

# EMERGENCY MANAGEMENT OF COASTAL EROSION IN NSW

**D.J. Hanslow<sup>1</sup> and M. Howard<sup>2</sup>**

<sup>1</sup>Coastal Unit, NSW Department of Infrastructure Planning and Natural Resources,  
Newcastle, NSW 2309

<sup>2</sup>Mitigation and Risk Management, NSW State Emergency Management Committee  
Secretariat, Sydney, NSW 2000

## ABSTRACT

The southeast coast of Australia has a long history of adverse impact from coastal storms. Past responses to coastal erosion events have included the placement of temporary mitigation works ranging from sandbag and rock walls through to dumping of building waste and car bodies. These works have varied significantly in their effectiveness and most have had a significant adverse impact on beach amenity.

This paper examines arrangements for emergency management of coastal erosion in NSW. This includes details of the roles and responsibilities of the various agencies involved in coastal erosion emergency management as well as the requirements of relevant legislation. A number of principles are suggested as a guide to both planning and response decisions relating to coastal erosion emergencies.

## INTRODUCTION

Approximately 60 percent of the NSW open ocean coastline is characterised by sandy beaches. These beaches are dynamic environments undergoing continual cycles of erosion and accretion in response to the action of tides, wind and waves. In many places, existing foreshore development has been built within the active beach system and is at risk from coastal erosion.

Major coastal erosion events along the NSW coast are usually associated with the occurrence of east coast low-pressure systems, decaying ex-tropical cyclones or mid-latitude cyclones, which generate large waves and elevated water levels. Erosion occurs as the beach adjusts to the conditions by transporting sand offshore to form an offshore bar. At times the erosion may be exacerbated by processes such as rip currents and beach rotation or the presence of structures. Substantial damage may occur to any buildings located within the active zone, including partial or complete collapse, necessitating evacuations. With current predictions of climate change (IPCC 2001, CSIRO 2004) and increasing population growth in coastal communities this situation is expected to get worse with time (Lord and Gibbs, 2004).

Past responses to coastal erosion events have included the placement of temporary mitigation works ranging from sandbags and rock walls through to dumping of building waste and car bodies. Often these hastily erected structures do little to reduce beach erosion during the storm event, which may continue unabated. The adverse effects of such walls and dumped material may, however be long lasting, severely impacting beach amenity and beach access, often posing a serious safety risk to beach users, and exacerbating erosion of neighbouring areas. Many beaches along the NSW coast are still scarred by material dumped during storms in the 1960s and 1970s.

Existing guidelines for the management of coastal erosion as outlined in the Coastline Management Manual (NSW Government 1990) address the long-term management of coastal hazards but provide little guidance for emergency response. To address this issue the NSW Government, in November 2002, amended the *Coastal Protection Act (1979)* to require coastal zone management plans to make provision for emergency actions that may be undertaken during periods of beach erosion, including the carrying out of related works.

The current paper examines the coastal erosion incident and emergency response components of Coastal Zone Management Plans and discusses the relationship between these plans and other emergency response plans prepared under NSW emergency management legislation.

## **BACKGROUND**

Erosion is part of the natural response of a beach to changing wave and water level conditions. However, the large waves, elevated water levels and strong winds generated by a storm can cause severe damage to coastal properties.

The southeast coast of Australia has a long history of adverse impact from coastal storms. Both Thom (1974) and Chapman et al. (1982) document histories of erosion events dating back to the 'Dunbar storm' in 1857. Major events threatening property have occurred on average every 10-20 years since the mid 1800's. A number of these events involved a series of storms rather than a single storm, for example in 1912, 1950, 1967 and 1974. Some of the more recent events have been correlated with the combined occurrence of storm related erosion and beach rotation linked with the El Niño/Southern Oscillation (eg Ranasinghe et al., 2004).

The worst of these historical events, in terms of property damage, were the 1944-6, and 1974 events. During the 1944-6 event two houses were 'lost to the sea' and up to seven others suffered substantial damage at the southern end of Collaroy Beach (Warringah Shire). These were subsequently demolished and the properties within the affected zone were resumed and converted to public reserve and car park.

In 1974 wide spread erosion associated with a series of storms led to damage and later abandonment of the village of Sheltering Palms (Byron Shire) on the far north coast as well as wide spread damage along the central coast including many Sydney beaches. This included the undermining and damage of houses at Bilgola Beach and Narrabeen, the loss of the Paragon restaurant in Botany Bay, and substantial damage to Manly jetty and many surf Clubs.

Emergency response activities undertaken during these events have varied widely both in scale and effectiveness. These have ranged from the construction of sandbag and rock and even hay bale walls through to dumping of building waste and car bodies as undertaken at Byron Bay during 1967 and 1974. While, on occasion, these works were effective in locally halting erosion, they often exacerbated erosion in neighboring areas. More often, the dumping did little to reduce beach erosion during the storm event, which continued unabated.

