



Our future on the coast

NSW Coastal Management Manual Part B:
Stage 3 – Identify and evaluate options

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Cover photograph:

Caves Beach (Photo: Bob Clout)

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ISBN 978-1-76039-968-9

OEH 2019/0093

First published in April 2018; second edition published February 2019

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Identify and evaluate options

Stage 3 involves the identification and evaluation of management options.

This includes:

- identifying and collating information on management options
- evaluating management actions, considering:
 - feasibility (is it an effective and sustainable way to treat the risks?)
 - viability (economic assessment)
 - acceptability to stakeholders
- engaging public authorities about implications for their assets and responsibilities
- evaluating mapping options and implications if a planning proposal is being prepared
- identifying pathways and timing of actions
- preparing a business plan for implementation.

3.1 Overview of Stage 3

The following sections of the *Coastal Management Act 2016* and associated mandatory requirements in Part A are most relevant to this stage.

Section 14 Preparation of coastal management programs.

Section 15 Matters to be dealt with in a coastal management program.

Stage 3 of the coastal management program (CMP) process involves councils identifying coastal management issues affecting the areas to which the CMP is to apply and identifying coastal management actions required to address those coastal management issues in an integrated and strategic manner. The aim is to develop strategies and identify coastal management actions that address coastal management issues, reduce exposure to coastal hazards, and to take advantage of opportunities, consistent with provisions in Section 14 and 15 of the *Coastal Management Act 2016* (CM Act). Councils also decide the priority of identified coastal management actions and propose integrated and strategic delivery pathways.

In previous stages, councils will have developed and shared an understanding of the coastal management issues, including an analysis of the risks, vulnerabilities and opportunities in their local area. This information helps to determine what coastal management actions may be identified in a CMP to address coastal management issues in an integrated and strategic manner.

In Stage 3, councils identify and evaluate management options to select preferred coastal management actions with a focus on achieving the objects of the CM Act. When selecting coastal management actions to be included in a CMP, councils must promote the objects of the CM Act and give effect to the management objectives for each coastal management area as required, among other things.

3.2 Steps in Stage 3

In Stage 3, it is recommended that councils complete four main steps (refer to **Figure B3.1**).

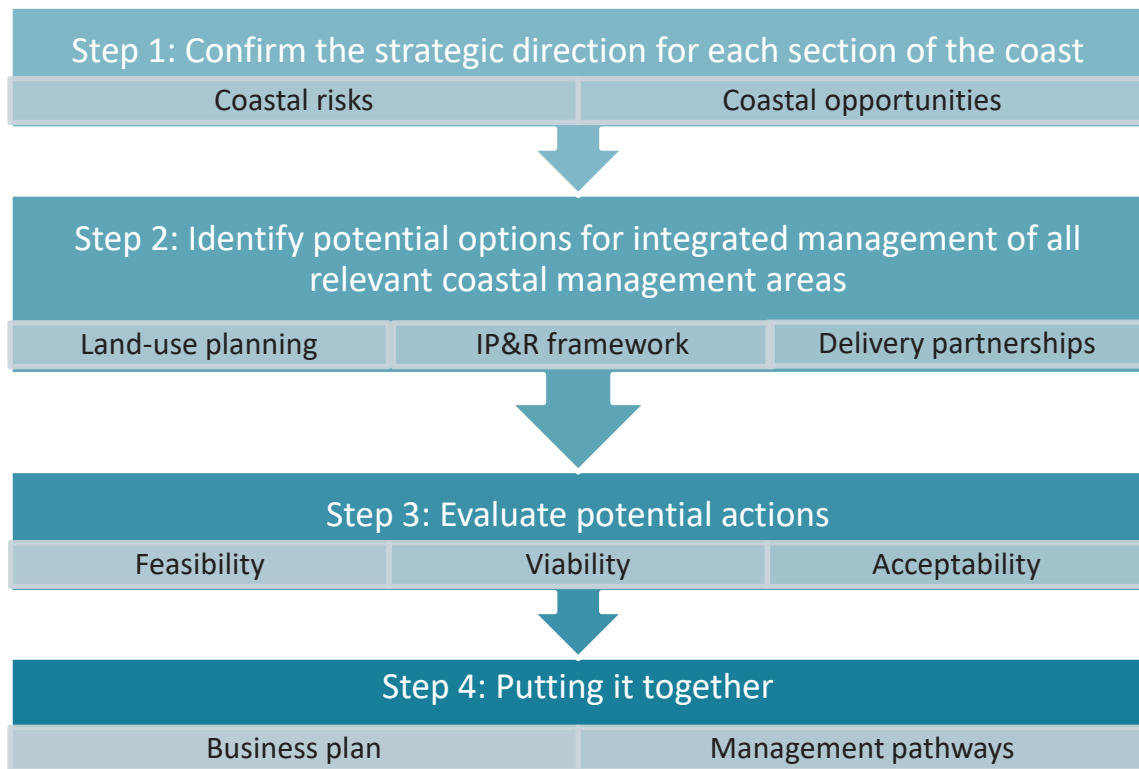


Figure B3.1 Four main steps in action identification and evaluation

Step 1: Confirm the strategic direction

It is recommended that councils review the strategic direction identified in Part B Stage 1 of the manual for each relevant coastal management area, to confirm that it reflects:

- the character, values and management objectives of the particular coastal management areas
- the vulnerability and risks to coastal assets and values identified in studies conducted in Stage 2
- opportunities to enhance the environmental, social, cultural and economic wellbeing of coastal communities.

It is also important to consider if any previously identified thresholds for changing the management approach have been reached.

Step 2: Identify potential management options

Where the risk assessments in Stages 1 and 2 of Part B of the manual have identified unacceptable risks in any of the coastal management areas, the potential options may include risk treatment measures to address those risks.

Different strategic approaches are relevant to different levels of risk and attitudes to risk. The management options suggested for each of the coastal management areas in this stage of preparing a CMP can be organised into five broad categories:

- **Alert** – includes coastal management actions that seek to ‘watch and wait’ such as monitoring change and setting thresholds, low regret responses and research to improve knowledge.
- **Avoid future impact** – includes recommending proactive land use planning and encouraging new development only in locations of low-risk.
- **Active intervention** – includes coastal management actions that seek to protect assets or accommodate change in any of the coastal management areas, while maintaining current systems and values.
- **Planning for change** – includes coastal management actions that seek to facilitate habitat migration and transformative changes to natural systems. For built areas, this includes planning to relocate or redevelop assets to consider the dynamic and ambulatory nature of the shoreline. It may be timed to commence as opportunities arise or when thresholds of exposure, impact and risk are exceeded.
- **Emergency response** – includes coastal management actions to address residual risk in emergency situations.

These strategic approaches can be adopted on their own for specific locations or issues; however, they are often combined or the emphasis may change from one to another over time as circumstances change. **Section 3.9** provides further information on linking actions over time and adaptation pathways.

The potential coastal management actions may best be implemented individually or by a combination of stakeholders, for example:

- by council through its land use planning instruments
- by council through its Integrated Planning and Reporting (IP&R) framework
- by council in conjunction with adjoining councils
- by or in conjunction with public authorities
- by or in conjunction with other organisations such as universities or industry groups
- by community and volunteer groups
- by private landholders.

Important considerations when planning the timeframes for implementing coastal management actions include the:

- variability of coastal processes and hazards
- variability of processes in coastal ecological systems (ecological health)
- asset life of public and private development and essential infrastructure
- life expectancy of strategic land use planning decisions
- rate and type of economic and social change in the coastal zone
- the proposed adaptation pathway, including agreed thresholds and triggers.

Sections 3.4 to 3.7 provide details about the types of coastal management actions which may be appropriate for the four types of coastal management areas.

The Marine Estate Management Authority Strategy (MEMA Strategy), is likely to recommend some actions that could be considered along with other coastal management actions identified at this stage. It would also be helpful to establish any projects or pilot programs being undertaken through the MEMA Strategy in the area covered by the CMP. This will be most relevant for CMPs covering estuaries.

Step 3: Evaluate potential actions

Coastal management actions can be prioritised through examining the feasibility, viability and acceptability of coastal management actions (summarised in **Figure B3.2**), over a range of timeframes.



Figure B3.2 Components of the evaluation of recommended coastal management actions

Important considerations include:

- promoting and achieving the objects of the CM Act
- meeting the coastal management objectives within the coastal management areas
- the environmental, social, cultural and economic context and potential impacts
- the vulnerability and risks
- the feasibility of coastal management actions: determined by effectiveness, practicality and reliability of the measure or technology
- viability of implementation: determined by anticipated cost, availability of resources, time and commitment and anticipated benefits
- the acceptability of the risks to the council, key stakeholders such as public authorities, and the community, including willingness to contribute to the upfront and ongoing maintenance costs.

During the evaluation component of Stage 3 of Part B of the manual councils will need to think about the:

- roles and responsibilities of particular stakeholders
- approval processes and legislative requirements
- time required to plan, design and implement a coastal management action
- staging and sequencing of coastal management actions
- cost of different coastal management actions, including long-term maintenance
- benefits and beneficiaries of implementing the coastal management action
- disadvantages of implementing the coastal management action and how they are distributed across stakeholders, community and environment
- level of uncertainty associated with the outcome.

Section 3.8 provides further information about the evaluation process.

Step 4: Putting it together – document the rationale

It is important to consider how the proposed coastal management actions will be implemented over time, within an adaptive pathway that includes thresholds and triggers for change; **Section 3.9** provides details.

A business plan demonstrates viable funding mechanisms for implementing proposed CMP actions that are consistent with council's Integrated Planning and Reporting (IP&R)

framework including its resourcing strategy and asset management plan; **Section 3.10** provides details.

3.3 Involving the community and stakeholders in Stage 3

Stage 3 involves input from a range of stakeholders from council, public authorities and the community. The engagement process is designed to facilitate community and stakeholder involvement in identifying and evaluating local and regional-scale coastal management actions and determining their viability and acceptability. Specific consultation activities will be drawn from the engagement strategy prepared in Stage 1 of Part B of the manual.

3.3.1 Engagement within and between councils

Council officers responsible for the preparation or update of the CMP may need to brief councillors about the evaluation and option selection processes. It is also important to liaise with relevant sections of council, such as those involved in land use planning, asset management and community development, about potential or proposed coastal management actions.

Consultation with adjoining councils may assist regional collaboration and facilitate a coordinated approach to the management of coastal issues that cross council boundaries.

3.3.2 Engagement with public authorities

Consultation with other public authorities about any proposed coastal management actions that are recommended to be their responsibility, or that may affect their land and/or assets, including coastal management actions in a coastal emergency action subplan will be an important consideration.

Aims of engagement during Stage 3 include:

- the integration and coordination of council and public authority delivery programs
- streamlined review and approval processes
- reduced duplication
- public authority commitment to implementing relevant coastal management actions in the CMP.

3.3.3 Engagement with the community

The decisions made in Stage 3 of Part B of the manual may have significant implications for coastal communities. Councils may need to revisit the engagement strategy prepared in Stage 1, to make sure it remains appropriate. This is important if the results of studies in Stage 2 have changed the understanding of the level of risk or the knowledge base for decision-making.

In Stage 3, community engagement may include discussion about issues such as:

- awareness and knowledge of coastal threats, vulnerabilities, risks, thresholds and potential management actions
- awareness of residual risks and emergency responses

- the community's acceptance and tolerance of risk
- costs and benefits of coastal management actions
- the community's role in implementing coastal management actions
- distribution of benefits and impacts of different coastal management actions, to public and private interests, including any unintended consequences
- financial affordability, willingness to pay for upfront and ongoing management costs
- how coastal management actions could be sequenced to build resilience and maximise flexibility and adaptability



Figure B3.3 Community engagement is important at each stage of CMP development, Lake Illawarra, September 2016 (Photo: D Wiecek/OEH)

3.4 Managing coastal wetlands and littoral rainforests areas

Coastal management actions for coastal wetlands and littoral rainforests areas will focus on considering, promoting and achieving the objects of the CM Act and the management objectives for the coastal wetlands and littoral rainforest area.

Some councils and public authorities have existing programs or plans of management that manage coastal wetlands and littoral rainforests for conservation, restoration, education or low key recreational access and use. These include boardwalks and fencing, interpretation and education activities, clean-up and litter reduction programs and habitat management activities.



