Coastal Erosion Aboriginal Heritage Strategy, Northern Sydney

Funded by Heritage Near Me

2019

Local Heritage Strategy
REPORT – PART 1

Written and compiled by the Aboriginal Heritage Office
Ku-ring-gai, Lane Cove, North Sydney, Northern Beaches, Strathfield and Willoughby Councils.

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Executive Summary

This report documents works undertaken during a two year coastal erosion project in northern Sydney under a grant provided by the NSW Government’s *Heritage Near Me* program. The project aims to better plan for Aboriginal sites in northern Sydney’s foreshore. This is Part 1 of the report, covering the entire project. Part 2 provides more detail on the rock art and rock engraving component.

There are a total of 242 foreshore sites (sites 10m horizontally and 2m vertically from mean high tide level). The majority, 137 (or 57%), are open shell middens and the majority of the remainder are shelter sites. Other site types include burials, rock engravings, fish traps and a waterhole. A total of 92 sites were monitored. From the original 92 sites monitored in Year 1, 40 were categorized as Priority 1. Recommendations for further work included ongoing coastal erosion monitoring and for 12 sites, further recording and possible salvage. These 12 sites are summarized in Appendix 2. Of the Priority 1 sites, nearly 80% were considered to be in poor condition or experiencing ongoing erosion (including coastal, water, human induced or animals induced), with only 23% considered to be stable.

The overall total for foreshore sites (99) over two years shows a third are experiencing ongoing erosion and several sites are in poor condition due to coastal erosion. Erosion is occurring at different rates at different sites, which is dependent on the localised conditions at each site. One site has had significant erosion, with over 700mm of horizontal shore loss, whereas another only 200m further up the estuary shows very little erosion over a similar period. While a majority of sites is considered stable, the longer term picture is bleak due to predictions of continued sea level rise, increasing large boat traffic in estuaries, increase in peak storm and tide events, ongoing and increase in human and animal impacts.

For rock art there are 120 pigment and 240 engraving sites. A total of 22 rock art sites and 17 rock engraving sites were visited and monitored. Re-recording work included 360 photography, stills and drone photography and video. Many sites have already been vandalised or damaged and all sites are subject to natural deterioration. The rock art in the northern Sydney region is diverse and extensive and much has survived the pressures of urban and city life.

A catalogue of photos has been captured from the field work, including 360º images, and has been used to develop community engagement materials. Video has also been captured of sites and interviews with AHO staff and consultants and has been put into different online media. The AHO provided information to the NSW OEH that has been used in the production of new material for the *Heritage Near Me* app and a Stage 4 Geography education package.

Final conclusions include:

- at least a third of foreshore middens in the region are seriously eroding.
- most middens not currently eroding are still at risk from severe storm and tide events.
- some middens are in vulnerable condition and may soon be lost completely.
- detailed recording and monitoring work needs to be expanded urgently.
- Salvage of some middens should be considered before complete loss to the tides.
- most rock art and engraving sites have images that are difficult for the casual observer to see.
- most rock art and engraving sites have been affected by graffiti and other human impacts.
- most rock art and engraving sites are stable but extremely vulnerable to human or natural impacts that could cause irreversible damage.
- the continued deterioration of rock art and engraving sites suggests that more detailed recording and monitoring is urgently required.
- ongoing professional and volunteer monitoring should continue.
- ongoing education and training programs should continue.
- conservation works for sites have been generally piecemeal and more resources and coordination is required to better protect sites from threats and respond to actual impacts.
1.0 Introduction

This report documents works undertaken during a two year coastal erosion project in northern Sydney under a grant provided by the NSW Government’s (Office of Environment and Heritage) Heritage Near Me program (Local Heritage Strategic Projects). The project has been carried out by staff and consultants of the Aboriginal Heritage Office (AHO), in partnership with Ku-ring-gai, Lane Cove, North Sydney, Northern Beaches, Strathfield and Willoughby Councils.

This is Part 1 of the report, covering the entire project. Part 2 provides more detail on the rock art and rock engraving component.

1.1 Project Aim

The coastal erosion Aboriginal heritage project aims to better plan for Aboriginal sites in northern Sydney’s foreshore.

Year 1: The aims of the project were:

- To provide a regional Aboriginal heritage coastal erosion management strategy for northern Sydney to prioritise detailed recording, monitoring, management and salvage options of vulnerable sites and to further engage the local community in the rich Aboriginal heritage of their local area.

The Year 2 aims were:

- To target prioritised foreshore sites for full recording and to extend recording to important and vulnerable rock art (pigment and engraved) outside of the foreshore zone to build on the management and community engagement work carried out previously. This gives a broader picture of heritage values in the region that are under increasing threat from human and natural impacts.

1.2 Why is this project necessary?

There are over 1000 recorded Aboriginal sites in the partner councils of the Aboriginal Heritage Office (AHO) in northern Sydney and Strathfield, which include art sites, engravings, and burials, grinding grooves, extensive shell middens and stone artefact scatters as well as places of important historical events. They range from paintings in excellent condition to shell middens degraded by erosion and disturbance. The project is particularly important now as 242 of the sites are in the foreshore zone and many are experiencing active and significant erosion and there are approximately 120 pigment and 240 engraving sites. Many sites have already been vandalised or damaged and all sites are subject to natural deterioration. The risk of irreparable damage and loss of art figures increases every year.

Coastal Erosion

There has been anecdotal evidence of increased erosion on foreshore sites around northern Sydney, particularly associated with boating traffic and storm events. The issue of increased sea levels due to climate change is also a factor. In other parts of the world there has been more noticeable erosion issues and significant archaeological survey and salvage responses, such as in Scotland since 2001 (SCAPE, 2014). While there has been increasing concern among heritage managers there has been
little previous systematic and detailed study, including monitoring, of the Aboriginal heritage in northern Sydney, which also has a very high number of sites (see Section 2.0 for more). The AHO therefore has been carrying out more detailed studies in the region to provide a better understanding of current impacts and ameliorative management options. A previous project by the AHO monitored 16 sites in a range of environments and conditions. Recorded impacts included slumping of shoreline deposit, undercutting, loss of embedded rock, ongoing surface loss, vegetation dieback and recreational user damage. The AHO recommended the development of a regional strategy and increased recording and monitoring (see Section 2.1 for details) (AHO, 2015).

MAP 1: COASTAL SITES WITHIN THE AHO PARTNER COUNCILS, NORTHERN SYDNEY

Rock Art and Engraving Sites

The northern Sydney landscape has a large number of rock art sites (pigment and engraved). The majority of surviving sites are not in the immediate foreshore zone, however, they are considered by heritage managers and the wider community as having high significance. They are particularly vulnerable to erosion and human interference. They also provide a means with which to introduce the general public to Aboriginal heritage. New Council walking tracks as well as illegal mountain bike tracks are making areas of bushland more accessible. In many areas there have been 10 or more years of regular bush regeneration as well as hazard reduction burns and access is becoming easier. With the increasing accessibility of urban reserves there is more risk of deliberate or accidental damage to sites from increased visitation, mountain bike use, vandalism and natural processes. Natural processes are also altering in intensity as climate change and other human impacts affect the environment. It is therefore important to re-record and monitor sites and capture as much of the surviving information as possible which can be used for future site conservation, for example, determining where original pigment is near new graffiti, or the original groove of an engraving that has been vandalized. Section 6 provides the latest information.

NEWLY RECORDED ROCK ART SITE
1.3 How significant are these sites?

Each individual site is considered to be of high significance by the Aboriginal community. Overall, they have national and international significance due to their age (some in the wider region dated over 30,000 years, most are at least 4000 years old), the style of art and engraving, their level of preservation in the context of Australia’s biggest city, the representative variety of different site types, and their association with the place where Europeans first settled Aboriginal land. Some of the sites are within Sydney Harbour, which is itself heritage listed and the Aboriginal heritage is an important part of this (it has been identified in Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005).

These sites are important to local Aboriginal people and to Aboriginal communities across Australia where they symbolise the survival of Aboriginal culture even where the impacts of invasion have been the longest and hardest felt. The heritage of the region is also important to the wider public. Local residents have grown up with the sites and many have undertaken Sites Awareness Training and guided walks to learn more. During the course of the AHO’s work, a number of these residents introduced themselves and discussed the history of the sites from their local perspective, identifying change and threats to their future existence. There are many local people involved in reconciliation issues, as well as in Bushcare and the AHO’s volunteer site monitor program, who appreciate the Aboriginal heritage of their local area and are active in trying to protect it. Visitors from Australia and internationally value the heritage and appreciate the opportunity to see at first hand Aboriginal heritage in Sydney, not just ‘outback’.

Currently only one site, a large rock engraving complex, is specifically listed on a heritage register (‘Moon Rock’, listed as an Aboriginal Place under the National Parks and Wildlife Act). Other sites are likely to be incorporated in harbour landscapes to be recognised with State Heritage listing in the near future. However, the small number of listings is not due to the paucity of significant sites but due to historical neglect of Indigenous heritage in this context and a general policy of keeping such sites low profile.

![Rock Art, Shell Midden and Rock Engraving Sites in the Region](image)

1.4 Benefits to Indigenous Communities?

By re-recording sites more unrecorded sites and rock art figures have been identified and measures taken for their protection. The results (including photographs) will be used in education and training packages that will increase the profile of Aboriginal heritage among local residents. This will add to the increasing level of awareness and increasing respect for Aboriginal issues in the region. For example, the results will be shared with other members of the local Aboriginal community for things like the annual Aboriginal Festival in the region.

Aboriginal people have worked on the project and were involved in the direction and management of the field work, and in report production and administration. The most important benefit is identifying sites and ensuring they are not accidentally damaged or destroyed due to not having been recorded or having out of date information.
1.5 Legislative Framework

All Aboriginal sites in NSW are protected under the National Parks and Wildlife Act 1974. Whilst ultimately it is the NSW Government that is responsible for the protection of Aboriginal heritage, it is understood that land owners and managers, such as local councils and private land holders, have responsibilities to the heritage places under their control. It should be noted that legislation and the regulatory process for the protection of Aboriginal heritage in NSW is in a state of flux, with the actual state government authority changing regularly and in the context of an ongoing proposal of reform that would change the legislation significantly. In acting to protect Aboriginal heritage in the coastal zone, land owners need to follow the laws and policies that are in place and be aware that these may change.

Coastal Erosion Management

There is increasing documentation and regulation regarding the management of coastal environments, as well as in the design and implementation of protection measures for eroding coastal landscapes. However, it is also clear that the level of detail required to manage and carry out protective works for Aboriginal heritage is far from adequate. Even at a more general level for built assets authorities have been trying to develop better guidelines:

Some authorities have guidelines for design risk level and/or design conditions, but these are not comprehensive...In a management and regulatory environment where it is increasingly common for local authority personnel (who may not be expert in coastal engineering) to have to authorise or accept designs for coastal protection structures (or non-structural measures), it is essential that specific guidelines be produced (National Committee on Coastal and Ocean Engineering, 2000: 12).

