

COASTAL RISK MANAGEMENT PLAN



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1. SUMMARY

This document provides guidance for developing Coastal Risk Management Plans in the coastal zone. It is designed for managing the risks to specific assets, or discrete local areas where a number of particular assets at risk occur together.

The hazards targeted by this document are coastal flooding and erosion, especially where they are exacerbated due to the impacts of climate change and sea-level rise.

This document provides a simple template of headings for a Coastal Risk Management Plan, and Guidelines for how to develop a plan based on the Template.

The use of the Coastal Template Risk Management Plan in this document will arise *after* an initial Risk Assessment has been undertaken. It is important to have an understanding of the broad range of hazards, and the assets and values at risk in a region, before specific management plans are developed.

The sections in the document are:

Part A: Purpose and Overview

Part B: Coastal Template Risk Management Plan

Part C: Guidelines for using the Coastal Template Risk Management Plan

Part D: References

Wherever possible, risk management plans for individual assets or values should be undertaken in a manner that is consistent with the approaches taken elsewhere by the managing authority. However, where a methodology has not been developed, the following Template and Guidelines will prove useful for undertaking a structured and transparent approach to developing a risk management plan for individual assets or local areas, with clear actions for how risks will be managed and treated into the future.

The Template is structured to follow the Australian and New Zealand Standard for Risk Management, and is guided by the following simple questions:

- What is the risk?
- What is the impact of not treating the risk?
- Should the risk be treated?
- Which treatments to use?

The development of this Template has been designed for dealing with assets and values such as the following, but may be used or adapted for other situations:

- Local Roads;
- Sewage and Waste-Water Plants;
- Community/Public Buildings; and
- Natural Reserves.

Part A

Purpose and Overview

1. INTRODUCTION

This document provides guidance for developing Risk Management Plans in the coastal zone. It is designed to assist with considering risks to specific assets, or discrete local areas where a number of particular assets at risk occur together, and then to identify realistic and effective options for how to respond to those risks.

While it has been confidently established that the world's climate is changing, the magnitude of changes and the full scale of impacts remain unclear. Risk management approaches that use quantitative and/or qualitative techniques and information to describe risks are useful where there is uncertainty about the likelihood of an occurrence, and also in assessing the consequences of such an occurrence.

The coastal zone is particularly vulnerable to the impacts of natural hazards such as **storm surge flooding** and **erosion**.

Storm surge flooding is the result of extremely high sea levels that occur through a combination of low atmospheric pressure, on-shore winds and high tides. Low-lying coastal areas are vulnerable to storm-surge flooding and will experience a more significant level of flooding as a result of rising sea levels.

Erosion is the process of the gradual wearing away of land by water, wind and general weather conditions. Coastal landforms, particularly "soft" shores such as sandy, muddy, clayey and gravelly coasts are mobile and dynamic environments. As such, the normal cut-and-fill erosion cycle of shorelines will tend towards progressive erosion as a result of sea-level rise.

Climate change and sea-level rise will also exacerbate these hazards in ways that will increase damage to assets and values within the coastal zone. DPIW (2008a) provides a desktop analysis of the range of assets and values that could be vulnerable to these hazards during the century.

By employing a risk management approach, authorities responsible for local level planning and management of coastal zones will be able to ensure that the risks posed by climate change and associated sea-level rise are managed appropriately. **Risk** is generally defined as a combination of an exposure to a **hazard**, the **likelihood** of an occurrence, and a **consequence** of that occurrence.

In all risk management planning, it is recommended that an **initial risk assessment** process is undertaken to broadly identify what risks are likely in which areas. Following this initial assessment, detailed planning can be undertaken. This "Template and Guidelines" assumes that the initial risk assessment has occurred and that, now that a discrete asset or value has been identified as being at risk, a **specific risk management plan** is needed to provide a detailed assessment of the risks and assess the appropriate options for dealing with those risks.

The "Template and Guidelines" has been developed to primarily consider the objective that is trying to be maintained; defined as the **Success Criteria**. That is: what 'service' is the asset or value providing? How important is it to the community or environment? How much are we willing to pay to have that 'service' continue, or should we move that 'service' elsewhere – if that is possible?

During the development of a Risk Management Plan, guidance from relevant experts is highly recommended. Asset managers, engineers, coastal geomorphologists and sea-level rise experts will all be able to provide relevant expertise to the development of a soundly based plan.

1.1. PURPOSE

This “Template and Guidelines” has been developed to assist with:

- providing a structure for the development of risk management plans for certain types of assets;
- the process of developing a risk management plan;
- determining appropriate content for risk management plans; and
- assessing options for appropriate treatments of risk.

The “Template and Guidelines” will help with the identification and assessment of appropriate treatment actions for certain classes of assets and values, taking into account local considerations. Once completed, the resulting Risk Management Plan will provide a sound basis for an ongoing program to manage these assets and values in the coastal zone.

Importantly, this structured process allows for the early identification of potential problems so that appropriate risk management responses can be established. It can also be used to frame the assessment process and development of treatment responses. Planning and management authorities can then prioritise those areas most vulnerable to the impacts of climate change and rising sea levels and manage the risks accordingly.

1.2. RISK MANAGEMENT PLANNING

Risk assessment involves a combination of the presence or threat of a hazard to an asset, the likelihood of the hazard occurring, and consequences.

The coastal zone is a dynamic environment. As such, assessing the potential impacts of sea-level rise following hazards such as storm surge-induced flooding and coastal erosion requires a risk management approach that analyses the hazard, estimates the costs and benefits of various treatment options, and then implements and evaluates appropriate responses.

Risk assessment follows a standardised approach as depicted in Figure X.