Only with hindsight do we realise the long lasting effect that many of these structures have had on beach amenity and public safety. On numerous beaches along the NSW coast, material dumped during the 1967 and 1974 storms is still visible today. In many cases beach widths available for recreational usage have been significantly reduced, public access impeded and the natural character of the beach severely changed. At Belongil Spit (Byron Shire) injuries resulting from the dumping of car bodies are still reported some 25 years after the dumping of cars (Thom, 2004). With rising sea levels

and the potential for increased frequency and intensity of storms associated with climate change the impacts of these works are likely to increase, as is the likely pressure for further coastal hardening. (Lord and Gibbs, 2004, Herbert and Taplin, 2004). As coastal populations increase, the pressure on scarce coastal resources is likely to grow along with the pressure for more intensive development of the coast. (eg Lord and Gibbs, 2004).

In 1999, concern over ongoing degradation of beach amenity led to a statewide review of beach management by the NSW Coastal Council. The Coastal Council recommendations included measures to provide legal protection to beaches, and to ensure emergency actions during storms are planned in a coordinated way involving the Local Council, the State Emergency Service, the Department of Infrastructure, Planning and Natural Resources, and affected property owners (Coastal Council 2000, Thom 2004). These recommendations have resulted in extensive consultation between the key agencies with the outcome that changes have now been made to policies and legislation in both the land management and emergency management arenas in NSW.

## **ROLES AND RESPONSIBILITIES OF LAND MANAGERS AND EMERGENCY MANAGERS**

### **Land Management**

Local councils, as the local land managers, are responsible for much of the day-to-day management of the NSW coastal zone. This includes local environmental planning and development approval under the *Environmental Planning and Assessment Act (1979)*, the preparation of coastal zone management plans under *the Coastal Protection Act (1979)*, as well as the management of community land including most beaches under the *Local Government Act (1993)*.

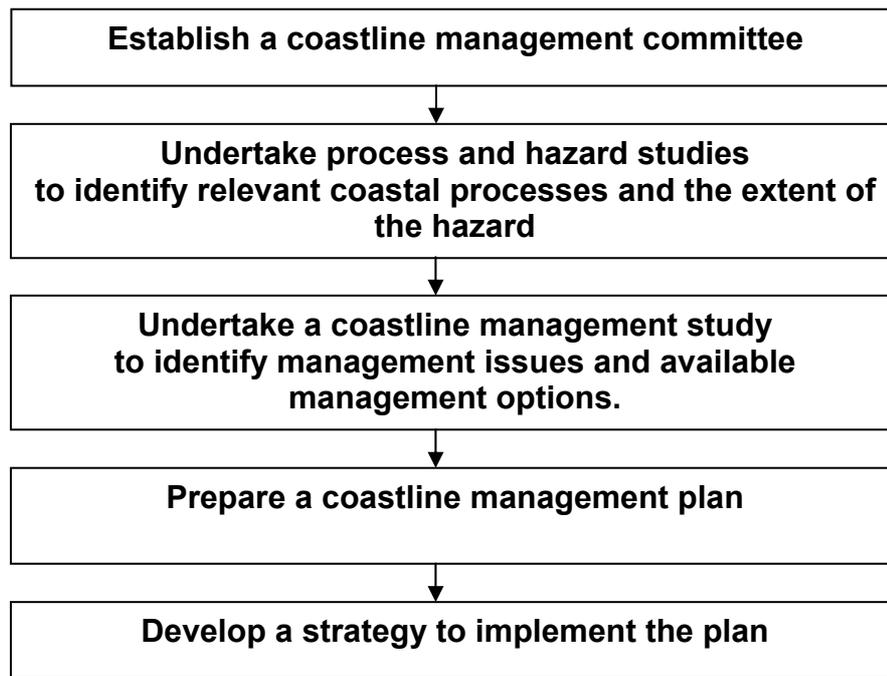
In managing the coast, councils are guided principally by the Coastal Policy 1997 (NSW Government 1997) and the Coastline Management Manual (1990). The Coastal Policy 1997 promotes better management of the coastal zone of New South Wales through the application of ecologically sustainable development (ESD) principles. The policy aims to facilitate the development of the coastal zone in a way, which protects and conserves its values. This includes recognising and accommodating natural process and protecting beach amenity and public access.

The Coastline Management Manual (NSW Government, 1990) provides detailed guidelines for councils to follow to address coastal erosion issues. The manual, which is currently being reviewed, outlines a series of steps for local councils to follow to prepare and then implement Coastal Zone Management Plans (see figure 1).