Within the last decade there has been a great deal of progress on developing guidelines and improved procedures for coastal management, but again for Aboriginal heritage this is more limited and generally consists of identifying registered sites only without any specific management recommendations. Even recent plans appear to have only carried out desk-top studies of recorded sites in an area and rely merely on the too often out of date and erroneous AHIMS data without further investigation. A 2016 report concluded that for one area “there are no known Aboriginal objects or Aboriginal Places that need to be protected from coastline hazards” (Northern Beaches, 2016: 64) when there are in fact half a dozen recorded sites, all being eroded and damaged by coastal erosion and pedestrian activity. The main focus for heritage in these documents is for historic or European built structures.

In terms of estuaries, the Estuary Management Process in NSW has been guided by the Estuary Management Policy (1992) and Estuary Management Manual (1992). Previously the NSW Government introduced various reforms to coastal management, including the Sea Level Rise Policy Statement (2009), the Guidelines for Preparation of Coastal Zone Management Plans (2010) and the Coastal Zone Management Guide Note – Emergency Action Subplans (2011), some of which were aimed more at estuary health.

More recently NSW has revised much of its coastal management through the 2018 SEPP and the 2016 Coastal Management Act. All of the partner LGAs (except Strathfield) and the Aboriginal heritage sites referred to in this project are covered by this SEPP as coastal use areas.
Coastal Management Act 2016

The Coastal Management Act 2016 establishes the framework and overarching objects for coastal management in New South Wales. The purpose of the CM Act is to manage the use and development of the coastal environment. It also supports the aims of the Marine Estate Management Act 2014, as the coastal zone forms part of the marine estate.

The CM Act defines the coastal zone, comprising four coastal management areas:

- coastal wetlands and littoral rainforests area
- coastal vulnerability area
- coastal environment area
- coastal use area.

The CM Act establishes management objectives specific to each of these management areas.

State Environmental Planning Policy (Coastal Management) 2018

The State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) identifies and maps the coastal zone according to definitions in the CM Act. The CM SEPP streamlines coastal development assessment requirements.

The CM SEPP identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the CM Act.

The CM SEPP establishes the approval pathway for coastal protection works.

Statewide mapping is available for:

- coastal wetlands and littoral rainforest areas
- coastal environment areas
- coastal use areas.

Draft legislation and supporting documents were put out for public consultation in 2015. A large number of submissions covering many topics were received by the government. Several submissions raised the issue of Aboriginal heritage, along the following lines:

‘There is no specific object in the draft Bill to identify and protect Aboriginal cultural heritage sites in the coastal zone. Information is lacking on Aboriginal sites and values, and a key object of the Bill should therefore be to “comprehensively investigate, document and protect Aboriginal sites in the coastal zone”. (Jervis Bay Regional Alliance)’ (NSW Government, 2016: 2)

The final legislation, SEPP and management framework do not tackle Aboriginal heritage beyond a general level.

As mentioned above, all coastal areas of the partner LGAs and the Aboriginal heritage sites referred to in this project are covered by this SEPP as coastal use areas (see Map 2, below).
These overarching documents are to provide guidance for regional and local plans. Councils are developing new strategies based on the latest legislation and policy framework, while continuing to follow their existing processes. In the AHO region a number of plans already exist. Partner Councils of the AHO have sometimes included a recommendation to refer to the AHO’s Aboriginal Site Management Plan for that particular Council for further detail when determining management requirements. For example, in the Lane Cove River Coastal Zone Management Plan in table 4.1 (“Develop an inventory of Aboriginal and cultural sites throughout the estuary”), the status review for Willoughby Council was:

Aboriginal Sites report completed for all estuary Councils by Northern Sydney Aboriginal Heritage Office, WCC is a partner in the Northern Sydney Aboriginal Heritage Office
(Lane Cove River CZMP: Table 4.1 p.20)

Existing plans for the region include those listed below:

**Lane Cove River**
Lane Cove River Coastal Zone Management Plan – Draft (including AHO partners Lane Cove Council, Ryde Council and Willoughby Council) (BMT WBM, 2012)

**North Harbour, Middle Harbour and Middle Creek**
Clontarf Bantry Bay Estuary Management Plan (Manly Council, 2008)
Little Manly Coastal Management Plan
Forty Baskets Coastline Management Plan
Manly Cove Coastline Management Study (Manly, 2004)
North Harbour Coastline Management Plan (Manly Council, 2010)
Ocean Coastline
Manly Ocean Beach Coastline Management Plan (Manly, 2008)
Collaroy Narrabeen Coastal Management Plan (Warringah, 1997)
Coastal Zone Management Plan for Collaroy-Narrabeen Beach and Fishermans Beach (Northern Beaches, 2016)

Northern Beaches Estuaries and Lagoons
Dee Why Lagoon Estuary Management Plan (Warringah, 2004)
Narrabeen Lagoon Plan of Management (Warringah, 2011)

Sydney & Region
Mapping and Responding to Coastal Inundation (Sydney Coastal Councils Group & CSIRO, 2012)
Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005
Sydney Harbour & Foreshores Area DCP 2005

While these plans mention Aboriginal heritage with the aim of protecting Aboriginal sites, it is at a general level and few Aboriginal sites actually have detailed management plans, let alone in relation to coastal erosion.

Other Plans and Policies

The project also fits in with key recommendations of the:
- Northern Sydney Aboriginal Social Plan (Moylan-Coombs, 2010)
- Foreshores Aboriginal Heritage Promotion Report, 2007 (AHO, 2007)
- The AHO Business Plan (Appendix of AHO Annual Reports, various years)
- Aboriginal Site Management Report for each Council (various)

In terms of these plans, there are specific recommendations for site protection works, more detailed recording, monitoring, signage and in terms of community education and professional training.
1.5 Environmental Framework

The current erosion of coastal sites needs to be put into perspective of past and current issues. Most archaeological sites in the Sydney area have been dated to within the last few thousand years, which coincides with the stabilizing sea levels of the late Holocene. Eroding shores of earlier eras would be long submerged. More recent sea level rise (ie from the twentieth century) is the major issue in current erosion.

Rising Sea Levels

From around 7000 to 3000 years ago, global mean sea levels rose 2 to 3m to near present-day levels. The Intergovernmental Panel on Climate Change (IPCC) states that there is medium confidence that fluctuations in sea level over the last 2000 years have not exceeded approximately +/- 0.25m on time scales of a few hundred years. Sea level began to rise above this late Holocene background from between 1905 and 1945. (Church et al 2013: Chap 13: 1146).

This sea level rise of the 20th and 21st century has been well documented:

*Sea level rise has been evident from very long-term tide gauges stationed around the world, particularly those in northern Europe. The two longest continuous tide gauge records in Australia, Fremantle (from 1897) and Fort Denison (from 1866) show similar trends in increasing sea level over time. Tide gauge records from 1920 to 2000 tell us that the change in relative mean sea level around the Australian coastline was about 1.2 mm/year over that timeframe. (Watson & Lord, 2008: 26).*

The IPCC states that “global mean sea level will continue to rise during the 21st century … the rate of sea level rise will very likely exceed that observed during 1971 to 2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets” (IPCC 2013: 23).
Australia’s climate has warmed since 1910. It is consistent with warming in the surrounding oceans.

CHART 1: SEA LEVEL (CMAR: 2019)

CHART 2: SEA LEVEL (CLIMATE CHANGE IN AUSTRALIA: 2019)
The global projections must be taken with some caution as regional variations are likely to exist. For example, in Australia sea level rise in the 20th century was below global projections. However, it is expected that additional glacial melt and other factors that create a greater impact in this region will result in sea level rise at the global average by 2100 (McInnes et al, 2015: 143).

The current generation of global climate models have horizontal resolutions of the order of 1° and therefore do not fully resolve the details of ocean currents such as the East Australian Current and its eddies and the representation of deep-ocean/continental shelf interactions. As a result, the coastal response of sea level to climate change contains uncertainties in addition to those associated with the
Regardless of the broader sea level rise, the risk to the foreshores areas of Sydney is clear, as illustrated in the following map excerpts (blue shows expected sea level inundation at 2100 at highest tide with +0.74m increase, based on the Intergovernmental Panel on Climate Change Fifth Assessment Report scenarios). These can be viewed through the Coastal Risk Viewer (Coastal Risk: 2019).

**Map 3: Expected 2100 Sea Level (Blue) – Middle Harbour**
Map 4: Expected 2100 sea level (blue) – Pittwater (L) and ocean beaches (R)

Map 5: Expected 2100 sea level (blue) – Lane Cove and Parramatta Rivers
Flooding Behaviour

The increase in mean sea level may appear relatively minor, however, the greatest impact is most dramatically seen during peak events, such as ‘King Tides’. In the southern hemisphere high tides peak during summer and winter months. ‘King Tides’ are the colloquial term for the highest ‘spring’ tide that takes place on the new or full moon during these months. In summer the peak tides are during the day, while the peak tides are usually at night in winter. A peak spring tide is usually higher than 2m above tide gauge zero (Fort Denison, Sydney Harbour), compared with a normal high tide of 1.5m to 1.7m (DECCW, 2009: 6).

For the Sydney Region the following impacts are envisaged:

Flooding behaviour is likely to change

The combination of rising sea levels and catchment-driven flooding is likely to increase flood frequency, height and extent in the lower portions of coastal floodplains. Increases in the intensity of flood-producing rainfall events are likely to change flood behaviour, but catchment conditions at the time of each rainfall event (soil moisture conditions and levels in major water storages) will affect the degree of the change.

Rising sea level is virtually certain to increase coastal recession

Sea level rise and storms are virtually certain to increase coastal inundation and erosion, causing the erodible coastline to recede... Impacts will be locally intensified or reduced by changes in other factors such as rainfall patterns, storm intensities and frequencies, river flows, and wind and wave action. Shoreline retreat is very likely to be higher in estuaries and on beaches with lower gradients, particularly where the ocean breaks through or washes over coastal dunes. Where beaches are backed by seawalls and promenades, as is commonly the case in the developed Sydney Basin, there is very likely to be a narrowing and potential loss of sandy recreational areas unless beach replenishment programs are put in place.

Sea level rise and flooding are likely to affect Aboriginal cultural heritage values

The Sydney/Central Coast region includes a variety of sites, places and objects that are culturally significant to Aboriginal people, including stone artefacts, rock art, middens, grinding grooves, rock shelters and ceremonial sites. Sea level rise and extreme rainfall events are likely to result in the loss of or damage to middens and other coastal ceremonial sites.

(DECC, 2010a: 134-135, 137-138)
Wave Action from Storm Surges

Wave action has been identified as a significant impact on Aboriginal heritage sites on shorelines (e.g., in freshwater reservoirs, (O’Halloran and Spennemann, 2002)). The size and impact of waves has many contributing factors with wind and fetch being perhaps the most significant. Ocean shores have larger ocean derived waves to contend with whereas estuarine harbours can be quite protected from natural wave action as the water surfaces can be sheltered from wind and too small to allow much build up of wave force. Extreme weather events obviously change the equation and when coupled with high tides and floodwaters can increase the impacts to Aboriginal heritage on the foreshore.

