

Coast Protection Board

Policy Document

Revised 22 May 2012



Cover photographs courtesy Coastal Protection Branch

Coast Protection Board Policy Document

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PREAMBLE

1. Vision Statement

A Vision Statement for Coastal Management within South Australia

The Coast Protection Board recognises that the South Australian coast is one of the State's most valuable assets. The coastal zone includes many diverse marine, estuarine and terrestrial ecosystems, which are subject to great natural change and variability. The diversity of coastal and marine plants and animals is rich and includes many unique species. Many special areas need identification and protection.

Vision Statement



Seacliff Beach
Courtesy Coastal Protection Branch.



Courtesy Coastal Protection Branch.

The Coast Protection Board recognises the need for governments, the Community and industry to work together to develop and manage coastal and marine resources sustainably.

Cooperation

Preamble cont.

The coast is a place of great natural beauty, that is a source of inspiration for many South Australians, and a space for reflection and relaxation. Coastal waters and much of the land immediately abutting the coast is in public ownership, resulting in a strong tradition of access to the shore. The Board supports the continuation of the high level of public ownership of coastal lands.

The Coast Protection Board seeks to enhance the sense of stewardship that South Australians feel for their coastal and marine areas, by encouraging participation within all spheres of government, local government and the community in the planning and management of our coast.

2. The 1972 Coast Protection Act

2.1 The Coast Protection Act & Coast Protection Board.

The Coast Protection Act was passed in 1972, providing the basis for the creation of the Coast Protection Board.

The membership of the Board is defined as:

- The Director of Planning or nominee
- The Director of Marine & Harbours or nominee
- The Director of Tourism or nominee
- A representative of Local Government
- A person with expertise in biological processes affecting the coast
- A person with expertise in physical processes affecting the coast

The Act

Preamble cont.

2.2 Duties of the Coast Protection Board.

The Board's duties as defined in the Act are:

- (a) to protect the coast from erosion, damage, deterioration, pollution and misuse;
- (b) to restore any part of the coast which has been subjected to erosion, damage, deterioration, pollution or misuse;
- (c) to develop any part of the coast for the purpose of aesthetic improvement, or for the purpose of rendering that part of the coast more appropriate for the use or enjoyment of those who may resort thereto;
- (d) to manage, maintain and, where appropriate, develop and improve coast facilities that are vested in, or are under the care, control and management of, the Board;
- (e) to report to the Minister upon any matters that the Minister may refer to the Board for advice;
- (f) to carry out research, to cause research to be carried out, or to contribute towards research, into matters relating to the protection, restoration or development of the coast;

**Board's
Duties**

2.3 Definitions of the Coast

2.3.1 Coast as defined in the Coast Protection Act 1972-1975;

Means all land that is;

- (a) *within the mean high water mark and the mean low water mark on the seashore at spring tides;*

**Definition of
coast in
Coast
Protection
Act**

Preamble cont.

- (b) *above and within one hundred metres of that mean high water mark;*
- (c) *below and within three nautical miles of that mean low water mark;*
- (d) *within an estuary, inlet, river, creek, bay or lake subject to ebb and flow of the tide; or*
- (e) *declared by regulation to constitute part of the coast for the purposes of this act.*

2.3.2 The definition of the coast as defined by regulation under the Development Act 1993, for the purposes of development application referrals;

Means all land and water around the State's coastline that is within;

- *the seaward boundary defined as 3 nautical miles out to sea from the mean low water mark, and*
- *the landward boundary, being that boundary defined in approved Management Plans. In cases where there is no approved Management Plan the landward boundary is defined as 100 metres from the mean high water mark in townships and 500 metres from the mean high water mark in rural areas. (Including rivers, estuaries and creeks subject to the ebb and flow of the tide.)*

[Within this document this is taken to include land (including seabed), seawater, air and biota within the boundaries indicated above.]

Definition of coast in Coast Protection Act

Definition of coast in Development Act

Preamble cont.

3. Proposed Objectives of the Coast Protection Board Policies

With regard to the coastal, estuarine and marine areas of South Australia:-

- A. To provide for fair, orderly and ecologically sustainable use and development.
- B. To conserve the variety of all life forms and to ensure that the productivity, stability and resilience of ecosystems is maintained. Where there are threats of serious or irreversible environmental damage, lack of scientific certainty is not to be used as a reason for postponing measures to prevent environmental degradation.
- C. To promote the sharing of responsibility for resource management and planning between the different spheres of government, the community and industry in the State.
- D. To promote the enhancement of knowledge and expertise for coastal resource management and planning.