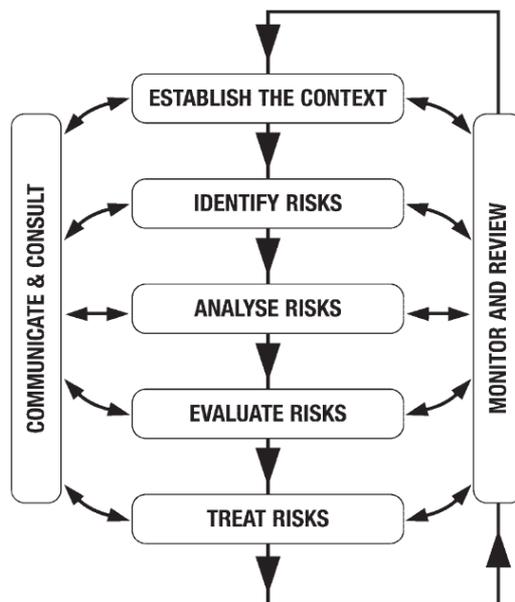


Figure 1.2. The risk management process

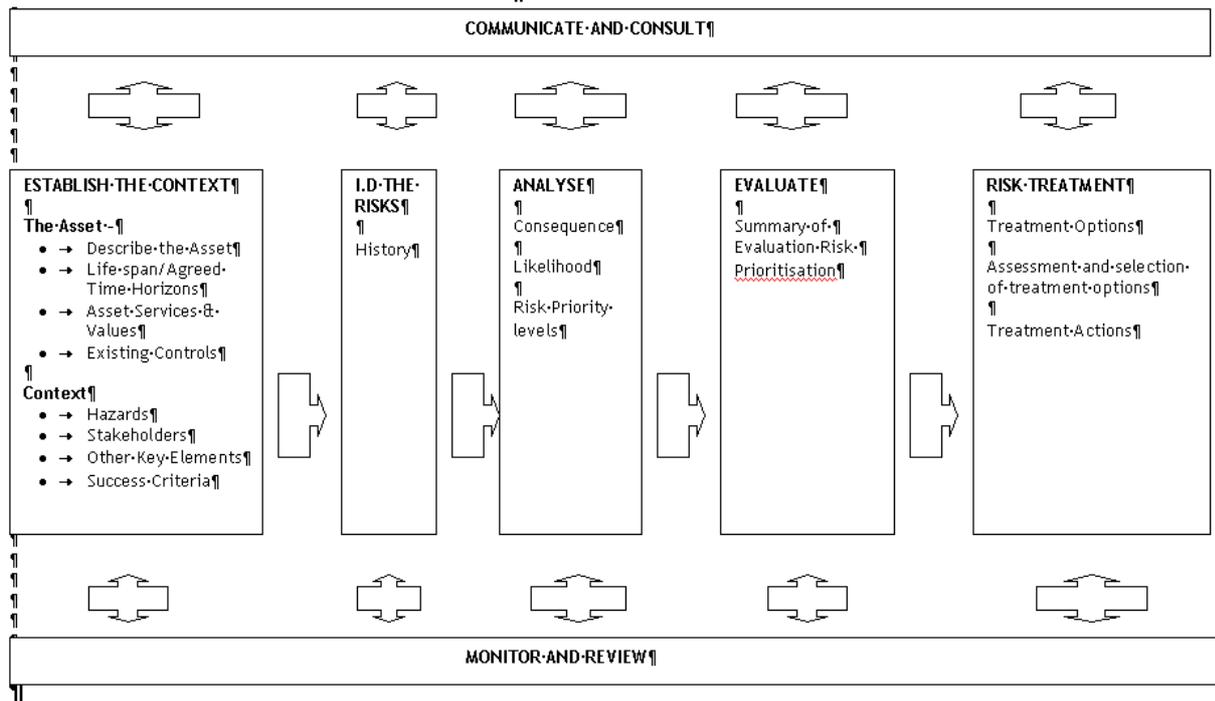
(Source: Emergency Management Australia 2004 *Emergency Management in Australia: Concepts And Principles*).

Risk management builds recognition of risk and uncertainty into decision making, and takes the form of:

- **reduction** (eg. incorporating procedures or design features to limit the consequences of risk);
- **control** (eg. actions taken to avoid risks occurring); and
- **acceptance** (eg. provision of an appropriate allowance in risk management planning costs in case risk arises). (Source: Adapted from DEFRA 2006, *Shoreline management plane guidance Volume 2: Procedures*. Appendix H: Policy appraisal methodology, p2).

THE FOLLOWING FLOW CHART ILLUSTRATES THE RISK MANAGEMENT PROCESS IN GREATER DETAIL AND LINKS THE PROCESS TO THE TEMPLATE.

RISK MANAGEMENT PROCESS FLOWCHART



IN APPLYING THE RISK MANAGEMENT PROCESS TO A LOCATION IT WAS FOUND THAT IT ASSISTED THE UNDERSTANDING OF THE PROCESS TO BREAK IT INTO THREE STEPS;

STEP 1 IS LOCATION FOCUSED AND INVOLVES ESTABLISHING THE CONTEXT, IDENTIFYING THE RISKS AND EVALUATING THE RISKS

- Step 2 is **asset** focused and involves investigating the risk treatment options for each of the individual assets that have been identified within the location as being at risk. At this point individual assessments need to be conducted for each asset.
- Step 3 involves combined evaluations that bring the individual asset risk assessments back into the Template and allows for consideration of these combined risk assessment options to see what coordinated actions might achieve the best risk mitigation for the location.

1.3. BACKGROUND TO THIS TEMPLATE AND GUIDELINES

The "Template and Guidelines" are informed by the Emergency Risk Management Applications Guide Manuals produced by Emergency Management Australia, and *Climate Change Impacts & Risk Management: A Guide for Business and Government* (2006). These publications draw on the Australian Risk Management Standard AAS/NZS 4360:2004 that is used throughout Australia, and has been adopted by both Emergency Management Australia and the Tasmanian State Disaster Committee. It is also informed by the work of the UK Department for Environment, Food and Rural

Affairs (DEFRA) in relation to shoreline risk management planning (see References for further details).

The sections in the “Template and Guidelines” will assist in the development and implementation of an effective and cost efficient Risk Management Plan by following a series of important steps:

1. Asset Description;
2. Targeted hazards;
3. Context (incorporating stakeholders, legislation and policies, other relevant factors and risk evaluation criteria);
4. Identification of risks (historical and future);
5. Analysis of risks;
6. Evaluation criteria; and
7. Risk treatments.

Throughout the development of a Risk Management Plan, it is necessary to ‘**communicate and consult**’, and ‘**monitor and review**’. Undertaken appropriately, in relation to the assets concerned, these components contribute significantly to the success of the risk management process. Key personnel and stakeholders are thus engaged at the outset and understand the need for managing risks associated with climate change.

Communication and consultation contribute to the success of risk management analysis and treatment implementation by:

- Promoting understanding of all stakeholders’ perspectives;
- Ensuring that all stakeholders’ views are considered;
- Clarifying roles and responsibilities;
- Ensuring stakeholders are actively involved in, and contribute to, the decision making process; and
- Providing tangible and qualitative support to the authority implementing the risk management plan.

Monitoring and review keeps analysis and evaluation updated by providing a mechanism for feeding in new information about climate change impacts, tracking progress on actions flowing from the risk management process, and ensuring that the process itself is implemented in a timely and cost-effective fashion.

1.4. TARGETED HAZARDS

The Coastal Template Risk Management Plan is specifically designed to address the impacts of two particular hazards exacerbated by climate change:

1. Coastal flooding – the inundation of low-lying coastal land due to extreme sea levels, often caused by storm surges.
2. Coastal erosion – the gradual wearing away of the shoreline by the sea, wind and general weather conditions.