### **Emergency Management**

Emergency management arrangements in NSW are primarily guided by the *State Emergency and Rescue Management Act, 1989*. The Act provides the legislative basis for coordination of emergency preparedness, response and recovery and provides for the preparation of the NSW State Disaster Plan (Displan) and subordinate plans for specific hazards.

The State Displan details emergency preparedness, response and recovery arrangements for NSW to ensure the coordinated response to emergencies by all agencies having responsibilities and functions in emergencies. The primary functions of this document as specified in the *State Emergency and Rescue Management Act, 1989*, are:



**Figure 1: The NSW coastal management process (NSW Government 1990)**

- to identify the agency primarily responsible for responding to each different form of emergency (this is done using the ‘All Hazards Approach’ to emergency management);
- provide for the coordination of the activities of other agencies in support of the agency with primary responsibility for a particular emergency;
- specify the tasks to be performed by all agencies in the event of an emergency; and
- specify the responsibilities of the minister and senior emergency managers.

In NSW, the agency responsible for damage control from storms and tempests, including damage control for coastal erosion and inundation from storm activity, is the NSW State Emergency Service. The State Emergency Service is also the combat agency for floods in this state.

The key responsibilities of the State Emergency Service as specified in the State Storm Plan (a sub-plan of the State Displan) for the management of damage control from coastal storms are:

- The protection of life through warning and evacuation of residents at risk; and
- The coordination of the lifting and/or relocation of readily movable household items and commercial stock and equipment.

This means that the actions carried out by the State Emergency Service and supporting agencies during coastal erosion events caused by storms are carried out under the authority of the *State Emergency and Rescue Management Act, 1989*. Planning for the emergency management of this hazard is carried out by the State Emergency Service

under the authority of *the State Emergency Service Act, 1989* as described in the following section of this paper.

Further details of the respective roles and responsibilities of key agencies are contained in Appendix 1.

### **EMERGENCY MANAGEMENT PLANNING**

In 2002, *The Coastal Protection Act (1979)* was amended to ensure that Coastal Zone Management Plans prepared by local councils address both coastal emergency responses and the protection of beach environments. The Act stipulates that a Coastal Zone Management Plan must make provision for:

- protecting and preserving beach environments and beach amenity;
- emergency actions of the kind that may be carried out under the *State Emergency and Rescue Management Act 1989*, or otherwise, during periods of beach erosion, including the carrying out of related works, such as works for the protection of property affected or likely to be affected by beach erosion, where beach erosion occurs through storm activity or an extreme or irregular event; and
- ensuring continuing and undiminished public access to beaches, headlands and waterways, particularly where public access is threatened or affected by accretion.

Addressing both the protection of beach environments and beach amenity and the management of emergency actions where property is threatened as required under the *Coastal Protection Act, 1979*, as amended, is a difficult balancing act. The agencies involved in each different aspect of planning need to be aware of the various legal requirements and policies guiding both coastal management and emergency management in NSW in order to do the job well. The most effective way to achieve this task is for the key players to consult early and often during the planning process.

In addition, the following points are suggested as a guide to both planning and response decisions relating to coastal erosion emergencies:

- The first priority of any emergency response should be to protect any lives which may be threatened. Under the *State Emergency and Rescue Management Act, 1989*, this includes the safety and health of people and animals. This should usually be undertaken through the warning of occupants and evacuation of buildings identified as being at immediate risk. This is the responsibility of the State Emergency Service (during storms) and is planned for in Local Flood Plans. Councils may also use warning signage and safety fencing to keep individuals away from unstable erosion escarpments. Community education to advise people of the risks and what they can do to reduce the effects of coastal erosion is a joint responsibility of councils and the State Emergency Service and should be ongoing.
- The second priority should be to minimise damage to property through the removal of household contents or commercial stock and equipment from buildings at risk of collapse or inundation by sea water. The State Emergency Service is responsible for coordinating such actions during storms and Local Flood Plans will also make provision for such actions.
- As coastal erosion emergency engineering response measures have the potential to seriously impact on long-term public beach amenity as well as neighbouring properties, any emergency response actions should be planned for in advance and based on assessment of all available options and their pros and cons. Emergency engineering works should generally be restricted to the protection of high-value built

assets. Where possible, natural processes of erosion and accretion should be allowed to continue. Councils are responsible for planning for and conducting any such works both during and outside of storm periods.

- Emergency engineering responses to protect development from coastal erosion should favour options that do not compromise the natural and cultural values of the area, such as building relocation, or beach and dune replenishment (with sand). The Department of Infrastructure, Planning and Natural Resources is responsible for providing advice to councils on appropriate options during preparation of Coastal Zone Management Plans.
- Impacts generated by emergency engineering works on beach environments, beach amenity or beach access must be mitigated following the emergency. This may involve removal of structures, burial with dune sand, re-establishment of dune vegetation, dune re-establishment, and other methods. Where structures are not removed, plans should specify measures to ensure the ongoing mitigation of any adverse impacts for example by burial or revegetation. These actions are the responsibility of council and should be included in Coastal Zone Management Plans.
- Emergency engineering works should be consistent with long-term coastal management strategies where they have been adopted. For example where a policy a retreat or voluntary purchase has been adopted, no protection works should be allowed.