Low pressure and strong winds associated with severe weather events can cause fluctuations in coastal sea levels which are commonly called storm surges. Associated with storm surges are wind driven waves which can also contribute to elevated sea levels through wave setup (McInnes et al., 2012: 5).

![Wave Action from Storm Surges](image)

**Figure 2:** Schematic illustrating the contributions to coastal sea levels. Extreme sea levels comprise some combination of storm surge and astronomical tide, often referred to as a storm tide. Note that a storm tide can comprise a large surge in combination with a small or even negative tide or a moderate surge in combination with a particularly high tide. Sea levels may be further amplified at the coast due to wave breaking processes such as wave setup and run-up.

**Chart 4: Wave and Sea Level (McInnes et al., 2012: 5).**

Wave Action from Boating Traffic

In the estuary areas of Sydney boating traffic is significant and boat generated waves are arguably a more immediate and frequent impact to foreshores. In tranquil coastal, estuarine and river environments boat wakes may be the leading cause of shore line erosion and wave period is as important as wave height. In both wind and boat derived waves:

“It appears that wave period is at least as important as wave height, due to the increased seabed particle velocities and often plunging breakers associated with long wave periods, as well as the fact that riverbanks are not naturally adapted to long wave periods.” (Gourlay, 2011).
In Sydney there is a large number of recreational, commercial and government boating movements each day, with daily and seasonal fluctuations, with at least 70% being recreational (there are over 17,000 boats currently registered in the wider Sydney Harbour area with numbers estimated to increase to over 22,000 by 2021, OBSMA, 2013). Nearly 15% of boating movements were Motorcruisers (Widmer et al, 2003). The number of watercraft is increasing in most categories, including larger vessels over 5m in length which are also more likely to create damaging boat wash (see Chart 7 below).

In 2012 a study was carried out of wave size, duration and distance from watercraft showing significant wave / wash from the many types of vessel operating in the harbours (see table 4 below). Wave maximum height from boats in the Sydney Harbour and Parramatta River estuaries were between to 0.25m to 0.87m (Watson, 2012: 42). AHO survey teams have noted that even small boats could set off a series of waves to the shore that would exacerbate erosional processes if concurrent with very high tides lapping directly on foreshore exposures.

<table>
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<th>Location</th>
<th>Craft Class</th>
<th>Averages</th>
<th>Maxima</th>
<th>Distance From Sail Line (m)</th>
<th>Power (W/m)</th>
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<td></td>
<td></td>
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<td>T (sec)</td>
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<td>T (sec)</td>
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<td>0.4</td>
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<td>0.54</td>
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</tr>
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Table 1: Boating waves in Sydney Harbour and Parramatta River (Watson, 2012: 42)

Waved generated by a passing motorcruisers in Middle Harbour (no wash zone), Dec 2013 and Nov 2011
Many areas of Sydney estuaries are no wash zones, however, AHO staff, consultants and volunteers have all witnessed significant wash from boats supposedly in no wash zones (see below).

*Source: NSW Maritime database*

**Figure 1b: Change in total vessel numbers between 2000 and 2010, by size class**

**Chart 5: Vessel Size in Sydney Harbour (Maritime, 2011: 9)**
**Commercial vessels**

There is a large commercial fleet using Sydney Harbour with a total of 368 vessels operating in one or more of the categories of interest shown in Table 1 below. Note that many of the 368 vessels have multiple operations and therefore qualify in more than one of the 5 analysed groups. Similarly with the charter vessels which have multiple charter operations.

**Table 1: Selected categories of the Sydney Harbour commercial fleet as at August, 2011**

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<tr>
<th>Vessel class</th>
<th>Number of operators</th>
<th>Number of vessels</th>
</tr>
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<tbody>
<tr>
<td>Commercial  adventure vessel (CAV)</td>
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<tr>
<td>Water taxi</td>
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</tbody>
</table>

*Source: NSW Maritime database*

**Table 2: Vessel Type in Sydney Harbour (Maritime, 2011: 11)**

**Map 6: Speed Restriction Zones in Sydney Estuaries (Maritime 2011: 3)**

There are many different speed restrictions in Sydney Harbour and its tributaries. In terms of this Aboriginal heritage project the most relevant areas are (see individual monitor areas for details on sites):
Middle Harbour: upper sections are 4 knot restriction zones designed to protect foreshores from erosion and conflict between users. There are also No Wash zones at certain points.

Upper Lane Cove River: this is a 4 knot restriction due to the narrow congested waterway, and to reduce erosion and noise in areas further north.

North Harbour: the western bay area is a 4 knot restriction due to congestion and swimmers. There are other speed restrictions and most areas have no set restrictions (Maritime 2011).
Wake from watercraft, Middle Harbour (left) and Sydney Harbour ferry (right) (AHO GIS, 2011, Google Maps 2013)

Ferry (circled) passing near rock shelter

Wave action from ferry wake
2.0 Heritage Research and Review

In order to develop the coastal erosion strategic plan, a review of previous work was required followed by fieldwork, analysis and report writing. The following work was proposed:

- Review of Aboriginal heritage site management reports, site cards and AHIMS (the Aboriginal Heritage Information Management System of the NSW Office of Environment and Heritage) site records for sites in tidal / erosion zone.
- Visit, record and assess accessible sites using multiple media.
- Develop risk assessment list, conservation and salvage list, and priority action plan.
- Final Year 1 report (including individual site recommendation summaries).

In Year 2 the project would build on the previous work increasing the number of sites being fully recorded and expand to include vulnerable rock art (pigment and engraved) sites outside the foreshore zone to maximise heritage and community outcomes in the region at a time when sites are under increasing pressure (there are around 50 pigment and 100 engraving sites surviving in Council areas):

- additional recording and monitoring of foreshore sites (10+ sites)
- additional recording and/or monitoring of art sites (20+ sites)
- an Aboriginal heritage rock art management plan
- risk assessments for sites (50+)
- management and conservation options (50+)

The material generated from this work was used to produce education material.

The following sections detail the work carried out for the foreshore sites under immediate threat of coastal erosion. For the background information on the rock art and engraving site work, a separate report has been prepared (Part 2).

2.1 Previous Project Findings

The Aboriginal Heritage Office received a grant from the Federal Department of Environment and Heritage for a two year coastal erosion project in northern Sydney in 2013-2014. The project aimed to better understand erosion issues affecting Aboriginal sites in northern Sydney’s foreshore (AHO, 2015).

Sixteen sites were chosen from a range of estuary and environmental types across the region as a sample to represent different harbour/ocean environments and other variables, including:

- Sites in different environmental zones (eg lower or higher in estuary zone).
- Areas subject to different human induced wave action (eg proximity to ferry routes).
- Areas exhibiting coastal erosion.
- Areas more prone to impact by Council / public.
- Areas considered to have high potential for unrecorded sites.
- Accessibility, particularly at high tide and for frequent monitoring.

It was found that despite some similarities, each individual site has characteristics that made it difficult to compare between sites. For example, the height above mean high water (MHW) varies between

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1 OEH – part of the heritage section has been moved into a new department. Prior to the OEH it was the Department of Environment, Climate Change and Water, before that DECC, before that DEC and prior to 2002 it was the NPWS).
sites and even within a site. Each site is affected by tidal wash in different ways due to localized rock outcrop or shoreline shape, type of shore, common wave action, frequency of boating traffic and so on. The information provided below gives useful insights into the issues affecting individual sites and those in similar contexts around the region.

![High tide waves lap middle, Middle Harbour (left) and Sydney Harbour (right)](image)

![Ferry waves over 40cm high in sets crash on the shore](image)

**Results**

Slumping of foreshore embankments occurred at two sites (Roseville Chase in an upper estuary sheltered area and Collaroy in a very exposed ocean shoreline), a site in Gladesville (Parramatta River estuary) lost large rock and shell material from the midden deposit, and many sites were showing smaller but ongoing deposit loss.

The largest loss of deposit was an ocean shore. The next largest losses came from an upper estuary and a lower estuary. These sites have the smallest height above mean high water despite their difference in estuary and it would be expected that sites closer to MHW would be most adversely affected by very high tides. The remaining sites are variable in relation to site height above MHW, estuary type, shore type and observed boat wave height and further work would be required to try and elucidate definitive patterns from among the many different variables. During monitoring several sites were found to have had vegetation cover reduction, such as grass die back from salt water splashing.
Discussion

The program’s results confirmed the anecdotal evidence that erosion is occurring and also confirming the premise that localized influences and conditions are likely to be the most important function of how a particular site is impacted by coastal processes. A key factor is the site height above mean high water (MHW). However, the measurable erosion rates at each site (at specific cross-sections) did not reflect this pattern consistently and shows other local conditions need to be considered. An important factor is wave action from boating traffic. This increases the reach, duration and wash over archaeological deposits and therefore those sites in proximity to more frequent boating traffic and larger vessels are more at risk.
The image above shows why digital mapping (including Lidar) is not of sufficient accuracy to give a full understanding of the very localized erosion issues of an individual shoreline and site, making field inspections essential (AHO, 2015: 30).

**Site Protection Options**

The study found that there are no easy solutions for providing protection for Aboriginal heritage on the foreshore. Coastal protection options are far more limited in number and much more complex (and expensive) than those available on land. For most Aboriginal sites in the northern Sydney area the most likely option would be a sea wall. Other options include maintaining good vegetation cover on ground surfaces and archaeological salvage.

**Conservation Management Plans & Feasibility**

Having completed monitoring and reviews of available options the reality is for most sites the only practical protective solution would be a sea wall, which would be hard for landowners to justify for bushland areas, for long and extensive sites and those sites with no other public asset associated with the shore.

**Monitoring Strategy**

It was determined that the level and detail of monitoring across the region needs to increase so that changes can be documented. It was also felt that the AHO volunteer network should be expanded to include a specific coastal erosion monitoring program.

**Next Steps**

Recommendations for short term and longer term actions were presented, including ongoing monitoring, a regional or Council wide foreshore Aboriginal heritage erosion management plan, and options for archaeological salvage of sites at risk of being lost to erosion. The current work in 2018-2019 is an outcome of this earlier study and aims to implement the recommendations.
2.2 Archaeological Background

An update of the site cards and reports held by AHIMS was carried out, as well as the AHO’s data and reports.

Review of AHO Site Management Plans\(^2\) (7 reports)

A desk-top review showed that as of March 2018 approximately 242 recorded sites were identified as being in the foreshore zone (of partner Councils only - the study area does not include National Parks or non-partner Councils) and either currently being affected by coastal erosion or likely to be affected within the foreseeable future (see Map 7 below). The foreshore zone was taken to be approximately 10m horizontally and 2m vertically from the mean high tide level.