These types of hazards will be exacerbated by sea-level rise in that coastal flooding will increase, and in most instances, intensification of the normal cut-and-fill coastal erosion processes.

Decisions about the impacts of coastal flooding and erosion should be based on a sound understanding of coastal processes and how they affect existing controls and assets.

Part B

Coastal Template Risk Management Plan

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4.1 Summary of Evaluation Risk Prioritisation

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.RISK TREATMENT

5.1 Risk Evaluation Table for Individual Assets identified as being at risk

5.2 Risk Treatment Options

STEP 3 COMBINED EVALUATIONS

5.3 Assessment and Selection of Treatment Options (bring together individual asset assessments back into Template tables)

5.4. Treatment actions

6. MONITORING AND REVIEW

REVIEW

1. ESTABLISH THE CONTEXT

1.1 Background Assessment

1.1.1 Levels of Risk Assessment Previously Undertaken

Levels of Risk Assessment	Comment
Location has been highlighted as at risk by simply looking at topographic maps	
Area has been highlighted by previous report	
Risk determined by site visit	
Calculations of projected Still water sea levels	
Assessment of extreme tide events	
Detailed storm surge and wind wave calculations	

1.2 The Asset

1.2.1 Asset Description

	Description
Name of asset:	
Asset life*	
Location	
Topography	
Geomorphology	

1.2.2 Notional Life Span and Agreed Time Horizon

The notional life span of the asset is <number of years> years.

The Agreed Time Horizon for assessment is to the year <insert year>.

1.2.3 Asset Services and Values

Table 1.2.3. Values of the Asset

Value	Specific Issues	Who benefits?	Importance
Economic			
Social/Cultural/ Historical			
Political			
Environmental			

1.2.4 Existing Controls

TABLE 1.2.4: HAZARD AND CONTROLS

Hazard	Existing key control measures
Coastal flooding	
Coastal erosion	

1.3 CONTEXT

1.3.1 Hazards

The Hazards targeted by this Risk Management Plan are coastal flooding and erosion, and the way they are exacerbated by climate change and sea-level rise.

1.3.2 Stakeholders

Table 1.3.2: Relevant Stakeholders, their roles, motivations, and levels of engagement.

Stakeholder	Role	Motivation or Concern	Engagement

1.3.3 Other Key Elements

Table 1.3.3(a): Relevant Legislation

Statute	Level	Relevance

Table 1.3.3(b): Relevant Policies

Policy	Level	Relevance

1.3.4 Success Criteria

The successful management of this asset will require the following key objectives to be met: Refer to Section 2.4 of the Guidelines

2. WHAT IS THE RISK?

IDENTIFY

2.1 History

Table 2.1 Summary of relevant historical events

Date	Event	Description	Source

2.2 Future Vulnerability

3. WHAT IS THE IMPACT OF NOT TREATING THE RISK?

ANALYSE

3.1 Consequence

Table 3.1 Consequences of not achieving Success Criteria

Success Criteria	Consequences (summary)	Consequence rating

3.2 Likelihood

Table 3.2 Likelihood of not achieving Success Criteria

Success Criteria	Current Risk Priority Level	Future Risk Priority Level

3.3 Risk priority levels

Table 3.3. Risk Prioritisation.

Success Criteria	Current Risk Priority Level	Future Risk Priority Level

4. SHOULD THE RISK BE TREATED?

EVALUATE

4.1 Summary of Evaluation Risk Prioritisation

Table 4.1 Summary of the Evaluation of Risk Prioritisation

Success Criteria	Risk level severity	Importance	Urgency	Timeframe for treatment

5. WHICH RISK TREATMENTS TO USE?

RISK TREATMENT

5.1 Risk Evaluation for Individual Assets identified as being at risk

Having completed the Template to this point, an understanding of what assets are most at risk is now possible. At this point those assets most at risk need to be assessed individually in terms of their level of risk. To assess each of the assets individually the following Table should be completed for each asset. The most appropriate mitigation option for reducing the risk to the each of the identified asset should then be taken and used to populate the remaining Tables in the Risk Treatment section of the Template.

Table 5.1 Risk Evaluation Table for Individual Assets identified as being At Risk

Identified Asset	
Location	
Asset Description	
Key Stakeholders	
Estimate of Asset Value	
Community Benefit	
Risk Analysis Event	
Consequence	
Likelihood	
Consequences	<i>Public Safety – Local Growth/Economic – Community and Lifestyle – Environment – Public Administration –</i>
Overall Consequence Rating	
Risk Rating	<i>Calculate from likelihood and consequence assessment</i>
Risk Management Strategies	
Lower Likelihood by:	a) b) c)
Lower Consequence by	
Recommended Treatment Options	

The Guidelines, in section 6.2 suggest additional criteria that could be used for Assessing Treatment Options for various assets. The relevance of them will depend on the asset in question.

5.2 Treatment Options

Table 5.2. Risk Treatment Options

No.	Title	Description
1.		
2.		
3.		

Step 3 Combined Evaluations

5.3 Assessment and Selection of Treatment Options

Table 5.3(a): Assessment of potential Treatment options (Note: add additional columns if required)

Criteria	Option 1	Option 2	Option 3	Option 4

Table 5.3(b). Selected Options and reasons.

No.	Selected Option Title	Reason for selection

5.4 Treatment Actions

Table 5.4: Treatment Actions to be implemented

Action	Responsibility	Timeframe	Resources	Review

6. MONITORING AND REVIEW

Part C

Guidelines for using the

Coastal Template Risk Management Plan

1. THE ASSET

1.1. Asset Description

To ensure it is clear what or where the risk management will apply, it is important to define the specific asset or area being considered.

	Description
Name of asset:	<i>Eg Community sports facility</i>
Location	<i>Insert location description, street name or map if appropriate</i>
Topography	<i>Note the features of the area in which the asset is located eg. Is it low-lying? Are there dunes? Is it an open coast or sheltered bay?</i>
Geomorphology	<i>Note the features of the area and shoreline in which the asset is located: Is bedrock present? Are there surface deposits eg sand dunes, gravel, clay areas?</i>

If developing a plan for a broader area, or grouping of assets, describe the total area/collection in this section.

1.2. Notional Life Span and Agreed Time Horizon

It is important to consider the notional life span of the asset for which it is expected to function without any changes to its form, function or service. This provides a guide on how far into the future changes in the climate need to be considered.

For example, if a structure has another 30 years of notional life before major re-development would be expected, then its ability to provide the necessary level of service should be considered in terms of the climate, and especially sea-levels, throughout that time.

For the purposes of the development of a Risk Management Plan, a time horizon should be chosen to allow consideration of the value of the asset still providing the necessary level of service. This then becomes the "Agreed Time Horizon".