#### **Provisions in Coastal Zone Management Plans**

It is suggested that the coastal erosion emergency components of Coastal Zone Management Plans should, as a minimum, address each of the following issues and that all planning should be undertaken in consultation with the State Emergency Service and other key agencies.

- *Coastal erosion hazard*—all coastal hazards present within the area should be identified, as should the extent and nature of the risks posed to existing development.
- *Appropriate responses*—the plan should outline responses that are appropriate given the nature of the hazards and local site conditions. Proposed responses should be based on an assessment of all available options and their pro and cons. A range of typical works options is outlined in Appendix 2.

Where planning for the protection of life and readily movable property during storms has been included in State Emergency Service Local Flood Plans, the Coastal Zone Management Plan should refer directly to the relevant State Emergency Service plans. Councils may choose to include a copy of these arrangements in the Coastal Zone Management Plan for convenience, although this is not considered necessary.

- *Preparedness*—the plan should include measures to facilitate efficient responses to coastal erosion emergencies, such as:
  - development of monitoring and warning systems (council responsible for components associated with engineering works, plans should also refer to relevant provisions in State Emergency Service plans).
  - identification of potential sources of sand and rock, plant and equipment, geotextile suppliers and other materials and resources required for physical protective works (council responsible).
  - obtaining development consent where works options require prior approval under the *Environmental Planning and Assessment Act, 1979*.(Councils)

- public education measures, including awareness of the contents of Flood Plans and the emergency provisions in Coastal Zone Management Plans,. The State Emergency Service and councils both have responsibility for educating the community about the contents of their respective plans and this is often done jointly by both agencies.
- *Trigger conditions*—the plan should identify the circumstances in which emergency responses (including any engineering works) should or should not occur.
- *Responsibilities and contacts*—the plan should clearly specify a hierarchy of responsibilities for the emergency engineering responses actions required to be undertaken by councils, and include contact details, default contacts and other details as required. The hierarchy of emergency management responsibilities and specific contact details for emergency management and supporting agencies are contained in Displan, the Local Flood Plan and State Emergency Service Standing Operating Procedures. In order to reduce confusion and duplication, councils should not attempt to reproduce or amend these in Coastal Zone Management Plans, but should simply refer to the Local Flood Plan where appropriate.
- *Recovery and rehabilitation*—the plan should clearly specify those actions which are to be undertaken to mitigate any impact of emergency works on beaches, dunes or other coastal settings, and should specify when they will be undertaken and by whom. (Note: mitigation and remediation of the coast following any physical works undertaken during a storm event is the responsibility of council).