The AHO has site data from previously completed Aboriginal heritage studies for each of the partner Councils that could be drawn from as it would be impossible to locate each of the sites from original AHIMS site cards in the time available due to its generally poor accuracy (see discussion at Appendix 3). A major component of the AHO studies is relocating each of the recorded and known Aboriginal sites and updating information, particularly about the location and condition. The AHO updated card information provided a streamlined method to review and prioritise sites for monitoring and further work.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Total Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burial</td>
<td>4</td>
</tr>
<tr>
<td>Engraving</td>
<td>6</td>
</tr>
<tr>
<td>Fish Trap</td>
<td>2</td>
</tr>
<tr>
<td>Grinding Groove</td>
<td>1</td>
</tr>
<tr>
<td>Isolated Find</td>
<td>1</td>
</tr>
<tr>
<td>Midden</td>
<td>137</td>
</tr>
<tr>
<td>Not a Site</td>
<td>1</td>
</tr>
<tr>
<td>Open Artefact Scatter</td>
<td>1</td>
</tr>
<tr>
<td>Shelter</td>
<td>1</td>
</tr>
<tr>
<td>Shelter Art</td>
<td>14</td>
</tr>
<tr>
<td>Shelter Deposit</td>
<td>4</td>
</tr>
<tr>
<td>Shelter Midden</td>
<td>68</td>
</tr>
<tr>
<td>Shelter PAD</td>
<td>1</td>
</tr>
<tr>
<td>Waterhole</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>242</strong></td>
</tr>
</tbody>
</table>

Table 3 & 4: Total sites by type and Council area

Note: does not include secondary features (eg Shelter Art + Midden, etc)

\(^2\) These reports are confidential documents for authorised access only.
The current review showing 242 is an increase from the previous coastal erosion project where only 221 sites were identified in the foreshore zone (AHO, 2015) and that earlier figure also included Ryde City Council, which is not in the current study. The new figure reflects both new recorded sites and a correction of erroneous data held by AHIMS.

Of the 242 recorded sites in the foreshore zone the vast majority, 137 (or 57%), are open shell middens (ie not associated with a shelter or overhang), and the majority of the remainder are associated with a shelter (see table breakdown above). Other site types include burials, rock engravings, fish traps and a waterhole. In terms of Council areas, over a third of sites (89 or 37%) in the foreshore zone are in Willoughby (mostly in Middle Harbour). Over 20% of sites are in Northern Beaches north (former Pittwater), with sites surviving along the ocean shore as well as the protected Pittwater water body. Northern Beaches central (former Warringah) has the least number of surviving sites, which is most likely due to the area having no harbour or sheltered coastal water body and a high proportion of ocean beaches and associated coastal development. Ku-ring-gai also has relatively few, mainly due to being an LGA with only upper estuary foreshore zones (Lane Cove River and Middle Creek).

3.0 Monitoring and Recording

The main objective of the first year of the project was to prepare a northern Sydney regional foreshore erosion management plan to identify priority sites for full recording, monitoring, risk assessments and management and salvage options. With such a large number of sites in the foreshore zone of the partner Councils, it would be difficult to visit each one. It was therefore important to try and create a preliminary priority list to help guide the fieldwork. This draft list could then be reassessed following fieldwork and become the basis for the strategic plan priority list.

Monitoring for year two consisted of additional foreshore sites, as well as rock art and engraving sites which are discussed in a separate document (see Part 2).

3.1 Sites for monitoring

From the original 242 foreshore sites, that is, those sites approximately 10m horizontally and 2m vertically from mean high tide level, each site was given a priority category. The criteria used is described below (note: the exact locations are not given here due to confidentiality issues and data license agreements).

Priority Categories

Each foreshore site was reviewed in terms of location, last monitor condition report, likely threats and archaeological significance. The sites were then given a draft priority score between 1 and 4 (with 1 being the most important) in order to prioritise fieldwork. The categorization was based on the following:

- Site type, size, rarity, threats, condition and time from previous monitor.

For example, rock art and rock shelters with archaeological deposit or midden are rarer and sometimes considered more fragile and therefore are considered a higher priority. Larger sites have the potential to contain more archaeological features and potentially represent an area where more people came together for a longer time and therefore become potentially a greater net loss if destroyed, so are also considered a higher priority. Sites that appear to have noticeable and active erosion and/or other impacts like erosion from human visitation are potentially more vulnerable than sites with no obvious significant impact, so are given a higher priority. Sites in better condition can potentially provide more
information on people’s use of the area and likewise are given a higher priority. Sites that were monitored more recently have some level of updated current information with which to carry out a desk top review and are given a lower priority weighting when compared to sites that have not been revisited in the digital era or within 10 years as the level of current impact and the potential loss of information is unknown without a reassessment.

As noted above, the initial desk-top categorization identified 242 registered sites. Fifty-five sites were identified as a higher priority for monitoring. The priority sites categories are proportionally similar to the breakdown of site types (see Table 3).

<table>
<thead>
<tr>
<th>Site Types</th>
<th>Priority 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burial</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Engraving</td>
<td>1</td>
<td>5</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Fish Trap</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Grinding Groove</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Isolated Find</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Midden</td>
<td>33</td>
<td>35</td>
<td>27</td>
<td>42</td>
<td>137</td>
</tr>
<tr>
<td>Not a Site</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Open Artefact Scatter</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Shelter</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Shelter Art</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Shelter Deposit</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Shelter Midden</td>
<td>15</td>
<td>17</td>
<td>13</td>
<td>23</td>
<td>68</td>
</tr>
<tr>
<td>Shelter PAD</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Waterhole</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>55</strong></td>
<td><strong>58</strong></td>
<td><strong>46</strong></td>
<td><strong>83</strong></td>
<td><strong>242</strong></td>
</tr>
</tbody>
</table>

**Table 5: Site Types by Priority**

*Note: does not include secondary features (eg Shelter Art + Midden, etc)*
The breakdown per LGA is also roughly similar proportionally, except for Willoughby where there are a greater number of sites in total and also in higher priority classes (see Table 4).

<table>
<thead>
<tr>
<th>Council</th>
<th>Priority 1</th>
<th>Priority 2</th>
<th>Priority 3</th>
<th>Priority 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Lane Cove</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>18</td>
<td>32</td>
</tr>
<tr>
<td>North Sydney</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>NthnBeaches-Manly</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>NthnBeaches-Warringah</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>NthnBeaches-Pittwater</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>30</td>
<td>52</td>
</tr>
<tr>
<td>Willoughby</td>
<td>22</td>
<td>39</td>
<td>13</td>
<td>15</td>
<td>89</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>55</strong></td>
<td><strong>58</strong></td>
<td><strong>46</strong></td>
<td><strong>83</strong></td>
<td><strong>242</strong></td>
</tr>
</tbody>
</table>

Table 6: Priority sites per Council
3.2 Monitoring Methodology

Field work was aimed at monitoring as many higher priority sites as possible. Lower priority sites would be revisited and reassessed when they were close to the higher priority sites and there was little or no additional travel time.

The monitor would firstly attempt to confirm that the site card information matched the actual site details (some sites have been mixed up in the past due to the poor original recording information and what subsequent monitors have found, eg. duplicate site cards, more areas of shell exposed along a shoreline than originally recorded, the loss of some sites to erosion or development and so on). Once the site details were confirmed, the monitor would carry out the following:

- checking the grid coordinates
- reviewing the site condition
- new photographs taken of the site
- identify monitoring points for assessing future erosion or impacts
- updated site plans, where necessary

A 360° (Richo Theta S) camera was used to capture images that could provide a fuller context of the sites or, for larger sites, key sections of them. It would also provide material for community engagement online content.

Equipment to capture 3D photogrammetry was explored and found to be too costly or too labor intensive for this project, however, discussions with university departments have provided some promising partnership opportunities (see Section 4.0 below).

Video was not taken during this stage of the project as it was decided to focus on monitoring as many sites as possible and identifying those most appropriate to do more detailed recording and video (see Appendix 1 for standard monitoring method).

In the second year for those sites that were included in the monitoring work a drone was also used to capture some images and video.
Eroding midden site in middle estuary area

Rocky shore site with eroding midden, 360 camera

Eroding midden with scale
3.3 Personnel

The project was supervised by AHO Manager, David Watts, and project managed by archaeological consultant Phil Hunt. Research and fieldwork was undertaken by archaeological consultants Phil Hunt, Dani Mitchell, Taylar Reid and Sharyn Croke. Year 2 works were carried out by Dani Mitchell, Phil Hunt and Dina Goranitis.
4.0 Community Engagement & Education

A catalogue of photos has been captured from the field work, including $360^0$ images, and has been used to develop community engagement materials. Video has also been captured of sites and interviews with AHO staff and consultants and has been put into different online media (see below).

The AHO provided information to the NSW OEH that has been used in the production of new material for the Heritage Near Me app and a Stage 4 Geography education package.

Partnerships have been developed with two universities to further expand the reach of the project beyond the current activities and the current time period. Discussions with Indigenous staff from two departments within Macquarie University have been ongoing. This saw the development of a project with a group of senior undergraduates from the Department of Environmental Sciences, Faculty of Science and Engineering, who were creating an app for monitoring coastal sites (this was not completed in time by 2018 students and is on hold). Staff and post-graduate students from the Department of Biological Sciences, also in the Faculty of Science and Engineering, are working with the AHO on 3D photogrammetry of selected eroding sites to measure the rate of erosion and also identify and quantify the shell species visible.

The AHO has also been working with the University of NSW’s Nura Gili Centre for Indigenous Programs, for the purposes of producing a number of education videos. Four have been produced on site management and education. The AHO has produced another on coastal erosion. These have been made available to the wider public through the AHO’s website and YouTube channel.

A more enhanced community engagement program was planned but due to a number of unforeseen events had to be scaled back and otherwise postponed. The AHO lost a key staff member to illness and the overall budget was held up making it impossible to progress the AHO’s volunteer program during year one. The AHO also vacated its poor accommodation in Manly for temporary desk space within council. A move to improved premises took over two months to finally restore the office to normal operating conditions. A volunteer monitoring program for the coastal sites is still on hold indefinitely due to health and safety restrictions for unsupervised volunteers near the foreshore (the volunteer program for sites away from the immediate foreshore is ongoing).

However, 2019 has been far more conducive operating out of the new office and re-instated Museum and Education Centre. The AHO held a community yarn up with guest speaker Cassie Leatham, produced three newsletters and two volunteer site monitor training nights. The number of site volunteers has increased as well as volunteers at the Museum and Education Centre.

The AHO has also produced two 360 virtual tours using images from the work. These provide opportunities to people anywhere to access images via internet, either using a normal computer, tablet or smartphone or using VR (virtual reality) headsets for a more immersive experience. The two themes are rock art / engravings sites and shell midden / coastal erosion.
In summary, there are now five videos and two 360 virtual tours available to online audiences via the AHO website and YouTube Channel.

