Shoalhaven City Council

DRAFT

Shoalhaven Coastal Emergency Response Management Plan

March 2009

Umwelt
Environmental Consultants

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Prepared by

Umwelt (Australia) Pty Limited

on behalf of

Shoalhaven City Council

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1.0 Coastal Emergencies

This preliminary draft Coastal Emergency Response Management Plan establishes protocols and processes for preparing for and responding to the impacts of natural disasters (events) that affect coastal assets (property and infrastructure, community safety and coastal amenity).

The draft Plan follows guidance provided in the NSW Coastline Management Manual (1990) and the Emergency Management Australia (EMA) guideline 'Emergency Planning' (2004). It takes into account the framework provided by the NSW DISPLAN (see **Section 1.1**) and existing emergency management plans and guidance (storm and flood management) for the Shoalhaven region (see **Section 1.1.2**).

The Shoalhaven Coastline Management Study and Coastal Zone Management Plan (CZMP) (2008) discuss the social, economic and natural values of the Shoalhaven coastline, and the short and longer term threats to those values. The Shoalhaven CZMP addresses the full range of threats and associated risks to coastal values, including:

- coastal erosion impacts on homes, community infrastructure, access, amenity and ecological values;
- inundation associated with major storms, including catchment flooding, elevated sea level and high waves;
- geotechnical hazards that affect homes, gardens, the safety and stability of public pathways, rock platforms and lookout points;
- the impacts of coastal development and coastal recreation on biodiversity, visual quality and social values;
- interactions between recreational and other users; and
- other hazards such as bushfire, weeds and feral animals.

The Shoalhaven CZMP presents strategies to minimise risk and support resilient coastal landscapes in the context of predicted significant climate change, i.e. they are coastal zone sustainability strategies. Many of the risks discussed in the CZMP are gradually accumulating risks. Some coastal hazards are, however, associated with specific high intensity events, principally major storms. These are coastal emergencies.

The scope of coastal process events for which emergency responses may be required includes:

- Erosion associated with major storms – high energy waves and elevated water levels that cut into beaches and frontal dunes, undermining homes, public recreation space and facilities, access to beaches and headlands, infrastructure.
- Inundation (dune overtopping) associated with elevated water levels and high wave run-up during major storms, causing flooding of homes, businesses, recreational areas and infrastructure.
- Inundation associated with flood tail water in coastal lakes (ICOLLS), causing flooding of homes, businesses, shoreline recreation areas and along shore access, infrastructure.

All of the above will be exacerbated by sea level rise associated with medium to long term climate change. Events once considered rare will have a shorter recurrence interval (e.g. see Lord and Gibbs 2004, Church et al 2004, 2006).

Other immediate or emergency hazards may include:

- Aeolian sand movement due to high winds – burial of access ways, sand blasting of gardens and property
- Geotechnical instability – slumping and rock fall along cliff lines – undermining or destabilising of homes, public lookouts and pathways, stairways; impacts on access and risks to human life.
- Tsunami – erosion, inundation of public and private property at levels much above sea level and storm waves. Tsunami are rare events, but the consequence of a major tsunami event in terms of risks to human lives, property and infrastructure is devastating.
- Major water quality issues associated with significant failure of sewage management systems or major incidents involving a coastal industry (this industrial risk is negligible for the Shoalhaven coastline) or major traffic incidents on roads and bridges along the coast.

Other emergencies which occur in coastal landscapes include people being washed off rock platforms, and people drowning in the surf or estuaries (lakes or creeks). These are emergencies involving SES, ambulance and police and are not specifically the responsibility of Council. These medical emergencies are not considered further in the Coastal Emergency Response Management Plan.

Bushfire can also affect coastal landscapes, threatening homes and bushland down to Mean High Water level. Council and the Rural Fire Service address bushfire risks in specific strategic and operational plans and it is not considered further in this Coastal Emergency Response Management Plan.

1.1 Institutional, Statutory and Policy Context

1.1.1 NSW disaster management arrangements

The framework for disaster management in NSW is set out in the NSW State Disaster Plan (DISPLAN) (2005). Clauses 116 and 117 of the State DISPLAN identify the State Emergency Service as having overall control of operations in response to flood and storm.

The specific responsibilities of NSW State Emergency Service are identified in the State DISPLAN as:

- Combat Agency for dealing with floods and to coordinate rescue, evacuation and welfare of affected communities. This includes tsunami (there is a separate NSW Tsunami Emergency Management Sub Plan).
- Designated Combat Agency for damage control for storms and to coordinate the evacuation and welfare of affected communities (protection of life and protection of readily moveable household goods and commercial stock and equipment). However, planning for and construction of physical mitigation works for coastal property is the responsibility of local councils.

There is a hierarchy of disaster management committees, from state level, through districts to local areas. The State DISPLAN also identifies Functional Areas, such as engineering services and environmental services, for which other State agencies have a coordinating role.

Engineering services includes structural assessments, demolition and shoring up of buildings, removal of debris, construction of levees to control flooding; maintenance and reestablishment of essential services (water, sewer and power). At the State level, NSW Department of Commerce has coordination responsibility for these services during emergency events.

In the State DISPLAN, environmental services include the following. DECC is the coordinating agency.

- Protect the environment during emergency response and recovery operations
- Coordinate scientific support for the on-scene controller during operations to combat the pollution of the sea or inland waters
- Provide advice to relevant agencies on environmentally sound and legal practices for disposal of wastes or contaminated materials
- Direct and coordinate the clean up of hazardous materials once they have been rendered safe). Conduct post response operations investigations where incidents involve hazardous materials.

The NSW DISPLAN also provides the framework for emergency response operations. Procedures for alert, call out and stand down of emergency response staff are discussed, as are procedures for evacuation and recovery.

1.1.2 Shoalhaven local institutional context

Table 1.1 identifies the main organisations having a role in the management of coastal emergencies along the Shoalhaven coastline, and the relevant pieces of legislation and policy that they implement.

As noted in **Section 1.1**, Shoalhaven Council has responsibility for planning and works to protect property from coastal erosion, but all other aspects of disaster management for floods and storms are coordinated by other organisations.

Table 1.1 - Institutions and statutory context

Organisation	Legislation and policy responsibilities
State Emergency Services (SES) The Shoalhaven LGA is within the Illawarra District for emergency planning. Shoalhaven Local Emergency Management Committee	State Emergency and Rescue Management Act 1989. Combat agency and coordination roles as noted in Section 1.1. DISPLANS relate to a wide range of disasters/emergencies, often with separate detail in sub plans (e.g. for fire, tsunami).

Table 1.1 - Institutions and statutory context (cont)

Organisation	Legislation and policy responsibilities
Shoalhaven City Council (SCC) Shoalhaven Council Flood Risk Management Committee Shoalhaven Council Coastline Management Committee	Coastal Protection Act 1979 State Emergency and Rescue Management Act 1989 Local Government Act 1994 Environmental Planning and Assessment Act 1979 (LEP and local development assessment) Crown Lands Act 1989 Coastal lake entrance management plans Estuary Management Plans Coastal Zone Management Plan Flood Risk Management Plans Coastal Reserve (Foreshore) Plans of Management Responsible for coastal erosion mitigation works for protection of coastal property during storms.
Marine Parks Authority (MPA)	Marine Parks Act 1997
Department of Planning (DoP)	NSW Coastal Policy 1997 SEPP 71, SEPP 14 Environmental Planning and Assessment Act 1979
Department of Environment and Climate Change (DECC)	Coastal Protection Act 1979 Coastline Management Manual 1990 Protection of the Environment Operations Act National Parks and Wildlife Act 1974 Threatened Species Conservation Act 1995 Comprehensive Coastal Assessment. Responsible for coordination of environmental services during and after storms.
NSW Department of Commerce	Supervise engineering services, particularly in relation to shoring up or demolition of buildings affected by erosion (see State DISPLAN).
Commonwealth Bureau of Meteorology (BoM)	Identified as the key provider of weather advice, particularly in relation to extreme weather events.
Shoalhaven Water	Protection of the Environment Operations Act 1997 (license to discharge)
Emergency Management Australia	Prepares guidelines for nationally consistent approaches to emergency planning and management. Provides funding though the Disaster Mitigation Program and Regional Flood Mitigation Program to address priority risks. Funding can be used for disaster risk assessment, mitigation strategies and measures, resilient infrastructure and community awareness and warning systems.
Jervis Bay Territory Emergency Management Committee (Commonwealth Territory)	Comprises Royal Australian Navy, Wreck Bay Aboriginal community, Booderee National Park, private leaseholders and Shoalhaven Local Emergency Management Committee. Prepares and manages Jervis Bay Territory Disaster Plan. There is a Mutual Aid Agreement between the Jervis Bay EMC and Shoalhaven LEMC.

The specific responsibilities of SES, SCC and BoM in relation to storm driven coastal erosion are discussed in Hanslow and Howard 2006. These pre-storm, during storm and post-storm responsibilities are summarised in **Table 1.2** (based on Appendix 1 of Hanslow and Howard 2006).