### **State Emergency Service Plans**

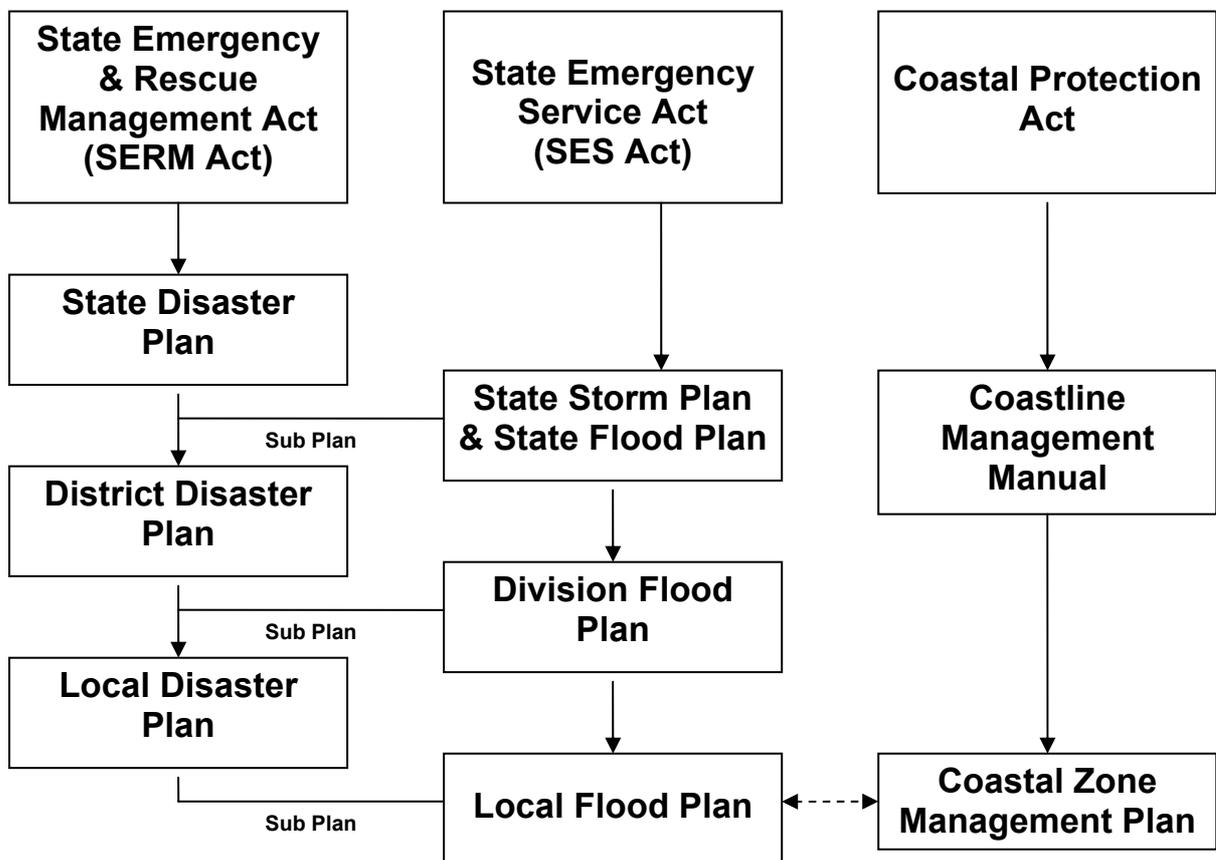
The NSW State Emergency Service is the combat agency for storms, including storms resulting in coastal erosion. Under the *State Emergency Service Act, 1989*, the State Emergency Service prepares plans outlining arrangements for preparedness, response and recovery from these events. This is done, in the first instance, through the NSW State Storm Plan. As there are no local storm plans in NSW, planning for emergency management of coastal erosion events at the local level is included, for convenience, in Local Flood Plans.

These Local Flood Plans identify and describe the hazard in the local area and the properties at risk. They include details of the responsibilities of all of the emergency services and other key agencies, as well as local community and volunteer organisations with a role in supporting the State Emergency Service during a response operation. Monitoring and warning systems are outlined including the issue of Severe Weather Warnings by the Commonwealth Bureau of Meteorology. Appropriate emergency management response options are identified and detailed in accordance with the primary responsibilities of the State Emergency Service in relation to coastal erosion events - the protection of life and the coordination of the protection of readily movable property.

The plan will also include any other preparedness measures such as preparation and review of the plan itself, consultation with other agencies, involvement in relevant planning conducted by other agencies and community education. Immediate recovery measures are also noted in Local Flood Plans.

It is important to note here that it is through the State Emergency Service plans that the emergency management arrangements for responding to coastal erosion during storms are activated. Local Flood Plans are prepared under the authority of the State Emergency and Rescue Management Act, 1989 and can activate the support arrangements as detailed in the NSW State Displan providing access to significant

resources from other emergency management agencies. Whilst the Coastal Protection Act, 1979 specifies that Coastal Zone Management Plans are required to make provision for emergency actions of the kind that may be carried out under the *State Emergency and Rescue Management Act 1989*, or otherwise, inclusion of such arrangements in council plans does not activate the support provisions of the Displan. It is far simpler and more effective to include a reference to the appropriate Local Flood Plan in the Coastal Zone Management Plan in order to meet this requirement. This then is good cause for councils and the State Emergency Service to collaborate during their planning processes, to ensure that a link between both of these important planning instruments is established and maintained. The Department of Infrastructure, Planning and Natural Resources, in providing guidance to councils during the development and implementation of Coastal Zone Management Plans plays a pivotal role in encouraging councils to foster this collaboration. Figure 2 below illustrates the relationship between emergency management and coastal protection legislation, policies and planning.



**Figure 2: Hierarchy of Emergency and Coastal Zone Management Plans in NSW**

## DISCUSSION

With effective long-term management by councils, the need for emergency response actions in the coastal zone during storms to deal with the residual risk should, over time, be reduced. There have been many significant achievements to date that have improved emergency management of the coastal zone, both on a statewide and a local scale. Already, a large number of councils have commenced the coastal zone management process and many have progressed through to the planning phase. At the same time, the State Emergency Service has been working closely with councils along the coast in the preparation of specific arrangements for the emergency management of coastal erosion within Local Flood Plans. The precursor behind many of these changes of course has been the specific requirements for emergency management planning contained in the *Coastal Protection Act, 1979*, as amended.