Figure B3.4 Hare Point Track estuarine wetlands including saltmarsh and mangroves Carama Inlet northern shores of Jervis Bay (Photo Michael Van Ewijk/OEH)

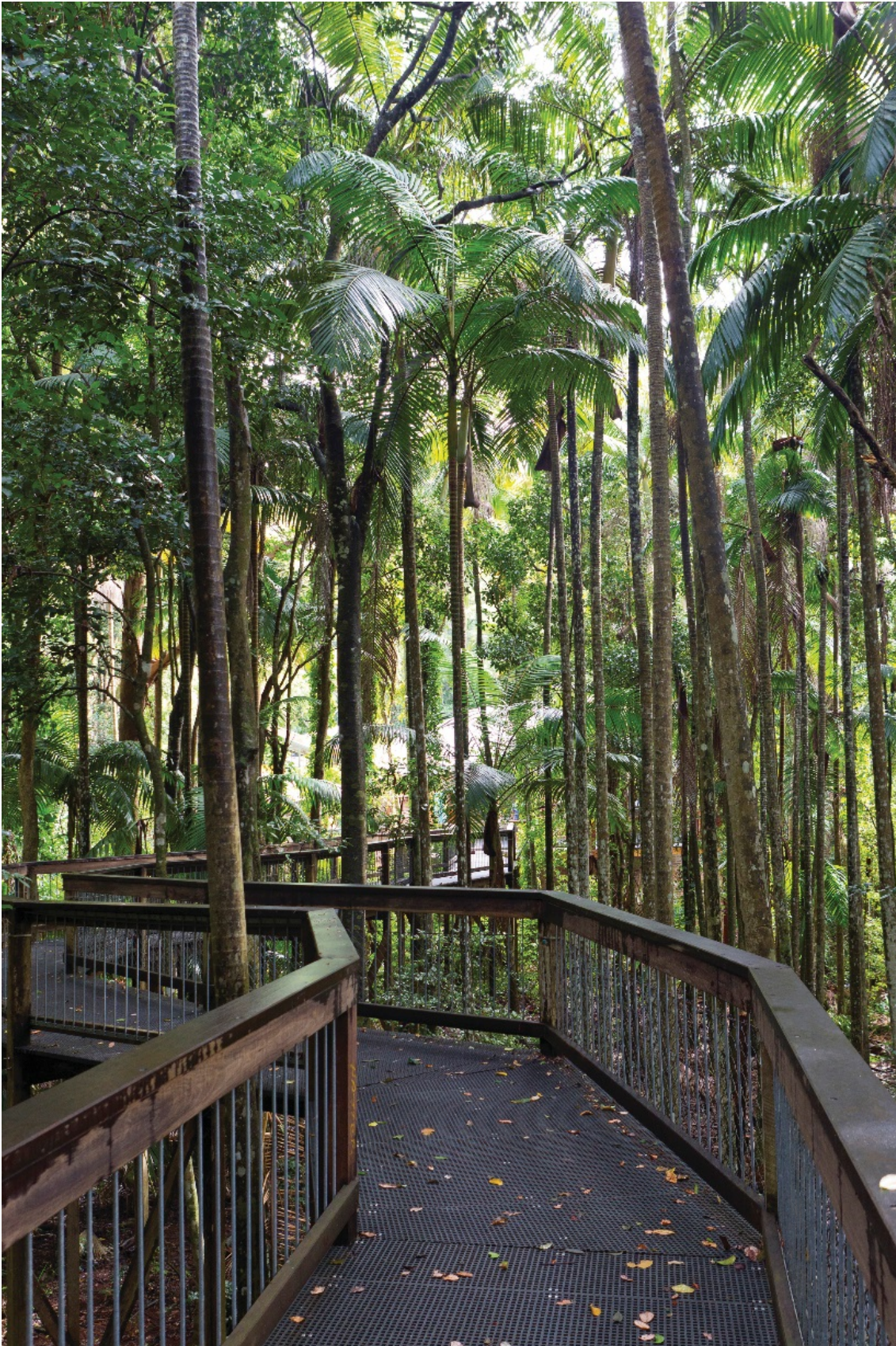


Figure B3.5 Wooden boardwalk through littoral rainforest, Sea Acres National Park (Photo: R Cleary, Seen Australia/OEH)

The effectiveness of existing strategies will have been considered in Stage 1 of Part B of the manual. Where the existing management arrangements have the capacity to control emerging threats and risks, and support emerging opportunities, maintenance of existing management may be appropriate. In this situation, consideration may be given to monitoring to identify if risk is increasing, decreasing or staying the same.

Additional coastal management actions may be required where current management is not appropriately addressing the threats to the values of the coastal wetlands and littoral rainforests, or when risks are increasing over time, and cannot be managed by the existing arrangements.

Coastal management actions for coastal wetlands and littoral rainforests may include:

Alert

- continued monitoring of the health and condition of coastal wetlands and littoral rainforests
- identifying thresholds and triggers for possible future intervention
- community education and awareness.

Avoid risk

- recommend that land use planning controls be adopted to ensure that proposed development will not impact on coastal wetlands and littoral rainforests
- recommend a planning proposal that will amend the extent of the coastal management area maps
- recommend the consideration of conservation agreements and possible changes in land tenure to provide protection.

Active intervention

- enhance opportunities for restoration of degraded wetlands to improve habitat values and ecosystem functioning
- promoting the improvement of flows and water quality entering wetlands and littoral rainforests
- recommending the construction of artificial wetlands or habitats
- recommending mosquito control
- recommending litter control and clean-ups
- recommending feral animal and weed control
- promoting enhanced and appropriate access to and use of wetlands and littoral rainforests.

Planning for change

- work towards establishing habitat migration pathways in response to climate change and sea level rise
- work towards establishing wildlife corridors to connect refugia
- promoting improvement of the resilience of wetlands and littoral rainforests to climate change
- work towards removing or altering the operation of works such as floodgates, levees, drains and culverts to facilitate ecological change
- identify opportunities for potential land acquisition to promote the protection, enhancement, maintenance and restoration of wetlands and littoral rainforests.

Emergency response

- plan emergency responses that limit the consequences of large and/or unpredicted events, such as major coastal storms, bushfires, droughts, pollutant spills, acid sulfate and low dissolved oxygen events, or sewage overflows.

3.4.1 Identifying and selecting strategic approaches

In general, coastal management actions that may have the effect of **alerting** and **avoiding risk** are appropriate for wetlands and littoral rainforests that are in good condition or where current threats are relatively low. **Active intervention** coastal management actions are appropriate when threats are currently impacting on the health, function or resilience of coastal wetlands and littoral rainforests.

Coastal management actions that are part of the **planning for change** group of recommended actions may be considered when the changes to condition and function are likely to be permanent.

Emergency response coastal management actions may include preparation for coordinated and rapid response to protect coastal wetlands and littoral rainforests, such as measures to control the spread of oil, sewage or other pollutant spills.

Further investment may be needed to support the work of volunteers, or for capital works that restore natural processes, or to maintain safe access or amenity, or to monitor the success of on-ground restoration programs.

Recommended coastal management actions for coastal wetlands and littoral rainforests are outlined in **Table B3.2** (in **Section 3.12**).



Figure B3.6 Coastal saltmarsh threatened ecological community (Photo: S Ruming/OEH)



Figure B3.7 Mangroves at the RAMSAR wetland, Towra Point (Photo: J Spencer/OEH)

3.5 Managing coastal vulnerability areas

Recommended coastal management actions for coastal vulnerability areas may focus on considering, promoting and achieving the objects of the CM Act and the management objectives for the coastal vulnerability area.

An important aspect will be assisting coastal communities to adapt to a dynamic and ambulatory shoreline over short and longer-term timeframes.

There are five broad strategic approaches which may be applied when managing risk in coastal vulnerability areas, consistent with the management objectives in the CM Act. These are depicted in **Figure B3.8** and outlined in **Table B3.3** (refer to **Section 3.12**).

Where possible, management approaches for areas exposed to coastal hazards or mapped as coastal vulnerability areas will focus first on enhancing natural defences such as sand dunes, vegetation and wetlands, and/or avoiding future risk by encouraging land uses that reduce exposure to coastal hazards.



Figure B3.8 Strategic risk management approaches for coastal vulnerability areas

To achieve the best outcomes for any section of the coast, it is likely that a combination of approaches will need to be implemented over time as circumstances change and thresholds are reached.

When identifying the appropriate mix of strategic approaches, important aspects to consider will be the nature and type of the hazard. Mitigation strategies may differ for:

- areas subject to erosion, long-term recession or cliff collapse
- areas subject to coastal inundation that could be the result of a storm surge and wave overtopping
- tidal inundation areas, where services, access and liveability are intermittently disrupted and subsequently restored.

The nature and scale of existing and proposed development are also important considerations. The feasibility of risk management strategies may differ between lands that are:

- already developed, as there may be limited options, or a different range of options, for sites where the management issues are a legacy of past planning decisions
- greenfield (undeveloped) sites
- reserves, conservation areas and stretches of coast where there are neither built assets nor infrastructure likely to be threatened.

Other factors include:

- trends and expected changes to the type and intensity of coastal use and access to different coastal landforms (such as beaches, cliffs and estuary entrances)
- the potential to reduce the consequences by changing the management of coastal activities
- the capacity of a regional community to manage impacts, considering the value of existing development, its age and the ability of the community to invest in adaptive redevelopment.



Figure B3.9 Coastal protection works, Belongil Beach (Photo: P Davies/OEH)



Figure B3.10 Coastal protection works, Kingscliff (Photo: P Davies/OEH)

3.5.1 Alert

Low regrets responses to risks

Low regrets responses that are cost-effective, best practice and yield multiple benefits are likely to be part of any coastal risk management strategy overall timeframes.

Low regrets strategies are part of routine, best practice environmental management. They usually involve low cost and low impact actions that produce a net benefit now and help communities prepare for future changes to risk exposure. For instance, these actions often increase community awareness and involvement or achieve environmental improvement outcomes (enhancing resilience), as well as reducing risks.

Low regrets actions alone are seldom sufficient to manage medium to high risks but they do allow councils to strengthen coastal resilience and build management capacity.

Examples of low regrets actions in coastal vulnerability areas include:

- enhancing natural defences such as sand dunes, foreshore vegetation and wetlands
- community awareness and education programs about coastal processes of all coastal systems (open coast beaches and headlands, estuaries, lakes, lagoons, coastal wetlands and littoral rainforests)
- early warning systems and preparedness for storm events

- raising public awareness, education and understanding of coastal process, hazards and risks to public safety
- monitoring changes in the coastal environment, including long-term trends and responses to erosion, recession and inundation both on the open coast and in estuaries, lakes and lagoons
- monitoring community attitudes to risk
- monitoring use, safety and satisfaction with access and amenity
- monitoring development pressure and population change
- research to improve coastal knowledge and understanding
- identifying opportunities and preparing and planning for change
- identifying potential future threats, vulnerabilities and risks resulting from changing processes and climate change
- plans and strategies to improve resilience of coastal assets to the impacts of climate change and extreme events.

The environmental and social context and accepted best practice will change over time. The CMP could recommend changes to low regrets responses as circumstances change, to ensure they continue to deliver benefits efficiently and support other responses.

Natural defences

Natural defence actions include dune management, reshaping the beach (re-profiling and beach scraping), relocating nuisance wind-blown sand back onto a beach, relocating sand within a sediment compartment (sand back-passing) or adding sand to the beach (beach nourishment).

In estuaries and coastal lakes and lagoons, natural defences may include maintaining and enhancing foreshore revegetation and wetlands, managing stock access, beach nourishment and placing coarse (more resistant) material on the shoreline.

Re-profiling, beach scraping, sand back-passing and beach nourishment can be used to reinstate a beach system to:

- restore beach amenity and access
- reduce risks to public safety
- reduce risks to development
- offset the impacts of protection works
- protect and enhance significant vegetation, habitat or cultural heritage values.

Re-profiling, beach scraping and sand back-passing involves transferring sand from one part of a beach to another or within a sediment compartment. The purpose is to return sand which has been eroded from the beach and moved to another location.

Beach nourishment is the replenishment of an active beach system using imported sediment of a similar size to balance erosion losses, re-establish the beach or to form a wider dunal zone to act as an erosion buffer.

Minimum design standards for beach nourishment projects are outlined in **Box 3.1**.

Box 3.1 – Suggested design standards for beach re-profiling, beach scraping and beach nourishment

Where beach re-profiling, beach scraping and beach nourishment are the preferred management action, the following provides the minimum design standards:

- The landward extent of the work is recommended be limited to the existing erosion scarp or the seaward edge of dune vegetation.
- Earthworks associated with beach re-profiling are designed to avoid exposure or disturbance of underlying bedrock, coffee rock and other cemented sediment material or consolidated mud/organic material layers.
- Established vegetation is not to be buried or otherwise harmed by the work.
- Beach re-profiling and beach nourishment are to be finished to a stable slope consistent with typical beach and dune forms in the area.
- For beach re-profiling, sand is sourced from an intertidal area immediately seaward of the intended deposition area. For beach scraping and sand back-passing, sand is to be sourced from the active beach system and/or flood tide deltas in estuaries.

For major beach nourishment programs:

- The 100-year ARI (average recurrence interval) Zone of Reduced Foundation Capacity does not reach un-piled structures.
- After a one-year ARI erosion event, there is a 20-metre-wide dry beach on a mean high-water spring tide under average wave conditions.
- There is a 30-metre-wide dry beach for 90% of the time and provide for alongshore pedestrian access for 99% of the time.

