harbour. The geological formations provided shelter, rock holes acted as freshwater reservoirs and surfaces used for illustrations and implement sharpening. The lack of grinding grooves indicates that these implements may have been traded from other areas rather than sources locally (AMBS, 2005).

The Harbour and its surrounds provided food and medicine, with hunting and gathering for fish, shellfish and other marine animals, as well as land animals, birds, reptiles and plants. (AMBS, 2005; Attenbrow and Steele, 1992; Hawthorne, 1982)) Some of these were also used for making weapons, shelter and body decorations. Communities closest to the Harbour had a greater diet from fishing than those communities in the hinterland, and Umwelt (2011) documented the importance of particular fisheries to NSW indigenous communities.

Middens and archaeological deposits have been identified on or in close proximity to the shoreline (DECCW, 2010a), mainly surviving into the 21st century on public lands. Due to the sensitivity of some of this information, it is not always publicly available.

Key coastal sites of indigenous significance will need to be identified in order to ensure that they continue to be protected. This will require discussions with traditional owners and confidentiality issues to be addressed.

7.3.2 Non-Indigenous Heritage

The majority of heritage assessments focussed on the built environment or the usage of the land in that municipality, e.g. Proudfoot (1971). Stephenson and Kennedy (1966) provide a comprehensive narrative history and description of Sydney Harbour.

The post-European settlement history and condition of the islands within Sydney Harbour was documented by Wagner (1971). Since this time, however, usage and management of, and access to the islands have changed significantly (O'Brien, 2001).

Settlement by Europeans, and their interactions with local indigenous communities are described in detail by Barratt (1981).

ANU (2009) considered the potential implications of climate change impacts on Australian world heritage properties, of which only the Sydney Opera House is located within the study area. This included consideration of World Heritage status, and ecological, geomorphic, aesthetic, and cultural values of these properties.

Interrogation of the NSW Office of Environment and Heritage Maritime Heritage Database (DEH, 2014b) indicated that there were 171 maritime heritage sites within Sydney Harbour, 154 of which were shipwreck sites. The database identifies known incidences where shipwrecks were removed or relocated, but the site is still recorded.

A brief description of the heritage value of various NSW maritime heritage assets is provided in Hawkless (2006).

7.4 Values

Values are a subjective aspect of coastal zone management held by users, stakeholders and the general community. Few literature sources identify what the community values in relation to Sydney Harbour are, with most studies reporting on the key issues for the community rather than values. However, some key strategic planning documents provide insights into community values and an important piece of research is also in progress. The Marine Estate Management Authority (MEMA) assessed community values for the entire NSW marine estate, which includes part of Sydney Harbour (Sweeney Research, 2014). Specifically this study identified community values, benefits they derive, and their perception of threats and potential management options.

The key values of the Marine Estate identified in the survey were:

- Identity
 - Uniqueness
 - Continuing Health
 - Access (provision of and safety)
 - Cultural heritage
- Enabler
 - Enabling connection
 - Escape/relaxation
 - Offering choice
- Provider
 - Trade/tourism gateway
 - Support for local/State economies
 - Source of food and industry
 - Facilities to access the Marine Estate
- The Great Outdoors
 - Enjoyment in knowing it is there
 - Celebration of biodiversity
 - Source of scientific discovery
 - Safe interaction

In 2009 Woollahra Council undertook an inclusive community engagement process as part of developing *Woollahra 2025*. The comprehensive community engagement process identified that the community of Woollahra strongly value coastal assets and the natural environment. The consultation indicated that the Woollahra community values:

- good access to the Harbour, beaches and facilities
- well maintained foreshores, beaches, parks, sports fields and recreation areas
- reduced water pollution and improved stormwater drainage
- water views from parks and properties

Other local government areas, in the development of their Council Community Strategic Plans, articulated values that include the Harbour without referring to it directly. For example, Sustainable Sydney 2030 (COS, 2008) mentioned community values such as wanting a city that “celebrates the outdoors” and that has “environmental leadership”. MOSPLAN 2013-2023 (Mosman Council, 2013) sought to maintain the existing character of its precincts, which include harbourside areas managed by the Council and by partner organisations such as the Sydney Harbour Federation Trust.