1.3. Asset Services and Values

Describe the 'services' and values of the asset, including specific issues, benefits and importance. Consideration should also include the relative importance of the asset. This could include national, state or local significance.

Specific issues might include:

Economic:

- Provides local employment
- Provides essential services
- Provides transport services
- Tourist drawcard
- Seasonal population

Social/cultural/historical:

- Historical asset
- Strong community attachment

Environmental:

- Rare/threatened flora, fauna and/or habitats
- Rehabilitation site
- Important geomorphic features

Political:

- Government/community partnerships
- Funding programmes
- Policy initiatives

In providing the 'service', most assets have a combination of economic, social, political and/or cultural values. An example is a sports venue (ground, stands, club rooms, bar facilities etc) that has recently been refurbished, with construction co-funded by state government and local community fundraising, and which is home to a football team with a strong and long local history. Table 1.3 below provides an example.

Table 1.3. Values of the Asset

Value	Specific Issues	Who benefits?	Importance
Economic	Provides local employment Draws extra \$ to area when home team hosts games.	Individual residents. Local community	Employs 4 FT and 8 PT local staff.
Social/Cultural/ Historical	Football team formed in 1897, and construction of original oval, stands and club rooms completed in 1912. National heritage listed.	Local community. National heritage. Visitors.	Construction largely done by local volunteers. Weekend focal point for locals and visitors. Strong social capital.
Political	Election platform promise. High media profile when state funding announced, local community access to media outlets during campaign to access public funding.	Local community. Local council. State government.	\$200,000 in community fundraising. \$200,000 in state funding. Service upgrades provided by local council.
Environmental	Maintains local landscape quality	Local fauna. Local community.	Migratory shore birds use area to feed when area not in use.

1.4. Existing controls

It is necessary to consider the range of controls currently in place to reduce the hazards of flooding and erosion, including natural defences such as dunes or heavily vegetated areas. Only measures that are already in place or committed and require no further action can be claimed as controls. Measures that might be taken to treat risks in the future cannot be assumed to be controls.

The 'life' of existing control measures also needs to be taken into account. For example, while a sea wall exists, it may be entering the final phase of its asset life and will be of limited utility as a control measure. Likewise, the condition of waterproof wiring will need to be examined and evaluated in order to determine both its efficacy and contribution to risk management now and in the future.

TABLE 1.4 HAZARD AND CONTROLS

Hazard	Existing key control measures
Coastal flooding	<i>Examples may include:</i> <ul style="list-style-type: none"> • sea walls; • dunes; • development controls; • planning scheme provisions, for example, setbacks; • evacuation plans; or • protected utilities, for example waterproof wiring.
Coastal erosion	<i>Examples may include:</i> <ul style="list-style-type: none"> • sea walls, • dunes; • development controls; • planning scheme provisions; • erosion control planting; • artificial reefs; • groynes • breakwaters; or • shoreline recession monitoring and reporting.

2. CONTEXT

The context for risk management establishes a framework for identifying and analysing risks. It provides a solid foundation on which to build the risk management process. It enables everyone to commence from a common understanding of the scope of the exercise, how risks are rated and how to approach the analysis. Establishing the context assists in identifying and assessing treatment options later in the risk management process.

A crucial step in establishing the context is determining what objectives the asset is providing. The success of a risk management plan will be determined by whether the asset continues to provide the 'service' it is currently providing. By setting "Success Criteria" (Section 2.4 below), it will be possible to evaluate the risks, and the "costs" of treatment options to enable decisions to be made about what treatment options (if any) will be effective in ensuring the asset continues to provide the 'service'. The success criteria can therefore be considered a threshold between a continuation of an acceptable level of 'service', and an unacceptable level of risk.

2.1. Hazards

The Template has been designed for the hazards of coastal flooding and erosion, especially where they will be exacerbated by climate change and sea-level rise. However, both these hazards may not occur together, or a different hazard may also need to be addressed in the Risk Management Plan.

This section allows for the specific recognition of which hazards are being addressed. A statement should be included such as:

"The hazards covered in this Plan are *coastal erosion and flooding*."

2.2. Stakeholders

It is important to engage stakeholders and define their involvement at the outset of the Risk Management Plan development process, especially when developing risk evaluation criteria. Community viewpoints and values should be reflected when developing criteria, and valuable local and regional knowledge bases and information can be drawn on and incorporated. By engaging with stakeholders at all phases of the Risk Management Plan, a sense of shared responsibility is engendered.

Stakeholders are individuals, groups or organisations whom need to be taken into account in order to achieve a successful outcome for the risk management process. List stakeholders with a short summary of their roles, motivations, concerns, and levels of engagement in relation to the risk management planning process. Stakeholder groups should have an endorsed representative who is able to act on their behalf. It is recommended that broad groups of stakeholders be identified initially, rather than small groups of individuals, and that stakeholders with the same or similar motivations be grouped together.

Stakeholder groups might include:

- local communities
- community or care groups
- emergency management agencies
- emergency service organisations
- essential services
- Local, State and/or Commonwealth governments
- science organisations
- industry/business
- industry/business associations
- Insurers
- Others

Table 2.2: Example of Relevant Stakeholders, their roles, motivations, and levels of engagement.

Stakeholder	Role	Motivation or Concern	Engagement eg liaison, regular reporting, information to raise awareness.
<i>Local Coast Care Association</i>	<i>Caring for the coast on a volunteer basis.</i>	<i>Dune restoration and shore protection – protecting local natural values and assets</i>	<i>Excellent knowledge of local geomorphology; awareness raising; communication networks.</i>
<i>Local Volunteer Emergency Service</i>	<i>Emergency services</i>	<i>Protecting community interests and safety, including people and economic values and assets</i>	<i>Trained in emergency services; vehicle availability; communication networks</i>
<i>Coastal Tourism Business Association</i>	<i>Ensuring viability of local tourism</i>	<i>Protecting viability of local tourism, assets, and values that attract tourists to area. Maintenance of employment</i>	<i>Providing alternative means of accommodation in the event of an extreme event; communication networks.</i>
<i>Local Council</i>	<i>Ensuring effective functioning & maintenance of council-provided essential goods, services, assets and values within jurisdiction.</i>	<i>Protecting local goods, services, assets and values within jurisdiction</i>	<i>RMP expertise; communication networks; integral part of essential services governance structure</i>
<i>Local RSL/Football Club</i>	<i>Maintenance of local football ground and rooms</i>	<i>Protecting local football ground and rooms; protecting source of social networking and social capital</i>	<i>Source for volunteers; communication networks; alternative means of shelter in case of extreme event</i>

2.3. Other Key Elements

Other key elements to take into consideration are existing legislation and policies that have a bearing on the asset and the risk management planning process. Describe their relevance and how they can inform, complement or enhance the risk management plan.