4. Policies

Existing policies are grouped into 8 areas.

- 1. Development
- 2. Hazards
- 3. Protection Works
- 4. Conservation
- 5. Heritage
- 6. Access and Amenity
- 7. Partnerships, Integration and Capacity Building
- 8. Research, reporting, monitoring and assessment

Objectives

Policies

1. DEVELOPMENT

Coastal developments are of major social and economic value to South Australia. The development of coastal resources for these activities needs to be constrained by the capacity of those resources to meet the foreseeable increasing needs of future generations and social sustainable goals.



Photographs courtesy Coastal Protection Branch.

“The benefits of competing commercial activities such as recreational access, eco-tourism and aquaculture, need balance through integrated planning. Individual sectoral decisions should not unwittingly foreclose on multiple or sequential use, requiring better communication between the sectors and understanding of each other's needs and proposals.

The clear interrelationship between management and use of the land and the effects of that use on marine and coastal environments must be factored in to the planning process. Continuing population pressures on the coast and associated development of housing, industry and support infrastructure means coming to grips with these issues. Failure to do so will see the continuing degradation and decline of coastal, marine and estuarine habitats and species and an inability to develop and sustain new and existing marine industries.” (Page 21 Marine and Estuarine Strategy)

**State
Resources**

**Competing
Activities**

Development Policy cont.

Competition for coastal sites for development, together with the fragile and dynamic nature of many coastal ecosystems imposes special difficulties in achieving sustainable development. Stewardship of the coast is a particular duty of the Coast Protection Board under the Coast Protection Act and this is reflected in the Board's comments on strategic planning documents and development applications. The Board seeks to

- retain coastal open space,
- minimise impacts of development on the coast,
- maintain compact coastal settlements and restraining 'sprawl' along the coastline,
- protect scenic amenity;
- protect coastal biodiversity;
- minimise or stop development in areas subject to coastal hazards (including acid sulphate soils);
- minimise future protection costs by ensuring new development satisfies the Board's flooding and erosion policies; and
- conserve developed coastal areas for land uses that require a coastal location.

Stewardship

Board Objectives



Development Policy cont.

Policy 1.1 The Board will seek;

- (a) integrated coastal management.

[In doing so, it recognises that ecosystem integrity, wealth generation, resource usage and equity policies extend beyond the coast and need to be taken into consideration in coastal management decision making]

- (b) to promote a strategic pro-active management of coastal areas.

[In doing so, the Board will involve state agencies, local government and the community in these strategic and regional planning processes, which involve coastal matters.]

- (c) the incorporation of its policies into Council's Development Plans and State Strategic Plans where it is relevant to do so.

Policy 1.2 The Board will **advise and/or direct** planning authorities on individual development proposals. The Board's advice or direction will include;

[Direction will only apply to those types of development defined in the Development Act 1993, Schedule 8, Part 1B.]

- (a) an assessment of hazard exposure and any hazard strategies provided by the developer for compliance with the Board's Hazard Policies.

- (b) an assessment of the potential coastal impacts of the development on;

- ecological processes,
- physical processes
- the environment;
- the visual amenity, and
- public open space.

Integrated Management

Strategic Planning

Development Plans

Planning Advice

Development Policy cont.

Policy 1.3 The Board will identify specific areas of the coast that require particular management actions.

[In doing so, it shall have regard to coastal flooding and erosion, acid sulfate soils, areas of conservation significance and landscape amenity values.

The Guidelines relating to Flooding and Erosion and Acid Sulfate Soil are contained in Appendix 1 and 2, respectively of this Policy Document.]

*(*policy amended Board meeting 20/12/02 Item 12)*

Issue evaluation

- Policy 1.4 The Board will **seek** to;
- (a) have areas identified as requiring particular management action, included in the Coastal Zones of the relevant Development Plans.
- [In doing so, the Board will consider allowing areas exposed to hazards to be covered by alternative zones, if those alternative zones contain adequate development principles to address the coastal hazard.]*
- (b) minimise the exposure of new and existing development to risk of damage from coastal hazards and risks to development on the coast.
- [This will be achieved by assisting/working with appropriate groups and agencies to prepare protection strategies. These strategies will include monitoring guidelines and remedial strategies for development in these areas.]*
- (c) minimise the impact of stormwater discharge to the coast and nearshore waters.
- [Stormwater should preferably be directed to wetlands or when appropriate to natural drainage channels.]*
- (d) have adequate buffer distances between development and the coast.