Online Resources

AHO Website Video Page: [http://www.aboriginalheritage.org/resources/videos/](http://www.aboriginalheritage.org/resources/videos/)
AHO YouTube Channel: [https://www.youtube.com/channel/UCyv6itHQrz9b07l-UAiH-LSQ](https://www.youtube.com/channel/UCyv6itHQrz9b07l-UAiH-LSQ)
Video – Rock Art and Engravings: [https://youtu.be/-VwFmUr1h18](https://youtu.be/-VwFmUr1h18)
Video – How to Identify Rock Art: [https://youtu.be/mtdeUGaRWho](https://youtu.be/mtdeUGaRWho)
Video – A Guided Aboriginal Heritage Walk: [https://youtu.be/8cLVfmOgyqo](https://youtu.be/8cLVfmOgyqo)
Video – Rock Art: [https://youtu.be/nh5Xv2f3Cys](https://youtu.be/nh5Xv2f3Cys)
AHO Website 360 Tour Page: [http://www.aboriginalheritage.org/resources/resources-360virtualtours/](http://www.aboriginalheritage.org/resources/resources-360virtualtours/)
360 Tour – Rock Art and Engravings: [https://ths.li/7pJCyZ](https://ths.li/7pJCyZ)
360 Tour – Midden and Coastal Erosion: [https://ths.li/P11f7](https://ths.li/P11f7)
5.0 Results – Year 1

The results of the first year were very pleasing, with 92 foreshore sites being monitored. An additional ten sites were revisited in the second year, as well as 22 rock art and 17 rock engraving sites. The full results are presented below.

Monitoring Results – Foreshore Sites

The original project aim for field work in Year 1 was to provide, across 5 LGAs in varying estuarine contexts

- additional recording and monitoring of foreshore sites (30+ sites)
- an Aboriginal heritage erosion management plan
- risk assessments for sites (50+)
- estimate of archaeological deposit (20+)
- estimate of time frame before total loss (10+)
- management and salvage options (30+)

It was found that trying to estimate the amount of archaeological deposit and time frame before total loss was problematic as there is insufficient information about the rate of erosion at each site. For most sites the estimate would entail a large margin of error and would not be particularly helpful in developing management options. It was decided to focus instead on monitoring more sites and capturing basic data that could be used in a greater number of ways.

A total of 92 sites were monitored of a total of 242 foreshore sites. Prior to the field work, 55 sites were assessed as higher priority for monitoring. Of these, 50 were visited and 5 were not relocated. A total of 24 Priority 2 sites were visited (5 not relocated and 11 not visited), 9 Priority 3 sites (4 not relocated) and 9 Priority 4 sites (2 not located and 5 not visited).

As a result of the field work, the priority categorization of each site was reviewed with seven sites being downgraded from Priority 1 to Priority 2 and three from Priority 1 to Priority 3. One site was downgraded from Priority 1 to Priority 4 and several sites were readjusted within the lower categories. The following information is about the sites that were monitored only.

<table>
<thead>
<tr>
<th>Revised Priority</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
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<tbody>
<tr>
<td>Total</td>
<td>40</td>
<td>27</td>
<td>13</td>
<td>12</td>
<td>92</td>
</tr>
</tbody>
</table>

TABLE 7. REVISED PRIORITY CATEGORIES OF MONITORED SITES.

![Chart 8. Revised Priority Categories of monitored sites.](chart)
Of the total sites monitored, the vast majority were in Willoughby Council, which has the highest number of foreshore sites. Middle Harbour is also the estuary with the largest number of sites and the greater variety of site types.

<table>
<thead>
<tr>
<th>Council</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>5</td>
</tr>
<tr>
<td>Lane Cove</td>
<td>3</td>
</tr>
<tr>
<td>N-Beaches Nth</td>
<td>6</td>
</tr>
<tr>
<td>N-Beaches Sth</td>
<td>3</td>
</tr>
<tr>
<td>N-Beaches-Cntrl</td>
<td>6</td>
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<td>Nth Sydney</td>
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<td>Willoughby</td>
<td>61</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>92</strong></td>
</tr>
</tbody>
</table>

**TABLE 8. SITES BY COUNCIL**

Note: Northern Beaches Council was amalgamated from 3 previous LGAs (Manly, Warringah and Pittwater).

**CHART 9. REVISED PRIORITY CATEGORIES BY ESTUARY.**

**ERODING MIDDEN SITE IN MIDDLE ESTUARY AREA**
By Site Type
The main site types in the foreshore zone are shell middens (51) and rock shelters with shell midden (27) (Note: this is based on the primary feature and does not include secondary archaeological features, for example, a Shelter Art site may also have shell midden and/or stone artefacts but the primary type is simply Art). Of the 40 Priority 1 sites, there are only three main site types.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Priority 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
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<td>Fish Trap</td>
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<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Isolated Find</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Midden</td>
<td>25</td>
<td>14</td>
<td>9</td>
<td>3</td>
<td>51</td>
</tr>
<tr>
<td>Shelter</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Shelter Art</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Shelter Deposit</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Shelter Midden</td>
<td>12</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>Waterhole</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>27</strong></td>
<td><strong>13</strong></td>
<td><strong>12</strong></td>
<td><strong>92</strong></td>
</tr>
</tbody>
</table>

*Table 9. Revised Priority Categories by Site Type*

Condition
The two tables (10 and 11) below show that of the 92 sites monitored around two thirds were stable, which was one of the reasons many sites were reclassified as a lower priority. Of the revised Priority 1 sites, nearly 80% were considered to be poor condition or experiencing ongoing general erosion (including coastal, water, human induced or animals induced), with only 23% considered to be stable.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>stable</th>
<th>ongoing erosion</th>
<th>poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitored Sites</td>
<td>61</td>
<td>29</td>
<td>2</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>66%</td>
<td>32%</td>
<td>2%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site Type</th>
<th>stable</th>
<th>ongoing erosion</th>
<th>poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1 Sites</td>
<td>9</td>
<td>29</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>23%</td>
<td>73%</td>
<td>5%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Tables 10 & 11. Revised Priority Categories by Condition*

Of those sites in the foreshore zone that were monitored (Table 12, below), 61 sites are considered to be facing evident coastal erosion. All but one Priority 1 site is in this situation, whereas lower priority sites are less prone to coastal erosion at this time. However, as Table 13 shows, there are a range of other impacts occurring at sites, particularly human activity such as pedestrian traffic, that need to be taken into account.
Year 1 Conclusions

Erosion is occurring at different rates at different sites, which is dependent on the localised conditions at each site. Of the 92 monitored sites it was recommended that detailed erosion monitoring be maintained or initiated at 35 sites, with the remaining sites being included in the less intensive general monitoring.

A total of 12 sites were earmarked for more specific work, either further detailed recording or archaeological salvage. Of these sites, the majority are open middens.

### Table 12. Evidence of Coastal Erosion

<table>
<thead>
<tr>
<th>Coastal Erosion</th>
<th>Priority 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>1</td>
<td>11</td>
<td>9</td>
<td>10</td>
<td>31</td>
</tr>
<tr>
<td>yes</td>
<td>39</td>
<td>16</td>
<td>4</td>
<td>2</td>
<td>61</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>27</strong></td>
<td><strong>13</strong></td>
<td><strong>12</strong></td>
<td><strong>92</strong></td>
</tr>
</tbody>
</table>

### Table 13. Evidence of Other Erosion and Impacts

<table>
<thead>
<tr>
<th>Other Impacts</th>
<th>Priority 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>animal activity</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>human activity</td>
<td>17</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>natural activity</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>negligible</td>
<td>16</td>
<td>16</td>
<td>7</td>
<td>9</td>
<td>48</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>27</strong></td>
<td><strong>13</strong></td>
<td><strong>12</strong></td>
<td><strong>92</strong></td>
</tr>
</tbody>
</table>

### Table 14. Recommendations

<table>
<thead>
<tr>
<th>Actions</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion monitor</td>
<td>35</td>
</tr>
<tr>
<td>Record</td>
<td>8</td>
</tr>
<tr>
<td>Salvage</td>
<td>4</td>
</tr>
<tr>
<td>Monitor</td>
<td>23</td>
</tr>
<tr>
<td>General monitor</td>
<td>57</td>
</tr>
<tr>
<td>Monitor</td>
<td>57</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>92</strong></td>
</tr>
</tbody>
</table>

### Table 15. Recommendations by Site Type

<table>
<thead>
<tr>
<th>Site Types</th>
<th>Record</th>
<th>Salvage</th>
<th>Monitor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burial</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Engraving</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Fish Trap</td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Isolated Find</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Midden</td>
<td>6</td>
<td>1</td>
<td>44</td>
<td>51</td>
</tr>
<tr>
<td>Shelter</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Shelter Art</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Shelter Deposit</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Shelter Midden</td>
<td>1</td>
<td>2</td>
<td>24</td>
<td>27</td>
</tr>
<tr>
<td>Waterhole</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
<td><strong>4</strong></td>
<td><strong>80</strong></td>
<td><strong>92</strong></td>
</tr>
</tbody>
</table>
6.0 Results - Year 2

From the original 92 sites monitored in Year 1, 40 were categorized as Priority 1. Recommendations for further work included ongoing coastal erosion monitoring and for 12 sites, further recording and possible salvage. These 12 sites are summarized in Appendix 2.

The Year 2 work aimed at increasing the number of sites being fully recorded (as detailed above) and expanding to include vulnerable rock art (pigment and engraved) sites outside the foreshore zone to maximise heritage and community outcomes in the region at a time when sites are under increasing pressure. It was proposed there would be:

- additional recording and monitoring of foreshore sites (10+ sites)
- additional recording and/or monitoring of art sites (20+ sites)
- an Aboriginal heritage rock art management plan
- risk assessments for sites (50+)
- management and conservation options (50+)

The material generated from this work would be produced into education material.

Monitoring Results – Foreshore Sites

The year two work carried out on foreshore sites consisted of an additional ten higher priority middens being re-recorded or monitored. Seven sites were located and monitored, while three sites turned out to be more complicated. Two of the sites were found to be duplicates of other nearby recorded sites, while a third site was not found due to the confusing information on the site card. The time was not wasted as it has allowed the clarification of site data, which is crucial for ongoing monitoring and protection work. See Appendix 3 for discussion of some of the difficulties in relocating sites.

The overall findings reinforce the first year findings. Excluding the three sites that were not found or were duplicates, of the remaining seven sites monitored only two were considered stable, the other five having ongoing erosion.