Sand for beach re-profiling will have the following characteristics:

- The sand used for the work is to have a similar or coarser grading to the upper beach sand at the site, and a similar colour.
- The sediment contains less than 10% fines (i.e. sediment with a grain diameter of less than 0.06 millimetres).

Sediment for beach nourishment will have the following characteristics:

- The sediment is sourced from outside the active beach system of the sediment compartment or another approved site.
- The sediment consists predominately of sand (i.e. 90% of the sediment has a grain size diameter greater than 0.06 millimetres).
- The sand used for the work has a similar or more coarse grading to the upper beach sand at the site.
- The sediment contains less than 10% fines (i.e. sediment with a grain diameter of less than 0.06 millimetres).
- The sediment is clean, free of contaminants and does not contain any deleterious material such as builders' waste or rock.



Figure B3.11 Beach nourishment, Jimmy's Beach (Photo: Great Lakes Council)

3.5.2 Avoid

The land use planning framework can be used to avoid risk arising from the dynamic and ambulatory nature of shorelines and foreshores of the open coast (including sandy beaches and coastal cliffs and bluffs), and estuaries, lakes and lagoons. It is recommended that any risk approaches are implemented early so they can provide long-term benefits.



Figure B3.12 Beach scraping at New Brighton Beach, Byron Shire Council (Photo: B Fitzgibbon/Byron Shire Council)

An avoid risk approach is particularly relevant for greenfield sites where planning controls can facilitate new development and associated infrastructure being sited in low-risk areas or outside a coastal vulnerability area for a relevant timeframe.

A CMP may include recommendations to manage risk and provide opportunities for strategic controls on land use in two different ways:

- strategic planning and investigation to identify areas suitable for future development (consistent with the s. 9.1 direction relating to coastal management)
- recommendations for changes to land use planning and development controls, such as permitted and prohibited uses for zones and design standards in a development control plans (DCP).

Examples of land use planning recommendations that may be considered in a CMP to avoid future risk include:

- Recommending the location of new or replacement essential infrastructure in low-risk areas or outside of mapped coastal vulnerability areas for relevant timeframes. This will result in significant savings/benefits for councils, public authorities and the community.

- Recommending locating new critical infrastructure landward of the 100-year 1% probability line and outside of the area rarely impacted by coastal hazards.
- Identifying land suitable for future settlement in regional and local-scale settlement strategies. This future development could be outside the mapped coastal vulnerability areas, considering hazard impacts from storms and flooding at least equivalent to a one in 100-year ARI event (that is, an event with a 1% probability of occurrence in any year) for a 100-year planning horizon.
- Identifying areas where redevelopment or infill development is not acceptable due to risks.
- Identifying development types, design standards and controls to allow appropriate development to occur in areas where coastal risks are anticipated to change over time. Councils could consider the risk, the level of uncertainty, the desire not to unnecessarily sterilise coastal land and the importance of avoiding future legacy problems.
- Identifying and recommending alternative development sites to accommodate existing development that is expected to be displaced by shoreline recession or inundation in the future.

Councils may wish to recommend the inclusion of additions to their Development Control Plan or consent conditions. These may include guidance on:

- only permitting time-limited and removable structures in the short-term, high probability hazard impact area appropriateness of removable or relocatable assets such as lifeguard towers or picnic shelters seaward of the 50-year 90% exceedance line
- more readily movable development may be encouraged for areas between the 50-year 90% exceedance line and 50-year 50% exceedance line
- appropriateness of relocatable dwellings (with appropriate consent conditions) between the 50-year 50% and the 50-year 10% exceedance line
- appropriateness of traditional housing on pile foundations, between the 50-year 10% and the 50-year 1% exceedance line.

Note: The '50-year 50% exceedance line' is the landward position of the shoreline that has a 50% probability of being exceeded in the next 50 years. The examples above are not intended to be prescriptive and can be amended by local considerations.

Land use zones in coastal areas may be used to encourage appropriate new development and create opportunities for coastal communities to be sustainable and resilient. Zoning is a mechanism to relocate settlement away from the area affected by hazards while maintaining community cohesion, resilience and socioeconomic viability. Examples of zoning changes councils could consider recommending include:

- zoning land likely to be subject to extreme events as open space to provide valuable access and recreation space (noting that compensation may need to be considered if the land is in private ownership)
- zoning land as open space (with necessary compensation if changing from a private land zoning) to facilitate migration of ecological communities such as saltmarsh (noting that compensation may need to be considered if the land is in private ownership)
- zoning areas as working waterways to encourage coast-dependent development, such as marinas and fishery infrastructure or tourism-related activities
- identifying opportunities for improved coastal access and public use on land acquired by a public authority
- encouraging new residential development to occur on land outside coastal vulnerability areas where appropriate.

These actions recognise the local and regional-scale effects of coastal processes and the dynamic and ambulatory nature of the shoreline.

Progressing a planning proposal

In Stage 3, an evaluation of the mapping options and implications to determine the extent of the coastal vulnerability area may be required. It is important that councils consult with affected communities, stakeholders and public authorities about the mapping options and the implications. This will help councils to define the appropriate area where it is recommended that changes to planning controls will occur.

3.5.3 Active intervention

Active intervention approaches may be recommended and implemented over short or longer-term timeframes, as risk, management cost and community objectives change. They aim to mitigate current and future risks from coastal hazards, taking into account the effects of climate change and the dynamic nature of the shoreline.

Accommodate risk responses

Accommodate measures are designed to reduce the immediate to medium-term consequences of risks in areas exposed to coastal hazards and coastal vulnerability areas. This approach may extend the time a development can remain in place or a use can continue.

This can be achieved by recommending modifying the current land used to be more resilient or changing to a less vulnerable land use or development.

Accommodation strategies are usually more effective for hazards that do not lead to complete or permanent loss of built assets or where the built assets that are lost are of low value. In some cases, avoid risk management responses (**Section 3.5.2**) will be used in conjunction with 'alert' and accommodate risk responses.

Coastal management actions may include recommendations involving:

- Retrofitting buildings and infrastructure, including roads and sewer systems.
- Enhanced or redesigned drainage systems.
- Changes to design requirements for infill and redevelopment of existing development areas.
- Strategic planning to reduce risk by relocating, or increasing the elevation of, infrastructure assets during maintenance or at the end of the asset life, without changing the general function and use of the land.
- Responses encouraging:
 - raised floor levels
 - movement of assets and infrastructure
 - reinstating and maintaining natural defences such as dune management, beach re-profiling or beach nourishment.
- Providing additional and regular information to affected landowners about in coastal hazards and risks, and the performance of management actions.
- Improving the resilience of coastal assets to climate change.
- Potential tenure arrangements to not sterilise land use in the short to medium-term. These may include easements, voluntary purchase and leaseback.

Coastal protection responses

Coastal protection options are generally proposed when the coastal vulnerability area overlaps with a coastal use area that has high-value uses or assets. Section 27 of the CM Act and clause 19 of the State Environmental Planning Policy (Coastal Management) 2017 (CM SEPP) relate to development consent and approvals for coastal protection works carried out by public authorities and other persons.

A range of options are available where a council and its community has determined that protection of significant public and/or private infrastructure or other community assets is desirable. The choice will be influenced by the local context and acceptability to the community.

In the first instance and wherever possible, the priority is restoring or enhancing natural defences such as coastal dunes, vegetation or wetlands and maintaining natural processes and functions as much as feasible.

It is important not to overestimate the resilience of natural defences to long-term coastal change, or their capacity to protect assets on receding coastlines.

Structural protection works

Structural protection works are an option when natural defences are not sufficient to reduce risks from coastal hazards to an acceptable level. They include:

- seawalls and revetments
- entrance breakwaters
- groynes
- artificial reefs
- levees and drains
- cliff stabilisation works.

Examples of potential structural protection works are summarised in **Tables B3.3** and **B3.4** (in **Section 3.12**).

Each structural protection option has advantages, disadvantages and impacts, and careful evaluation is necessary before a protection action is included in a CMP. Coastal protection measures may be designed and implemented to create modified and diversified habitat or to improve public access and amenity.

Approvals for coastal protection works

Section 27 of the CM Act and clause 19 of the CM SEPP relate to development consent and approvals for coastal protection works carried out by public authorities and other persons.

Design standards for coastal protection works

When proposing structures such as seawalls and revetments for the protection of public infrastructure or private assets, it is most important that design criteria are clearly stated and that minimum design criteria for stability and safety are met.

The engineering design event (stormwater level and wave conditions) is determined from the accepted probability of exceedance over the design life of the structure.

It is recommended that a seawall is designed to be consistent with the design life of the development or assets it protects (typically for residential or commercial development it will

be 50 or more years). Allowing for not more than 10% probability of event exceedance over the design life requires the engineering design event to be at least the 1 in 500-year ARI.

Effective seawalls are recommended to be designed with due allowance for beach scour at the toe and overtopping/over-wash of the crest. Risks to adjoining public and private land and mitigation measures are also important considerations.

Where a seawall or revetment is critical to the protection of important infrastructure or high-value or sensitive development, or where the seawall/revetment is intended to provide protection for 20 years or more, rigorous design and testing are necessary to manage risks.

It may be necessary to undertake testing of such seawalls/revetment designs with physical models to demonstrate their capability and fitness-for-purpose.

Box 3.2 outlines design criteria for seawalls and revetments. These requirements are based on Australian Standard AS 4997–2005 Guidelines for the Design of Maritime Structures (Standards Australia 2005).

It is recommended that all planning for proposed coastal protection structures acknowledge the concept of residual risk associated with events larger than the design event. Potential impacts include overtopping, out-flanking or failure of protective structures. Coastal protection structures (such as seawalls or groynes) have an asset life and a defined period when they are expected to be effective.

Councils develop a coastal zone emergency action subplan where required to address residual risk (see **Section 3.5.5**).



Figure B3.13 Geotextile sandbag wall, Kingscliff (Photo: M Daley/OEH)



Figure B3.14 Seawall at Kogarah Bay showing step-type seawall with a bench of saltmarsh vegetation (Photo: D Wiecek/OEH)

Box 3.2: Recommended criteria for design of seawalls and revetments on the open coast

Where protection is to be the recommended management option, and seawalls/revetments are the method of protection, the following provides a minimum level of standards for the design and construction of seawalls and revetments:

- Seawalls and revetments are to be designed and constructed to achieve the design life necessary to provide protection for the asset/land used to be protected, for its design life. For example, where a seawall or revetment is to protect residential or commercial development the design life of the structure is to reflect the proposed land use design life, typically for residential/commercial development 50 to 60 years. For less intensive development such as public facilities or relocatable development the design life may be less, but for essential or critical infrastructure, the design life may be greater.
- The selection of the design life will determine the necessary design criteria such as the design storm conditions (wave height, period and water levels) that will ensure the design life has at least a 90% probability of being achieved.
- It is recommended that all seawall and revetment designs with proposed lives exceeding 20 years are tested with physical models to demonstrate their capability and fitness-for-purpose.
- The design scour level on the beach at the toe of a seawall or revetment shall be determined to achieve no undermining of the structure during its design life. For a seawall, the design scour level is to accommodate the additional scour due to the interaction of the seawall with wave action. For revetments, a fit-for-purpose toe apron (including geotextile filters of sufficient strength), is to be provided to accommodate any potential settlement of the structure during its design life.
- Seawalls and revetments are to be designed and constructed, to be structurally capable of resisting the design conditions required to achieve the design life, including adequate drainage to release pore pressures behind the wall, including excess pore pressures where overtopping occurs.
- Seawalls and revetments are to have a slope and primary armour size capable of resisting the design conditions required to achieve the design life, with no more than 10% damage, and to have suitable underlays and filters (including geotextile filters of sufficient strength to be fit-for-purpose) to support the revetment slope for the design life.
- The crests of seawalls and revetments are to be of sufficient elevation to ensure that any overtopping will not endanger public safety or assets. Where overtopping is envisaged in the design, there is to be suitable crest reinforcement to accommodate that overtopping. It is recommended that the design include adequate and effective provision for catching and draining overtopping water, without compromising the integrity of the seawall or revetment. Where the design includes any overtopping, testing with physical models, at an appropriate scale, is recommended to demonstrate the crest and drainage design is fit-for-purpose.

3.5.4 Planning for change

In dynamic coastal environments, planning for a long-term change to the location or extent of residential development and infrastructure is inevitable in locations when the risk to life and property from coastal hazards is extreme. This option is generally a last resort to be considered when mitigation measures are no longer technically feasible, financially viable or acceptable to the broader community.

This situation may arise where coastal recession or permanent inundation is occurring and existing coastal assets, infrastructure, public safety, liveability and environmental values are being progressively lost or degraded, or lives are at risk.