There is still a long way to go however, before the risk is reduced to an acceptable level and a number of issues are yet to be addressed. One issue relates to the approval of emergency works. Neither the *State Emergency and Rescue Management Act, 1989* or the *Coastal Protection Act, 1979* specifically override the normal approval processes of the *Environmental Planning and Assessment Act, 1979*, unless a State of Emergency is declared (and this is not the usual case in emergencies of this scale). As a result, any physical mitigation works such as sea walls may require approval prior to construction, even if adopted as the appropriate emergency response option in a Coastal Zone Management Plan. This means it may be necessary to seek development consent in advance for adopted options or alternately it may be necessary to modify relevant local environmental planning instruments to allow actions which are supported in the Coastal Zone Management Plan.

Another key issue which many councils face is the ever-increasing value of beachfront property and therefore the low cost-benefit ratio of mitigation options such as voluntary purchase and planned retreat policies. Funding the implementation of management plans is an ongoing challenge for many councils and an important issue which needs to be addressed. Of more immediate significance in this planning phase, is gaining a full understanding of the scope of the coastal erosion hazard in this state.

A number of programs are underway to remedy these deficiencies however, including the Coastal Risk Assessment currently underway and the NSW Coastal Hazards Definition Database soon to be compiled by the Department of Infrastructure, Planning and Natural Resources. Under the Natural Disasters Mitigation Program (NDMP) and Coastal Management Program (CMP) there is also significant Commonwealth and State funding available to councils for coastal zone studies and management plans and a number of councils have successfully applied for and received funding to date. Under the 2004/2005 funding round for NDMP, over \$9.5 million of Commonwealth and State funds were allocated to mitigation projects in NSW (including a number of coastal projects). In the 2005/2006 program, there is a further \$4.9 million Commonwealth and State funds available for projects in this state. This is in addition to the State Coastal Management Program, which provides about \$2 million per year to councils for the preparation and implementation of Coastal Zone Management Plans.

The Department of Infrastructure, Planning and Natural Resources are also in the process of reviewing the 1990 Coastline Management Manual to provide councils, consultants and other relevant agencies with more explicit and up-to-date guidelines on the preparation of Coastal Zone Management Plans. The revised Coastal Zone Management Manual will include a chapter on emergency management of the coastal zone. In the interim, the State Emergency Service and the Department of Infrastructure, Planning and Natural Resources intend to prepare a brief outline of the general

requirements of both agencies to assist councils who have already commenced or are soon to begin their Coastal Zone Management Plans.

## **CONCLUSION**

As with the long-term responses to coastal erosion, emergency actions to protect coastal development must also recognise the value and importance of the beach environment as a community and environmental asset. Structural protection works such as sea walls have the potential to negatively impact on beach amenity, public safety and neighbouring properties. Careful consideration should be given during the preparation of Coastal Zone Management Plans, to the potential impact of response actions and to how the beach will be rehabilitated after the event. The successful execution of these responsibilities is dependent upon the continuing development of a strong, cooperative relationship between the key agencies involved in planning for and conducting emergency actions in the coastal zone.

## **DISCLAIMER**

The views expressed in this paper are those of the authors and not necessarily those of either the Department of Infrastructure, Planning and Natural Resources or the State Emergency Management Committee Secretariat.

## **ACKNOWLEDGEMENTS**

The support and advice of the NSW State Emergency Service during the background research conducted for this paper during the period 2001-2004 is gratefully acknowledged. In particular, the assistance provided by Andrew Gissing in reviewing the paper has been most helpful.

The authors would also like to thank Brian Dooley, Major-General Hori Howard, Heinz Mueller, Professor Bruce Thom, Samantha Thomas and Rosh Ranasinghe for reviewing the paper.

## **REFERENCES**

- Chapman, D.M., Geary, M., Roy, P.S. and Thom B.G. (1982). Coastal Evolution and Coastal Erosion in New South Wales. Coastal Council of NSW, Sydney, 341p.
- CSIRO (2004). Climate Change in New South Wales. CSIRO consultancy report for the New South Wales Greenhouse Office.
- Herbert, K & Taplin, R (2004). Climate Change Impacts and Coastal Planning in the Sydney Greater Metropolitan Region.
- Lord D. and Gibbs J. (2004). The Day After Tomorrow - The reality of climate change for coastal New South Wales. *Proceedings of the NSW Coastal conference*, Lake Maquarie.
- Intergovernmental Panel on Climate Change (2001). *Scientific Assessment of Climatic Change*. United Nations Environmental Program, IPCC Working Group 1.
- NSW Coastal Council (2000) Beach erosion in NSW. Unpublished Report.
- NSW Government (1979). Coastal Protection Act 1979 As amended 2002 (legislation).
- NSW Government (1979). Environmental Planning and Assessment Act (legislation).
- NSW Government (1993). Local Government Act (legislation).