Community consultation for Leichhardt 2025+ (Leichhardt Council, 2013) identified general values for the community, but did not report on specific key values. However the reduction of waste entering the Harbour was identified as a priority for the community. Interestingly, priority actions relating to adaptation to climate change did not mention coastal specific hazards such as sea level rise or storm tide.

Community consultation for North Sydney’s review of their Community Strategic Plan (North Sydney, 2013) indicated that people valued views, foreshore reserves, proximity and access to the Harbour, and the waterfront.

Consultation processes for the various Manly Council Coastal Management Plans articulated key values as they applied to those areas (Manly Council, 2004a,b). Later plans adopted the generic community values from the Community Strategic Plan (Manly Council, 2011). Key community values used in these plans specific to Sydney Harbour included:

- appreciation of low-key/natural characteristics of public lands;
- appreciation of recreation opportunities;
- access to the foreshore and Harbour for passive and active recreation, in a safe and healthy way;
- preservation of natural areas and threatened species;
- cultural heritage; and
- sustainable use and management of resources, land and the harbour for posterity.

7.5 Key Management Issues

The array of user groups and their diverse aspirations for Sydney Harbour illustrates the pressure on the coastal zone. All user groups report likely growth in demand including the cruise and tourist industry, boating and fishing. The use of the Harbour as a part of the transportation system for Sydney as urban consolidation continues is also critical. Harbour foreshores are being increasingly opened as former industrial uses decline. While pedestrian, cycle and boat access may have a different footprint to port related uses the intensity of use in particular locations has the potential to give rise to conflict over management priorities. Effective community engagement as a coastal zone management plan is developed will be critical. A transparent process for determining and prioritising the goals and actions set in a CZMP will need to be established and agreed with stakeholders.

The ongoing preservation/conservation of heritage sites is expected to continue to be a high profile management issue for the community. The identification of heritage sites and their treatment within a CZMP will need careful management, particularly with respect to cultural sensitivities. Support from indigenous stakeholders should be specifically sought as part of determining the nature of and extent to which indigenous heritage sites are included in a CZMP.

Ongoing access to the Harbour, for active and passive recreation, as well as maintenance of views and improvements to water quality were the most common values expressed by the community. Actions that strive towards the retention of or improvements to access and the sustainable use of the Harbour are expected to be well regarded by the community.

7.6 Significant Gaps

Key user groups were invited to be part of this project's Advisory Committee, and input was encouraged via the SCCG website and direct communications. However the time and budget for this project did not permit extensive individual consultation with user groups to invite contributions to the literature review. Many contacts did not appear to consult widely within their own organisation, or provide information likely to be held by other parts of their own organisation. Future stages of the CZMP development could address this.

A significant volume of heritage information for Sydney Harbour is not available electronically and is stored in archives/hard copy in local libraries, and was therefore not able to be reviewed within the scope and budget of this project. Further research into key aspects of interest, such as if key coastal indigenous heritage sites are to be protected in a CZMP, will be required.

Whilst generic information is available on community values, there is limited information available on values specific to the Harbour. It is likely that local government has already gathered this information as part of the development of previous plans for the Harbour, but has not necessarily published this information, and depending on its age, may need to be updated to reflect societal changes. The MEMA survey results (Sweeney Research, 2014), whilst not specific to Sydney Harbour, show alignment with the general statements contained in community values statements.

7.7 Recommendations for Further Work

It is recommended that key user groups be included in future stages of community engagement for the development of the CZMP. Local government will need to lead engagement with their community and local user groups. More detailed consultation within some of the larger key user groups is required to clearly identify additional information, such as existing and projected demand, which is expected to be available.

Should the CZMP be tasked to identify key heritage sites for conservation purposes, a separate research project to identify individual sites would be required.

A compilation of unpublished values information, largely already gathered by local government, is required to confirm the spatial applicability of values across the study area. Assessment of this information should be undertaken in light of the MEMA survey (Sweeney Research, 2014) to confirm the specific relevance of values to Sydney Harbour.