If planning for long-term change is contemplated, it is most appropriate when councils adopt a staged approach that moves from accommodation and protection to long-term relocation or realignment strategies over time, once a predetermined and critical threshold has been reached. A staged, adaptive approach allows development in coastal vulnerability areas to remain in place until the risks to life and property become extreme and unacceptable. It also helps improve the resilience of coastal development and communities by improving adaptive capacity and reducing reliance on emergency responses.

Where temporary or time-limited development is proposed, it is important to have a clear plan for implementation, developed with and understood by the community. Clearly defined steps, thresholds and stages towards the removal or relocation of temporary development will assist community acceptance of the approach. This will help to reduce socioeconomic impacts and increase community acceptance when a change is required.

Recommending coastal management actions that lead to the relocation of assets may have a distinctive distribution of costs and benefits between public and private stakeholders.

Relocating private development and associated public infrastructure may be an option to consider when:

- the risks to existing residential development are extreme and unacceptable
- the public benefits of protection structures and mitigation measures are low
- the benefits to the environment and the broader community are high
- it is no longer feasible or viable to mitigate the impacts of protection works on coastal processes, environmental values, beach amenity or public access
- there are significant costs associated with remaining in place
- there is a high degree of uncertainty about the adverse impacts of coastal protection works
- there are significant opportunities to benefit environmental, cultural and social values including continued public access to a beach.

Recommending the relocation of assets may involve:

- intensive engagement and negotiation with affected landholders
- recommending the rezoning of land
- recommending a change of tenure, easements or voluntary purchase and land acquisition
- specifying the thresholds and triggers for changing the response from accommodation or protection to the relocation of assets
- ongoing reporting and discussion with affected landowners and the community as responses are implemented
- recommending social adjustment packages and incentives to support affected property owners

- not encouraging the protection and rebuilding of damaged private assets located in the beach fluctuation zone
- removing any waste, building materials or contaminants that endanger the public and restore the area
- an integrated and coordinated response involving public and private landowners and asset managers
- public authorities having regard to the CMP in their plans of management and management activities for public land.

Thresholds and triggers may be linked to a specific magnitude or frequency of hazards and damages, the condition of environmental or built assets, or the effectiveness of other mitigation or emergency response measures.

In determining thresholds and triggers, the interdependencies between service-related infrastructure and development that is reliant on it (e.g. roads, water supply and sewerage systems), may be a consideration.

3.5.5 Emergency response

Emergency response will be required to address residual risks that remain after all mitigation measures have been implemented. Emergency responses aim to:

- protect human life and public safety
- minimise damage to property and assets
- minimise impacts on social, environmental and economic values
- not create additional hazards or risks.

Effective coastal emergency responses will prioritise actions that support the continued functionality of essential infrastructure during and immediately after a coastal emergency. They will also help to improve the resilience of coastal communities and reduce their future reliance on emergency responses.

Coastal zone emergency action subplans

A CMP will include a coastal zone emergency action subplan (CZEAS) if the local government area includes land within the coastal vulnerability area and beach erosion, coastal inundation or cliff instability are occurring on that land.

A CZEAS is a plan that outlines the roles and responsibilities of all public authorities (including the local council) in response to emergencies immediately preceding or during periods of beach erosion, coastal inundation or cliff instability, where the beach erosion, coastal inundation or cliff instability occurs through storm activity or an extreme or an irregular event. The roles and responsibilities include the carrying out of works for the protection of property affected, or likely to be affected by beach erosion, coastal inundation or cliff instability.

When preparing a CZEAS, councils must consider and promote the objects in Section 3 of the CM Act and give effect to the management objectives for the coastal vulnerability area (in s.7 of the CM Act).

In preparing a CZEAS as part of the CMP, it is recommended that councils:

- identify objectives and scope of the CZEAS, consistent with the objects of the CM Act, management objectives of the coastal vulnerability area (CVA) and the strategic direction in the CMP

- review effectiveness of existing emergency management responses
- identify and map land within the coastal vulnerability area which is, or may be, affected by beach erosion, coastal inundation or cliff instability
- consult with public authorities that own or manage land or assets in the coastal vulnerability area that may be affected by beach erosion, coastal inundation or cliff instability and seek their agreement to any proposed actions to be included in the CZEAS
- consult relevant emergency management authorities and committees to ensure the CZEAS does not include matters that are in plans made under the *State Emergency and Rescue Management Act 1989* (SERM Act)
- seek advice/clarification on the scope of the CZEAS from Office of Environment and Heritage (OEH) or the NSW Coastal Council, if necessary

Under the CM Act a CZEAS must outline:

- the roles and responsibilities of all public authorities (including the local council) in response to emergencies immediately preceding or during periods of beach erosion, coastal inundation or cliff instability, where the beach erosion, coastal inundation or cliff instability occurs through storm activity or an extreme or an irregular event; and
- any works to be carried out for the protection of property affected or likely to be affected by beach erosion, coastal inundation or cliff instability.

It is recommended that the CZEAS also include:

- the objective and scope of the CZEAS
- definition of coastal emergencies: beach erosion, coastal inundation and cliff instability
- criteria/thresholds for when a coastal emergency is occurring
- a map and /or register of land and assets that are, or may be, affected by beach erosion, coastal inundation or cliff instability
- coastal emergency actions for the four phases of emergency management: prevention; preparedness, response and recovery
- a protocol for communication and engagement before, during and after an emergency event.

Figure B3.16 shows emergency response actions that are consistent with councils' responsibilities and the principles for coastal emergency response.



Figure B3.15 Signage and fencing to prevent public access to eroded beach area, Byron Bay
(Photo: S Holtznagel/OEH)

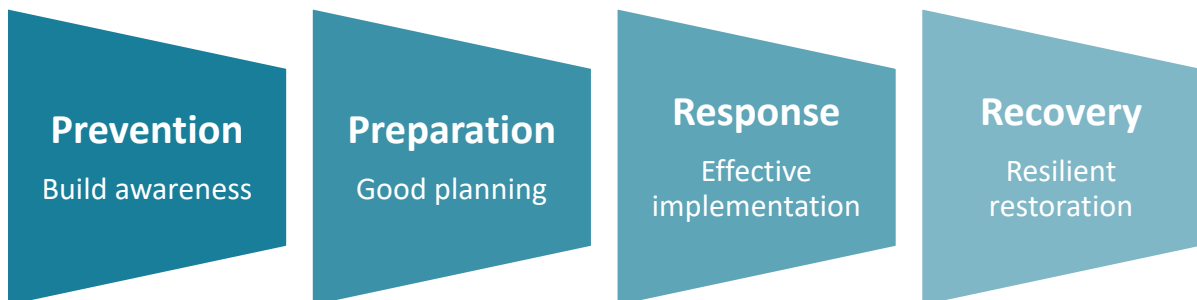


Figure B3.16 Emergency response in the coastal management context

3.6 Managing coastal environment areas

The key features of the coastal environment area are the coastal waters of the State, estuaries, coastal lakes and lagoons and land adjoining those features such as coastal cliffs and bluffs, rock platforms, sand dunes and riparian zones. The management objectives for coastal environment areas are to protect and where possible enhance, the natural and cultural values and ecosystem functions of these important areas.

Management actions for coastal environment areas will focus on considering, promoting and achieving the objects in the CM Act and the objectives for coastal environment areas. Due to the overlap with the marine estate, it is recommended that councils also consider the objects of the *Marine Estate Management Act 2014*.

Coastal management actions may also be designed to protect and enhance coastal environmental values and natural processes and to enhance natural character, scenic value, biodiversity values and ecosystem integrity.

Management actions designed to reduce threats and improve the resilience of coastal waters and waterways, including in response to climate change are appropriate. Actions that maintain or improve water quality and estuary health, and maintain the presence of beaches, dunes and natural features of foreshores will be consistent with the objectives of the coastal environment area.

It is important that coastal management actions that support social and cultural values of coastal waters and waterways and maintain or improve public access, amenity and use of the coastal environment area are also considered.

Like coastal wetlands and littoral rainforests, the broad strategic approaches to management of coastal environment areas may include:

Alert

- continued monitoring of the condition of coastal environment areas
- identifying thresholds and triggers for change and future intervention
- raising public awareness, education and understanding of coastal process and values and the implications of threats and hazards for the amenity, wellbeing and prosperity derived from the coastal environment.

Avoid

- recommending the implementation of land use planning controls, zoning, management plans and tenure arrangements to protect and enhance the coastal environmental values and natural coastal processes, including biodiversity, ecosystem integrity and resilience
- recommending the progression of a planning proposal to amend the extent of the coastal management area maps
- reducing adverse impacts and where possible enhancing the natural character, scenic value, biological diversity and ecosystem integrity
- considering the cumulative impacts of proposed development.

Active intervention

- enhancing opportunities for the enhancement and restoration of degraded habitats
- reducing threats and risks to coastal waters, foreshores and natural environment areas
- maintaining and improving water quality and estuary health
- improving public access to environment areas, foreshores and waterways.

Planning for change

- identifying opportunities to maintain the presence of beaches, dunes and natural features of the foreshore
- preparing to allow nature to take its course so that coastal landforms and ecological communities can change over time
- planning for habitat migration and identifying wildlife corridors
- identify opportunities for land acquisition to promote the protection, enhancement, maintenance and restoration of coastal environments.

Emergency response

- managing the impacts of intermittent very large events and encouraging recovery and resilience

- actions to limit the consequences of large and/or unpredicted events, such as a major coastal storm, bushfires, droughts, pollutant and oil spills, toxic algae and pathogen events, acid sulfate and low dissolved oxygen events, or sewage overflows.



Figure B3.17 Volunteers undertaking weed control, Hat Head National Park (Photo: N Cubbin/OEH)

3.6.1 Identifying and selecting strategic approaches

It is generally considered easier and more cost-effective to protect and enhance coastal ecosystems (and particularly sensitive ecosystems such as coastal lakes and lagoons) that are in good condition than to attempt to return areas in a poor condition to their natural state.

Where coastal ecosystem health is good, councils may seek to maintain and enhance this condition through **avoid** approaches. This includes recommending land use and infrastructure planning decisions that support appropriate community uses of the coastal environment and avoid irreversible impacts. **Alert** responses may also be implemented to monitor conditions and ensure communities are aware of emerging changes.

If coastal ecosystem health is poor or uses of the coastal environment are impacted by poor ecosystem health, councils may seek to improve the condition of coastal landforms and ecosystems through a range of **avoid** and **active intervention** approaches.

These may include minimising further impacts on coastal landforms and ecosystem health with recommending appropriate land use planning. Councils may also seek to reduce current pressures on ecosystem health and identify and manage future pressures.

In some situations, removing the pressure may allow the system to recover naturally; in other situations, active rehabilitation or offsets may be required. If funding for rehabilitation is limited, prioritised, staged implementation with demonstrable (measurable) outcomes to indicate progress may be appropriate.

Remediation of degraded or contaminated sites in the coastal environment area may take many years before improvements in coastal ecosystem health are measurable.

Consideration of an appropriate funding stream which can be sustained over the right timeframe for inclusion in council's Resourcing Strategy and Delivery Program.

The processes, landforms and shorelines that provide habitat for coastal ecological communities are dynamic and ambulatory. Natural systems are constantly adapting to new environmental circumstances.

Planning for change and allowing coastal environments to adapt to climate change is often a more cost-effective approach that will lead to higher value environmental outcomes. Habitat migration may be appropriate when monitoring demonstrates that change may be inevitable or irreversible.

Enabling habitat migration may be appropriate for a variety of natural coastal systems in the coastal environment area where space permits. Examples include planning to allow:

- coastal dunes to migrate landward or to be eroded
- coastal wetlands to migrate with rising water levels
- areas to be inundated more frequently
- coastal entrances to adjust their position along the shore
- floodplain wetland to change from a freshwater to a saline ecological community.

For natural areas of public land subject to long-term environmental change, councils and public authorities may seek to recommend an approach that allows natural systems and processes to continue to adapt and maintain natural functions and values.

Emergency response may be used to address residual risks and natural disasters or events. Residual risks in coastal environment areas may include short-term but significant impacts on coastal waterways, foreshores and adjacent natural areas associated with major events, including events whose impact on the coastal environment area is exacerbated by development.

Emergency responses in these locations may recommend temporary works to manage algal blooms, oil spills or storm runoff, control access, or to protect sensitive but high-value natural assets such as nesting migratory shorebirds.

The CMP may recommend coastal management actions that can be implemented by the council or other public authorities or stakeholders.

The application of the five strategic approaches to coastal environment areas is outlined in **Table B3.5** (in **Section 3.12**). Some strategic approaches will address multiple risks.



Figure B3.18 Environmentally friendly seawall made with sandstone blocks at Bobbin Head, Cowan Creek, Hawkesbury River estuary (Photo: D Wiecek/OEH)

3.7 Managing coastal use areas

Management actions for coastal use areas will focus on considering, promoting and achieving the objects of the CM Act and management objectives for the coastal use area.