- NSW Government (1990). Coastline Management Manual, NSW Government Printer.
- NSW Government (1997). NSW Coastal Policy 1997, A sustainable future for the New South Wales Coast. NSW Government printer.
- NSW Government (2000). NSW State Disaster Plan, P&E Promotions.
- NSW Government (2000). NSW State Storm Plan, P & E Promotions.
- NSW Government (1989). State Emergency and Rescue Management Act (legislation).
- NSW Government (1989). State Emergency Service Act (legislation).
- Ranasinghe, R., McLoughlin, R., Short A. and Symonds, G. (2004). The Southern Oscillation Index, wave climate, and beach rotation. *Marine Geology* Vol. 204, pp 273-287.
- Thom B.G. (1974). Coastal Erosion in NSW. *Search*, Vol. 5, No 5, pp198-208.
- Thom, B, (2004). Geography, Planning and the Law: a coastal perspective. *Australian Geographer*, Vol. 35, No. 1, pp3-16.

**APPENDIX 1: – RESPONSIBILITIES OF KEY AGENCIES**

<b>AGENCY RESPONSIBLE</b>	<b>BEFORE THE STORM</b>	<b>DURING THE STORM</b>	<b>AFTER THE STORM</b>
<p><b>State Emergency Service (SES)</b></p>	<ol style="list-style-type: none"> <li>1. Prepare and maintain the Local Flood Plan, including arrangements for the management of coastal erosion during storms.</li> <li>2. Consult with councils, Coastal Zone Management Committees, DIPNR and other agencies during the development of emergency management arrangements for the management of coastal erosion for inclusion in SES Local Flood Plans and council Coastal Zone Management Plans.</li> <li>3. Prepare, coordinate and deliver community awareness programs and educational material with the assistance of the local councils to ensure that people in locations potentially threatened by coastal erosion understand the threat and its management.</li> </ol> <p><b>Note;</b> the SES is not responsible for the planning or conduct of emergency beach protection works during periods of storm activity or otherwise.</p>	<ol style="list-style-type: none"> <li>1. Activate the Local Flood Plan.</li> <li>2. Advise the local council and other emergency management agencies of coastal storms that are likely to affect the council area.</li> <li>3. Conduct regular reconnaissance at locations identified as being susceptible to coastal erosion.</li> <li>4. Coordinate the provision of advice to the community at risk regarding the likely problem and actions they should take. These actions may include evacuation and/or removal of portable property from households and businesses.</li> <li>5. Coordinate the evacuation of people at risk.</li> <li>6. Coordinate the transport of removable household possessions and stock, records and equipment from business premises (if time and resources permit).</li> <li>7. Provide a ‘phone-in’ service for the local community to take requests for assistance and give advice as necessary.</li> </ol>	<ol style="list-style-type: none"> <li>1. Assign personnel to gather intelligence in areas susceptible to coastal erosion/inundation.</li> <li>2. Review and update the arrangements for managing coastal erosion/inundation in Local Flood Plans following coastal erosion events.</li> <li>3. Liaise with the DIPNR to obtain information on the impact of storm events on coastal properties once the storm has abated.</li> </ol>

<b>AGENCY RESPONSIBLE</b>	<b>BEFORE THE STORM</b>	<b>DURING THE STORM</b>	<b>AFTER THE STORM</b>
<p><b>Local Councils</b></p>	<ol style="list-style-type: none"> <li>1. Carry out the ecologically sustainable planning and management of the coastal zone.</li> <li>2. Prepare Coastal Zone Management Plans in accordance with the Coastal Protection Act, 1979 including arrangements for the emergency management of coastal erosion.</li> <li>3. Consult with the communities at risk, Coastal Zone Management Committees, DIPNR and other agencies during the development of emergency management arrangements for the management of coastal erosion for inclusion in council Coastal Zone Management Plans and SES Local Flood Plans.</li> <li>4. Establish and maintain Coastal Zone Management Committees to facilitate the development of the Coastal Zone Management Plans and ensure that key agencies are represented on such committees.</li> <li>5. Participate in education campaigns and assist the SES in the development and delivery of educational material to ensure that people in areas potentially threatened by coastal erosion understand the threat and its management.</li> </ol>	<ol style="list-style-type: none"> <li>1. Conduct reconnaissance at coastal erosion trouble spots in consultation with the SES.</li> <li>2. Liaise with the SES Local Controller to determine the need for any response actions by the SES such as evacuation of residents at risk and any support that may be required to carry out these measures as detailed in the Local Flood Plan.</li> <li>3. Liaise with the Engineering Services Functional Area Coordinator (ESFAC) before constructing or allowing the construction of any unapproved physical mitigation works to protect coastal property or other structures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove and/or mitigate the impact of any temporary physical protective measures from the beach.</li> <li>2. Liaise with DIPNR to determine any changes to the coastal zone and any new areas at risk following storms at sea.</li> <li>3. Maintain and review council Coastal Zone Management Plans in consultation with other stakeholders.</li> </ol>