7.8 Data Summary – Human Use and Values

Table 7-2 Human use and values – summary of data sets identified

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Tourism	Tourism Statistics	Domestic and international Tourism data	Destination NSW	Visitors, stay length and \$ spent	Quarterly 2012-2014	Greater Sydney	Informing tourism opportunities	M	N	To March 2014	http://www.destinationnsw.com.au/tourism/facts-and-figures/sydney-tourism-statistics
Heritage	Australian Heritage Database	Identifies items of National Significance	Department of the Environment	Locations	Up to 2014	Worldwide	Historical Record	H	N	Current	http://www.environment.gov.au/cgi-bin/ahdb/search.pl
Heritage	Aboriginal Heritage Information Management System	Indigenous heritage objects, places and reports	Department of Planning and Environment, Office of Environment and Heritage	Items, Places and Reports	Up to 2014	NSW	Historical Record	M	Y	Current	http://www.environment.nsw.gov.au/licences/AboriginalHeritageInformationManagementSystem.htm
Heritage	Maritime Heritage Database	Maritime heritage sites	Department of Planning and Environment, Office of Environment and Heritage	Sites	Up to 2014	NSW	Historical Record	M	Y	Current	http://www.environment.nsw.gov.au/maritimeheritageapp/WebsiteSearch.aspx
Heritage	State Heritage Inventory	Heritage items	Department of Planning and Environment, Office of Environment and Heritage	Items and Places	Up to 2014	NSW	Historical Record	M	Y	Current	http://www.environment.nsw.gov.au/heritageapp/heritagesearch.aspx

7.9 Summary of issues, gaps and recommendations

Table 7-3 Human use and values – summary of issues, gaps and recommendations

Key Management Issues	Significant Gaps	Recommendations for Further Work
Large number and diversity of competing users Projected growth in demand	Limited identification of local user groups and their interests within each local government area	Identify user groups and their interests as part of consultation and engagement activities. Assess impacts of increasing demand over time
	Limited input from some key user groups into Literature Review	Consult, one-on-one, including meetings with multiple parts of larger organisations
Sensitivity of indigenous heritage sites to public disclosure	Identification of key coastal sites	Resolve confidentiality issues to ensure key coastal indigenous areas are either protected or are not adversely impacted by a CZMP
Identification and prioritisation of which heritage sites should be included in a CZMP	Large amount of information available in hard copy only or not readily available	Compile relevant knowledge and data
Confirmation of community values specific to Sydney Harbour	Limited documentation clearly detailing community values as they relate to the Harbour	Compile unpublished values information, already gathered by local government Assess the values of Sydney Harbour in light of the findings of the 2014 Marine Estate Management Authority survey