Management actions that ensure that the scale and form of development is appropriate for the location, cultural and built heritage and the natural scenic quality of the coast are most suitable. It is recommended that new development incorporate quality urban design including water sensitive urban design.

Coastal management actions for this area may be designed to intend to provide adequate public open space and infrastructure for recreation, including the use of the surf zone.

Coastal use areas may overlap with coastal environment areas and coastal wetlands and littoral rainforests areas. Council may wish to consider progressing a planning proposal to amend the extent of the coastal use area maps to achieve the management objectives.

Integration and coordination of approaches for the coastal environment area and coastal wetlands and littoral rainforests areas may assist to create sustainable opportunities for socioeconomic and cultural benefits for coastal communities.

Other important considerations include recreational access, residential land value and coast-dependent economic development are closely linked to the scenic amenity, safety and accessibility of waterways, beaches, headlands, foreshores and the surf zone.

Table B3.6 (in **Section 3.12**) identifies potential management actions for coastal use areas. **Sections 3.7.1 to 3.7.3** provide further information about opportunities and management challenges.

3.7.1 Design of coastal urban areas

It is recommended that councils attempt to facilitate coastal development that is consistent with the natural and existing urban components of the coast. This can be progressed by incorporating a mix of coastal management action types in these areas including **alert**, **avoid risk**, **planning for change** and **active intervention**.

The *Coastal Design Guidelines for NSW* recommend that coastal development is designed so that it:

- is aligned with the natural form of the coast
- protects scenic amenity
- has a design and scale consistent with the natural scenic quality of the coast, its culture and heritage character and built environment character
- incorporates designs and planning requirements that protect the natural assets and social values of the coast, including water sensitive design, preventing wind funnelling, overshadowing controls and accessibility management
- includes adequate public open space in developed coastal areas, including provision for diverse recreational activities
- enhances the accessibility of beaches, headlands, foreshores and the surf zone for community recreation and enjoyment
- ensures that the design and implementation of any coastal protection works consider the direct and indirect impacts on coastal access and amenity
- minimises public safety risks to local coast users and visitors
- avoids risks associated with the impact of coastal hazards on residential, commercial and community recreation areas, now and in the future
- protects and maintains the social cohesion of coastal communities.

Linking actions through council's Community Strategic Plan, Asset Management Plan and Delivery Program may assist in achieving these outcomes. By doing this, council will also implement **alert** management approaches, as these strategic planning tools require ongoing monitoring and reporting of progress, effectiveness and outcomes.

Effective implementation will also depend on the shared recognition of the priority of coastal access and amenity issues in council and public authority management plans, such as:

- council's community development plan, recreation plan, tourism/economic development plan, or cultural plan
- regional growth plans focusing on projections of population growth and the needs of coast-dependent business, such as tourism, fishing, accommodation and services
- plans of management for coastal crown reserves and national parks.



Figure B3.19 An example of water sensitive urban design: vegetated swale with floodway, Bankstown (Photo: P Vella/OEH)

3.7.2 Managing coastal heritage

Coastal management actions that aim to protect coastal heritage values and Aboriginal sites or places in a CMP may relate to archaeological sites or the maintenance or restoration of the values of a coastal Aboriginal cultural landscape that supports the continuing practice of cultural activities, teaching and knowledge transfer. It is recommended that any such coastal management actions be developed in close consultation with the relevant Aboriginal community members.



Figure B3.20 Dark Point Aboriginal Midden Site protected area, Myall Lakes National Park
(Photo: J Spencer/OEH)

The CMP may also include management responses for other coastal heritage items such as shipwrecks, lighthouses, wharves, boatsheds and geological features, subject to consultation with the relevant authorities. There are also some use-related reserves, such as the national surfing reserves, that may be important considerations of management of heritage issues.



Figure B3.21 Shipwreck near Woolgoolga (Photo: R Cleary Seen Australia/OEH)

The CMP may propose amendments to existing Local Environmental Plans (LEPs), Development Control Plans (DCPs) and plans of management for reserves and places with cultural and heritage values, to better manage issues such as:

- the impact of uncontrolled access and use
- appropriate land use zoning to protect coastal heritage
- coastal hazards affecting the cultural and heritage values.

Opportunities may be identified to maximise linkages between the CMP and Aboriginal and non-Aboriginal cultural, historical or social heritage plans pertaining to the area. These links may be established through the council's Community Strategic Plan and specified in its Delivery Program.

In developing coastal management actions, an important consideration may be aligning with or enhancing heritage management programs for the heritage item. Effective implementation of heritage protection or management responses depends on integration of local and state level programs and priorities, so consultation with relevant public authorities is recommended.



Figure B3.22 Heritage boatsheds at Forsters Bay, Narooma (Photo: J Spencer/OEH)

3.7.3 Promoting and managing recreational uses

The CMP may include coastal management actions to maintain and enhance public access, amenity, use and safety in the coastal zone. Coastal management actions may be selected from **alert**, **avoid risk** and **active intervention** approaches and include projects which:

- protect and improve public access to beaches, headlands, waterways and surf breaks and associated viewing points
- provide access to areas of local biodiversity, scenic or heritage significance including wetlands and littoral rainforest, where appropriate
- improve beach amenity through beach nourishment, scraping and dune reshaping activities
- maintain visual and recreational amenity through appropriate design and siting of facilities
- propose new or upgraded swimming enclosures, coastal walking tracks, boat launching ramps, pontoons and jetties
- manage the interaction between active and passive recreational users
- manage impacts of recreational uses on waterways including moorings, boat cleaning activities, effluent, fishing line, litter and plastics
- manage the impacts of recreational access and use on beaches, headlands and dunes
- improve the safety of recreational users such as surfers, swimmers, paddlers, boaters and rock fishers
- improve navigation and boating safety, including dredging and upgrading breakwaters and port facilities

- raise public awareness about the safety risks of coastal areas including large waves, rips, strong currents, marine stingers and sharks, and appropriate responses
- create opportunities for enhancing recreational tourism, such as new national surfing reserves, lookouts, walkways, marinas and other facilities.

The CMP may, in consultation with the relevant public authority, recommend the preparation of new or updated plans, or highlight matters which need further investigation by public authorities. This may include recommending the preparation of or revision of boating management plans or plans of management for public lands.

The CMP may propose changes to the management of land by other public authorities when that management has impacts on, or implications for, land managed by council.

The CMP may also identify recommended linkages and opportunities for integration with statewide programs for essential infrastructure, such as roads, ports and sewerage systems.



Figure B3.23 Cape Byron headland walk, Byron Bay (Photo: M Vanderveer/OEH)



Figure B3.24 Marinas and slipways are regulated by the EPA (Photo: W Wickremeratne/OEH)

3.8 Evaluating management actions

Councils are advised to undertake a structured and transparent evaluation process to select and adopt the most appropriate coastal management actions. This will assist relevant stakeholders to understand the process.

It is recommended that proposed coastal management actions be evaluated in relation to feasibility, viability and acceptability. These evaluation steps would normally be conducted sequentially.

The evaluation of coastal management actions may involve multi-criteria analysis (MCA) or similar methods to evaluate feasibility or acceptability. A range of economic assessment methods (from simple economic assessment to cost-benefit analysis) can be used to determine viability.

Figure B3.25 shows how the staged evaluation combines to help councils identify a program of coastal management actions for their local area.

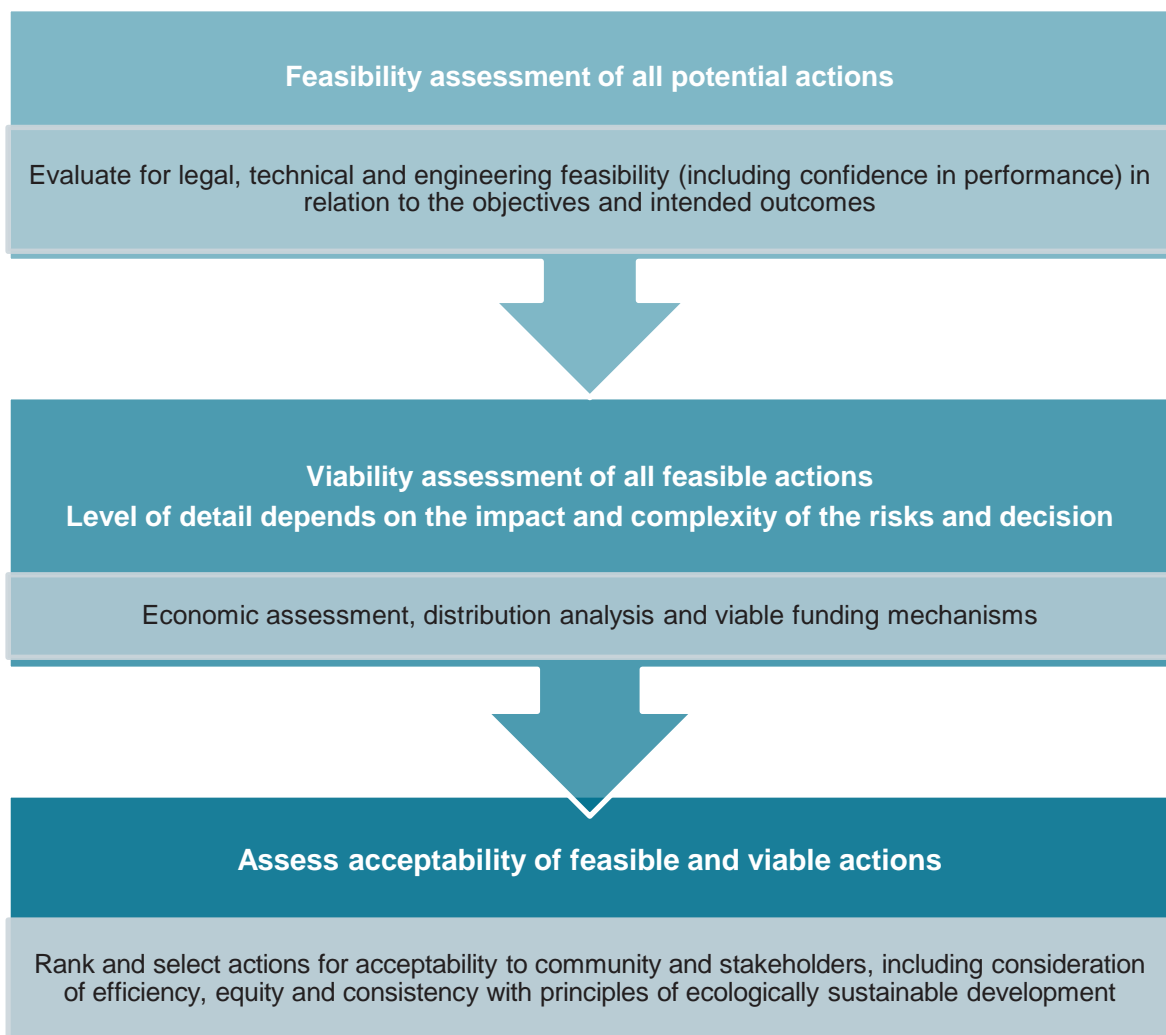


Figure B3.25 Staged option evaluation process

3.8.1 Assessing feasibility

Feasible coastal management actions are those which:

- are consistent with the objects of the CM Act and management objectives of the coastal management areas
- comply with statutory and policy requirements at local, state and Commonwealth levels
- are environmentally acceptable and consistent with Ecologically Sustainable Development (ESD) principles
- are feasible in engineering terms, i.e. a structure can realistically be built, given the local process context
- can address the identified issues, mitigating risks or enhancing opportunities, based on previous experience
- are adaptive and can transition to alternative approaches when circumstances change
- are broadly able to be implemented, in terms of available capacity and capability
- are likely to contribute new knowledge about effective management; for instance, a response that is structured as a carefully controlled trial of new technology.

When evaluating the feasibility of a coastal management action, councils may also consider:

- the timeframe over which the effectiveness of an action can be maintained
- evidence from application of the action in similar situations
- the limits to effectiveness (e.g. a threshold event in which a response will fail)
- the potential for any unintended or unanticipated negative consequences (sometimes referred to as perverse outcomes)
- the irreversibility of some actions that predetermines the future action or pathway
- the level of expertise required to evaluate the design, implementation, monitoring and review of actions
- whether the selection of a strategy allows for adaptive management.

It is important to recognise that some actions will create a path dependency that reduces the ability to adapt when certain environmental, social or economic thresholds are exceeded. For example, extensive investment in protect actions over the next decade may limit the ability to transition to alternative adaptation options when the protect pathway is deemed unsustainable. **Section 3.9.1** provides further information on adaptive management.

3.8.2 Evaluating viability through economic assessment

Economic assessment approaches can help decision-makers better understand the socioeconomic implications of adopting different management actions and help them to make choices about which actions will provide net benefits to the community. This information will also assist in developing a business plan and determining cost-sharing arrangements (see **Section 3.10** for further details).