The role of BoM is to provide accurate and up to date forecasts and severe weather warnings to assist other organisations to plan, communicate and act effectively. The principle division of roles between the SES and SCC is in relation to protection of human life and property (SES) and emergency beach protection works (Council) during an emergency event. The SES has protection of human life as its first priority, followed by evacuation and/or rescue of animals, household and business possessions. It is not responsible for emergency beach protection works. Council is responsible for emergency beach protection works, in consultation with DECC, Department of Lands and Marine Parks Authority.

DECC and DoP share responsibility for policy and technical advice in relation to managing the impact of coastal processes. DECC (regional operations office and coastal unit) has specific on ground roles during emergency events. These responsibilities are also discussed in **Table 1.2**.

Council, DECC and SES share important information needs. Communication between these organisations is critical during an emergency response exercise, to ensure that consistent messages are provided to the community, and that evacuation and protection responses are effectively coordinated.

A significant portion of the length of the Shoalhaven coastline is within Marine Park. This includes Jervis Bay, the waters off Currarong Beach and the far south Shoalhaven. Emergency response issues that will require the involvement of MPA are noted in **Table 1.2**.

The Department of Lands is also a significant land manager along the Shoalhaven coastline and is responsible for the beds of estuaries and the ocean floor within the NSW State limits.

Shoalhaven Water manages sewage and effluent reticulation and discharge in the Shoalhaven local government area, including extensive reticulation systems, pumping stations and discharge points that lie within coastal hazard zones or may be affected by sever storm events. For this reason, Shoalhaven Water is also included in **Table 1.2**.

Local community organisations, such as Precinct Committees, Landcare, etc. will have a strong interest in proposals for emergency response management, in terms of human safety, protection of assets, protection of ecological diversity (and robustness of their rehabilitation and stabilisation efforts on dunes) and rapid restoration of suitable access to beaches and dunes. These groups will require details about emergency response procedures before, during and after any emergency event.

The community of interest includes anyone who lives along or uses the Shoalhaven Coastline for recreation, conservation or business.

Table 1.2 - Roles and responsibilities of key organisations in coastal emergency response

In this table actions are shown as follows: planning responsibilities, consultation, communication and awareness actions, on ground works and review processes

Organisation	Pre storm responsibilities	During the storm	Post storm
State Emergency Service	Prepare and maintain the Local Flood Plan, including arrangements for the management of coastal erosion during storms. Consult with council, DECC ad coastal zone committees re management of coastal erosion in various Plans. Prepare and deliver community awareness material (with SCC) to ensure people living in high hazard areas are aware of the erosion threat and the measures that will e implemented during major storms.	Activate the Local Flood Plan. Ensure BoM storm warnings are passed on the SCC and other organisations. Monitor at risk locations during the storm Coordinate advice to the community during the storm – re evacuation and what should be removed from properties. Provide a phone in service for requests for assistance or advice. Coordinate evacuation of people. Coordinate evacuation of livestock and portable assets.	Take feedback on the implementation process during the storm; update records on areas susceptible to inundation or erosion. Review/update plans as necessary. Liaise with Council, DECC etc. about feedback and about new information on future risk to coastal properties.
Shoalhaven City Council	Prepare Coastline Management Study and Coastal Zone Management Plan. The Plan must address emergency actions for coastal erosion. Consult with affected communities re the CZMP and also about proposed emergency management measures for coastal erosion. Coordinate community and agency liaison on the implementation of the CZMP Collaborate with SES on community awareness and education programs Ensure approvals are in place (e.g. for dredging of creek entrances) if emergency sand supplies are likely to be required as part of the emergency response.	Monitor at risk locations during the storm. Liaise with SES about support for potential evacuations. Liaise with 'Engineering Services Functional Area Coordinator' (ESFAC) (DECC) before any physical erosion mitigation works (to provide temporary protection for property or other assets) commence. Monitor and install hazard barriers at compromised locations.	Remove all temporary erosion mitigation structures and rehabilitate/restore access. Liaise with DECC re changes to risk assessments. Update CZMP as necessary, in consultation with community and agency stakeholders. Survey and photo monitoring of affected sites.

Table 1.2 - Roles and responsibilities of key organisations in coastal emergency response (cont)

In this table actions are shown as follows: planning responsibilities, consultation, communication and awareness actions, on ground works and review processes

Organisation	Pre storm responsibilities	During the storm	Post storm
Marine Parks Authority	Contribute to the preparation of the CZMP, highlighting any issues affecting the interface between Marine Park and council/private land along the coastline. Provide input to approvals process for emergency sand supplies.		Participate in review of emergency response program and update of CZMP
DECC	Provide technical and policy advice on coastal issues to Council Review coastal hazard assessments and provide advice to Council to ensure that risks are adequately recognised. Review draft CZMP and Emergency Response proposals	ESFAC provides advice to council about activation of emergency erosion mitigation measures – which temporary measures are warranted.	Liaise with and support Council in removal of temporary structures and rehabilitation of beaches Provide advice on any post storm re-evaluation of coastal hazards and risks. Contribute to discussion of updates of the CZMP as necessary to accommodate new risk information.
Bureau of Meteorology	Contribute to community awareness material about coastal storms and emergency response Monitor evolving storm conditions. Prepare Severe Weather Warnings for high waves (dangerous surf) or storm surge. Provide warning information to SES, radio stations, council during the lead up to and during storm events likely to cause erosion.	Maintain monitoring of storm conditions and keep SES and Council updated as the storm progresses	
DoP	Incorporate hazards associated with major storms in local and regional land use planning requirements		

Table 1.2 - Roles and responsibilities of key organisations in coastal emergency response (cont)

In this table actions are shown as follows: planning responsibilities, consultation, communication and awareness actions, on ground works and review processes

Organisation	Pre storm responsibilities	During the storm	Post storm
Department of Lands	Contribute to preparation of the Coastline management Study and CZMP. Assess hazards and risks affecting structures such as breakwalls and jetties and implement plans to enhance resilience of structures. Approvals for emergency sand extraction from estuary mouths	Monitor assets at risk during storm events, in communication with other responsible organisations.	Restore and remediate structures that are damaged by storm erosion or inundation. Contribute to review of the Emergency Response Management Plan.
Shoalhaven Water	Contribute to risk assessments for coastal hazards, in relation to water and sewerage infrastructure. Conduct in-house risk assessments. Prepare risk management plans to address issues associated with major storms.	Monitor infrastructure in at-risk sites. During a storm. implement emergency protection or other measures in consultation with Council and DECC, as necessary	Clean up/remediate any impacts of emergency discharges from the sewerage system. Restore and remediate any damage to infrastructure caused by storm waves or inundation. Review risk management plan as necessary.

1.2 Purpose of this Plan

The purpose of this Plan is to clearly define the actions and effective working relationships that are essential to minimise the emergency risks associated with coastal hazards and to provide a rapid and effective response in the event of coastal hazards that threaten life, property or community amenity along the Shoalhaven coastline.

The Emergency Response Management Plan sets out the responsibilities of key players and how they will communicate and collaborate in planning and implementing coordinated responses to emergencies associated with coastal hazards.

DECC (Hanslow and Howard) 2006 suggest that planning and implementing responses to coastal emergencies should address three priorities:

- Protection of the life and safety of people and animals.
- Minimising damage to property (structures and contents).
- Protection or timely restoration of beach amenity.

Planning and response in emergencies for each of these three priorities must also recognise the natural resource and cultural heritage values of the coastal landscape. This includes Endangered Ecological Communities, habitat for threatened species, habitats and landscapes protected under the EPBC Act and culturally significant landscapes.

1.2.1 Objectives: What SCC wants to achieve and what it wants to avoid

In relation to coastal processes emergency management, SCC wants to achieve the following:

- Local communities that are aware of the nature and extent of coastal hazards that could occur in an emergency context;
- Local communities that are aware of and capable of implementing the principal steps required in the event of a coastal emergency;
- Coordinated and effective responses to minimise immediate harm. Clear definition of responsibilities, collaborative relationships and communication protocols;
- Emergency actions are not hindered by unfulfilled requirements for planning or other approvals;
- Investment in preventative measures that is balanced against risk;
- Responses to immediate and short term threats which are consistent with the long term natural resource and amenity objectives for the coastline;
- Well trained council personnel for response to coastal emergences; and
- Gradual reduction of risk associate with coastal emergencies as planning, training and community preparedness improve over time.

SCC wants to avoid the following:

- Loss of life, and unnecessary loss of public or private assets
- Haphazard and uncoordinated responses to coastal emergencies
- Conflicts between Council and SES officers during on ground operations
- Dumping of rubble or other unsuitable materials on beaches in the mistaken belief it will slow down or prevent erosion or inundation
- Poorly designed coastal protection structures – not suitable for the magnitude of erosion or high water level events.
- Duplication of investment or significant gaps in investment in preparedness and response capacity for coastal emergencies
- Extended periods where coastline access and amenity are compromised
- Increasing risks associated with coastal emergencies.