Development zones

Hazard risk Minimisation

Stormwater Management

Buffers

Development Policy cont.

Policy 1.4 The Board will **seek to**; (Continued)

- (e) ensure that the siting and design of development on the coast minimises its impact on the environment, heritage and visual amenity of the coast.

[In doing so the Board will have regards to areas of important visual significance, built heritage and aboriginal sites of significance.]



- (f) minimise development on public land.

[In doing so, the Board will recognise the need for public facilities on the coast, for which a lower hazard risk standard may be acceptable for such facilities, providing the applicant is aware of and accepts the risk.]

Scenic amenity

Public land

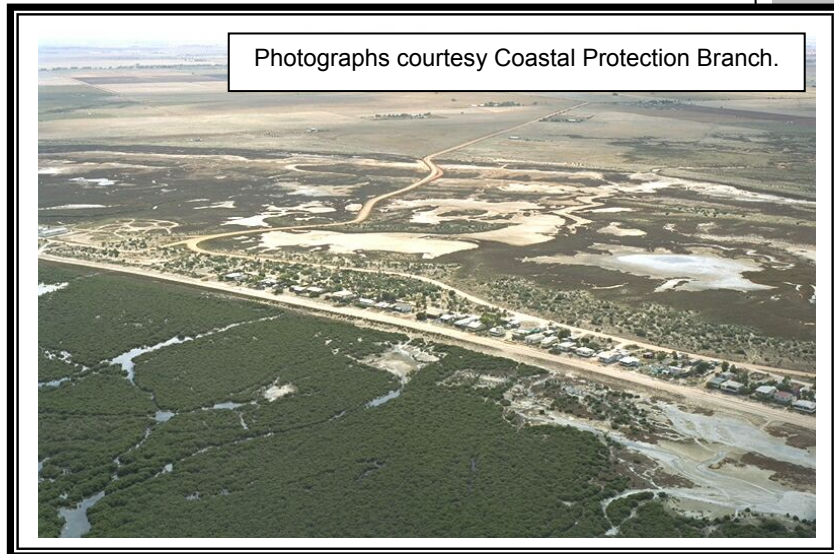
Development Policy cont.

Policy 1.5 The Coast Protection Board opposes;

- (a) linear or scattered coastal development.

[the Board preferring development to be concentrated within existing developed areas or appropriately chosen nodes, or nature-based tourist accommodation with a high quality of design to minimise potential impacts in areas of high conservation or scenic value, or in areas subject to coastal hazards.]

**Linear
development**



- (b) development, including land division, which is subject to coastal hazards or will impact on areas of significance.

**Coastal
hazards
Sand dunes**

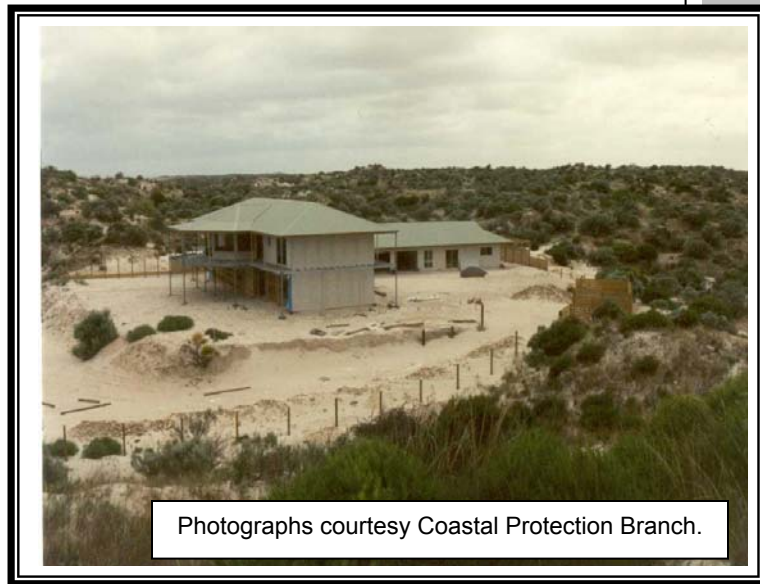
Development Policy cont.

Policy 1.5 The Coast Protection Board opposes; (cont.)