The scope and level of detail included in an economic assessment will be proportionate to the nature and scale of the coastal issue(s) being addressed. Detailed cost-benefit analysis (CBA) is not warranted for projects that are only expected to have minor costs and/or benefits for a very limited number of parties.

Coastal management actions which will operate over relatively long timeframes, including engineering works with long design lives, are likely to affect a range of stakeholders, and

generate potentially large direct and indirect costs and benefits. A detailed CBA for such large-scale or long-lasting actions will determine whether the benefits outweigh the costs.

Figure B3.26 provides guidance for selecting the appropriate level of economic assessment, based on a matrix of risk and complexity. There are three levels of assessment:

- simple economic assessment when the risk, impact and complexity are low
- intermediate level where either risks or complexity are high, data are available or specific issues need more detailed consideration
- CBA when the risks, impacts and complexity are high.

		Complexity	
		Low	High
		<ul style="list-style-type: none"> • Limited number of stakeholders. • Little or no quantitative data. 	<ul style="list-style-type: none"> • Disagreement or conflicting views among stakeholders. • Difficulty defining beneficiaries or apportioning costs. • Good quantitative data.
Risks and impacts	<p>Low</p> <ul style="list-style-type: none"> • Limited spatial scale • Low-risk and low impact 	<p>Simple economic assessment</p> <p>These assessments ask similar questions as the more complex analysis, but use qualitative analysis and expert opinion rather than quantitative data.</p>	<p>Intermediate level assessment</p> <p>These assessments ask the same questions as the more complex analysis, but may use detailed costings.</p>
	<p>High</p> <ul style="list-style-type: none"> • Addressing high or extreme risks • An option involves major investment (see Treasury Guideline 2017) 	<p>Intermediate level assessment</p> <p>Monte Carlo modelling or significant social analysis may not be necessary, but some detailed costing, e.g. for maintenance, is required.</p>	<p>Detailed cost-benefit analysis</p> <p>This may involve a systematic comparison of all foreseeable costs and benefits and the probability that they will arise over the planning period.</p>

Figure B3.26 Matrix of risk and complexity for selecting the level of economic assessment

It is recommended that councils provide a clear statement that assists the community to understand the benefits of a management response (why it should be done) and any constraints or side effects that would need to be managed.

The economic assessment may assist to identify:

- the cost of the action
- the distribution of costs and benefits of coastal management options to different stakeholders
- any proposed cost-sharing arrangements and funding mechanisms
- whether proposed management actions are affordable.

Consideration of potential benefits and costs includes environmental and social values as well as financial implications. Estimates of social and environmental values such as

ecosystems services can be considered using a range of qualitative and quantitative approaches.

In designing the assessment, an important consideration may be to provide an appropriate level of rigor, transparency and discriminating power to reflect the complexity and impact of the decision to be made. Another important consideration will be the levels of uncertainty and availability of quantitative data.

When undertaking an economic assessment, councils may be required to identify the full capital, operational and ongoing maintenance costs of potential management actions. The value of benefits is to be estimated in dollar terms, where possible.

An analysis of the distribution of the costs and benefits to council, public authorities, stakeholders and the environment is recommended. When undertaking this analysis, an important consideration will be the capacity of beneficiaries to pay when apportioning the costs.

It is also important to determine the viable funding mechanisms that are consistent with their IP&R Resourcing Strategy and any other source of funding. This includes consideration of the timing of the funding to ensure delivery of the action.

Cost-benefit analysis

CBA is an economic assessment approach which can be used to compare options and assist councils to make complex decisions when risks and impacts are high and costs and benefits can be quantified.

A CBA can be used to estimate changes to the economic wellbeing of local and wider communities. A CBA is used to estimate and compare the costs and benefits of implementing a proposed project or management activity with the costs and benefits of a base case, which represents a continuation of current conditions under which the proposed project/policy is not implemented.

CBAs tend to be data-intensive, require higher level technical skills, and may take longer to prepare than the simpler, rules-based economic assessments. However, they provide rigorous, defensible outcomes for complex high-risk decisions.

Where there is uncertainty as to whether the impact or complexity is sufficient to warrant a detailed economic appraisal, councils may seek advice from the Office of Environment and Heritage.

Important considerations in a detailed cost-benefit analysis include:

- the coastal management issues that are being addressed in a CMP
- a socioeconomic profile of the local government area's community
- a profile of the environmental values of the subject area (including amenity and recreational values)
- a base case representing a continuation of current management approaches
- alternative actions for achieving the desired objective
- the key features of the base case and each alternative, and their costs and benefits
- the results of the economic analysis of the base case and alternatives, clearly describing the assumptions used, and showing their estimated net present values (NPVs) and benefit-cost ratios (BCRs)
- conclusions about the preferred option, as demonstrated by the analysis
- a distributional analysis of the allocation of the costs and benefits of the preferred option
- a description of costs and benefits which cannot be quantified, and other material which may inform council's decision-making.

3.8.3 Assessing acceptability and selecting responses

The final step in the evaluation process is to determine which of the feasible and viable coastal management actions are recommended to be included in the CMP. This involves consulting with the community and stakeholders to determine the acceptability of the actions.

Proposed coastal management actions may be assessed in terms of:

- consistency with the objectives of the CM Act and council's long-term strategic direction
- public interest and wider public benefit
- effectiveness in reducing risks and threats
- whether the action is proportional to the level of risk
- sustainability
- potential impacts and their distribution
- value for money and efficient use of resources
- timeliness
- fairness and equity
- community cohesion and resilience.

Transparency, objectivity and clarity are important considerations when designing the assessment framework. The use of techniques such as multi-criteria analysis and paired comparison analysis may complement the economic assessment.

3.9 Linking management responses over time

3.9.1 Adaptive management

An adaptive management approach can be used where an action is required now but there is uncertainty about future conditions including climate change, or disagreement about which action should be taken.

Adaptive management is not the same as trial and error. It is a systematic approach for improving coastal management by learning from the outcomes of previous actions.

Adaptive management recognises explicitly that the coast is a dynamic environment; that uncertainty will vary over time (generally increasing for events that are further into the future); and that agreed goals may also change over time.

It involves monitoring and reviewing the effectiveness of actions against expected performance to increase knowledge and certainty. This will allow councils to refine management responses and maximise environmental, social and economic benefits over time.

Clear communication during the adaptive management process can help reduce resistance and prepare the community for change by linking management decisions to evidence that agreed thresholds have been met.

Effective adaptive management depends on:

- clear definitions of the overall vision, objectives (acknowledging that both may change at some future time) and acceptable outcomes
- specific management actions, with timeframes and measurable performance criteria

- targeted monitoring of trends in environmental condition and of the performance of specific responses, i.e. it is intended to be evidence-based
- clear thresholds and triggers for change (see **Section 3.9.2**).

Adaptive pathways may be specified in advance (e.g. when this threshold is passed council is committed to change management to a predetermined new response), or may be left open and subject to a review when the threshold is approaching.

This approach recognises uncertainty and provides longer-term flexibility. Adaptive approaches require continuity of management responsibility, to enable changes in the risk to be monitored and intervention to occur as triggers are reached.

A more precautionary approach with a one-off intervention may be necessary where it is not possible to adapt with multiple interventions due to technical feasibility or where adaptive management is too complex to administer. **Figure B3.27** outlines the difference between a one-off intervention and an adaptive approach.

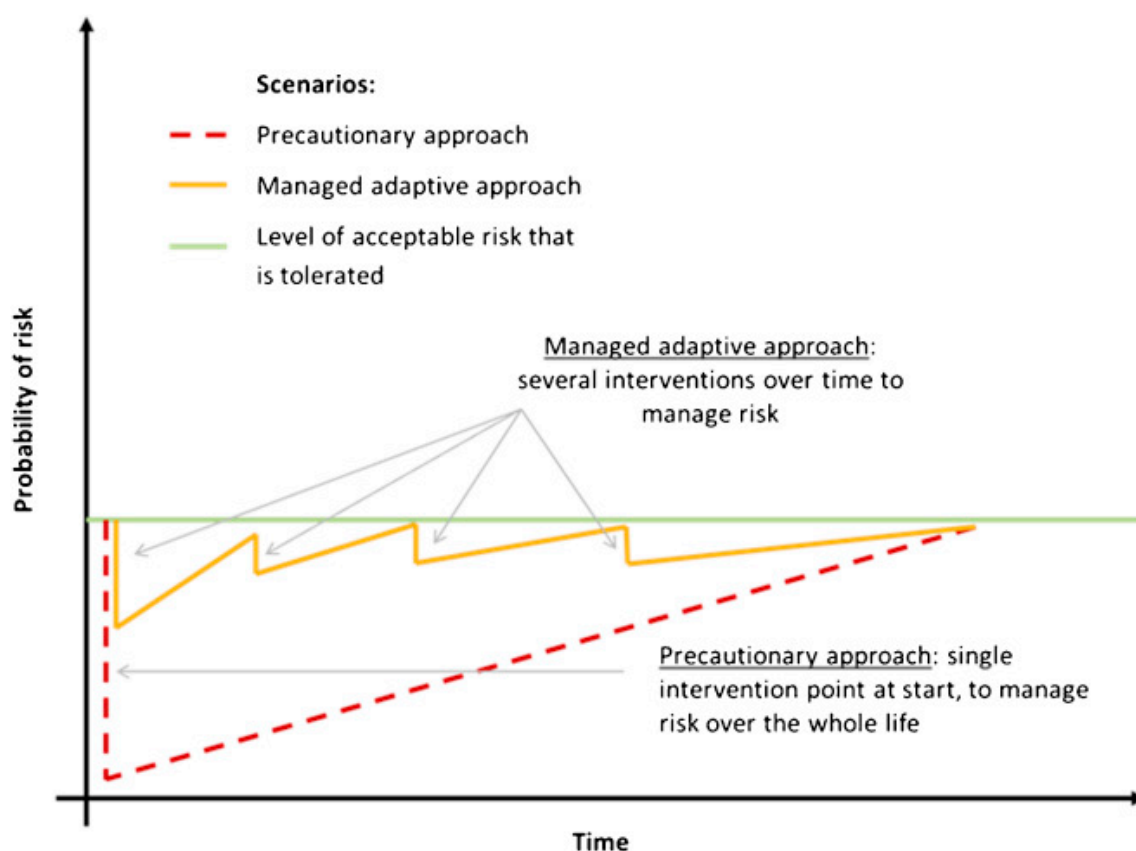


Figure B3.27 Alternative precautionary and managed adaptive approaches to risk-based management (Source: After Defra (2009: 23), used under open access licensing)

It will be important to consider linkages between the CMP and their broader climate change adaptation plans to strengthen community resilience. Community consultation during the preparation of adaptation plans may assist to:

- build goodwill and a collaborative approach
- test values, objectives, feasibility and viability of potential actions
- prepare an agreed schedule of actions and thresholds.

This intensive engagement practice is a key task to incorporate into the council's Delivery Program and Operational Plans.

Important considerations in preparing adaptation plans include:

- increased frequency and timing of inundation of coastal infrastructure utilities
- increased maintenance costs for roads and pavements as they are affected by coastal erosion, elevated groundwater levels or salt water inundation
- uncertainty about the longevity of existing coastal development and appropriate ground levels, floor levels, building design and land use planning for areas that are vulnerable to coastal hazards
- uncertainty about how, and at what cost, safe coastal access will be maintained when access ways (to the shore and along the shore) are impacted by coastal hazards and climate change.

The preparation of a climate change adaptation plan enables communities to make choices about coastal management actions and how they will impact on the local population. This includes the implications for the resilience and viability of the community and community services such as public transport, medical facilities and shops.

3.9.2 Using thresholds and triggers

Thresholds are the point when irreversible change is likely to occur, risks become unacceptable and the current management response will no longer be effective.

An ecological threshold may be a tipping point where irreversible change (decline) occurs to the structure, functioning and resilience of an ecosystem. A physical threshold may be a point where natural defences are no longer effective in managing the risk of coastal erosion.

In a community context, a threshold can be the point where a building becomes uninhabitable due to safety concerns, or a village or small town is no longer viable through functional failure of essential infrastructure, or loss of employment opportunities or population.

A trigger is an incident or occurrence that initiates other events. In the case of decision-making, a trigger is used to indicate when a management response is required and/or an action should be implemented.

When applying an approach that takes uncertainty into account when determining thresholds and triggers, it is important to identify:

- what is natural variability and what is outside the normal range, based on monitoring
- when affected owners or the community will be notified that a change of management may be required
- when to start preparing for a new management response, allowing sufficient lead time for analysis, design, consultation and allocating funding in the Resourcing Strategy and Delivery Program
- when the new management response will be implemented.

Generally, physical rather than time-based triggers are preferable as they are based on actual events rather than uncertain predictions. Triggers can be controversial and community members may have different views about where the trigger should be set, so engagement is necessary to identify an acceptable balance.