1.3 The plan making process

EMA 2004 provides general guidance on emergency risk management, identifying five main steps. These steps (see below) define a similar risk identification, evaluation and management process to that used to identify priority strategies and actions in the Shoalhaven CZMP. Each stage is linked by continuing communication and engagement of stakeholders and by ongoing monitoring and review of implementation. These plan (identify and evaluate risk), act (treat risk) and communicate and review processes are also clear in the summary of agency responsibilities presented in **Table 1.2**.

Establish the context

The context of the Shoalhaven Coastline Emergency Response Management Plan is the 165 kilometre Shoalhaven coastline and the information about coastal processes, coastal communities and coastal issues that is presented in the Shoalhaven coastline Management Study and Coastal Zone Management Plan. As noted in **Section 2.1.1**, the key driver of emergency events along the Shoalhaven coastline is the occurrence of East Coast Low systems, which generate severe winds, high waves, storm surge and flooding rainfall over a period of a few days. On average these storms will occur about once a year, but the severity of storms varies and the most severe storm on record (May 1974) is considered to have a recurrence interval of more than 100 years. Climate change predictions for the NSW coast suggest that the influence of tropical cyclones may extend further south in the future. This will be taken into account in future reviews of the Emergency Response Management Plan as the risk becomes better defined.

Identify, analyse and evaluate the risk

Coastal erosion, coastal inundation and geotechnical risks are identified and evaluated in SMEC (2008 and b) and Umwelt 2008. The Emergency Response Management Plan was identified as the priority strategy to address immediate coastal hazard risks. A summary of hazard risks that would require emergency management is presented in Section 2. The Emergency Response Management Plan also considers implementation risks, i.e. the risks associated with implementing emergency actions. These can include access issues, communication and coordination issues, preparedness in terms of resources and skills, and community awareness. These implementation issues and risks are discussed in **Section 3**.

Treat risks

The Shoalhaven Coastline Management Study (Umwelt 2008) identifies a range of options to reduce risk, based on technical and scientific advice and suggestions fro the Shoalhaven coastal communities. These options are assessed against a set of criteria and the Shoalhaven CZMP presents an integrated suite of preferred risk management strategies for the coast.

However, the detail of the analysis needed to support the effective operation of an Emergency Response Management Plan is much finer than for the whole of coast, medium to long term strategic plan.

The Shoalhaven Coastal Emergency Response Plan considers a range of local scale implementation risks, such as access for emergency operations, local communication and coordination, which will ensure a high level of preparedness and effective immediate timeframe risk management.

Monitor and Review

An implementation review should be conducted after each emergency event, to evaluate the extent to which the plan was effectively operationalised, any problems and any new information that should inform a review of any of the actions in the plan.

Because coastal risks are evolving, the Coastal Erosion Emergency Response Management Plan should also be reviewed at intervals of approximately five years, coinciding with reviews of coastal hazards (linked to new sea level and other climate change information from IPCC and CSIRO), risks and the Shoalhaven CZMP.

2.0 Localities exposed to immediate coastal erosion hazard

This section provides background information on the processes which drive coastal erosion events and the parts of the Shoalhaven coastline that are identified as being most exposed to storm driven erosion hazards.

2.1 Principal drivers of coastal emergency events

The most important underlying process causing coastal emergency events on the NSW south coast is the 'east coast low'. **Section 2.1.1** provides general background on these storms and why they are a threat to coastal assets. Two other natural hazards may also drive severe coastal erosion; these are the southern tail of a tropical cyclone and tsunami. These less common process drivers are discussed in **Section 2.1.2**.

2.1.1 East coast lows

The Bureau of Meteorology (BoM) defines an East Coast Low as an intense low pressure system. The BoM discussion of the genesis of East Coast Lows provides a succinct explanation of the challenge that these systems present to weather forecasters and to emergency response planning. Key points are noted below:

- East Coast Lows occur on average several times each year off the southern Queensland, NSW and eastern Victorian coast.
- They are more common in autumn and winter.
- They may develop out of tropical cyclones, but more often (certainly for the south coast) develop rapidly offshore from a pre-existing low pressure trough, or in the wake of a cold front moving from Victoria into the Tasman Sea. Warm sea surface temperatures can contribute to their development.
- They can intensify rapidly overnight and their movement can be difficult to predict.
- East Coast lows typically generate gale or storm force winds, heavy widespread rainfall (leading to flash flooding or major river flooding), very rough seas and prolonged heavy swells. Wave heights are usually in the range 5 metres to 10 metres. During the two most documented storms, the 1974 'Sygna' storm and the 2007 Pasha Bulka storm, maximum wind gusts of 165 km/hour and 124 km/hour were recorded. In other major east coast low storms, very heavy short term rainfall has been recorded. For instance, the August 1998 East Coast Low produced 401 millimetres of rain in Kangaroo Valley over three days; an August 1996 storm produced 386 millimetres of rain over two days in the Illawarra.
- The major severe weather impacts occur to the south of the centre of the low pressure system. BoM notes that even for severe storms, there can be clear skies to the north, so the change in conditions can be rapid and dramatic as the storm centre moves north.
- East Coast Lows usually last only a few days.
- Whilst there are about ten significant marine storms each year, the most dangerous storms occur on average only once a year.

- East Coast Lows have varying intensities, and the recurrence interval of the most severe storms, such as the May 1974 storm has been calculated as at least 100 years.

- Significant beach erosion events along the Shoalhaven coastline occurred in 1974, 1978, 1986, 1998, associated with major East Coast Low storms.

- Coastal inundation associated with East Coast Low storms can occur because of major catchment flooding, flash flooding or because elevated sea level and high waves overtop low coastal dune systems. Elevated sea level associated with low pressure systems and strong offshore forcing winds is known as 'storm surge'. The highest and most dangerous sea level occurs when a storm surge and high waves are superimposed on a high astronomical tide.

- Intermittently open and closed coastal lakes and lagoons (ICOLLS) are common on the Shoalhaven coastline. Most of these coastal lakes are closed to the sea most of the time, by the deposition of an accreting coastal berm. These lakes may have water levels set up above mean sea level because of the height of the berm. The entrance opens naturally if the head of water inside the lake overtops the berm, often as a result of the very heavy rainfall associated with an East Coast Low. High velocity flows driven by differential lake and ocean water levels result in entrance scouring which delivers sand to the nearshore zone along the beach and contributes to rapid recovery of sand volume on the beach after the storm has passed. High lake levels can also lead to early artificial opening to protect low lying property from flooding.

2.1.2 Other severe natural hazards affecting the Shoalhaven coastline

2.1.2.1 Tsunami

Geoscience Australia report that there is geological evidence that suggest that large tsunami may have reached the Australian coast over a time scale measured in thousands of years. The Shoalhaven Coastline Management Study discusses observations of perched boulders on cliffs in the Shoalhaven, which have been interpreted by some geologists as evidence of a very large tsunami in geological time.

The historical evidence of tsunami events is less on the east coast than the north-west coast. Gissing, Webb and Hanslow 2007 (drawing on Dominey-Howes 2007) report that the NSW coast has experienced 40 tsunami since European settlement, but most of them were very small. Geoscience Australia describes a tsunami that reached Sydney and the south coast in 1960, following a major earthquake off Chile. The tsunami waves were recorded at approximately one metre. Although this was sufficient to cause minor damage to boats in harbours along the NSW coast, it was a very small event compared with those experienced on the Western Australian coast and north into Indonesia.

Gissing, Webb and Hanslow (2007) also note the speculation that the 'Black Sunday' event at Bondi Beach in 1938 could have been due to the influence of a tsunami on wave size. At this stage, the event, in which five people died in very large waves, has not been directly linked to an earthquake and associated tsunami, but it is possible that an earthquake around the Pacific Rim could have caused the waves. Strategy CI3 of the Shoalhaven CZMP refers to the importance of improving awareness of tsunami probability and hazard.

The most recent tsunami warning for the east coast was the April 2007 Solomon Islands Tsunami.

2.1.2.2 Tropical cyclones

Tropical cyclones do not normally have a direct impact on the NSW south coast, but as noted above some East Coast Lows develop out of the remains tropical cyclone low pressure systems. Indirect effects of tropical cyclones can include extended rain periods leading to flooding in major river systems and prolonged periods of high ocean swell. A possible consequence of predicted climate change is that tropical cyclones could track further south. If this occurs, the intensity of rainfall events and high ocean swells could increase.

2.1.2.3 Floods and electrical storms

The coastline and coastal catchments are affected by seasonal electrical storms and by occasional flash flooding or major flood events. SCC has prepared a Flood Policy and a number of Floodplain Risk Management Studies and Plans for various subcatchments and has a priority list for other Floodplain Risk Management Plans. The highest priority Plans are all currently either complete or in preparation. Of these, Lower Shoalhaven River, Currumbene Creek, Lake Conjola, Burrill Lake, Moona Moona Creek and Tabourie Lake Floodplain Risk Management Plans are also relevant to the emergency management processes for the coastline, because these lakes, rivers and creeks are potential sources of emergency sand supplies for beach nourishment.