- (c) development in sand dunes, wetlands, coastal estuaries and marine vegetation.

[In doing so the Board will have regard to development that in fact provides protection or has a significant public benefit in these sensitive coastal areas, or includes nature-based tourist accommodation with a high quality of design to minimise potential impacts in areas of high conservation or scenic value, or in areas subject to coastal hazards.]

[Refer to Policy 1.3]



- (d) land division that increases the number of allotments abutting the coast, except where the subdivision is an orderly development of existing developed areas or concentrated into appropriately chosen nodes.

**Unauthorised
Development**

Development Policy cont.

Policy 1.5 The Coast Protection Board opposes; (cont.)

- (e) aquaculture development, particularly finfish culture, over sensitive habitats, such as seagrass and algal communities.

[In doing so the Board will have regards to the extent of the sea grass beds, potential for de-stabilisation of the sea bed from the development, impacts of fish food and fish excrement on sea grasses, coastal processes, etc.]

- (f) works which significantly affect coastal processes unless;



- a binding management plan is in place, which prevents unacceptable effects on the coast
- the works are designed to modify coastal processes with a demonstrable net improvement in the protection of the coast, or
- compliance with Section 3 - Protection Policies, can be demonstrated.

Aquaculture

Coastal processes

Development Policy cont.

Policy 1.5 The Coast Protection Board opposes; (cont.)

- (g) The Board will seek the removal of unauthorised development on the coast that does not comply with the Board's policies.

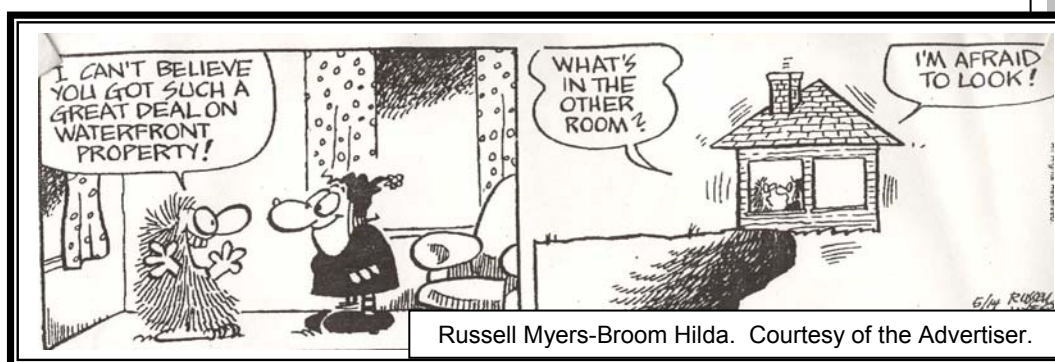
[In doing so the Board will have particular regards to coast protection works and development in sensitive coastal areas and areas at risk from coastal hazards.]
Meeting 30 August 2002 Item 11

**Unauthorised
Development**

2. HAZARDS

Coastal flooding and erosion are natural features of the dynamic coastal environment whereby beaches erode, prograde or are in dynamic equilibrium, cliffs erode and low lying land is periodically flooded during storm surge events.

Such phenomena become hazards where life or development is placed at risk. In some locations the public may be placed at risk by un-managed access to dangerous or unstable cliffs. Often development has been located in coastal areas which were considered safe at the time, but which later were revealed to be at



risk from extreme events or changing coastal dynamics. The level of risk in many instances will change over time, due to global sea level rise or local relative sea level change, or from a local long-term erosive trend.

The Coast Protection Board accepts that mean global sea level has been rising over recent decades at approximately 1.5 mm per year.

The Inter-governmental Panel on Climate Change (IPCC) has modelled global climate and climate influences and produced scenarios of accelerated sea level rise. This predicted rise in sea level is due to global warming consequent upon the accumulation of Greenhouse gas emissions in the atmosphere, (these assessments have been frequently updated, with reports released in 1991, 1996 and 2001).

The Board believes it has taken the best advice available (Coast Protection Board sub-committee on Mean Sea Level 1989 to 1993) in resolving to use the IPCC median sea level predictions as part of its hazard policy. In its most recent Working Papers, the IPCC has also laid emphasis on increased magnitude and frequency of extreme events, including storm surge, as part of the climate change scenario.

**The
Mobile
Coast**

**Global
Climate
Change**

Hazard Policies cont.