Where exceeding a threshold is likely to have significant resourcing implications for councils, it may be important to consider their likely occurrence within the Resourcing Strategy and Delivery Program review cycle.

3.10 Business plan for implementing the CMP

3.10.1 Requirements of the business plan

A business plan will be included in the CMP. This will outline the full cost of the program, cost-sharing arrangements, funding and financing mechanisms and scheduling of implementation.

The information compiled in Stage 3 may include:

- The full capital, operational and maintenance costs of the coastal management program.
- The distribution of costs and benefits of the management program. The distribution analysis may consider council, public authorities, directly affected stakeholders (such as landholders in coastal hazard areas), indirectly affected stakeholders, and the environment.
- How funding and financing for the CMP will be secured for short, medium and longer-term actions, including capital works and ongoing maintenance obligations.
- How the council will work with public authorities, adjacent councils, private landholders and the broader community to manage the costs of investment in coastal issues, scheduling of activities and the delivery of local and regional benefits.

3.10.2 Funding and cost-sharing principles

Best practice cost-sharing arrangements reflect the benefit derived from coastal management actions, minimise cross-subsidies, and avoid additional burden on taxpayers and ratepayers.

It is important that the equity of cost-sharing arrangements is considered and documented. The mechanisms used to enable cost-sharing will be most acceptable where they are efficient, transparent to the community and relatively easy to understand.

It is recommended that councils consider the following seven principles when recommending the appropriate allocation of costs associated with coastal management actions (**Table B3.1**).

Table B3.1 Cost-sharing principles for coastal management

Principle	Definition
Aligned with local and strategic objectives	Cost-sharing is consistent with the agreed strategic management direction for that part of the coast and consistent with other government objectives at the state and local level.
Reflects benefit derived	Cost-sharing has regard to the beneficiaries of the action and the relative benefits enjoyed by each party. Where only private benefits are derived and the capacity to pay is limited, consideration is given to whether the investment is in the public interest and whether greater public benefit could be derived from (Australian, state or local government) investment in other issues or approaches.
Reflects full capital expenditure and operational expenditure of the option	Where practical to do so, cost-sharing arrangements recover all costs associated with coastal management activities and ensure adequate resources are allocated to enable effective action.
Minimises cross-subsidies	Costs are shared based on direct impacts and at a level that is proportional to the resources devoted to delivering actions.
Encourages efficient costs	The level and structure of costs are based on the most efficient and effective way of delivering actions.
Simple and predictable	The cost-sharing mechanism is simple to administer and monitored against results. It is consistent with public policy directions on expenditure.
Effective implementation	Cost-sharing arrangements are decided in consultation with relevant parties (including other councils, public authorities, private landholders and the community), to be transparent and be reviewed regularly.

3.10.3 Funding contributors

There is likely to be a mix of contributors to the costs of implementing a coastal management program. A distribution analysis may help councils to identify how the benefits of coastal management actions are shared and the capacity of beneficiaries to pay. The range of potential funding contributors could include:

- the broader community
- people who live in the local council area
- property owners who will directly benefit from coastal management actions
- people who use the coast
- stakeholders from outside the council area
- coast-dependant businesses
- councils and public authorities including land managers, asset owners and service providers
- public authorities involved in emergency management
- Commonwealth Government where there are national benefits.

The role of each of these groups in the implementation of a CMP will vary depending on the nature of the coastal management actions proposed and who benefits from those actions. A CMP business plan may also identify the intended and actual contributions.

Funding approaches will vary between CMPs, and councils may need to use a mix of mechanisms to enable cost-sharing and securing of funds from the relevant groups.

A cost-benefit analysis and distributional analysis may assist councils to identify the mix of contributors and determine equitable contributions to be included in the business plan.

3.10.4 Funding and financing options

A range of funding and financing mechanisms are available to enable councils to resource the cost of implementing coastal management actions consistent with agreed cost-sharing arrangements. These include local rates, levies, charges, developer contributions, low-interest loans and grant schemes.

Borrowings are a primary financing mechanism used by councils. Where this is used, the project may be self-sufficient with an adequate income/funding stream to support loan repayments.

Under Section 495 of the *Local Government Act 1993*, a council can levy a special rate for meeting the cost of any works, services, facilities or activities provided or undertaken, or proposed to be provided or undertaken, by the council, within the whole or any part of the council's area.

This mechanism may be used by councils in certain circumstances to secure reasonable and proportionate funding from private beneficiaries for the cost of implementing coastal management actions such as constructing, maintaining and repairing coastal protection works.

Councils must consult, and reach an agreement, with public authorities if the CMP recommends any:

- proposed actions or activities to be carried out by that public authority; or
- relates to, affects or impacts on any land or assets owned or managed by that public authority; or
- proposes specific emergency actions, activities or works to be carried out by that public authority under the coastal zone emergency action subplan.

A CMP must not include proposed actions or activities to be carried out by a public authority or relating to any land or other assets owned or managed by a public authority unless the public authority has agreed to the inclusion of those proposed actions or activities in the program.

3.10.5 Other mechanisms to support CMP implementation

Councils are encouraged to consider opportunities to:

- reduce costs by cooperating with councils that have similar requirements, such as major beach nourishment programs
- leverage effort where consistent approaches are required across local government boundaries and/or economies of scale could produce opportunities to reduce costs
- coordinate state and local government programs

- build resilience and mitigate risks, in preference to relying on emergency management actions.

For example, dredging to improve navigation may provide opportunities for local councils and public authorities to work together to identify beneficial reuse of the dredged material such as beach nourishment programs.

Volunteers also make a substantial in-kind contribution to coastal planning and management. Coordinated volunteer programs create opportunities to raise community awareness, undertake citizen science programs, restore degraded habitats and build commitment to sustainable coastal management.

Examples of volunteer programs include beach monitoring, the Witness King Tides photography project and monitoring and restoration programs for estuary water quality, migratory waders, coastal wetlands, dunes and coastal biodiversity.



Figure B3.28 Citizen science is an important tool helping to fill knowledge gaps (Photo: P Robey/OEH)



Figure B3.29 Community conservation volunteers heading from Birchgrove to Goat Island Sydney Harbour National Park (Photo: Rosie Nicolai)

3.11 Moving to Stage 4

At the end of Stage 3, councils will have identified preferred coastal management actions in consultation with stakeholders and the community.

Information documented through Stage 3 of Part B of the manual may include:

- an outline of the methods used to identify proposed coastal management actions
- an overview of all proposed coastal management actions considered and their advantages and disadvantages
- the criteria and process used to evaluate proposed coastal management actions, including any assumptions
- the outcomes of the evaluation and preferred proposed coastal management actions
- priorities, timing and adaptation pathways
- a business plan which includes an economic assessment and the distribution of the costs and benefits.

3.12 Compendium of strategic approaches and management actions

Table B3.2 Strategic approaches and examples of responses for coastal wetlands and littoral rainforests

Broad risk management concept	Strategic approach	Examples of this approach for coastal wetlands and littoral rainforests
<p>Alert – includes low regrets, watch and wait, preparing for change and research to improve knowledge.</p>	<p>This approach is broadly equivalent to maintaining the current management, but also acknowledges the potential for change that will require active intervention once thresholds have been reached.</p>	<p>Monitor changes in water levels, flows or water quality and ecosystem responses in coastal wetlands.</p> <p>Monitor changes in invasive species in coastal wetlands and littoral rainforests.</p> <p>Monitor wetland or rainforest responses to increasing threats and hazards.</p> <p>Regular consultation and information for stakeholders.</p> <p>Preparation within council for change including policy development, defining thresholds for intervention or forward budget planning to set aside funds for expected future intervention and adaptation.</p> <p>Investigate opportunities for new solutions or improved options for sustainable management of emerging or complex threats such as potential impacts of climate change including sea level rise, impacts on species and ecosystem distribution, and opportunities for the migration of mangroves and saltmarsh as water levels rise.</p> <p>Assessment of impact of extreme heat days or changes to storminess on coastal wetland and littoral rainforest communities.</p>
<p>Avoid future impact.</p>	<p>For coastal wetlands and littoral rainforests, this includes considering the natural migration of habitats.</p>	<p>Recommend zoning measures, tenure arrangements or removal of barriers that prevent the migration of coastal wetlands or littoral rainforests in response to changing water levels or rainfall/storm patterns.</p> <p>Recommend inclusion of the coastal wetlands or littoral rainforests in a national park or state conservation area.</p> <p>Recommend the creation of and maintenance of buffers and manage them to benefit the connectivity or function of coastal wetlands and littoral rainforests.</p> <p>Recommend the prevention of the expansion of development.</p>
<p>Active intervention – includes accommodate (accept changes to the condition of coastal wetlands and littoral rainforests), protect ecological communities</p>	<p>These responses are all forms of risk mitigation, generally intended to improve the resilience of coastal wetlands and littoral rainforests to the diverse threats, and risks identified in Stage 2.</p>	<p>Recommend the prohibition of certain types of development in the catchment to protect coastal ecosystems.</p> <p>Restore tidal circulation to coastal wetlands.</p> <p>Wetland restoration.</p>

Broad risk management concept	Strategic approach	Examples of this approach for coastal wetlands and littoral rainforests
and processes, or improve the condition of coastal wetlands and littoral rainforests.	In general, these responses are designed to achieve existing objectives and maintain existing operating models; however, in some cases, the management response will result in directed transformative change.	Manage acid sulfate soils. Change mowing and clearing practice around coastal wetlands. Weed management programs to enhance resilience. Improve fire management. Change stormwater quality or quantity entering a coastal wetland.
Planning for change – or accept change and allow processes and communities to evolve and adapt.	This approach acknowledges that for some coastal wetland and littoral rainforest areas the cost of intervention is very high and the certainty of improved outcomes is low. It allows undirected transformative change of natural systems.	May be used in coastal national parks, allowing shoreline change to progress without intervention.
Emergency response	Plan for occasional large events, hazards or incidents that will require coordinated actions to protect the values and functions of wetlands and littoral rainforests.	Hazards could include extreme heat periods, bushfire, algal blooms, plant diseases, etc.

Table B3.3 Strategic approaches and examples of responses for coastal vulnerability areas

Broad risk management concept	Strategic approach	Examples of this approach for coastal vulnerability areas
Alert – includes low regrets, watch and wait, preparing for change and research to improve knowledge.	Implement strategies that are cost-effective now whether hazards or change occur or not. All risk profiles from very low to extreme, and all existing and future land use contexts, as an adjunct to other approaches. May be the primary response when risks are low. Seldom sufficient in high-risk situations.	Watch (monitor) and review. Maintain and enhance awareness. Community education. Natural defences. Dune management in accordance with the Dune Management Manual. Managing public access. Beach scraping. Public access ways. Riparian management. See Section 3.5.1 .
Avoid risk through recommending changes to land use planning provisions	Act to reduce future risk, for example: <ul style="list-style-type: none"> • where moderate to extreme risks are associated with coastal hazards • in greenfield development areas • where there is potential for an escalating long-term risk profile if avoidance actions are not implemented. 	Land subject to threats, and not currently developed, may be maintained in open space. Recommending changes to zoning controls and location of new assets outside areas that are, or are expected to be, (at specified probability) exposed to coastal hazards. Strategic planning to ensure high impact or intensive recreational use to avoid sensitive areas. See Section 3.5.2 .
Active intervention	Accommodate risk – recommended actions to reduce immediate to medium-term consequences,	Short and medium-term risks are tolerable.