TABLE 2.3(A) RELEVANT LEGISLATION

Statute	Level (i.e State or Cwlth)	Relevance
<i>Eg. Threatened Species Protection Act</i>	State	• •
<i>Eg. Environment Protection and Biodiversity Conservation Act 1999</i>	Cwlth	• •
EG. WEST TAMAR PLANNING SCHEME (9 AUGUST 2005):¹ S4.4 EXCAVATION AND FILLING DOES NOT: <i>c) increase run-off characteristics for storm events up to at least the 1 in 5 year design storm;</i>		• •

¹ This example drawn from “Background Report: Coastal Flooding: Review of the use of Exceedance Statistics in Tasmania”. V4 (part of *Coastal Hazards in Tasmania – General Information Paper* June 2008 confidential draft from DPIW).

TABLE 2.3(B) RELEVANT POLICIES

Policy	Level (i.e Local, State or Cwth)	Relevance
<i>Eg. Local Government Policy not to allow development in a flood-prone coastal area</i>	Local	• •
<i>Eg Tasmania Together Goals 11 & 12</i>	State	• •
	Local	•

2.4. Success Criteria

If your organisation already has a risk management framework, use it or stay as close to it as possible so that the output of analysis is comparable with other risk assessments carried out.

The objectives of the Risk Management Plan will be achieved by meeting certain criteria for success. **Success criteria** summarise the objectives of stakeholders, and should be developed by consulting with stakeholders. It is recommended, however, that they be limited to no more than six ‘themes’ – for example, economy, infrastructure, environment and social – to keep the Risk Management Plan process streamlined and achievable (Department of Climate Change 2006, 38).

The Success Criteria should be developed to reflect the services and values being provided. The Success Criteria also provide a statement of a risk ‘threshold’ that will be used later in the Risk Management Plan process to assess whether risks are tolerable, or if they need to be treated in some way.

For instance, broad success criteria for a managing authority might be:

- Maintenance of public safety
 - Protection and enhancement of the local economy
 - Protection of critical infrastructure (eg. roads, sewerage treatment plants)
 - Protection of existing community structures and the lifestyle enjoyed by people in the region
 - Sustaining and enhancing natural environmental values/conservation values/threatened species
 - Ensuring sound public administration and governance
- (Department of Climate Change 2006, p.33).

The Success Criteria may also be quite specific, for example:

- Preventing damage to sewage pipes from an eroding shoreline.
- Ensuring continued operation of pumping stations feeding the Sewage Treatment Plant.
- Flooding and erosion will not stop the normal operation of the Sewage Treatment Plant.
- Ensuring roads will be passable by an Emergency Service vehicle at all times.
- Damage to the road from flooding and/or erosion will not exceed \$10,000 in a 12-month period.
- The local community will not be isolated due to unusable roads for any longer than 6 hours.
- Ensuring that if there is flooding of Community/public buildings, then:
 - There must be adequate warning mechanisms to allow personnel and significant equipment to be evacuated;
 - Flooding must not cause structural damage;
 - The period for which the facility is not useable will not exceed 5 days; and
 - If the building is a designated Evacuation Centre, then alternative locations/options are available.
- Loss of natural values will not exceed <threshold value eg the national average>.
- Public infrastructure on the reserve will not be damaged by flooding and/or erosion (eg picnic facilities)
 - Conservation status of threatened species or communities will not deteriorate.

As the Success Criteria are used through the Coastal Risk Management Plan as a basis for the various assessments, it is important to have these as clear as possible. They may also need to be revisited during the development of the Coastal Risk Management Plan to ensure they do provide a suitable and effective means for assessment.

An example of possible Success Criteria might be:

The successful management of this asset will require the following key objectives to be met:

- *Community facilities such as walking tracks, picnic areas and recreational space to be inundated for no more than 3 days a year.*
- *Football oval to be inundated no more frequently than once a year for no longer than six hours (to allow grass to recover from saline inundation).*
- *Public roads to be inundated for no more than 2 hours, only once a year or less;*
- *Community Hall floor level to remain 300mm above the 100 year ARI (1% AEP) for the remainder of its life span.*
- *Sewerage pump station has emergency spills due to inundation or water ingress from rising ground water level, less than once every 10 years for life span of asset,*
- *Community housing floor levels to remain 300mm above the 100 year ARI (1% AEP) for the asset life.*
- *Environmental assets maintained for time horizon of study (defined as to 2050), and specifically the beach is maintained for its current purposes for the time horizon of the study.*

3. IDENTIFY

The Identification stage establishes:

- What has happened (history); and
- What might happen over the agreed time horizon.

The section considers where past events and problems in the location have occurred, and future vulnerability briefly examined. This is addressing the ‘when, where, how and why’ of the situation. The knowledge of locals and experts will be particularly important in this section.

3.1. History

Collate evidence of coastal flooding and/or erosion affecting the asset (or the area) using evidence and information gathered from a range of sources including:

- scientific data and research;
- historical records and accounts of past events (including photographic records and newspaper articles);
- Council records; and
- Local community knowledge and anecdotal evidence.

Table 3.1 Summary of relevant historical events

Date	event	description	source

3.2. Future Vulnerability

It is necessary to define how climate is projected to change in the future in order to manage the risks of climate change. This can be achieved through the use of **climate change scenarios**.

A climate change scenario is described as:

A coherent, plausible but often simplified description of a possible future state of the climate. A climate scenario should not be viewed as a prediction of the future climate. Rather it provides a means of understanding the potential impacts of climate change, and identifying the potential risks and opportunities to an organisation created by an uncertain future climate. A 'climate change scenario' can be defined as the difference between a climate scenario and the current climate (Department of Climate Change 2006, p.70).

It is not necessary, nor is it practical, to attempt to appraise all possible scenarios or potential combinations. Rather, the scenarios should be tailored to gain maximum understanding of the implications of coastal flooding and erosion hazards across the agreed time horizon (DEFRA 2006, Vol. 2, p.51). Information and data for defining scenarios across the agreed time horizon can be found through numerous sources including:

- DPIW (2008b) Summary and Practical Guide for Planners and Managers
- Hunter, J.R. (2007) "Historical and Projected Sea-Level Extremes". Published by the Department of Primary Industries and Water, Tasmania. (see www.dpiw.tas.gov.au/climatechange)
- Sharples, C. (2006), Indicative Mapping of Tasmanian Coastal Vulnerability to Climate Change and Sea-Level Rise: Explanatory Report 2nd Edition.
- Climate Futures for Tasmania (see www.acecrc.org.au)
- Climate Change in Australia (see www.climatechangeinaustralia.gov.au)
- CSIRO Marine & Atmospheric Research: (see www.cmar.csiro.au)
- National Tidal Centre, Bureau of Meteorology (see www.bom.gov.au/oceanography/tides)

Based on the patterns and cycles identified through the historical analysis, and the projections of the future climate for the agreed time horizon, identify the likely vulnerability of the asset.