8. Glossary of Author Names

AUSGOV = Australian Government

BPCRG = Bays Precinct Communities Reference Group

CCB = City of Canada Bay

COS = City of Sydney

CSIRO = Commonwealth Scientific and Industrial Research Organisation

DAFF = Department of Agriculture Fisheries and Forestry

DEAP = Department of Environment and Planning

DEC = Department of Environment and Conservation

DECC = NSW Department of Environment and Climate Change

DECCW = NSW Department of Environment, Climate Change and Water

DEH = Department of Environment and Heritage

DEP = Department of Environment and Planning

DOE = Department of Environment

DIPNR = Department of Infrastructure, Planning and Natural Resources

DLWC = Department of Land and Water Conservation

DNP = Director of National Parks

DNR = NSW Department of Natural Resources

DOP = Department of Planning

DPI = NSW Department of Primary Industries

DPWS = NSW Department of Public Works and Services

DUAP = NSW Department of Urban Affairs and Planning

ECCW = NSW Department of Environment, Climate Change and Water

EDAW = EDAW Australia Pty Ltd

EDO = Environmental Defenders Office

EPA = NSW Environment Protection Authority

FSA = Food Standards Australia

GRCCC = Georges River Combined Councils Committee

HCC = Hawkesbury City Council

HSC = Hornsby Shire Council

IPCC = Intergovernmental Panel on Climate Change

KBR = Kellogg Brown and Root Pty Ltd

LPRSMC = Lower Parramatta River Stormwater Management Councils

MEMA = NSW Marine Estate Management Authority

MES = NSW Maritime Environmental Services

MHL = Manly Hydraulics Laboratory
MMC = Maritime Management Centre
NRMMC = Natural Resource Management Ministerial Council
NSC = North Sydney Council
NSW = NSW Government
NSWDP = NSW Department of Planning
NSWDPI = NSW Department of Primary Industries
NSWFA = NSW Food Authority
NSWMA = NSW Maritime Authority
NTA = National Trust of Australia
OEH = Office of Environment and Heritage
OFW = NSW Office for Water
OPC = Office of Parliamentary Council
ORS = Australian National Centre for Ocean Resources and Security
OSHM = Office of Sydney Harbour Manager
PB = Parsons Brinckerhoff
PCC = Parramatta City Council
PCTSC = Passenger Cruise Terminal Steering Committee
RAAHS = Royal Australian Artillery Historical Society
RBGDT = Royal Botanic Gardens and Domain Trust
RMS = NSW Roads and Maritime Services
SCCG = Sydney Coastal Councils Group
SCMA = Sydney Catchment Management Authority
SHA = Sydney Harbour Association
SHCMB = Sydney Harbour Catchment Management Board
SHFA = Sydney Harbour Foreshore Authority
SHFT = Sydney Harbour Federation Trust
SHNP = Sydney Harbour National Park
SHRO = Sydney Harbour Regional Organisation
SMCMA = Sydney Metropolitan Catchment Management Authority
SOPA = Sydney Olympic Park Authority
SPC = Sydney Ports Corporation
SSRCC = Southern Sydney and Sydney Harbour Regional (Catchments) Coordinating Committees
SW = Sydney Water
TEEB = The Economics of Ecosystems and Biodiversity
TIC = Tourism Industry Council NSW

TTF = Tourism and Transport Forum

UNSW = University of NSW

WMC = Woollahra Municipal Council

WSROC = Western Sydney Regional Organisation of Councils Ltd

WSUD = Water Sensitive Urban Design

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Appendices

Appendix A - Results from EPBC Protected Matters Search and BioNet Wildlife Atlas

Appendix B - Summary of Data Sets Identified

Sydney Harbour – summary of data sets identified

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Planning Administration	New South Wales State Environmental Planning Policies	New South Wales State Environmental Planning Policies 14, 26, 59 and 71	Department of Planning and Infrastructure	Vector	1980-2012	NSW	Identify areas that, in the opinion of the Minister, is of State or regional environmental planning significance	H	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B3FA0508F-A2F1-4AD1-839A-C406AECAF0D6%7D
Planning Administration	Coastal Protection (State Environmental Planning Policy No. 71) - SEPP 71	Defines the NSW Coastal Zone	Department of Planning and Infrastructure	Vector	n/a	NSW Coastline	Defines the NSW Coastal Zone for use in assessing coastal development applications	H	N	Available	https://sdi.nsw.gov.au/catalog/nrdd/C/Coastal%20Protection%20(State%20Environmental%20Planning%20Policy%20No.%2071)%20-%20SEPP%2071.html
Planning Administration	Planning Region	Administrative boundaries	Department of Planning and Infrastructure	Vector	2012	NSW	To clearly define administrative planning regions that support statewide planning and development	H	N	Planned	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B54DBBF8-6148-4935-844A-0B1486FA288B%7D
Planning Administration	NSW Local Government Area Boundary Map	Local Government Administrative boundaries	Land and Property Information	Vector	2012	NSW	A meaningful administrative subdivision of land	H	N	Ongoing	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B4D7D4F49-56E1-4562-B559-B17AA139D9F5%7D
Infrastructure	Estuary Foreshore Structures	Data on the location of licensed foreshore structures	Office of Environment and Heritage	Locations	2009	NSW	To assess and better manage the health of natural resources across the State	M	N	Ongoing	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B3F2B8EFF-CD19-438A-9D23-BA5A0A3BE68E%7D