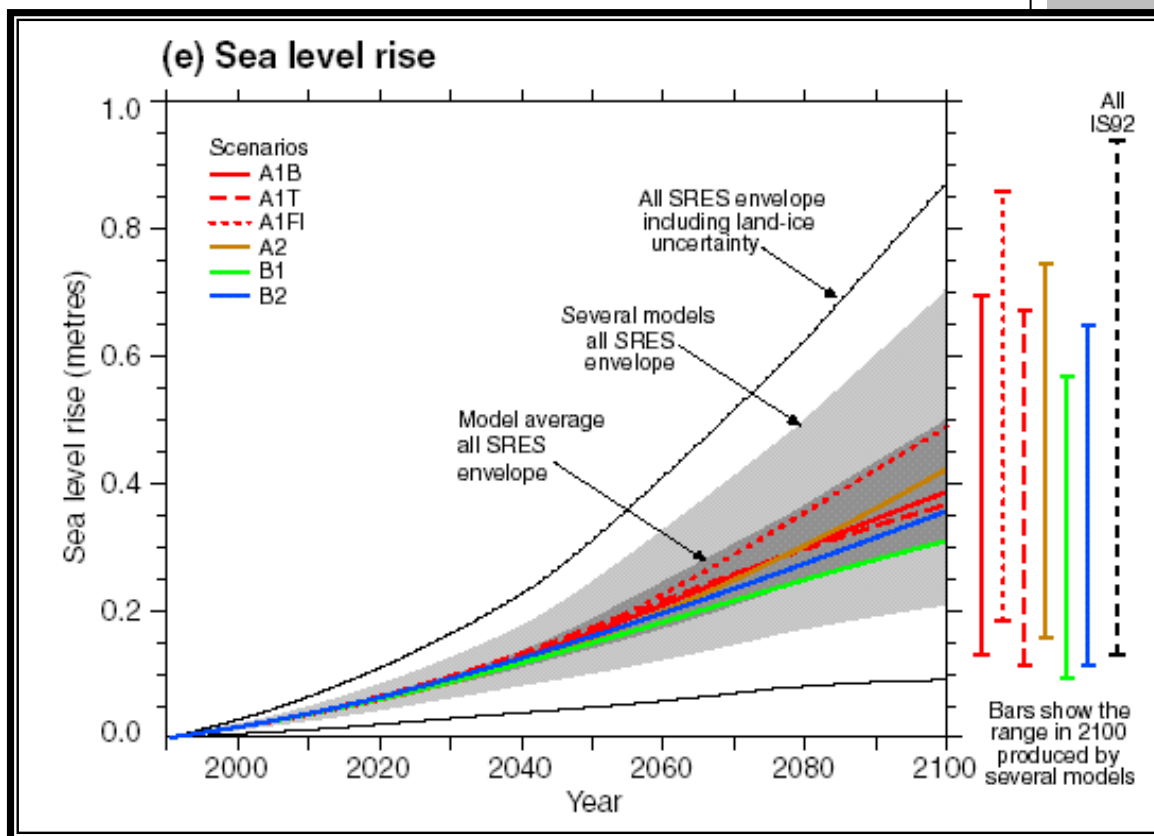


Figure extracted from IPCC Report

In order to recognise this situation and to minimise future risks to developments proposed now, the Board has developed policy and standards, which apply to new development. State and local governments have endorsed the Board's standards and policy. The policy shows the intent of the Board; the standards apply to site specific locations and site levels of development proposals. The standards are detailed in Appendix 1 of this policy document. These standards may need to be adjusted from time to time, as knowledge of accelerated global sea level rise improves. The standards were written into the Development Plan, through the Regional Coastal Areas Policies Amendment, by the Minister, 1994. Specific application of the flooding standards on a town by town basis is being included at local zoning level in Development Plans the coastal Councils through the normal 3 to 5 year revisions of the each Plan.

Planning Standards

Hazard Policies cont.

- Policy 2.1.** The Board will **formulate** hazard standards for the state of South Australia with reference to;
- Risk management approaches to hazard management using the Inter-governmental Panel on Climate Change's recommendations to policy makers, and
 - Commonwealth recommended approach to management of Coastal Acid Sulfate Soils .

[In doing so the Board shall seek to have these standards widely disseminated and referred to by State Policy, Council's Development Plans, Strategy Plans and Coastal Management Plans, in accordance with Development Policy 1.1.C.

The Guidelines relating to Flooding and Erosion and Acid Sulphate Soil are contained in Appendix 1 and 2, respectively of this Policy Document.]