Broad risk management concept	Strategic approach	Examples of this approach for coastal vulnerability areas
	<p>maintaining the current land use and settlement structure.</p> <p>Recommend changes to zoning to facilitate sustainable and adaptive coastal management.</p> <p>Recommend structural protection works and actions that aim to reduce likelihood of risk now, by protecting the relevant parts of the coastal vulnerability area. This may be achieved by placing a physical barrier between the asset and coastal processes, subject to the requirements of sections 27 and 28 of the CM Act.</p>	<p>Recommendation of landfilling, house raising and flood proofing in the case of coastal inundation where appropriate.</p> <p>Recommend development controls for infill and redevelopment of existing development areas, and recommend need for any notifications on land titles.</p> <p>Recommend tenure arrangements that do not sterilise land use in the short to medium-term.</p> <p>Moderate to extreme risks, such as localities affected by hazards, but with regionally significant assets, assets that cannot reasonably be relocated or high-value assets where the cost of protection can be justified and where the social and environmental impacts from protection, may be managed. Examples may include recommending beach nourishment, seawalls, revetments and groynes.</p> <p>See Section 3.5.3.</p>
Planning for change	<p>Where other protect or accommodate options are not viable, it may be appropriate to take actions to reduce likelihood or consequences of coastal hazards.</p>	<p>Recommend removing or relocating existing assets to less vulnerable areas.</p> <p>Recommend planning controls to encourage appropriate development that is compatible with the hazards and risk.</p> <p>Recommend reduced development intensity where no alternatives are available and/or down-zoning to ensure more appropriate forms of land use.</p> <p>See Section 3.5.4.</p>
Emergency response	<p>To control risk until management strategies have been implemented or to manage the residual risk when all viable strategies have been implemented.</p> <p>Aim to protect public safety and to ensure that ad hoc protection does not pose a threat to safety or detract from beach amenity or access.</p>	<p>Emergency response is aimed at protecting public safety including people using public spaces and those whose properties are impacted by coastal hazards. It is primarily the responsibility of emergency services. The role of councils is to prepare a coastal zone emergency action subplan.</p> <p>See Section 3.5.5.</p>

Table B3.4 Coastal protection options relating to different coastal hazards

Hazard	Coastal protection options
Beach erosion	<ul style="list-style-type: none"> • Maintain natural defence processes on beaches, dunes and foreshores, including beach scraping (if beach scraping is proposed consultation with land managers such as the National Parks and Wildlife Service (NPWS) or Department of Industry – Lands (DI – Lands) will be required). • Maintain coastal wetlands, reed beds, mangroves and riparian vegetation on estuary foreshores to buffer against wave impacts on foreshore stability and amenity. • Sand relocation using sources such as beneficial reuse of sand dredged from the entrance of an estuary or coastal lake. • Beach nourishment using terrestrial or offshore sand sources.

Hazard	Coastal protection options
	<ul style="list-style-type: none"> • Seawalls and revetments. • Groynes. • Offshore reefs. • Sand bypassing and back-passing systems.
Shoreline recession	<ul style="list-style-type: none"> • Maintain natural defence processes on beaches, dunes and foreshores, including beach scraping (if beach scraping is proposed consultation with land managers such as the NPWS or DI – Lands will be required). • Sand relocation using sources such as beneficial reuse of sand dredged from the entrance of an estuary or coastal lake. • Beach nourishment using terrestrial or offshore sand sources. • Seawalls and revetments. • Groynes. • Sand bypassing and back-passing systems.
Coastal lake or watercourse entrance instability.	<ul style="list-style-type: none"> • Entrance training (rock training walls) to prevent migration. • Berm management (raising or lowering), using reshaped sand (sometimes obtained from dredging of the bar). <p>See also coastal environment areas for information about the interaction between entrance condition and the health of coastal lakes, including the importance of preparing an entrance management plan for coastal lakes which close intermittently, and linking entrance management to other measures which can mitigate impacts such as flooding.</p>
Coastal inundation	<ul style="list-style-type: none"> • Dune reshaping and nourishment to raise crest height. • A seawall or revetment may be designed with a crest height that limits the likelihood of wave overtopping and therefore is also likely to reduce consequences by limiting flow velocities or depths.
Coastal cliff or slope instability.	<ul style="list-style-type: none"> • Maintain or restore coastal vegetation on poorly consolidated materials. • Drainage works. • Shot-creting, rock bolting and catch fences. • Remove unstable materials.
Tidal inundation	<ul style="list-style-type: none"> • Maintain coastal wetlands, reed beds, mangroves and riparian vegetation on estuary foreshores to buffer against wave impacts on foreshore stability and amenity. • Foreshore levees or other reshaping. • Filling of land. • Floodplain drains and floodgates on stormwater drains and small coastal creeks. • In limited circumstances, consider dredging entrance areas and deltas.
Erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.	<ul style="list-style-type: none"> • Foreshore levees or other reshaping. • Seawall or revetment. • Cobble foreshores.

Table B3.5 Strategic approaches and examples of responses for coastal environment areas

Broad risk management concept	Strategic approach	Examples of this approach for coastal environment areas
Alert – wait and see, prepare for change and research to improve knowledge.	<p>Suitable for areas that are in good condition.</p> <p>Coastal land or waters that have high biodiversity conservation value may be</p>	<p>Recommend revisions to zoning.</p> <p>Recommend the location of new development outside the catchments of coastal lakes and estuaries that are particularly vulnerable to elevated sediment</p>

Broad risk management concept	Strategic approach	Examples of this approach for coastal environment areas
	<p>managed to protect and enhance coastal biodiversity values.</p> <p>The alert approach acknowledges the potential for change, and that more active intervention may be required.</p> <p>Apply best practice solutions, monitor and prepare for change.</p>	<p>or nutrient loads; or place strict controls on water quality and quantity discharged from development in these catchments.</p> <p>Water sensitive urban design in new and redevelopment areas.</p> <p>In some cases, consider and recommend if appropriate the transfer of small parcels of council land to the management of NPWS or a state conservation area, to enhance connectivity, or to protect a specific habitat.</p> <p>Monitoring and evaluation of condition indicators, for instance using report cards.</p> <p>Consider actions to support:</p> <ul style="list-style-type: none"> • meeting targets in Local Lands Services (LLS) strategies • water quality objectives in the NSW Oyster Industry Sustainable Aquaculture Strategy. <p>Set standards for water quality where catchment flows enter the estuary or coastal lake and require new development to demonstrate that these standards can be achieved and maintained.</p> <p>Set thresholds and triggers for more active intervention.</p> <p>Conduct stakeholder and community awareness and knowledge enhancement programs.</p>
<p>Avoid future impacts on coastal environment areas and create opportunities.</p>	<p>For coastal environmental areas, this includes enabling habitat migration.</p>	<p>To help mitigate longer-term risks associated with climate change, councils may identify land that is required for the migration of important coastal ecological communities, such as foredunes and saltmarsh around estuaries, as water levels rise. They may consider and recommend changes to land tenure, where possible, and recommend changes to current zoning as necessary to allow migration or transgression of coastal morphological features.</p> <p>Consider and recommend changes to current zones (and consider whether it is more appropriate to use E zones or W1 or W2 zones).</p> <p>Consider and recommend changes to development controls in the Development Control Plan (DCP) to lessen the impact of urban expansion into coastal environment areas and the ongoing impacts of urban development and intensive recreational use on coastal environment areas.</p> <p>Studies completed in Stage 2 of Part B of the manual may identify new sites where the coastal values recommend changes to the zoning or the DCP.</p> <p>Recreational access controls and management to avoid impacts on</p>

Broad risk management concept	Strategic approach	Examples of this approach for coastal environment areas
		Endangered Ecological Communities (EEC) and other ecological communities in certain circumstances.
Active intervention	<p>These responses are all forms of threat and risk mitigation, generally intended to improve the resilience of coastal environment areas to the diverse pressures, threats, vulnerabilities and risks identified in Stage 2. A wide range of measures may be recommended to mitigate medium to high risks, depending on the specific type of coastal environment area and the specific risks to be managed.</p> <p>Active intervention may be recommended to maintain existing values, objectives, systems and models, or to support transformation of a natural landscape when pressures and risks cannot be mitigated within the existing model.</p>	<p>Recommending retrofitting improved stormwater treatment and drainage controls such as opportunities for constructed wetlands and sediment traps to address legacy issues from existing development.</p> <p>Riparian and foreshore rehabilitation and protection (e.g. buffer areas).</p> <p>Improved effluent management (e.g. sewage treatment plants, dairy effluent).</p> <p>Protection of seagrass through regulation of mooring design and location.</p> <p>Intermittently closed and open coastal lake or lagoon (ICOLL) entrance management plans and triggers for opening.</p> <p>Incorporation of habitat features into existing or proposed seawalls.</p> <p>Rationalising uncontrolled public access.</p> <p>Recommending habitat migration of elements of the coastal environment area can also be used when land uses are having an unacceptable impact on the condition and system integrity of a coastal wetlands and littoral rainforests area or a coastal environment area. In the short-term, this could include recommended actions such as identifying a perimeter area, not cultivating a riparian area, or removing livestock from a riparian area or coastal floodplain.</p>
Planning for change – allow trends and changes to take their course with minimal additional intervention.	This approach acknowledges that for some areas the cost of intervention is high and the certainty of outcomes is low. The response involves allowing a transformation of the coastal environment area to take place, with limited control.	<p>Where coastal environment areas are severely degraded and cannot be rehabilitated without significant impacts on resources or other values.</p> <p>On dynamic and ambulatory shorelines, allowing ecological communities and functions to adapt.</p>
Emergency response	Manage residual risks and prepare for occasional large/extreme events which are difficult to predict. May include coordinated, temporary works to protect important features, habitats and communities.	Examples of emergencies that may impact on coastal environment areas are oil spills, algal blooms, bushfires, intense storms/tornadoes, landslips and tsunamis.

Table B3.6 Strategic approaches and examples of responses for coastal use areas

Broad risk management concept	Strategic approach	Examples of this approach for coastal use areas
Alert – includes wait and see, preparing for change and research to improve knowledge.	This approach acknowledges the potential for change that will require active intervention.	<p>Establish the social, economic and cultural value of the coast, including identifying Aboriginal and other cultural heritage assets.</p> <p>Monitor the safety of, and community satisfaction with, coastal access. This</p>

Broad risk management concept	Strategic approach	Examples of this approach for coastal use areas
		<p>includes the impact of urban and transport design on coastal accessibility and amenity; locations of surf clubs in relation to changing coastal use patterns; and the resilience of foreshore parks to demand and environmental changes.</p> <p>Monitor patterns of coastal access and use in relation to population growth and changing regional access frameworks (such as new highway links).</p> <p>Audit the implementation of coastal design guidelines and principles.</p> <p>Education and awareness activities for coastal heritage and scenic values.</p>
<p>Avoid future impact.</p>	<p>This approach recognises the need to ensure future development does not adversely affect amenity, cultural and built heritage, or limit opportunities for access and use of the coastal use area.</p>	<p>Apply the coastal design guidelines for all new development.</p> <p>Recommend changes to development controls and zoning and consider use of notifications such as s. 10.7 planning certificates.</p> <p>Consider the value of redevelopment of coastal areas to reduce risks associated with coastal hazards, and enhance or restore scenic, environmental or social values.</p>
<p>Active intervention – includes responses that enhance opportunities for balanced and sustainable use of the coast for urban uses, open space, conservation, recreation and tourism.</p> <p>It also includes responses that address existing threats, hazards, issues and vulnerabilities to improve the design of coastal development, and reduce pressures on recreational and amenity assets.</p>	<p>These responses are intended to improve the resilience of the coastal use areas to the risks identified in Stage 2, and to enhance opportunities, particularly for safe public access to beaches and headlands.</p> <p>Ensure responses are aligned with Crown land management processes.</p> <p>Encourage sustainable development at locations highly unlikely to be adversely affected by coastal processes and hazards.</p>	<p>Actions to maintain and enhance access, use and amenity of the coastal use area including recommending changes to LEPs and DCPs.</p> <p>Identification of inappropriate existing development that limits public access, detracts from public amenity such as by overshadowing or wind funnelling, or development that does not take account of the <i>Coastal Design Guidelines for NSW</i> (2003).</p> <p>Recommendations to protect Aboriginal and historic heritage sites or places.</p> <p>Recommendation of maintenance or restoration of values of a coastal Aboriginal cultural landscape that supports and enhances the continuing practice of cultural activities, teaching and knowledge transfer.</p> <p>Recommendations to redesign water management in coastal urban areas, enhancing the sustainability of water supplies and reducing pressures on coastal waterways.</p> <p>Recommendations to address risks to the safety of people working in or enjoying recreation in the coastal landscape.</p> <p>Recommendations that enhance opportunities to enjoy the coastal</p>

Broad risk management concept	Strategic approach	Examples of this approach for coastal use areas
		<p>amenity such as walkways around headlands, boardwalks through coastal wetlands and promenades behind seawalls.</p> <p>Recommendations to enhance recreation and commercial opportunities for better use and enjoyment of the coast can be encouraged.</p> <p>Consideration of appropriateness of commercial activities such as cafes, outlets that service beach users and parking that can provide the rental income necessary to support maintenance, operation and upgrading of the public amenity and enjoyment of the beach.</p>
Planning for change	<p>Consider changes to settlement patterns to accommodate increased population and new economic activity.</p> <p>This may include changes to the nature, intensity and character of development.</p> <p>This approach acknowledges that for some coastal use areas the costs of intervention and new developments are very high and the certainty of improved outcomes is low.</p>	<p>Allow shoreline change to progress without intervention as part of a dynamic landscape.</p> <p>May recommend:</p> <ul style="list-style-type: none"> • relocation of existing development, infrastructure and services • changes to zoning • remediation of sites • support for communities that are disrupted by change.
Emergency response	<p>Coastal emergencies on coastal use areas are likely to be associated with the overlap of the use area and vulnerability area, so include the impacts of extreme events – winds, water levels and waves, on built assets and public safety.</p>	<p>Will generally involve recommendation of control of access to affected areas; assistance for affected landholders; works to maintain the function of essential assets and infrastructure. See also the coastal vulnerability area and CZEAS.</p>