When detailing future vulnerability, make a list of potential changes to the hazard(s), or sources of risk, such as:

- likely future sea-levels for the timeframes relevant to this asset (eg from IPCC 2007);
- relevant probabilities for extreme sea-level events (eg from DPIW 2008b and Hunter 2008); and
- relevant understanding of wave conditions (where known).

Also:

- outline the probable impact that increased flooding will have on the asset;
- outline the probable impact that increased erosion will have on the asset; and
- outline the impact of these changes on the asset.

4. ANALYSE

In this section, the impact of not achieving the Success Criteria is considered. This is done through three components:

- A scale to describe the level of consequence of a risk if it should happen;
- A scale to describe the likelihood of suffering that level of consequence; and
- A means of assigning a priority rating, given this consequence and likelihood.

Each Success Criterion is assessed against the consequences of that 'threshold' being exceeded, and against the likelihood of that exceedance occurring. **Once the consequences and likelihood have been determined, then a risk prioritisation level can be determined.** Doing this helps guide the development of treatments to the areas of greatest need.

There are four levels of Risk Priority.

- **Extreme** risks demand urgent attention at the most senior level and cannot be simply accepted as part of routine operations without executive sanction.

- **High** risks are the most severe that can be accepted as a part of routine operations without executive sanction but they will be the responsibility of the most senior operational management and reported upon at the executive level.
- **Medium** risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action, maintained under review and reported upon at senior management level.
- **Low** risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.

Source: Adapted from Commonwealth of Australia, 2006: Climate Change Impact and Risk Management – A Guide for Business and Government

4.1. Consequence

Using a categorisation that is appropriate for the managing authority and asset, the consequences of exceeding the threshold as stated in each Success Criterion need to be assessed. The consequence rating can be summarised in a table such as the following (Table X). The details of the consequences scales are given below.

Table 4.1(a) Consequences of not achieving Success Criteria

Success Criteria	Consequences (summary)	Consequence rating

The consequence of not achieving the Success Criteria are assessed using criteria such a those in the following table, which are focussed on requirements of local governments (Table X).

Table 4.1(b): Example of a consequence scales for a local authority

Consequence Rating	Public Safety	Local growth and economy	Community and Lifestyle	Environment & sustainability	Public administration
Catastrophic	Large numbers of serious injuries or loss of lives	Local decline leading to business failure, loss of employment, local hardship	Local area seen as very unattractive, significant decline, and unable to support community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public administration would fail and cease to be effective
<i>Major</i>	Isolated instances of serious injuries or loss of lives	Local stagnation such that businesses unable to thrive and imbalance between employment and local population growth	Severe and widespread decline in services and quality of life within community	Severe loss of environmental amenity and a danger of continuing environmental damage	Public administration would struggle to remain effective and would be perceived as being in danger of failing completely
<i>Moderate</i>	Small number of injuries	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under significant pressure on numerous fronts
<i>Minor</i>	Serious near misses or minor injuries	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of public administration being under significant pressure

Table 4.1(b): Example of a consequence scales for a local authority cont.

Consequence Rating	Public Safety	Local growth and economy	Community and Lifestyle	Environment & sustainability	Public administration
Insignificant	Appearance of threat by no actual harm	Minor shortfall relative to current forecasts	There would be minor areas in which the region was unable to maintain is current services	No environmental damage	There would be some minor instances of public administration being under more than usual stress but it could be managed

Adapted from “Climate Change Impacts & Risk Management: A Guide for Business and Government” (DCC 2006).

A generic categorisation used in the Australian emergency management framework is provided in Table 4.1(c) .

Table 4.1(c): General consequence scale

Insignificant	No injuries or fatalities. No displacement of people or displacement of only a small number of people for short duration. Little or no personal support required (support not monetary or material). Inconsequential or no damage. Little or no disruption to community. No measurable impact on environment. Little or no financial loss.
Minor	Small number of injuries but no fatalities. First aid treatment required. Some displacement of people (less than 24 hours). Some personal support required. Some damage. Some disruption (less than 24 hours). Small impact on environment with no lasting effects. Some financial loss.
Moderate	Medical treatment required but no fatalities. Some hospitalisation. Localised displacement of people who return within 24 hours. Personal support satisfied through local arrangements. Localised damage that is rectified by routine arrangements. Normal community functioning with some inconvenience. Some impact on environment with no long-term effect or small impact on environment with long-term effect. Significant financial loss.
Major	Extensive injuries, significant hospitalisation, large number displaced (more than 24 hours duration). Fatalities. External resources required for personal support. Significant damage that requires external resources. Community only partially functioning, some services unavailable. Some impact on environment with long-term effects. Significant financial loss - some financial assistance required.
Catastrophic	Large number of severe injuries. Extended and large numbers requiring hospitalisation. General and widespread displacement for extended duration. Significant fatalities. Extensive personal support. Extensive damage. Community unable to function without significant support. Significant impact on environment and/or permanent damage.

Source: Commonwealth of Australia, 2004: Emergency Management Australia – Emergency Risk Management Applications Guide Manual 5

4.2. Likelihood

While the consequence of failure to meet a particular Success Criterion may be very severe, the chance of that actually occurring may be extremely low. There is also the consideration that the conditions in which the asset currently exists may not be the same throughout the asset’s operational lifespan into the future. Sea-level rise and other climate change impacts require consideration of the conditions in which the asset will exist in the future.

Therefore the chances of failure to meet the Success Criteria are assessed using an understanding of the frequency of such extreme events, which are sometimes known as exceedance statistics (see DPIW (2008b) and Hunter (2008)).

The Success Criteria provide a statement of the threshold up to which risk can be tolerated, but beyond which the level of service required will fail. With a changing climate, the chance of exceeding the threshold as given by a Success Criterion needs to be considered – both under current conditions, and in the future for the agreed time horizon. If the agreed time horizon is still some decades away, the conditions for one or more time points in between may assist with the development of practical management programs.

The likelihood rating can be summarised in a table such as the following (Table X)

Table 4.2(a) Likelihood of exceeding Success Criteria

Success Criteria	Current Risk Priority Level	Future Risk Priority Level

A potential source of confusion that needs to be considered is how repeatedly the hazard might occur. While some hazards are events that occur only once, such as extinction of an endangered plant, animal species or loss of habitat, others make more sense when considered as recurring events, for example, structural damage to a community building that increases through time from repeated severe coastal flooding or erosion.

Information on the frequency of extreme sea-level events in Tasmania is given in DPIW (2008b) and Hunter (2008). These provide quantitative probabilities of likelihood, and emphasise that it is generally current practice to utilise the “annual exceedance probability” (AEP). This is the chance that an event will occur at least once in any one year. It should be noted though that the information in DPIW (2008b) and Hunter (2008) relate to still water conditions, so further information on the impact of waves in the local area may need to be sought.