<b>AGENCY RESPONSIBLE</b>	<b>BEFORE THE STORM</b>	<b>DURING THE STORM</b>	<b>AFTER THE STORM</b>
<b>Department of Infrastructure, Planning and Natural Resources (DIPNR)</b>	<ol style="list-style-type: none"> <li>1. Develop and advise on state wide coastal policy, planning and management.</li> <li>2. Provide ongoing advice to local councils and Coastal Zone Management Committees on coast and estuary management including procedures for addressing coastal hazards, coastal processes and risks, management options and coastal policies.</li> <li>3. Provide the SES and councils with advice on likely erosion ‘hotspots’ along the New South Wales coastline.</li> </ol>	<ol style="list-style-type: none"> <li>1. Provide advice and approval to councils regarding the most appropriate methods of dealing with coastal erosion and placement of temporary mitigation measures during storm events, via the Engineering Services Functional Area Coordinator (ESFAC).</li> </ol>	<ol style="list-style-type: none"> <li>1. Liaise with council staff to ensure appropriate remediation of beach and dunes following storm events.</li> <li>2. Provide the SES and council with updates on the current state of the coastal zone and any new areas at risk following a storm event.</li> </ol>
<b>Commonwealth Bureau of Meteorology (BoM)</b>	<ol style="list-style-type: none"> <li>1. Formulate and issue official forecasts and Severe Weather Warnings and provide them to the SES, radio stations and other organisations prior to and during potential and actual coastal erosion events. (Note: Severe Weather Warnings for dangerous surf are issued when onshore waves in the surf zone are expected to reach at least 5 metres within the following 24 hours or when a storm surge of 0.5 metres or greater is anticipated).</li> </ol>	<ol style="list-style-type: none"> <li>1. Formulate and issue official forecasts and Severe Weather Warnings and provide them to the SES, radio stations and other organisations prior to and during potential and actual coastal erosion events.</li> </ol>	

## APPENDIX 2:

### PHYSICAL WORKS OPTIONS FOR COASTAL EROSION EVENTS

The following options are likely to be of particular relevance to the management of emergency situations involving threats to buildings on beaches or dunes:

- *Do nothing*—this option may be appropriate where long-term coastal erosion strategies involve retreat or voluntary purchase, or where the costs of protective works and their likely effects on the environment exceed that of the development at risk.
- *Building relocation*—this is the preferred option for all relocatable structures, and may also be possible for timber structures with raised footings.
- *Sand dumping*—this option involves the addition of beach or dune sand to eroding areas. During an emergency, sand nourishment could be achieved through the dumping or placement of trucked material. This option is likely to be viable only if erosion problems are localised, nearby sand sources can be obtained and the problem areas accessed.
- *Beach scraping*—this option involves shifting sand from the lower to the upper part of the beach face or dune to provide a storm erosion buffer. This would usually be undertaken with a bulldozer at low tide, but may be difficult to undertake during the height of an erosion event. Its benefits may be limited since it does not generally involve the addition of sand from outside of the beach system. However, it may provide minor benefits that are sufficient to avoid property damage. If only part of a beach is treated, the benefit may be at the expense of untreated areas. Where sediment transport processes are dominated by longshore drift, scraping may effectively ‘borrow’ sand from the littoral system, thereby increasing local dune storage levels and lowering the risk to property. However, this is likely to increase down drift recession rates.
- *Geotextile or sand bag structures*—this option involves protection structures constructed from large, sand-filled geotextile containers. These are generally constructed parallel to the shore as seawalls, and can be built from layers of sand-filled geotextile bags or from longer ‘geotubes’. Coastal engineering advice should be sought regarding their design and construction, as well as their potential impacts on beaches and adjacent areas. Construction of these structures is very problematic during the height of a storm event. Impacts of these structures on beach amenity should be mitigated following the event through removal or other action.
- *Rock structures*—seawalls, revetments and other structures can be constructed to limit erosion during storms. Varying rock sizes can be used, although larger material is likely to be more stable and less likely to be transported elsewhere on the beach assisting subsequent removal. Coastal engineering advice should be sought about the design and construction of seawalls as well as their potential impacts on beaches and adjacent areas. Rock structures should only be considered as a last resort and preferably only when incorporated as a future element of a long-term management strategy. Impacts of these structures on beach amenity should be mitigated following the event through removal or other action.

**NOTE:** Prior development approval may be required for physical works options for emergency management in the coastal zone, including those examples listed above.