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Offshore Wave Climate	Sydney Waverider Buoy Data	Directional wave data since 3rd March 1992. Non-directional wave data since 17th July 1987.	MHL	Wave Height (Hsig & Hmax), Wave Period (Tz & Tp) and Wave Direction	Various	Long Reef	Defines offshore wave climate	H	N	Available	http://new.mhl.nsw.gov.au/data/realtime/wave/WaveDataCollection
Bathymetry	National Digital Elevation Model	Medium resolution dataset to provide elevation and depth data	Geoscience Australia	Elevations and Depths	Various	Australia	Regional scale depth and elevation usage	H	N	Under review	http://www.anzlic.gov.au/foundation_spatial_data_framework/elevation_and_depth
Bathymetry	N/A	Hydrographic Survey recorded by SPC	SPC	Points files, xyz, ASCII	Various	Sydney Harbour (part)	Defines seabed levels	H	N	Available	http://wavewindtide.sydneyports.com.au/wave/weather_original.asp
Topography	Sydney Heads 1:25000 Scale Geopdf Topographic Map		Land and Property Information	Map	1970-2011	Eastern Sydney Harbour	Emergency services	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B57A50E30-61A8-4AA1-A6C1-4BD0D9A2CA20%7D Note: also available in TIFF format
Landform	New South Wales DTDB Landform Theme	Digital terrain model	Land and Property Information	Elevations	2012	NSW	NSW wide DTM	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7BC09B0C21-34D0-4215-AED4-A8D7D08E7BED%7D
Water Level Data	N/A	Sydney Harbour (Fort Denison) Tides	SPC	Elevations	Various	Fort Denison	Defines water levels	H	N	Available	http://wavewindtide.sydneyports.com.au/wave/weather_original.asp
Extreme Water Levels	N/A	Modelling and Mapping of Coastal Inundation Under Future Sea Level Rise	SCCG & CSIRO	Maps and elevations	Various	Sydney Harbour	Defines extreme water levels	H	N	Available	http://www.sydneycoastalcouncils.com.au/Project/Mapping_and_Responding_to_Coastal_Inundation

Data Requirement	Title	Description	Source/Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Extreme Water Levels	Tsunami inundation	Inundation layers from Tsunami events of varying return periods	University of Sydney (?)	Maps and elevations (?)	Unknown	Unknown	Defines extreme water levels	M	N	Unknown	Not publicly available. Held by University of Sydney (?)
Wind Data	N/A	Sydney Harbour (Fort Denison) Winds	SPC	Wind Speeds	Various	Fort Denison	Defines wind speeds	H	N	Available	http://wavewindtide.sydneyports.com.au/wave/weather_original.asp
Aerial Imagery	N/A	Vertical and oblique aerial photography since 1928	Geoscience Australia	Various	Various	Australia	Identify change	H	N	Available	http://www.ga.gov.au/scientific-topics/earth-obs/accessing-satellite-imagery/aerial-photography
Aerial Imagery	Sydney 50cm Orthorectified Imagery	Standard Colour Orthorectified Mosaic with ground sample distance of 50cm	Land and Property Information	Standard Colour Orthorectified Mosaic	2007-2008	Sydney	Identify change	H	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B8D5D4D53-6BFE-402B-9ECB-49BB738F59FF%7D
Sediment Samples	Coastal CRC Sediment Data	Sediment samples were collected by the Coastal CRC during August 2003	Geoscience Australia	Various	2003	Sydney Harbour	Identify Sediment Properties	M	N	Available	http://www.ozcoasts.gov.au/geom_geol/web3d/sydney.jsp
Catchment	Water	Hydrology features	Geoscience Australia	Catchment boundaries	Various (to 2011)	Australia	Interaction with coastal risks and hazards	L	N	Available	http://www.ga.gov.au/metadata-gateway/metadata/record/gcat_73078
Sediment Samples	Coastal CRC Sediment Data	Sediment samples were collected by the Coastal CRC during August 2003	Geoscience Australia	Various	2003	Sydney Harbour	Identify Sediment Properties	M	N	Available	http://www.ozcoasts.gov.au/geom_geol/web3d/sydney.jsp
Water quality	Beachwatch Programs	Daily water pollution forecasts, annual reporting	NSW Department of Environment and Heritage	Water quality and metocean data	Annual reports 1989-current	Sydney Harbour (and greater region)	Predict likelihood of bacterial contamination at swimming sites in Sydney Harbour	M	Y	Available	http://www.environment.nsw.gov.au/eachapp/SydneyBulletin.aspx?NoMobile