SCC's web site also provides community information on what to do before, during and after floods and major electrical storms, including how and when to contact the State Emergency Service and other relevant service providers (see also contact details at the front of this document).

These floodplain management issues are not addressed further in this Coastal Emergency Response Management Plan.

2.2 Managing risk : the temporal and spatial context of coastal emergencies

Major storms such as East Coast Lows affect the entire coastline and associated storm bite erosion can affect any of the Shoalhaven beaches. However, the risks associated with this immediate hazard vary from one beach to another and from time to time because of the following factors:

- Orientation of the coastline in relation to storm wave alignment;
- Protection of parts of the beach from waves by headlands, reefs or islands;
- Off shore sea bed profile – shallow or steep gradient;
- Frequency of similar storm events, and time elapsed since the last event;
- Amount and distribution of sand in the embayment (offshore, nearshore, beach and dunes);
- Proximity of development to the predicted (or known) extent of storm bite;
- Nature of development – high economic value (major buildings or infrastructure); and
- Proximity of locations with special cultural significance or rare or endangered ecological communities of species relative to the anticipated storm erosion bite.

Coastal hazard studies conducted by SMEC (2008) identify the following localities, where severe coastal weather events are predicted to cause erosion or inundation that would place important community facilities and access at immediate risk, with potential impacts on large numbers of people.

Priority localities include:

- Shoalhaven Heads, where the surf club has previously been threatened by severe storm bite erosion.
- Culburra/Warrain Beach, where the surf club is threatened by long term erosion. Multiple beach accessways and residences could also be affected by immediate storm bite erosion.
- Callala Bay and Callala Beach, where immediate storm bits erosion has previously threatened residences and safe access from the foreshore reserve to the beach.
- Huskisson and Vincentia, particularly Collingwood Beach, where previous storm bite erosion has threatened residences and the location of a popular shared walking/cycling pathway.
- Currarong, where residences and assets near the creek mouth are threatened by long term erosion and beach user safety is already affected by steep erosion scarp in the dunes.
- Mollymook, where major community infrastructure is within the immediate and medium term erosion hazard zone. A few residences at Mollymook also have the potential to be inundated during major storm events.
- Narrawallee, where the dune could potentially be overtopped by high storm waves.
- Burrill Lake, where property and community infrastructure is inundated by high lake levels.

Coastal hazard planning line for these locations are shown in Figure 6.1 (a to h) of the Shoalhaven CZMP. These figures show long term retreat of the dune face over 50 year and 100 year planning horizons and also the locations of areas subject to coastal inundation. Immediate storm bite erosion currently occurs seaward of these planning lines, but is known to have already threatened residences at a few locations. The Shoalhaven CZMP proposes that all properties affected by immediate and longer term coastal erosion hazards would have notation to this effect on their s149 certificates. This information could be linked to Council's emergency response program.

In addition to these high risk localities, many public assets such as boat ramps, beach amenity buildings, car parks, sewer and water infrastructure and beach access ways in all 35 Council managed beach compartments are known to be at varying levels of risk.

3.0 Strategies to reduce risk in coastal emergency events

Risk management for immediate, storm bite related coastal erosion involves both pre-emptive management strategies and responsive strategies.

3.1 Preparation and precautionary management

3.1.1 Precautionary planning

The Shoalhaven CZMP identifies several precautionary measures to reduce the risks associated with coastal erosion hazards in the short to medium term. These include planning controls and on-ground works.

Planning controls

Introducing clear planning controls for new development to minimise further investment on land within coastal erosion hazard zones or to require specific engineering and design features to increase resilience or to facilitate relocation. Planning controls have been recommended for land subject to coastal erosion hazard, for land likely to be affected by coastal inundation and for land affected by geotechnical hazards. (See strategies CE5, CI1 and GI1 of the Shoalhaven CZMP. Strategy CE10 also addresses relocation and design of buildings in hazard zones.)

On-ground works

All of the following actions can be considered as precautionary emergency response works. They are designed to reinforce, rebuild and rehabilitate coastal dune systems so that they provide a robust buffer to development during severe storm events. Specific locations for each of these actions are listed in the Shoalhaven CZMP.

- Detailed site assessments and risk analysis for all beach assets (Council maintains a register of all its assets in beach front/foreshore reserve locations).
- Enhancing the resilience of coastal dunes by strategic closure, redesign and restructure of access ways and vegetation management (Shoalhaven CZMP Strategy CE7).
- Design reviews and reinforcement where necessary for existing rock walls that protect coastal community infrastructure and facilities such as the Shoalhaven Heads Surf Club and Mollymook Golf Club. Council does not currently propose to use rock walls as an emergency response for beach protection. This will be reviewed as new information on storminess and high water level events as a result of climate change becomes available (Shoalhaven CZMP Strategy CE8).
- Ongoing maintenance of other structural management solutions such as the sea wall along the Princes Highway at Ulladulla Harbour (Shoalhaven CZMP Strategy CE8).
- Installation of geotextile or similar structures to control the entrance of small creeks to minimise channel migration that exposes low lying property to dune overtopping by storm waves (Shoalhaven CZMP strategy CE8).
- Similarly, installation of geotextile sand bag reinforcement of the toes of stairs and ramps to increase resistance to storm wave erosion (Shoalhaven CZMP Strategy CE8).

- For some beaches (e.g. Currarong), ongoing periodic sand nourishment is recommended in the short to medium term, to increase the buffer of sand seaward of the crest of the foredune. In general, this periodic sand nourishment involves placing sand that is dredged from nearby creek or lake entrances on the beach (Shoalhaven CZMP Strategy CE6).

- For selected beaches, a combination of beach scraping, vegetation management and if necessary sand nourishment to ensure the dune crest is maintained at a level unlikely to be overtopped by storm waves (Shoalhaven CZMP Strategies CE6 and CI2).

- Review of vegetation and drainage around sites affected by slumping (Shoalhaven CZMP Strategies GI4 and GI5).

In addition to these precautionary structural measures, the Shoalhaven CZMP recommends community awareness and education material on coastal processes, hazards and mitigation measures (for instance Strategy CE3). The intent of this strategy is to increase community awareness of the extent to which the Shoalhaven coastline is exposed to severe coastal erosion in major storm events. Many recent arrivals may not be aware of the extent of erosion at Callala Beach, Collingwood Beach or Shoalhaven Heads in the 1970s (e.g. see Plate 1.2 of the Shoalhaven CZMP).

The precautionary on ground works noted above are part of Council's strategic management of a sustainable coastline and will be implemented as part of Council's ongoing 3 year investment plans. Because they are both strategic and precautionary emergency response measures, Council may seek funding for these works through emergency management programs (see Section 9.2 of the Shoalhaven CZMP).

3.1.2 Planning for physical intervention during storms

In addition to the strategic risk management projects, physical works may be necessary to protect specific sites during severe storm events.

Council has adopted a risk based hierarchy of actions during storm conditions, using the following criteria:

Risk level	Action during storm events
Low	Inspect affected sites, photograph, repair any damage post storm
Moderate	Inspect affected sites, photograph, assess damage implications, restrict access, consult and notify other organisations, implement repair Design A (beach scraping, rationalised access reconstruction).
Major	Trigger DISPLAN response, inspect, photograph, assess damage implications, restrict access, consult and notify other organisations, implement repair Design B (protection installation, beach scraping, sand nourishment, rationalised access reconstruction).
Catastrophic	Trigger DISPLAN response, inspect affected sites, photograph, assess damage implications, restrict access, consult and notify relevant organisations, undertake emergency repairs to services, collaborative planning to determine response, review Shoalhaven CZMP.

A range of planning actions are necessary to ensure that the physical intervention which may be necessary during a severe storm cycle can be implemented without delay.

The following planning and preparatory measures need to be in place:

- A review of any approvals that may be required for any aspect of the physical works, including emergency sand sources, installation of temporary structures, disposal of 'waste' after the storm.

- Ensure all necessary approvals are in place, particularly within MPA zones, and ensuring that detailed specifications are developed for each site. This will include Council consents but also any approvals required from State agencies (including MPA concurrence).

- Stockpiles or sources of material are established and maintained as necessary. Council should be able to access a minimum of 20000 m^3 of sand within 10 kilometres of the highest risk sites and able to be mobilised within 8 hours if emergency action becomes necessary. Council will maintain a stockpile of sand filled geobags at SCC depots and sewage treatment plants.

- Agreements are in place with any preferred contractors who may be required for emergency physical works at short notice.

- Allocation of staff and/or contractor resources for coastal emergency response to erosion during storms. This will include staff to monitor the condition of key beaches, liaise with SES and DECC and both supervise and implement the physical works,

- Ensuring that staff with emergency response responsibilities are appropriately trained and have access to essential resources.

- Council officers have clear communication arrangements with SES officers in relation to emergency physical works during storms and how these works will be integrated with other SES activities.