<table>
<thead>
<tr>
<th>Council</th>
<th>stable</th>
<th>ongoing erosion</th>
<th>poor</th>
<th>not relocated</th>
<th>duplicate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lane Cove</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>N-Beaches</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Nth Sydney</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Willoughby</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

**TABLE 16. FORESHORE SITE MONITOR – CONDITION**

<table>
<thead>
<tr>
<th>Council</th>
<th>negligible</th>
<th>ongoing</th>
<th>N/A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lane Cove</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>N-Beaches</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Nth Sydney</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Willoughby</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>5</td>
<td>3</td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

**TABLE 17. FORESHORE SITE MONITOR – COASTAL EROSION**
Perhaps the starkest example of the importance of continuing monitoring and recording work was for site KUR131 in Middle Harbour, Ku-ring-gai Council, where at each monitor further evidence of substantial shell and shore loss was noted. From 2013 it is estimated that over 700mm of horizontal shoreline containing shell midden has eroded. Saplings that are necessary to replace older trees have slipped into the harbour as they have been eroded out. The local landscape is such that there is very little flat land left at some parts of the midden to contain further archaeological deposit. It will soon be completely lost.

In terms of other impacts, human activity at six of the sites was an issue, ranging from a stormwater drain causing significant erosion of part of one site, the storage of dinghies, and to a shelter being used for social gatherings (Table 18).

An illustration of why each site needs to be taken on its own merits is site LCC-066 on the Lane Cove River, where a monitoring photos from 2011 shows a piece of plastic rubbish still in exactly the same position in 2019. There has been erosion, but none of significance in that period of time.

A separate section of the report shows a comparison of photos for 22 sites (Appendix 4).

Year 2 Conclusions

The overall total for foreshore sites (99) over two years shows a third are experiencing ongoing erosion and several sites are in poor condition due to coastal erosion (see Table 19). As most sites were visited and monitoring measurements taken for the first time, figures for erosion loss are generally not available, however, from those sites revisited again the findings from the 2015 report are supported, in that erosion is occurring at differing rates. See Appendix 4 for comparisons of erosion over different periods. For example, KUR131 mentioned above has had significant erosion, over 700mm of horizontal shore loss.
in some areas, whereas a dense midden, KUR132, only 200m further up the estuary shows very little erosion in one area over a similar period. However, further east back down the estuary from KUR132 and KUR131 there are two other sites, one experiencing smaller but ongoing midden loss and one that a comparison photo between 2007 and 2019 shows several linear metres and nearly a horizontal metre of foreshore loss.

Similarly, an upper estuary site in Lane Cove shows the same piece of rubbish in eroded midden material from 2011 shows as in 2019, indicating no current erosion (although erosion has occurred in the past).

<table>
<thead>
<tr>
<th>Council</th>
<th>stable</th>
<th>ongoing erosion</th>
<th>poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>2</td>
<td>4</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Lane Cove</td>
<td>1</td>
<td>4</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>N-Beaches Ctrl</td>
<td>5</td>
<td>2</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>N-Beaches Nth</td>
<td></td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>N-Beaches Sth</td>
<td>2</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>North Sydney</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Willoughby</td>
<td>49</td>
<td>13</td>
<td></td>
<td>62</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>63</strong></td>
<td><strong>33</strong></td>
<td><strong>3</strong></td>
<td><strong>99</strong></td>
</tr>
</tbody>
</table>

TABLE 19. FINAL FORESHORE SITE MONITOR – CONDITION BY LGA

Looking further at the overall results of the monitoring while the sample size is reasonably large, the number of variables (estuary type, location in estuary, type of shore, size of fetch, type of site, aspect, degree of boat wash, level of human visitation, and so on) makes more detailed analysis difficult and unlikely to provide meaningful results. It would require a larger sample with fewer variables or more detailed and repeated recording and measurement from each site to differentiate more robust data in this regard. It will be interesting to see if the work by Macquarie University with 3D photogrammetry can provide this.

TABLE 20. FINAL PRIORITY CATEGORIES BY LGA

The following tables provide a summary of different elements of the database (the site data tables are at Appendix 5, but due to site confidentiality, the information is confidential for authorized users only).
After the completion of all fieldwork and reviews, there are now 41 Priority 1 sites, of which 3 are considered poor condition (7%) and 29 with ongoing erosion (71%).

<table>
<thead>
<tr>
<th>Monitored Sites</th>
<th>ongoing erosion</th>
<th>poor</th>
<th>stable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitored Sites</td>
<td>33</td>
<td>3</td>
<td>63</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>32%</td>
<td>2%</td>
<td>66%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Priority 1 Sites</th>
<th>ongoing erosion</th>
<th>poor</th>
<th>stable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1 Sites</td>
<td>29</td>
<td>3</td>
<td>9</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>71%</td>
<td>7%</td>
<td>22%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Tables 21 & 22. Revised Priority Categories by Condition**

Impacts other than coastal erosion also include those from animal activity, natural impacts (non-coastal erosion or run off, tree damage, weathering and rock decay) and human activity (such as pedestrian traffic, drainage, etc).

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>animal activity</th>
<th>human activity</th>
<th>natural activity</th>
<th>negligible</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Cove River</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Middle Harbour</td>
<td>1</td>
<td>15</td>
<td>12</td>
<td>41</td>
<td>69</td>
</tr>
<tr>
<td>North Harbour</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ocean</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Sydney Harbour</td>
<td>6</td>
<td></td>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>The Pittwater</td>
<td>3</td>
<td>1</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>34</td>
<td>14</td>
<td>49</td>
<td>99</td>
</tr>
</tbody>
</table>

**Table 23. Sites by Non-Coastal Erosion Condition**

Overall for the 99 sites visited, 42 are recommended for specific coastal erosion monitoring (with 11 for more detailed recording and 4 recommended for salvage) and 57 for continued general monitoring (Table 24).

<table>
<thead>
<tr>
<th>Actions</th>
<th>Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion monitor</td>
<td>42</td>
</tr>
<tr>
<td>Record</td>
<td>11</td>
</tr>
<tr>
<td>Salvage</td>
<td>4</td>
</tr>
<tr>
<td>Monitor</td>
<td>27</td>
</tr>
<tr>
<td>General Monitor</td>
<td>57</td>
</tr>
<tr>
<td>Monitor</td>
<td>57</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>99</td>
</tr>
</tbody>
</table>

**Table 24. Recommendations**

As discussed previously, the majority of sites on the immediate foreshore are shell middens, mostly open sites (56) but 28 being associated with shelters (Table 25 below).
### Table 25. Recommendations by site type

<table>
<thead>
<tr>
<th>Site Types</th>
<th>Record</th>
<th>Salvage</th>
<th>Monitor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burial</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Engraving</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Fish Trap</td>
<td>2</td>
<td>2</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Isolated Find</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Midden</td>
<td>8</td>
<td>1</td>
<td>47</td>
<td>56</td>
</tr>
<tr>
<td>Shelter</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Shelter Art</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Shelter Deposit</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Shelter Midden</td>
<td>1</td>
<td>2</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Waterhole</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11</td>
<td>4</td>
<td>84</td>
<td>99</td>
</tr>
</tbody>
</table>

### Table 26. Recommendations by council

<table>
<thead>
<tr>
<th>Council</th>
<th>Record</th>
<th>Salvage</th>
<th>Monitor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Lane Cove</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>N-Beaches Ctrl</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>N-Beaches Nth</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>N-Beaches Sth</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>North Sydney</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Willoughby</td>
<td>4</td>
<td>58</td>
<td>62</td>
<td>124</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11</td>
<td>4</td>
<td>84</td>
<td>99</td>
</tr>
</tbody>
</table>

Overall, the conclusions of the 2015 report remain true:

The monitoring program’s results are confirming the anecdotal evidence that erosion is occurring and also confirming the premise that localized influences and conditions are likely to be the most important function of how a particular site is impacted by coastal processes. A key factor is the height above mean high water (MHW) that a site is situated. Clearly those sites closer to MHW will be more affected by very high (over 1.7m) and extreme high tides and storm events, as well as waves from boats. This was borne out during inspections at very high tide levels where some sites were subject to tidal wash or splash and others weren’t. However, the measurable erosion rates at each site (at specific cross-sections) did not reflect this pattern consistently and shows other local conditions need to be considered. An important factor is wave action from boating traffic. This increases the reach, duration and wash over archaeological deposits and therefore those sites in proximity to more frequent boating traffic and larger vessels are more at risk.

Other factors include the type of shoreline the site is on (hard or soft), the amount of open water (fetch) for wind to generate waves, the surrounding vegetation and so on. Sites on rocky shores deflect waves, but the shape of the shoreline can focus wave energy at particular areas increasing the erosion effect. Archaeological deposits sitting on rock platforms are still eroded, leaving the hard surfaces behind. Soft shore sites appear more vulnerable to erosion in general, but this is dependent on the height above tidal zone and wave reach. Vegetation cover is also an issue as plants
help shield the midden from splashing and wave action and roots hold the soil together. Salt splashing onto vegetation can speed up vegetation loss and hasten erosion. Human use of the foreshore, with pedestrian traffic and so on, can impact vegetation and the upper layers of an archaeological deposit, as well as causing slumping from walking near the edge or above an area that has been undercut. In summary, the following factors are considered to be the main influences to a site’s vulnerability to coastal erosion:

- Height above mean high water
- Proximity to boating traffic (particularly large and frequent vessels like ferries)
- Local landform features (regularity of shore, steepness of tidal area, interface with bedrock or soil, etc)
- Vegetation cover
- Human use of foreshore (AHO, 2015: 92)

The good news is that a large majority of sites are considered stable, however, the longer term picture is bleak due to predictions of continued sea level rise, increasing large boat traffic in estuaries, the increase in peak storm and tide events and the ongoing and likely increase in human and animal impacts.
Monitoring Results – Rock Art and Engravings

The initial review estimated around 120 pigment and 240 engraving sites surviving in Council areas. This part of the work proposed:

- additional recording and/or monitoring of art sites (20+ sites)
- an Aboriginal heritage rock art management plan

The methodology and detailed site descriptions are contained within a separate report (Part 2), however, the findings are summarized here.

A total of 22 rock art sites and 17 rock engraving sites were visited and monitored. Re-recording work included 360 photography, stills and drone photography and video.

Rock Art - Pigment

Of the 22 rock art sites monitored, two were actually not previously registered or recorded sites that were found during monitoring at nearby sites. The detailed monitoring work also revealed art figures that had not previously been recognized.

<table>
<thead>
<tr>
<th>Council Areas</th>
<th>Monitored</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Lane Cove</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>NorthSyd</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>NthnBeach-central</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>NthnBeach-Nth</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>NthnBeach-Sth</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Willoughby</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
<td><strong>120</strong></td>
</tr>
</tbody>
</table>

*Table 27. Rock art (pigment) monitored*

Of the 22 monitored sites, the overall condition of most sites is considered good. However, this is in the context of sites in the urban area or close to it. Rock shelters that are in National Parks, for example, and away from access tracks are generally in much better condition. In terms of impacts, the project divided them into three: graffiti, other human impacts (such as pedestrian traffic) and natural erosion.

<table>
<thead>
<tr>
<th>Council</th>
<th>Fair</th>
<th>Good</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Lane Cove</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>N-Beaches</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Nth Sydney</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Willoughby</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>4</strong></td>
<td><strong>18</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>

*Table 28. Rock art – Condition overall*
Those sites considered only fair condition were generally close to main roads or had previous impacts associated with post-invasion occupation (e.g., Depression era camping, significant graffiti attack, current picnic or other ongoing visitation).