Where quantitative data is not available, a more qualitative scale such as the one below can be used to rate the likelihood of both single and recurrent events (Table X). The time scale used should be comparable with the time horizon agreed at the outset of the Risk Management Plan process.

Table 4.2(b). Likelihood scale for single and recurrent events

<i>Rating</i>	<i>Recurrent risks</i>	<i>Single events</i>
ALMOST CERTAIN	Could occur several times per year	More likely than not - Probability > 50%
Likely	May occur once per year	As likely as not - 50/50 chance
Possible	May occur once in ten years	Less likely than not but still appreciable - Probability < 50% but still quite high
Unlikely	May occur once in 10 to 25 years	Unlikely but not negligible - Probability low but noticeably greater than zero
Rare	Unlikely during next 25 years	Negligible - Probability very small, close to zero

(Adapted from Department of Climate Change 2006, 39)

A more generic scale used in the Australian emergency management framework is provided in Table 4.2(c).

Table 4.2(c): Likelihood scale

almost certain	Is expected to occur in most circumstances; and/or there is a high level of recorded incidents; and/or strong anecdotal evidence; and/or a strong likelihood the event will recur; and/ or great opportunity, reason, or means to occur; may occur once every year or more
Likely	Will probably occur in most circumstances; and/or regular recorded incidents and strong anecdotal evidence; and/or considerable opportunity, reason or means to occur; may occur once every five years
Possible	May occur at some time; and/or few, infrequent or randomly recorded incidents or little anecdotal evidence; and/or very few incidents in associated or comparable organisations, facilities or communities; and/or some opportunity, reason or means to occur; may occur once every 20 years
Unlikely	Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or no recent incidents in associated organisations, facilities or communities; and/or little opportunity, reason or means to occur; may occur once every 100 years
Rare	May occur only in exceptional circumstances; may occur once every 500 or more years

Source: Commonwealth of Australia, 2004: Emergency Management Australia – Emergency Risk Management Applications Guide Manual 5

4.3. Risk priority levels

The following matrix (Table 4.3) determines the level of risk (the Risk Priority Level) based on the consequence and likelihood ratings. Depending on the particulars of the situation, it may be appropriate to modify the risk levels in the Table, which provides an example of a typical prioritisation of risk.

As described earlier, each level is categorised by the following features:

- **Extreme** risks demand urgent attention at the most senior level and cannot be simply accepted as part of routine operations without executive sanction.
- **High** risks are the most severe that can be accepted as a part of routine operations without executive sanction but they will be the responsibility of the most senior operational management and reported upon at the executive level.
- **Medium** risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action, maintained under review and reported upon at senior management level.
- **Low** risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.

Source: Adapted from Commonwealth of Australia, 2006: Climate Change Impact and Risk Management – A Guide for Business and Government

It should be noted that the most common pitfall in defining the priority matrix is to make the *Extreme* region too large and the *Low* region too small. Create a few examples of risk to test the scales, and if in doubt, err on the side of making the Extreme and High regions of the matrix smaller rather than larger. It is likely that severe risks that have been understated will be picked up in the review at the end, whereas it is often more difficult to downgrade risks that are overstated (DCC 2006, p.40–41). It is also important to document the source of the information (quantitative and/or qualitative) used to estimate the level of risk, for instance, engineering quantitative data, long-held community knowledge, or anecdotal evidence.

Table 4.3(a). Risk Priority Level Matrix

Likelihood (L)	Consequences (C)				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	MEDIUM	medium	high	extreme	extreme
Likely	low	medium	high	high	extreme
Possible	low	medium	medium	high	high
Unlikely	low	low	medium	medium	medium
Rare	low	low	low	low	medium

Adapted from DCC 2006, 40.

Using this matrix, a risk priority can be assigned for each Success Criterion for current and future conditions (Table 4.3(b)).

Table 4.3(b). Risk Prioritisation.

Success Criteria	Current Risk Priority Level	Future Risk Priority Level

5. EVALUATE

The previous section assessed the level of risk that the key objectives (the Success Criteria) of the asset would not be met.

This section considers how urgently the risks need to be dealt with, particularly in terms of the changing risk profile through time. Determining the importance and urgency helps guide the development of treatment options (in the next section).

As an example, a risk that is rated under current conditions as low or medium may not need to be dealt with immediately. However, if the risk was to reach high or extreme levels before the end of the agreed time horizon, then evaluating the importance and urgency of the risk will allow for consideration of when treatment of the risks needs to be undertaken. Does treatment of the risk need to be undertaken now (ie it is important but not yet urgent)? Can planning be started now, but no action need to be taken for many years?

For each Success Criteria, consider:

- how severe the risk priority level is and will become?
- how important it is to maintain the level set by the Success Criteria?
- how urgent treatment is to ensure the Success Criteria are maintained?
- and therefore over what timeframe do treatments need to be taken?

The table such as the following (Table 5) may assist in summarising the evaluation.

Table 5 Summary of the Evaluation of Risk Prioritisation

Success Criteria	Risk Priority Level (current and future)	Importance	Urgency	timeframe for treatment

As with the other sections, regularly monitoring and reviewing the evaluation is important to ensure that the risks being considered and dealt with, or not being dealt with immediately, remain appropriate. In addition, consideration may need to be given to whether there is a particular threshold, or trigger, that would mean that further investigation is required to better clarify the risks being faced. This may include a better consideration of consequences, a more detailed analysis of likelihood, or a re-consideration of the importance, urgency or timeframe for response.

6. RISK TREATMENT

This section identifies possible treatment options to ensure the Success Criteria will continue to be met throughout the agreed time horizon. It assists with the evaluation of each treatment option for effectiveness, and recognises that not all risks can be treated effectively.

When identifying treatment options, legal, social, political and economic issues need to be considered, especially in relation to the allocation of resources for reducing risk.

The AS/NZS Standard 4360:2004 outlines general principles that can be used to assist with the identification of effective treatment options. These are:

- **avoid the risk:** decide not to proceed with the activity likely to generate the risk
- **reduce the likelihood of harmful consequences occurring:** by modifying the source of risk
- **reduce the consequences occurring:** by modifying susceptibility and/or increasing resilience
- **transfer the risk:** cause another party to share or bear the risk
- **diffuse the risk:** involve several parties in sharing or bearing the risk
- **retain the risk:** accept the risk and plan to manage its consequences

In applying these principles, there are a number of considerations that should also be considered (adapted from Department of Climate Change 2006, pp.50–51):

1. Achieve balance between climate and non-climate risks – the risk treatment process itself is not risk free.
2. Manage priority climate change risks – focus on higher priority risks. This is a statement of the general rule necessary to set priorities for the allocation of management attention and resources.
3. Use adaptive management – put in small, incremental changes based on regular monitoring and revision of plans, rather than developing isolated, large-scale, one-off treatments.