3.1.2.1 Specific actions to enhance preparedness for physical works

Action P1: Develop a detailed response plan for each beach compartment and establish photo/survey monitoring points.

Who is involved	Timeframe	Resources required
▪ Council staff ▪ DECC (technical advice as necessary)	By December 2009	Within existing Council staff resources

Action P2: Review existing zoning and approvals (development consent, other approvals and licenses) and Entrance Plans of Management in relation to emergency sand extraction from the entrances of Currumbene Creek, Currarong Creek, Callala Creek, Lake Conjola, Swan Lake, Tabourie Lake and Burrill Lake. Ensure that emergency sand extraction is permitted (develop REFs and licence applications, amend Plans of Management if necessary).

Who is involved	Timeframe	Resources required
▪ Council staff Consult DECC, department of Lands, DoP, MPA, DPI and local communities if a Plan of Management needs to be revised. Discuss at Coastline Management Committee	By December 2009	Within existing Council staff resources

Action P3: Consult with Marine Parks Authority about the approval process for emergency sand extraction from creek entrances around Jervis Bay. Prepare relevant REF and applications for emergency sand extraction.

Who is involved	Timeframe	Resources required
▪ Council staff ▪ MPA Discuss at coastline Management Committee	By December 2009	Within existing Council staff resources

Action P4: Consult with DECC and Department of Lands about proposed approvals, amendments to Plans of Management for estuary entrances. DoP may be involved if the creek or lake is listed as a SEPP 14 wetland.

Who is involved	Timeframe	Resources required
▪ Council staff ▪ Department of Lands ▪ DECC and DoP as relevant Discuss at Coastline Management Committee	By December 2009	Within existing staff resources

Action P5: Inform and seek feedback from the Coastline Management Committee in relation to these sources of sand for emergency beach nourishment. Develop a detailed design for each site.

Who is involved	Timeframe	Resources required
▪ Council staff Coastline Management Committee (as noted above)	By December 2009	Within existing Council staff resources

Action P6: Identify sand quarry sites that could be used to source and for emergency beach nourishment if necessary. Liaise with quarry operators and identify any constraints emergency access and operation (e.g. this could mean operation of the quarry outside its approved hours of operation). Review and update development consent and Environment Protection Licence if necessary.

Who is involved	Timeframe	Resources required
▪ Council staff Quarry operators DECC	By December 2009	Within existing Council staff resources

Action P7: As for sand quarry sites, identify rock quarry sites that could be used to source boulder sized material for emergency beach protection works, at this stage as a last resort to protect high value assets. Review and update development consent and Environment Protection Licence if necessary to allow operation for emergency rock supply.

Who is involved	Timeframe	Resources required
▪ Council staff ▪ Quarry operators ▪ DECC	By December 2009	Within existing Council staff resources

Action P8: Identify truck and earthmoving equipment suppliers that can be utilised for emergency transport of sand. Identify routes from sand supply sites to the beach, both for sand extracted from creek mouths and sand from quarry sites. Identify potential implementation risks, such as access routes that may be blocked by coastal inundation during significant storm events. Identify alternative routes wherever possible to deal with these contingencies.

Who is involved	Timeframe	Resources required
▪ Council staff ▪ Quarry operators and earthmoving, trucking contractors DECC may provide technical advice on inundation and other possible environmental constraints.	By December 2009	Within existing Council staff resources.

Action P9: Link Section 149 notation about immediate and medium term coastal erosion and inundation hazards for coastal property to council's emergency management planning system. This will highlight localities where targeted consultation and community preparation activities would be beneficial and where close scrutiny of erosion during major storms would be necessary. Seek indicative cost sharing arrangements for emergency protection of private property.

Who is involved	Timeframe	Resources required
▪ Council staff Consult affected residents about s149 notation and target them for community awareness programs on coastal erosion processes and emergency response (see **Section 3.1.3**).	By December 2009	Could be achieved within existing Council staff resources.

Action P10: Identify access points for emergency sand dumping, focusing on priority locations (i.e. those with the highest immediate erosion risk). These access points must remain functional during severe storms – i.e. unlikely to be blocked by inundation, maintain safe access onto the beach in proximity to threatened structures.

Who is involved	Timeframe	Resources required
▪ Council staff As for s149 certificate information, link these locations in an emergency management data base.	By December 2009	Could be achieved within existing Council staff resources.

Action P11: Provide necessary training for relevant Council officers, so that they can prepare various REFs, communication materials, assess risk during storm events and liaison with SES and DECC personnel safely and effectively.

Who is involved	Timeframe	Resources required
▪ Council staff	By December 2009 and ongoing	Funds likely to be required for external training. Allow $10,000 for training of the identified coordinator in the first instance.

3.1.3 Coastal erosion emergencies - Community awareness to enhance preparedness

In relation to emergency response, the community awareness program (Strategy CE3 from the Shoalhaven CZMP) extends to ensuring that residents are aware of emergency procedures, such as who to contact about threatening erosion or inundation, evacuation, what they can and can't dump on the beach to protect property etc. Preliminary scoping of the development of this awareness program is provided below.

3.1.3.1 Preparatory activities

As per strategy CE3 of the Shoalhaven CZMP, conduct the following preparatory activities:

Action CA1: Prepare community awareness material on coastal hazards and the behaviour of beaches and dunes during major coastal storms. This should include a simple flyer style brochure, more detail on Council's web site and a local media strategy (radio and or community service discussion)

Who is involved	Timeframe	Resources required
• Council • Local media	Prepare basic community information kit by December 2009. The media strategy should involve annual reminders (e.g. each autumn)	Could be prepared in house; otherwise allow approximately $20,000 for information kit, plus printing and distribution costs.

Action CA2: As per CE3 in the Shoalhaven CZMP, place informative signage at beaches and along coastal walkways. An example would be at Collingwood Beach, which was severely eroded in storms in the 1970s. these signs should be integrated with other coastal signage recommended by the Shoalhaven CZMP, such as heritage signage, information about coastal species and coastal walk identification; i.e. the information is part of broader community awareness about how coastal zone systems function.

Who is involved	Timeframe	Resources required
▪ Council ▪ Local Chambers of Commerce and Precinct Committees	Within 2 years for priority sites such as Collingwood Beach, Shoalhaven Heads Beach and Callala Beach	Allow approximately $15,000 for preparation and installation of signs, per beach location.

Action CA3: Council's emergency response officer will give presentations at meetings and field days of relevant community groups, such as Bushcare, Precinct Committees, Surf Clubs and Chambers of Commerce.

Who is involved	Timeframe	Resources required
▪ Council ▪ Local community groups	Within 1 year for priority sites, with presentations at other sites over a 3 year period. This liaison cycle should be repeated at intervals of no more than 3 years.	Within Council's existing staff resources.

Action CA4: Liaise with SES about the information to be provided to communities about erosion during storms and how that information will be delivered. Erosion response information must be coordinated with SES advice about removal of assets from threatened locations and evacuation requirements. Local radio stations and house to house advice will both be part of this communication process. Prepare the communication action plan in advance.

Who is involved	Timeframe	Resources required
▪ Council ▪ SES ▪ Local radio stations	Initial liaison by December 2009	Within existing Council staff resources.

3.1.3.2 During a major storm

Council and SES will implement the communication action plan that has been jointly developed.

Action CA5: Where Council believes that emergency physical works may be necessary it will do the following:

- Maintain close liaison with BoM about storm intensity and tracking:
  - Discuss the issues and proposed physical works with the DECC ESFAC.
  - Discuss the proposed activity with SES.
  - Discuss options with Shoalhaven Water if water or sewer assets are threatened. Close public access to any unsafe area (affected by biological pollution).
  - Alert operators of relevant sand supplies, earthmoving equipment etc as necessary.
  - With SES, advise local radio stations and relevant land owners and community organisations.
  - With SES ensure that the works can be safely conducted – for instance, by managing onlookers.

Who is involved	Timeframe	Resources required
▪ Council ▪ BoM ▪ SES ▪ DECC ▪ Quarry operators ▪ Residents and community organisations	As required during each storm event. Determination of an agreed on-ground response must allow time for land owners to remove assets where possible, activation of sand sources and transport time.	Within the responsibility of Council and SES emergency response coordinators and teams.

3.1.4 Other types of coastal emergency events

As noted in **Section 1**, there is a possibility that the Shoalhaven coastline could be affected by a tsunami. Australia has a national tsunami warning system (part of the Pacific Tsunami Warning Centre, with warnings issued by the Bureau of Meteorology) and a national and NSW response process.

SES is the nominated Combat Agency for tsunami in NSW.

Information about the risk (hazard magnitude) of tsunami impact on the NSW coast is limited. NSW SES and DECC, with Geoscience Australia are currently preparing a tsunami assessment scoping study for the east coast. The results of this study will facilitate a more detailed and accurate hazard assessment which can then be used to identify vulnerable areas and to develop more targeted risk abatement strategies. For instance, the assessment will provide more information on the coastal erosion and inundation impacts of tsunami (using high resolution terrain data), which are currently poorly understood.