Graffiti is the main human impact. Other human impacts include tracks, visitation, camping, rock climbing, rubbish and so on. Natural impacts include rock decay, water erosion and animal impacts.

Further discussion about rock art can be found in the full rock art and engraving report at Part 2.

**Rock Engravings**

A total of 17 rock engraving sites were monitored. The overall condition of most engravings sites is considered good (Table 33). However, like the rock art sites, this should be taken in the context of sites in the urban area or close to it. Rock engraving sites that are in National Parks, for example, and away from access tracks are generally in much better condition. In terms of impacts, the project divided them into three: graffiti, other human impacts (such as pedestrian traffic) and natural erosion.

<table>
<thead>
<tr>
<th>Council Area</th>
<th>Monitor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ku-ring-gai</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Lane Cove</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>NorthSyd</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Nthn-Beach-Central</td>
<td>5</td>
<td>141</td>
</tr>
<tr>
<td>Nthn-Beach-Nth</td>
<td>4</td>
<td>39</td>
</tr>
<tr>
<td>Nthn-Beach-Sth</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Willoughby</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td><strong>242</strong></td>
</tr>
</tbody>
</table>

**Table 29. Engravings – Monitored**

![Drone image of engraving, Northern Beaches-Central](image1)

![Emu Track Engraving, Ku-ring-gai](image2)

Those sites considered only fair condition were generally close to public areas, such as picnic grounds and walking tracks. The two sites considered to be poor condition are both adjacent modified landscapes where drainage has changed the conditions, forming a damaging leachate at one and increasing excess siltation and vegetation regrowth at the other.

Further discussion about rock engravings is included in the full rock art and engraving report at Part 2.
7.0 Local Heritage Strategy

7.1 Outcomes

The main aim of the project was to identify vulnerable sites across the region and develop a strategy for how to respond to the impacts of coastal erosion and management needs for key rock art and engraving sites. Overall 138 sites were visited and scores more were reviewed. The project is complete and the successful outcomes include:

- a heritage database providing a priority action plan for individual sites across the region.
- a heritage strategy to prioritise detailed recording, monitoring, management and salvage options for coastal sites and key rock art sites.
- a series of community engagement tools to help educate the community.
- a photo and video database of Aboriginal sites that can help heritage management in terms of monitoring, training, educational and archival material.
- updated information for 138 visited sites and many other sites that were reviewed and information checked and updated where necessary.
- two new site recordings and many new rock art and engraving figures identified.

The data produced provides essential material for ongoing and future management. A number of conclusions can also be drawn from the work:

- at least a third of foreshore middens in the region are seriously eroding.
- most middens not currently eroding are still at risk from severe storm and tide events.
- some middens are in vulnerable condition and may soon be lost completely.
- the continued erosion and threat of impact suggests that detailed recording and monitoring work needs to be expanded urgently.
- Salvage of some middens should be considered to gain important scientific information and retain cultural material before it is completely lost to the tides.
- most rock art and engraving sites have images that are difficult for the casual observer to see.
- most rock art and engraving sites have been affected by graffiti and other human impacts.
- most rock art and engraving sites are stable but extremely vulnerable to human or natural impacts that could cause irreversible damage.
- the continued deterioration of rock art and engraving sites suggests that more detailed recording and monitoring is urgently required.
- ongoing professional and volunteer monitoring should continue.
- ongoing education and training programs should continue.
- conservation works for sites have been generally piecemeal and more resources and coordination is required to better protect sites from threats and respond to actual impacts.

Further Recording

As mentioned above, the AHO has partnered with Macquarie University to carry out a 3D photogrammetry project for eroding sites. This will provide very detailed baseline recording of sites as well as periodic follow up monitoring and analysis of documented changes. It is hoped that earlier photos of sites can be incorporated into the digitally produced 3D framework and used as comparative data. While the photogrammetry cannot be done for all sites as yet, it is still worthwhile to undertake further recording of some particularly vulnerable or noteworthy sites.
Unfortunately the Macquarie University project was delayed and results are not available to include in this report.

**Salvage**

The issue of archaeological salvage was discussed in the previous stage report:

> Archaeological salvage is looming as an important management consideration to the many sites where protection is impractical and that otherwise will be lost to rising seas. In other parts of the world, such as in Scotland (SCAPE, 2014), archaeological recording and salvage have been taking place at an increased rate as important heritage places are exposed, eroded and lost to the sea. Any archaeological salvage would require a significant investment of resources as permits would be required from the Office of Environment and Heritage (OEH), support from the local Aboriginal community, field teams suitably qualified and experienced to initiate and supervise the work, professional and volunteer teams to process and analyze the excavated finds, keeping places or other suitable repositories to house the materials and people to write up the results and findings (AHO, 2015: 95).

Four sites have been identified where salvage of some or all of the archaeological deposit may be appropriate to capture material that is at high risk of being lost in the coming years. It is out of the scope of this project to carry out any such salvage work, however, further research and discussion with relevant organisations is recommended to begin the process.

**Monitoring**

The issue of ongoing monitoring has been discussed in detail in the previous stage report. It is recommended that monitoring is continued so as to gather data in time to make the most appropriate management decisions according to changing conditions. As technology improves, the ability to capture data that can be used in more flexible and wide ranging ways will all accelerate. The AHO intends to continue follow up recording and monitoring when possible, particularly targeting measurement points set in this project, repeat 360 photos, drone images and using 3D photogrammetry.

**Education and Training**

Education of the wider community and training of specific volunteers and council staff (as well as state government staff in key positions) is essential to increasing the awareness and appreciation of Aboriginal heritage in the area. This is not only important in terms of site protection and management and planning and assessment, it is also responding to a real demand from the local community and from council staff.
7.2 Recommendations

These recommendations are based on the results of the work carried out and outlined above and the issues raised in the Outcomes section.

Short Term Actions

- Ongoing monitoring of sites according to the model guidelines (Appendix 1).
- Follow management actions identified in the heritage strategy database (Appendix 5) to protect, record, monitor or salvage sites (see also Recording and Salvage, 7.1).
- Follow management actions identified in the rock art and engraving report (Part 2), such as graffiti removal, re-recording, monitoring, track works and so on.

Longer Term Actions

- Archaeological salvage (see also 7.1). Look at options for developing partnerships between the Aboriginal community, local and state government, universities and archaeological consultants to carry out salvage in a cost-effective manner.
- Ongoing monitoring. Continued monitoring of sites according to the model guidelines (Appendix 1).
- Ongoing education and training program to educate the wider public and Council staff.
- Discussion topics raised in rock art and engraving report (Part 2 Section 8) be investigated further and opportunities sought by all relevant parties to improve the way that heritage is currently managed.
REFERENCES


Birch, Gavin (2013) pers.com. Associate Professor, School of Geosciences, University of Sydney.


Corkhill, T. Fisher Bay archaeological assessment. Water Board


Department of Environment, Climate Change, and Water, 2010a. NSW Climate Impact Profile. The Impacts of Climate Change on the Biophysical Environment of New South Wales.

Department of Environment, Climate Change, and Water, 2010. Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW.

Department of Environment, Climate Change, and Water, 2010. Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW.


Manly Council. Forty Baskets Coastline Management Plan

Manly Council. Little Manly Coastal Management Plan


New South Wales Government. 1990. NSW Coastline Management Manual; September


OEH / SMCMA Environmentally Friendly Seawalls Brochure.


Sydney Coastal Councils Group. 2013, Assessment and Decision Frameworks for Seawall Structures


SMCMA Environmentally Friendly Seawall Guidelines.


Water Research Laboratory. 2013. Use of Sandbags for Coastal Protection. Published letter to NSW Office of Environment and Heritage, 16 July 2013 from G. Smith. WRL, University of NSW.
Appendix 1 – Monitoring Guidelines

1. Baseline Recording
   - Full offset survey plan of site and adjacent areas, showing key monitoring points, cross-section monitoring points and photographic & video recording points.
   - Photographs of key repeatable monitoring points showing the site and surrounding foreshore (low tide preferable).
   - Written description of site / midden exposure and condition. Completion of monitoring sheets where applicable. Include current erosion issues, vegetation cover, human use of location and other pressures. Estimate of site area (including PAD).
   - Vertical and horizontal distance of main site area from Mean High Water (MHW).
   - Survey point or ‘Pin’ location and distances to key landscape features (particularly 2 or more that can be verified and referenced from GIS aerial imagery).
   - Laser or tape measurement to be taken from one or more fixed points along a transect to the eroding face of the midden/archaeological feature (cross-section).

2. Condition Monitoring
   - Photographs of key repeatable points showing the site and surrounding foreshore (low tide preferable).
   - Written description of site / midden exposure and condition. Completion of monitoring sheets where applicable.
   - Repeat laser or tape measurement along transect to the eroding face of the midden/archaeological feature (cross-section).
   - Make note of the following:
     - Extent of scouring or cleaning of midden face and undercutting (if exposed).
     - Wave run up levels and high tide issues.
     - Crest levels and notes on any damage to crest (dislodgement of units, slumping).
     - Slope of the face and any damage (slumping, loss of midden/archaeological deposit, damage to stratigraphical units.)
     - Measurement of materials exposed or dislodged (e.g. small rock, shell material, etc.)
     - Documentation of dislodgement or movement of midden / archaeological material.
     - Changes from previous monitoring inspections (damage to adjacent areas, etc.).
     - Noted erosion events / loss at site as a whole (e.g. adjacent areas).
     - Other pressures (e.g. human visitation, vegetation

3. Following a significant storm/erosion event
   - Undertake any necessary emergency response to stabilise site features and minimise potential risk to the public (contact relevant agencies).
   - Program repairs or salvage of material, as appropriate.
   - If site is not in council reserve, ensure that the relevant agency is contacted and land owner is aware of their obligations.
   - Estimate (if possible) of remaining archaeological deposit and likely survivability.
   - Update site registers with new data (AHO, AHIMS).
   - Description of weather and ocean conditions on site (inspection repeated at high and low tide where possible to get full understanding of issues).
   - Photographs and description of tidal effects on site features (splash and wave reach, overtopping, estimated water depth at midden face, etc.)
   - Observations and documentation of any damage to the site / midden, adjacent foreshore, vegetation or surrounding site area.
   - Summary of recorded weather including wind strength, wave height, wave period, boat activity, tide levels (recorded and actual), wave overtopping, run-up levels and so on.
This site is in the upper estuary area of Middle Harbour. It is an open shell midden in a low embankment above a sandy beach. Midden is exposed to tidal erosion with severe undercutting and large collapsed sections of embankment, as observed during the 2018 monitor.

Comparative photos show a rapid rate of erosion. Site is accessible to pedestrian traffic via a path and stairs at the northern end of the site, making this site more vulnerable to destruction.

Photos

Undercutting below casuarina. 2018
Below casuarina. 2016
P1060764 South-east end of site. 2018
2016
Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis.