Data Requirement	Title	Description	Source/Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
EPBC Act Protected Matters	Protected Matters Search Tool	Identify whether matters relevant to the EPBC Act are likely to occur in area of interest.	Australian Government Department of the Environment	Likelihood of occurrence of EPBC Act protected matters.	n/a	Australia-wide	Predict the likelihood of occurrence of EPBC Act protected matters within a specified search area	H	Y	Available	http://www.environment.gov.au/epbc/pmst/index.html
NSW Wildlife	BioNet	Identify sightings of plants or animals in a particular area	Office of Environment and Heritage	Sightings of plants and animals	n/a	NSW-wide	Report on sightings of plants and animals within a specified search area	H	Y	Available	http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx
Fisheries Management Act protected matters	Threatened species conservation	List of species/communities protected under FM Act	Department of Primary Industries	Status of species/communities protected under the FM Act	n/a	NSW-wide	Identify species/communities listed under the FM Act to manually cross reference habitat requirements against resources available	H	Y	Available	http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current
Vegetation	Sydney Harbour foreshore vegetation	API and ground truthed vegetation mapping of the Sydney Harbour foreshore	Office of Environment and Heritage	Vegetation mapping	2003	Sydney Harbour	Prioritise property-scale management objectives of NSW Maritime	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B97414205-ABE2-4881-BBC5-689E736934B6%7D
Vegetation	The Native Vegetation of the Sydney Metropolitan Area	Digital mapping of the native vegetation communities	Office of Environment and Heritage	Vegetation mapping	2013	Sydney	Provide a single detailed coverage of native vegetation communities in the Sydney metropolitan area using standardised vegetation classification	M	N	Under Development	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7B2CCFE4F6-4743-4597-AAEA-8575A0DF12DA%7D
Ecology	Nearshore subtidal marine reef systems and soft sediment mapping	Near-shore reef boundaries	Office of Environment and Heritage	Vector	2002-2012	NSW nearshore areas	Regional level marine conservation assessment	M	N	Available	https://sdi.nsw.gov.au/catalog/search/resource/details.page?uuid=%7BB4C0CFF6-D72A-453D-8223-4B710E9B066E%7D

Data Requirement	Title	Description	Source/ Custodian	Type	Temporal Coverage	Spatial Coverage	Purpose	Relevance (H/M/L)	Assessed?	Status	Location
Tourism	Tourism Statistics	Domestic and international Tourism data	Destination NSW	Visitors, stay length and \$ spent	Quarterly 2012-2014	Greater Sydney	Informing tourism opportunities	M	N	To March 2014	http://www.destinationnsw.com.au/tourism/facts-and-figures/sydney-tourism-statistics
Heritage	Australian Heritage Database	Identifies items of National Significance	Department of the Environment	Locations	Up to 2014	Worldwide	Historical Record	H	N	Current	http://www.environment.gov.au/cgi-bin/ahdb/search.pl
Heritage	Aboriginal Heritage Information Management System	Indigenous heritage objects, places and reports	Department of Planning and Environment, Office of Environment and Heritage	Items, Places and Reports	Up to 2014	NSW	Historical Record	M	Y	Current	http://www.environment.nsw.gov.au/licences/AboriginalHeritageInformationManagementSystem.htm
Heritage	Maritime Heritage Database	Maritime heritage sites	Department of Planning and Environment, Office of Environment and Heritage	Sites	Up to 2014	NSW	Historical Record	M	Y	Current	http://www.environment.nsw.gov.au/maritimeheritageapp/WebsiteSearch.aspx
Heritage	State Heritage Inventory	Heritage items	Department of Planning and Environment, Office of Environment and Heritage	Items and Places	Up to 2014	NSW	Historical Record	M	Y	Current	http://www.environment.nsw.gov.au/heritageapp/heritagesearch.aspx

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