In the meantime, there remains a relatively low awareness of tsunami risk and tsunami management on the east coast. The NSW Tsunami Emergency Sub Plan 2005 has only had one real test (Gissing, Webb and Hanslow 2007).

The NSW Tsunami Emergency Subplan follows the format of other NSW DISPLAN documents, with procedures for preparedness, response and recovery. NSW SES prepared the Plan in consultation with relevant State agencies and subsequently conducted regional briefings for some 800 emergency managers.

Should a large tsunami occur, its potential impacts on low lying coastal land are much greater than coastal storms (affecting both land based and marine elements) and multi agency coordination of a wide range of services would be essential.

Given the scale of potential impact, a wide ranging and effective warning system is necessary.

Council has a number of roles in the recovery process from a future large tsunami. In relation to erosion management, however, the currently available hazard information makes it difficult to specify exactly what would be required. In this context, Council's management response to tsunami comprises its measures to address severe coastal storm erosion, supplemented by a precautionary, watching brief, maintaining liaison with SES and DECC, so that its erosion control response can be refined.

Council will do the following:

Action T1: SCC will liaise with SES and DECC about the outcomes of current new studies into tsunami risks along the NSW coast, especially as they relate to the Shoalhaven coastline.

Who is involved	Timeframe	Resources
▪ Council ▪ SES ▪ DECC	As study results become available during 2009.	Within existing Council staff resources.

Action T2: SCC will develop local scale risk assessments and ensure that its coastal and emergency management personnel have an up to date awareness of the NSW Tsunami Emergency Subplan.

Who is involved	Timeframe	Resources
▪ Council ▪ SES ▪ Shoalhaven Coastline Management Committee	Immediate and ongoing	Within existing Council staff resources

Action T3: As new information about tsunami hazards, particularly in relation to coastal erosion, becomes available, SCC will update its emergency management plans in consultation with SES, DECC and local at-risk communities.

Who is involved	Timeframe	Resources
▪ Council ▪ SES ▪ DECC ▪ Shoalhaven Coastline Management Committee ▪ Communities likely to be vulnerable to tsunami impacts	Review will occur as information becomes available. As noted in **Section 1.3**, the Coastal Erosion Emergency Management Plan will also be reviewed when new information about climate change and sea level rise impacts becomes available. As much as possible, the review timing should take both sources of evolving hazard information into account.	The review process could be managed by Council staff. Alternatively, allow around $20,000 for a strategic update of the Emergency Management Plan. Council may also determine that more detailed hazard studies are required

Action T4: SCC will include information about currently understood tsunami risks on the coastal page of its website.

Who is involved	Timeframe	Resources
Shoalhaven City Council	By June 2009	Within existing Council staff resources. For instance, a link to the Geoscience Australia site or NSW Tsunami Emergency Subplan would be adequate.

3.2 Intervention (physical works) during and immediately after storms

In severe storms, risk minimisation may require emergency reinforcement of dunes to protect private residences, community facilities and infrastructure. This section addresses the logistics of four proposed emergency actions:

- Beach and dune monitoring as the storm progresses, particularly at known high risk sites, informing risk based response to access and asset damage.

- Temporary relocation of buildings (principally surf club buildings and related structures) in high hazard sites that have been designed and constructed to permit this level of flexibility.

- Site analysis and sand dumping (or sand bagging) for specific sites which can be accessed readily by trucks, and where there is a approved sand supply nearby

- Beach scraping. This is unlikely to be feasible during high storm conditions, but can be used to help shore up eroded dune escarpments in the immediate aftermath of a severe storm.

Other possible options such as emergency rock walls are not recommended for the Shoalhaven coastline, except as a measure of last resort.

3.2.1 Beach and dune monitoring and communication

As noted in **Section 2**, the behaviour of East Coast Lows can be difficult to predict, and sudden intensification is known occur commonly.

Action MC1: When BoM predictions indicate that severe storm conditions (high waves, potentially superimposed on high tides or storm surge, and heavy rain) are likely (i.e. a high alert situation for coastal erosion), Council will commence short term monitoring of key (high risk) sites, and will also activate a community phone-in service to report severe erosion threats.

Who is involved	Timeframe	Resources required
Council engineering staff, coastline management staff and emergency services personnel, in consultation with SES.	When waves reach 5m height, or as otherwise directed by SES.	Within existing Council staff resources (particularly maintenance engineers).

Action MC2: Council will provide ongoing advice to residents through local radio stations and also through its on ground personnel.

Who is involved	Timeframe	Resources required
▪ Council staff ▪ DECC ▪ SES ▪ Radio stations	At regular intervals during the storm, with frequency depending on severity and changeability of storm conditions. Expect to report at least twice times a day for key sites. Frequency of observations and reporting will increase as the probability of an erosion impact on property or infrastructure increases.	Within existing Council staff resources. Technical advice will be provided by DECC as necessary.

Action MC3: Council's emergency response coordinator will maintain contact with the SES controller and with the DECC ESFAC during the high alert period (to coordinate staff movements, maintain clear understanding of access issues, etc.).

Who is involved	Timeframe	Resources required
▪ Council ▪ SES ▪ DECC ESFAC	Throughout the declared emergency period. As above, frequency will increase as the scale of the threat increases or becomes clearer. Details of procedures are in the SES manual.	Within existing Council staff resources.

3.2.2 Determining when action is necessary

For most storms affecting the coastline, a 'do nothing' response is appropriate in terms of physical works. The beach and dune system will erode and rebuild with no or minimal impact on community assets and ongoing safe access. This approach allows natural accretion and erosion processes to continue on the coastline.

In addition, as noted in **Section 1**, Council's medium term management plans for the coast provide for reinforcing or nourishing beaches at specific locations; and retreat of structures from other locations. These actions are in part designed to minimise the need for major physical works in an emergency context.

Council will apply a risk based response level to storm scenarios of various magnitudes.

Action MC4: During a storm of the magnitude likely to impact on structures, rather than the dune buffer, Council will monitor priority locations (see Action MC1) and maintain close liaison with BoM, DECC, SES and affected residents or community groups (such as surf clubs) to evaluate the available options for managing threatening erosion.

Who is involved	Timeframe	Resources required
▪ Council ▪ BoM (storm information) ▪ DECC (technical advice on responses) ▪ SES (coordination and communication) ▪ Surf clubs, other community groups and landholders (impacted assets)	As soon as the meteorological information and pre existing beach conditions indicate that physical actions to control erosion may be necessary; and ongoing throughout the storm event.	Within existing Council staff resources.

3.2.3 Implementing physical works for coastal storm erosion

As noted in **Section 1**, physical works may involve beach scraping, sand dumping, geotextile or sand bag structures and relocation of structures that have been designed for temporary retreat. As set out in the Shoalhaven CZMP, the most probable emergency physical work during a storm in the Shoalhaven is sand dumping. Use of sandbags and beach scraping are likely to be hazardous activities at the height of a severe storm, but are both useful for minimising ongoing slumping of the eroded dune face.

All of these activities require safe access to the beach and dune area by trucks and earthmoving equipment. Where erosion is occurring along a section of beach and is threatening residences or important infrastructure such as sewerage systems, large numbers of truck movements may be required over a period of eight to sixteen hours to deliver sufficient sand to the beach system.

The following actions are proposed:

Action E1: After consultation with DECC, activate designated (pre-approved) response plan for beach protection works (including sand source(s)). This involves:

- Close liaison with operators of earthmoving equipment, trucks, pumps etc.

- Ongoing close liaison with SES and affected residents is essential. Unsafe access ways will be closed off.
- Ensure that relevant emergency beach access points are safe for use and that safe passage along the beach is available if necessary.
- Monitor sand emplacement and beach stabilisation.

These activities will be supported by post storm survey and photo monitoring of affected sites.

Who is involved	Timeframe	Resources required
▪ Council ▪ SES ▪ DECC ESFAC	Sand delivery should be able to commence within 4 hours of a decision to use imported sand for beach nourishment.	Within existing Council staff resources, supported by previously agreed operational resources.

Action E2: Where beach scraping is proposed, this can commence as soon as safe beach access is available as the storm abates. The intent of beach scraping is to enhance the natural beach recovery process by moving sand from the beach face to shore up erosion scarps. As above, beach scraping requires liaison with operators of earthmoving equipment and close liaison with SES. Approvals must be in place prior to the storm event (MPA and Department of Lands).

Who is involved	Timeframe	Resources required
▪ Council ▪ SES ▪ DECC ESFAC	As determined in consultation with DECC and as soon as beach conditions are safe for equipment and operators	Use Council earthmoving resources or contractors.

3.3 Post storm follow up

As shown in **Table 1.2**, the emergency response actions do not cease when the storm abates. After each storm, there are remediation and review actions which must be completed.