4. Look for win-win or no-regrets treatment options – measures that embrace the targeted hazard while also incorporating other environmental, social or economic benefits.
5. Avoid decisions that constrain adaptation – plan to manage for future climate change hazards. An example of an ‘adaptation constraining decision’ is permitting a development in an area that will be prone to coastal flooding.
6. Review and monitor – make it second nature!

Assessment of risk treatment options involves cost/benefit analysis, with an appropriate degree of formality. It is critical that the risk owner, or person likely to be responsible for risk treatment, is involved throughout the process. In addition to addressing political, social, economic and environmental factors at this stage, it may also be necessary to refer to state/territory policies relating to environmental risk management.

Underpinning the risk treatment phase is the need to develop a strategic yet flexible plan premised on cooperation, collaboration and effective corporate governance, the latter drawing on existing management structures and emergency management options.

Note that for significant risks, formal and detailed cost benefit analyses or other techniques may be required to assess treatment options (eg general equilibrium analysis or multi-criterion decision analysis methodologies). Selecting an appropriate method will depend on the particulars of the situation, so has not been addressed here.

6.1. Treatment Options

Based on the principles and considerations noted above, the range of treatment options should be listed. Consideration should be given to all possibilities, whether they be small or large, short or long term, or even regulatory in nature. It may even be necessary to undertake further studies to be able to examine what some of the options are. For example: is a rock sea-wall technically possible? Can foundations be waterproofed or will seepage occur anyway? Are flood defences worth it if the ground is highly vulnerable to erosion and is likely to be eroded away? Are there other sites to go to allowing withdrawal from the vulnerable area? Can the asset be picked up and moved?

Treatment options may also need to consider just monitoring and reviewing initially, with a plan to undertake further work in the future. The review could be planned for a certain time, or arise from a particular trigger or threshold event. If such approaches are to be included, then they should be considered in the context of the local/regional/etc importance and/or the risk priority levels.

A table such as Table 6.1 may assist in outlining the range of options available.

Table 6.1. Risk Treatment Options

No.	Title	Description	How it will help
1.			
2.			
3.			

6.2. Assessment and Selection of Treatment Options

At this point each asset needs to be put into a table outside of the Template and options for that asset considered against a range of criteria as indicated. Not all of these criteria will always be required to be considered: A possible Table based on the analysis conducted for a pump station is as follows:

Table 6.2(a) Risk Evaluation Table for Individual Assets

Identified Asset	<i>eg Pump Station</i>
Location	
Asset Description	
Key Stakeholders	
Estimate of Asset Value	
COMMUNITY BENEFIT	
Risk Analysis Event <i>Consequence</i> <i>Likelihood</i>	
Consequences	
Overall Consequence Rating	
Risk Rating	
Risk Management Strategies	
Lower Likelihood by:	
Lower Consequence by	
Recommended Treatment Options	<i>eg. bund the pump station</i>
Revise risk rating	

Each individual asset that has been identified as at risk within the location in question should be assessed and the highest priority management options identified. These priority management options then need to be assessed against relevant criteria to determine the most appropriate option, or combination of options.

Table 6.2(b) provides a range of criteria that may be used to assess the treatment options, while Table 6.2(c) provides a means for summarising the issues. This allows a comparison of the options, and a decision to be made on the most appropriate option(s).

Table 6.2(b): Suggested criteria for assessing suitability of potential treatment options

Criteria	Questions
Cost	What is the likely cost of implementing this option?
Timing	Will the benefits of this option be quickly realised?
Leverage	Will the application of this option lead to further risk-reducing actions by others?
Administrative efficiency	Can this option be administered easily or will its application be neglected because of the difficulty of administration or lack of expertise?
Continuity of effects	Will the effects of the application of this option be continuous or short-term?
Compatibility	How compatible is this option with others that may be adopted?
Authority	Does the organisation have the authority to apply this option? If not, can other organisations with authority be encouraged to do so?
Effects on the economy	What are the economic impacts of this option? Give an approximate value or a qualitative statement if an exact figure is not available eg. positive, negative.
Effects on the environment	What will be the environmental impacts of this option?
Risk creation	Will this option itself introduce new risks?
Risk reduction potential	What proportion of the losses imposed by this risk will this option prevent? How much will this option reduce losses related to the risk?
Public reaction	What are the community values and expectations on this issue? Are there likely to be adverse reactions to implementation of the option?
Individual freedom	Does this option deny basic rights?

Source: Adapted from Commonwealth of Australia, 2004: Emergency Management Australia – Emergency Risk Management Applications Guide Manual 5

Table 6.2(c): Comparative assessment of potential Treatment options
(Note: add additional columns if required)

Criteria	Option 1	Option 2	Option 3	Option 4
Cost				
Timing				
Leverage				
Administrative efficiency				
Continuity of effects				
Compatibility				
Authority				
Effects on the economy				
Effects on the environment				
Risk creation				
Risk reduction potential				
Public reaction				
Individual freedom				

Once a decision is made on the most appropriate option(s), include a list of the options and a summary of the reasons.

Table 6.2(d). Selected Options and reasons.

No.	Selected Option Title	Reason for selection

6.3. Treatment actions

Make a detailed list of actions to implement the selected treatment option(s). The actions should specify:

- areas of responsibility, key dates, the budget and other resource requirements; and
- broad reporting and review processes to assess the progress of implementation against critical implementation milestones.

Treatment actions should also be integrated with existing management and budgetary processes wherever possible.

TABLE 6.3: TREATMENT ACTIONS TO BE IMPLEMENTED

Action	Responsibility	Timeframe	Resources	Review

7. REVIEW

The Treatment actions above will reduce the risks identified for this asset. However, regular review and monitoring will be required to ensure that the treatments are reducing the risk as intended, and/or the nature of the hazards, their consequence or likelihood remain unchanged from that used during this risk management planning process. It is important to include stakeholders during reviews to ensure the issues are communicated, the levels of service expected remain valid, and whether consideration should be given to new or alternative treatment options (such as arising from technological advances or new funding programs).

A plan should be clearly identified to ensure that such review and monitoring occurs with a timeframe that is relevant to the asset and the treatment actions being implemented.

Sometimes it is not possible to completely remove all risk. Such 'residual risks' are generally considered either 'acceptable', or simply too costly (unacceptable) when weighed up against the benefits. The review plan should also consider what 'residual risks' remain once the treatment options have been implemented, and a program developed to ensure that the residual risks are monitored, and so that treatment activities can be developed if required.

Part D
References

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