Aboriginal Heritage Office, www.aboriginalheritage.org
Aboriginal Heritage Office

LCC-092

SITE NAME: Greenwich Path 3
SITE TYPE: Midden
DATE RE-RECORDED: 6/11/18

This site is in the lower estuary area of the Lane Cove River. It is an open shell midden above a rock platform. Midden is exposed to tidal erosion and boat wash, with a ferry terminal in close proximity. An informal walking track leads down to the site cutting through it.

An attempt to stabilise the site has been made with the placement of sandstone boulders. They remain in place but the embankment immediately above is losing vegetation and continues to erode.

Photos

P1060696 General site photo 2018
P1060696 South section 2018

2015
2015

Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis.

Aboriginal Heritage Office, www.aboriginalheritage.org
Aboriginal Heritage Office

MAN-082

SITE NAME: Wellings Reserve #4
SITE TYPE: Midden
DATES RE-RECORDED: 7/11/18

This site is in a secluded bay of North Harbour. It is an open shell midden above a sandy beach and rock platform. Midden is exposed to tidal erosion and has an informal walking track cutting through it. The track leads to a large tyre swing, indicating regular use of the location. Vegetation is thick but not preventing the erosion of the site.

Photos

P1060790 Looking from PIN to undercut 2018.
P1060799 Footpath entrance 2016

Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis. May be a candidate for salvage if erosion continues to occur or no other preventative measure will suffice.

Aboriginal Heritage Office, www.aboriginalheritage.org
This site is located in Wollstonecraft Bay, Sydney Harbour. The midden is approximately 6.5 metres long, extending back up to the shelter. Midden is exposed to tidal erosion, with very little shell remaining.

The site is not easily accessible to the public. Modern garbage can be seen mixed in with the remaining midden. Hand stencils are present in the shelter and have faded. The sandstone is eroding, taking with it early European engravings dated the mid to late 19th century.

Photos

P1060704 Shelter looking south 2018

2010

P1060703 White ochre hand stencils 2018

2010
Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis. May be a candidate for salvage if erosion continues to occur or no other preventative measure will suffice.
Aboriginal Heritage Office

NSC-052

SITE NAME: Cremorne Pt 1
SITE TYPE: Shelter & Midden
DATE RE-RECORDED: 22/3/18

This site is in Sydney Harbour in an area with little protection from more extreme weather events and from frequent larger boating vessels such as Harbour Ferries. It is a shell midden within a rock shelter above a rock platform. Midden is eroding from frequent wave action at high tides.

Photos

![Photos](https://example.com/photos)

Recommenations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis. May be a candidate for salvage if erosion continues to occur or no other preventative measure will suffice.
This site is located at the south end of Bilgola Beach. The site is currently exposed to all elements with a massive loss of vegetation coverage between 2016 and 2018.

**Photos**

![Photo 1](image1.jpg)

**PITT045 Midden adhered to rear wall 2018**

![Photo 2](image2.jpg)

**2016**

![Photo 3](image3.jpg)

**P1060805 Midden 2018**

![Photo 4](image4.jpg)

**2016**

**Recommendations**

Site should be recorded in detail, including 3D recording and cross sections. Due to the vulnerable nature of this site, a salvage excavation is highly recommended.
This site is located on a sandy foreshore at The Pittwater, approximately 300 metres southwest of the Marina. The site is heavy with pedestrian traffic and activities, including dinghy storage. Large sections of the embankment, including trees, have collapsed since the 2015 monitor. Very little shell remains.

Photos

Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis. May be a candidate for salvage if erosion continues to occur or no other preventative measure will suffice.
The site is located at the northern end of Long Reef Beach bounded by a wooden boardwalk and the Long Reef Golf Club. Minimal amounts of shell was observed during last monitor with none noted at the north east end of the site. Erosion has been ongoing and is sure to continue.

Photos

![Image 1](p1060680 northeast end of site 2018)

![Image 2](2014)

Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis. May be a candidate for salvage if erosion continues to occur or no other preventative measure will suffice.
SITE NAME: Long Reef Point
SITE TYPE: Midden
DATE RE-RECORDED: 13/12/18

This midden is on a sandy shore of ocean beach near to areas identified as high risk for coastal erosion. Lower sections are affected from wave action during more extreme weather and tides, and upper sections are likely to be affected on rarer occasions.

Recommendations
Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis.
This site is located in the Middle Harbour estuary, Explosives Reserve, approximately 230 metres west of Yeoland Point. It is an open midden on a foreshore below steep north facing slope. Beneath a sandstone boulder just above the high tide zone, there is a thin strip of soil where a 10cm layer of midden is exposed. A few metres to the west, there is more shell exposed in the embankment. The site is open to tidal and boat wash erosion as well as drainage from the steep slope behind.

Photos

P1060606 Midden on sandstone platform 2018

P1060608 Collapsed midden 2018

P1060614 Collapsed midden 2018

Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis.
Aboriginal Heritage Office

WILL-017

SITE NAME: Clive Park One
SITE TYPE: Shelter, Midden, Art & Burial
DATE RE-RECORDED: 22/10/18

This site is in the Middle Harbour estuary, Clive Park and adjacent a main boating thoroughfare. It is a shell midden on a rock platform with associated large rock shelter above. To the right of the shelter is a rock wall with a large engraving of a whale/fish. Public stairs lead down to the shelter and frequent public use of the area is evident. Embankment is unstable with trees collapsing on to the platform below.

Photos

![Image 1](image1.jpg)
![Image 2](image2.jpg)

![Image 3](image3.jpg)
![Image 4](image4.jpg)

![Image 5](image5.jpg)
![Image 6](image6.jpg)

Aboriginal Heritage Office, [www.aboriginalheritage.org](http://www.aboriginalheritage.org)
Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis. Due to the significance of the site, a seawall to protect it from ongoing coastal erosion is highly recommended.
The site is located in the Middle Harbour estuary, HD Robb Reserve. The midden sits on a sandstone platform below a shelter. There is areas of undercutting as a result of tidal erosion. The shelter is heavily used by the public as a social venue. The shelter has a pit fire with a pile of firewood, seating and a tarp set up to provide shelter.

Photos

![Replication of 2003 (2018)](P1060315)

![Set up in shelter 2018](P1060316)

![Stockpile of firewood 2018](P1060320)

![Fire pit 2018](P1060319)

![Graffiti in shelter 2018](P1060321)
Recommendations

Site should be recorded in detail, including 3D recording and cross sections and undergo erosion monitoring on a regular basis.
Appendix 3 – Relocating Sites

An important consideration regarding the relocation of sites is accuracy and consistency of site records maintained by the NSW Government’s Aboriginal site register, called the Aboriginal Heritage Impact Management System (AHIMS). Over the years it has been noted that many of the site locations, as given by AHIMS, have significant errors including significant errors of location. AHIMS does not appear to regularly audit the site data and the corrections made by the AHO reinforce the importance of having such programs. In 2011 the AHO began to roll out a revised update program which included a new review of every recorded site. After each update a review of any errors between the original AHIMS coordinates and the update was analysed. Table 1 illustrates the level of error, with between 11%* and 47% of site cards requiring significant corrections (errors of location greater than 50m, incorrect site type, incorrect site name, and so on). More detailed reviews have been conducted, with results for Ku-ring-gai Council outlined below. The initial results for former-Pittwater Council (now amalgamated into Northern Beaches Council), show an even greater level of inaccuracy (see below).

<table>
<thead>
<tr>
<th></th>
<th>Lane Cove</th>
<th>Manly</th>
<th>North Sydney</th>
<th>Warringah*</th>
<th>Ku-ring-gai</th>
<th>Pittwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sites</td>
<td>90</td>
<td>68</td>
<td>76</td>
<td>215</td>
<td>106</td>
<td>149</td>
</tr>
<tr>
<td>Updated</td>
<td>18</td>
<td>26</td>
<td>22</td>
<td>23</td>
<td>56</td>
<td>86¹</td>
</tr>
<tr>
<td>%</td>
<td>20%</td>
<td>38%</td>
<td>29%</td>
<td>11%</td>
<td>47%</td>
<td>58%</td>
</tr>
</tbody>
</table>

**Table 1 Errors in data found in LGA Reviews**

Note: updates for location here are only for errors of 50m or above.

* Warringah LGA data is from 2014 and does not include previous updates made in 2011 that corrected many errors.

¹ Pittwater LGA updates have not been completed due to Council mergers and workload adjustments.

For Pittwater, approximately 149 recorded sites were considered to be within the LGA or close to its border (ie not in a neighbouring Council or National Park) prior to the review. After the review and monitor work, of the 149 sites, only 52 sites (35%) were considered to have accurate site coordinates, that is, within 20m of the actual site (after relocation by the AHO and/or the confirmation of the actual location through the review). The level of inaccuracy ranged from 20m to over 7650m (1000m+ in five cases, or 3% of sites). Overall over 57% were very inaccurate (41m or more). A proportion of sites are in private property or could not be confirmed due to poor access or difficulties in locating the site and the level of error was estimated from the site card information.

The map below shows the level of inaccuracy of the AHIMS data. The black dots represent original AHIMS data and the blue squares are AHO corrections after the AHO revision program in Ku-ring-gai Council. It can be seen that in this particular area very few sites match up even closely and some are over 500m out. Relying on the original coordinates to track down sites can be very time consuming and only a careful and thorough review of each site card in combination with old maps, GIS and other mapping will reduce time wasted going to erroneous locations.
ACCURACY OF AHIMS DATA FOR PITWATER COUNCIL (8 CATEGORIES)

<table>
<thead>
<tr>
<th></th>
<th>Accurate</th>
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<tbody>
<tr>
<td></td>
<td>&lt;20m</td>
<td>21-40m</td>
</tr>
<tr>
<td>Sites</td>
<td>52</td>
<td>11</td>
</tr>
<tr>
<td>%</td>
<td>35%</td>
<td>7%</td>
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</tbody>
</table>

TABLE 2. SITE ACCURACY OF AHIMS DATA FOR PITWATER COUNCIL (8 CATEGORIES)

EXAMPLE OF DATA ERRORS (BLACK = AHIMS, BLUE = AHO CORRECTIONS).

The AHO reviews of Ryde LGA in 2012 and Ku-ring-gai LGA in 2015 also showed similar results. The comparison is provided below:

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td></td>
<td>&lt;20m</td>
<td>21-40m</td>
</tr>
<tr>
<td>Ku-ring-gai</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>%</td>
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<tr>
<td>Pittwater</td>
<td>52</td>
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<td>%</td>
<td>35%</td>
<td>7%</td>
</tr>
</tbody>
</table>

TABLE 3. SITE ACCURACY OF AHIMS DATA FOR KU-RING-GAI AND PITWATER LGA (7 CATEGORIES)
Appendix 4 – Foreshore Sites Comparisons

[See separate report section]
Appendix 5 – Heritage Database - Confidential

The full database contains confidential site location information.