These actions are designed to enhance stabilisation and recovery of the beach environment and to encourage reflection on the emergency operation so that:

- Any clean up of environmental hazards is completed efficiently. This would include any clean up required after overflows or other discharges from the sewerage system.
- Erosion around stormwater outlets is repaired and revegetated.
- Dune escarpments are stable and unlikely to collapse.
- Any sand excavation sites are stable and that any environmental damage is rectified to agreed standards (particularly if emergency sand has been sourced from a creek entrance).

- Stairs and ramps to the beach needing repair are identified and prioritised for remedial action. Access via these structures will be closed until repairs are carried out to make the access way safe.
- Other infrastructure is safe and ready for use (e.g. equipment for beach patrol).
- Hazard lines can be reviewed if necessary.
- Operational processes can be refined if necessary.
- Stakeholder and collaborator communication processes are as effective as possible.

SES will lead these processes as set out in its standard emergency protocols and procedures. Council is responsible for the following specific actions:

Action F1: Conduct post storm land survey and photographic records of the beach face and eroded scarps at designated monitoring points.

Who is involved	Timeframe	Resources
Council officer (natural resources unit)	Immediately following the storm	Within existing Council resources (natural resource management and engineering).

Action F2: Close unsafe access ways and restore safe beach access as quickly as is feasible (in accordance with a risk based strategy).

Who is involved	Timeframe	Resources
Shoalhaven City Council Discuss options and issues with local residents as necessary	Priority access ways restored within 4 weeks of events. Community needs to be aware of resource constraints to rapid restoration of beach access (steps and ramps) along the entire coast after a major event.	Within existing Council staff resources. Barriers and signage are needed for access ways to be temporarily closed due to safety concerns.

Action F3: Close access to unsafe dune escarpments until dune escarpments are stable and that stabilising measures such as dune fences and frontal dune vegetation are restored.

Who is involved	Timeframe	Resources
▪ Shoalhaven City Council. ▪ Consult DECC ▪ Involve Bushcare and other local community groups in planning and implementation (see discussion in Shoalhaven CZMP re species selection).	Consultation and planning commence within 12 weeks of erosion events	Within existing Council staff resources.

Action F3: Sand extraction sites are remediated if necessary. Remediation requirements will be determined in consultation with DECC, DPI, Department of Lands and MPA.

Who is involved	Timeframe	Resources
▪ Shoalhaven City Council ▪ DECC, DPI, Department of Lands and MPA	Necessary works should be identified within 16 weeks of the erosion event.	Planning is within existing Council staff resources. Contractors for on ground works?

Action F4: Sand supply and operational logistics are reviewed.

Who is involved	Timeframe	Resources
▪ Shoalhaven City Council	Review volume of sand within identified sources (creek entrances) on a regular basis after storm events, so that priority sources are known for the next event.	Within existing Council staff resources.

Action F5: Review of hazard lines. Note hazard lines will also be reviewed on a regular basis for other reasons. This action only applies if an erosion event brings existing hazard assessments into question.

Who is involved	Timeframe	Resources
▪ Shoalhaven City Council. ▪ Consult with DECC ▪ Consult with Coastline Management Committee and affected residents	Commence planning within 12 weeks of a major event	Likely to require consultant coastal engineering advice, plus discussion with DECC.

4.0 Action summary

Table 4.1 summarises all proposed emergency responses to prepare for and address coastal erosion during major storms. **Figure 4.1** is a flow chart which summarises the relationships between the emergency actions.

Table 4.1 - Action summary

Actions are to be completed within 1 year (most of the actions involving planning and preparation are programmed to be completed by end December 2009)		
Action ID	**Description**	**Comments/notes**
P1	Develop a detailed response plan for each beach compartment and establish photo/survey monitoring points.	The Plan will include key local contacts, local stockpiles of geobags or other sources of material for emergency works, constraints to access, information about high risk assets etc.
P2	Review existing zoning and approvals, licenses, Plans of Management and Entrance Management plans for coastal creek and lake entrances in relation permissibility of emergency sand extraction.	Amend Plans as necessary to ensure that authorised supplies of sand for emergency beach nourishment are available.
P3	Consult with MPA about approval processes for emergency sand extraction from creek mouths around Jervis Bay.	Essential consultation to facilitate access to emergency sand sources.
P4	Consult with DECC about proposed approvals, amendments to plans of Management. Also consult with DoP if SEPP 14 wetlands are involved and DPI if there is a risk that seagrass beds could be disturbed.	As above, essential consultation to facilitate access to emergency sand sources.
P5	Inform and seek feedback from the Coastline Management Committee in relation to these sources of sand for emergency beach nourishment.	Facilitates community awareness as well as feedback on proposed sand sources.
P6	Identify sand quarry sites that could be used to source sand for emergency beach nourishment if necessary. Liaise with quarry operators and DECC about constraints, licensing, operation of quarries outside normal approved hours of operation.	Ensures that approved quarry sites are available for emergency sand supply, or that alternatives (such as stockpiles of sand in approved locations).
P7	As above for rock quarries.	As above.
P8	Identify truck and earthmoving equipment suppliers that can be utilised for emergency transport of sand. Identify routes from sand supply sites to the beach, both for sand extracted from creek mouths and sand from quarry sites. Identify potential implementation risks, such as access routes that may be blocked by coastal inundation during significant storm events. Identify alternative routes wherever possible to deal with these contingencies.	Logistics analysis to minimise implementation risks during emergency events.
P9	Link Section 149 notation about immediate and medium term coastal erosion and inundation hazards for coastal property to council's emergency management planning system. This will highlight localities where targeted consultation and community preparation activities would be beneficial and where close scrutiny of erosion during major storms would be necessary.	Supports communication and planning processes.

Figure 4.1 – Emergency Response Actions

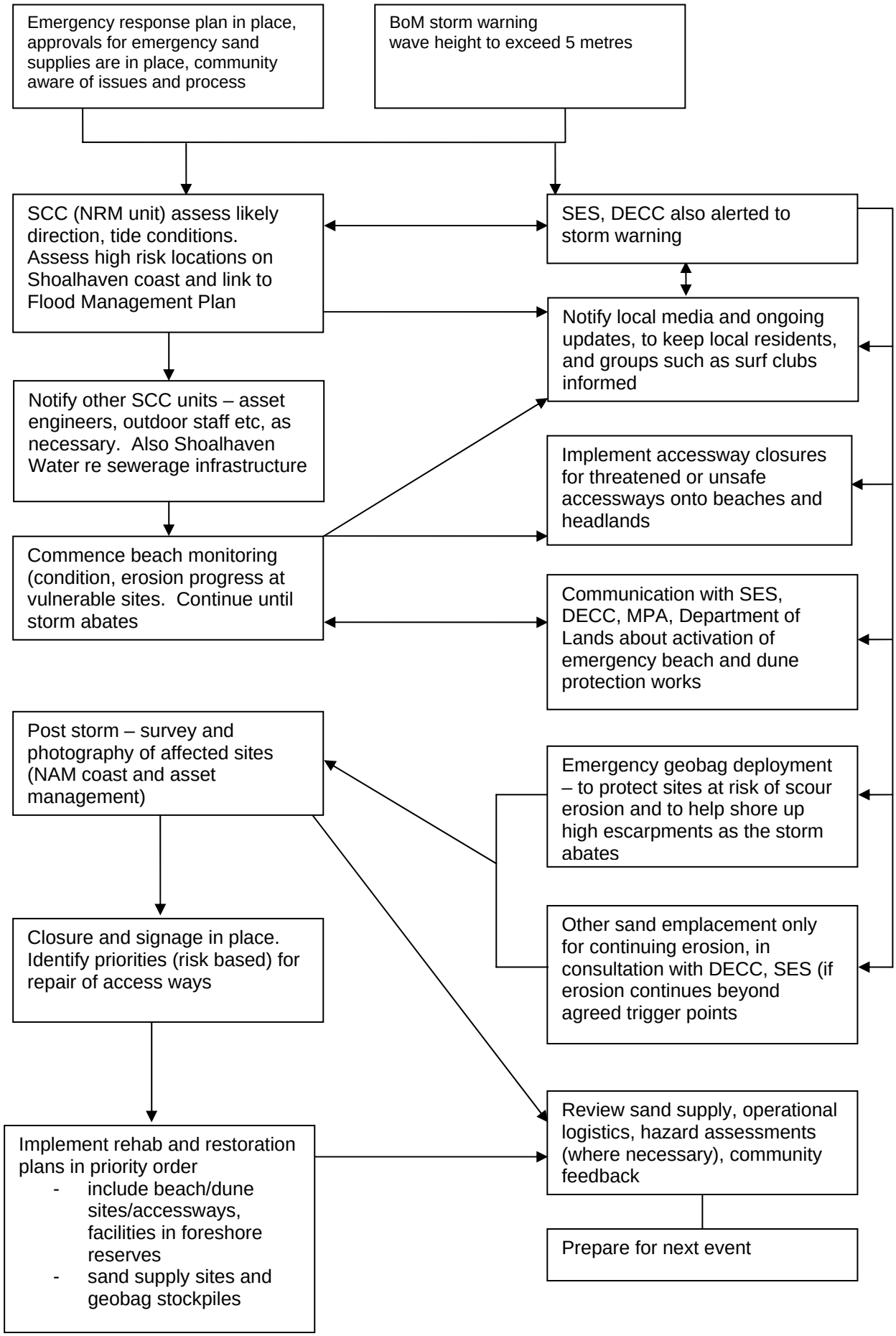

Table 4.1 - Action summary (cont)

Actions are to be completed within 1 year (most of the actions involving planning and preparation are programmed to be completed by end December 2009)		
Action ID	**Description**	**Comments/notes**
P10	Identify access points for emergency sand dumping, focusing on priority locations (i.e. those with the highest immediate erosion risk). These access points must remain functional during severe storms – i.e. unlikely to be blocked by inundation, maintain safe access onto the beach in proximity to threatened structures.	Link spatial data through an emergency management data base.
P11	Provide necessary training to relevant Council officers (identified emergency response coordinator in the first instance).	Ensures effective preparation (reduces operational risks) and good collaboration with SES, DECC and others during emergencies.
CA1	Prepare community awareness material on coastal hazards and storm impacts on beach and dune erosion.	Enhance community ownership of emergency response issues and willingness to cooperate with SES and Council during actual emergencies.
CA3	Council's officer(s) with responsibility for emergency response will give presentations at meetings and field days of relevant community groups – Bushcare, Precinct Committees, Surf Clubs, Chambers of Commerce.	As above.
CA4	Liaise with SES about protocols for delivery of community information during storms	Key relationship for all aspects of emergency response.
T4	SCC will include information about currently understood tsunami risks on the coastal page of its website.	Raise awareness of potential for tsunami to occur and potential impacts on the coast.
Activities to complete within two to three years		
CA2	Place informative signage at beaches (integrated with other coastal signage).	Supports general community awareness of the dynamic coastline.
T1	SCC will liaise with SES and DECC about the outcomes of current studies into tsunami risks.	Puts past NSW events into context and allows risks to be better evaluated.
T2	SCC will ensure that its coastal and emergency management personnel have an up to date awareness of the NSW Tsunami Emergency Subplan.	As above, plus allows preparation of informed responses.
T3	As new information becomes available about tsunami hazards, particularly in relation to coastal erosion, SCC will update its Emergency Response Management Plans in consultation with SES, DECC and local at-risk communities.	As above.

Table 4.1 - Action summary (cont)

Action ID	Description	Comments/notes
During storm events, as they occur		
CA5	Where Council believes that emergency physical works may be necessary it will do the following: ▪ Maintain close liaison with BoM about storm intensity and tracking ▪ Discuss the issues and proposed physical works with the DECC ESFAC ▪ Close damaged (unsafe) public access ways and access to other unsafe areas (high eroded scarps on the beach and/or landslip sites on cliffs and bluffs) ▪ Discuss the proposed emergency activities with SES ▪ Discuss options with Shoalhaven Water if water or sewer assets are threatened. Close public access to any unsafe areas (biological pollution) ▪ Alert operators of relevant sand supplies, earthmoving equipment etc as necessary. ▪ With SES, advise local radio stations and relevant land owners and community organisations. ▪ With SES ensure that the works can be safely conducted – for instance, by managing onlookers.	Clear and timely communication is the key task. Council needs a clear allocation of responsibility during emergency response events.
MC1	Council will commence short term monitoring of the condition of key (high risk) sites, and will also activate a community phone-in service to report severe erosion threats.	When BoM predictions indicate that severe storm conditions (high waves, potentially superimposed on high tides or storm surge, and heavy rain) are likely (i.e. a high alert situation for coastal erosion).
MC2	Council will provide ongoing advice to residents through local radio stations and also through its on ground personnel.	See CA5 re provision of clear advice. ABC radio has a demonstrated role and capacity in this regard.
MC3	Council's officer responsible for emergency response coordination will maintain contact with the SES controller and with the DECC ESFAC during the high alert period (to coordinate staff movements, maintain clear understanding of access issues, etc.).	As for CA5.
MC4	During a storm of the magnitude likely to impact on structures, rather than the dune buffer, Council will maintain close liaison with BoM, DECC, SES and affected residents or community groups (such as surf clubs) to evaluate the available options for managing threatening erosion.	As for CA5

Table 4.1 - Action summary (cont)

Action ID	Description	Comments/notes
During storm events, as they occur		
E1	After consultation with DECC, activate appropriate designated and pre approved local responses, such as activating emergency sand source(s).	This involves: • Close liaison with operators of earthmoving equipment, trucks, pumps etc. • Ongoing close liaison with SES and affected residents is essential. • Ensure that relevant emergency beach access points are safe for use and that safe passage along the beach is available if necessary. • Monitor sand emplacement and beach stabilisation.
E2	Where beach scraping is proposed, this can commence as soon as safe beach access is available (for emergency equipment) as the storm abates.	Use to prevent collapse of high dune escarpments and hasten recovery of a frontal dune.
After storm events		
F1	Carry out survey of beach face and eroded dune scarps and take beach condition monitoring photographs at designated monitoring sites, immediately after storm events.	This provides important information for linking storm magnitude (wave height, direction and period) to actual erosion impact, facilitating improved prediction of storm impacts and emergency response requirements.
F2	Close unsafe access ways and access to other unsafe areas (as in Action CA5). Council will inspect access structures in affected beach compartments (following from Action CA5) and identify priorities. Council will take action to restore safe beach access as quickly as is feasible (at priority sites, in accordance with its risk assessment).	Community awareness about resource constraints to rapid restoration of all structural access ways (steps and stairs) along the coast after a major event. Access ways will be repaired in priority order, according to risk assessment.
F3	Dune escarpments are stable and that stabilising measures such as dune fences and frontal dune vegetation are restored.	Requires consultation re species selection and planting.
F4	Sand extraction sites are remediated if necessary. Remediation requirements will be determined in consultation with DECC, DPI and MPA.	Most important when sand has been extracted from the mouths of estuarine creeks and lakes.
F5	Sand supply and operational logistics are reviewed.	Consider likely rates of recovery for extraction sites in natural waterways.
F6	Review of hazard lines.	Note hazard lines will also be reviewed on a regular basis for other reasons. This action only applies if an erosion event brings existing hazard assessments into question.

4.1 Resource implications

Preparing for and implementing emergency response management for significant coastal storm events requires Council resources, including trained personnel, equipment and diverse materials.

The Emergency Response Management Plan identifies the following resources to meet Council's emergency response obligations (**Table 4.2**).

Table 4.2 - Summary of resource implications

Task group	Resource requirements	Sources of funds
Preparedness tasks P1 to P10	Generally assumed to be within Council's existing personnel resources. Council will identify specific personnel (e.g. appoint a coordinator) to be responsible for planning and preparation for emergency response management. Allow up to $10,000 in first instance for training of the coordinator. Some planning tasks require preparation of REF and interagency liaison. These may be contracted to consultants (or appoint a project officer) to reduce load on Council officers (allow approximately $50,000 if this is done).	Council rates Commonwealth Natural Disaster Mitigation Funds
Update information about tsunami risk T1 to T3	Liaison with SES, DECC and NSW Tsunami emergency Subplan is within existing council personnel resources. Additional costs (up to $20,000) to update the Emergency Response Management Plan if new information requires significant changes to currently proposed procedures.	Council rates Commonwealth Natural Disaster Mitigation Funds DECC programs (coast and estuary program and Environmental Trust are possible options)
Community awareness aspects of preparation CA1 to CA5	Liaison and communication tasks are within Council's existing personnel resources. Allow approximately $20,000 (plus printing and distribution) for a community awareness flyer (like the existing flood flyer). Allow $15,000 per beach for preparation and installation of signage (up to $525,000 if all 35 beaches required signposting). This would be invested in order of priority and linked to other signposting tasks.	Council rates Environmental Trust CMA Programs Commonwealth Natural Disaster Mitigation Funds

Table 4.2 - Summary of resource implications (cont)

Task group	Resource requirements	Sources of funds
Physical works during and immediately after storms	Communication and decision making are within existing Council resources (coordination officer). Significant costs for emergency sand extraction and transport, depending on the magnitude and frequency of the events. Likely magnitude at least $100,000 per event.	State government assistance when local government areas are declared natural disaster areas (Emergency NSW). Grants are available to meet the additional costs of emergency work to restore essential services, including the provision of emergency levee structures, which are in excess of normal operations. Grants are available to help Councils to permanently restore infrastructure to pre-disaster standards.
Post storm follow up	Planning and communication are within existing Council staff resources. Costs for repair, remediation and restoration likely to be significant, depending on the magnitude and frequency of events. Likely magnitude at least $100,000 per event.	State government assistance when local government areas are declared natural disaster areas. As above, grants are available through Emergency NSW for a range of recovery activities, when an area is declared a natural disaster zone. Department of Lands administers a scheme providing grants to Trustees of parks and reserves.

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