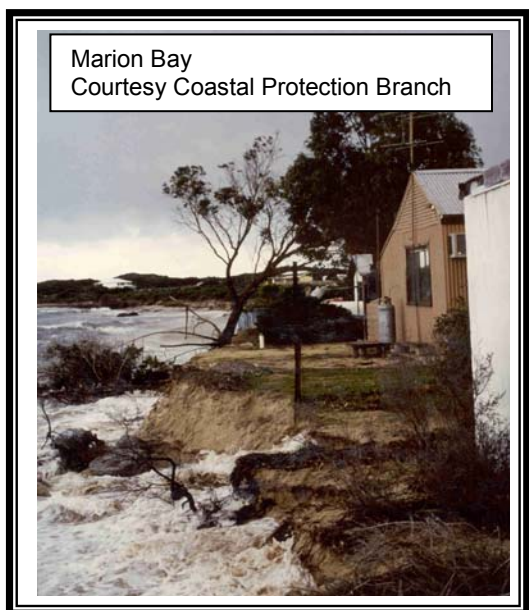
*(*policy amended Board meeting 20/12/02 Item 12)*

- Policy 2.2.** The Board will **facilitate**;
- (a) the use of strategic and legally enforceable agreements to manage the risk of damage from coastal hazards on development.
 - (b) a program of vulnerability assessment to ensure that sufficient coastal buffer zones are provided for predicted physical processes and to accommodate public infrastructure, use and access.

[In doing so the Board shall have regard to the identification of Coastal Acid Sulfate Soil areas.

In relation to coastal flooding and erosion a planning period of 100-years will be applied for small development and a 200-years for new significant development, e.g. power stations.]

*(*policy amended Board meeting 20/12/02 Item 12)*



Formulate Standards

Minimising Risk

Coastal buffers for new development

Hazard Policies cont.

Policy 2.3 The Board will **advise** on development proposals within coastal areas.

Advise on coastal hazard standards

[The standards to be applied to Flooding and Erosion and Acid Sulfate Soil are contained in Appendix 1 and 2, respectively of this Policy Document..

The coastal erosion potential, storm surge likelihood, land subsidence and sea level change, including sea level incorporate scenarios set by the Inter-governmental Panel for Climate Change. Protection standards will be based on hazard events with a 100 year Average Return Interval (ARI), and design periods of 50 years for minor development, 100 years for strategic planning in existing settled areas and 200 years for new settlements.

Development in areas identified as being at risk from CASS, the Board shall seek the following information before providing advice to the relevant planning authority;

- *Specific site and watertable levels, relative to Australian Height Datum (AHD),*
- *soil and water sampling and analyses to determine presence of coastal acid sulfate soils contamination, and*
- *where CASS are confirmed seek additional information on remedial strategies to minimise surface and ground water contamination, and a management plan for ongoing monitoring and best-practice management of the area.]*

*(*policy amended Board meeting 20/12/02 Item 12)*



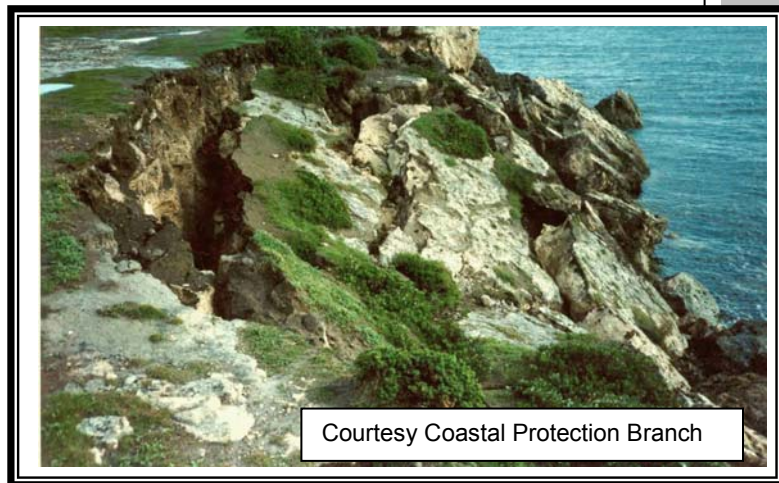
Hazard Policies cont.

Policy 2.4 The Board will **assist** with identifying public risk areas along the coast :

[In doing so the Board will have regards to;

- *unstable cliffs,*
- *areas subject to storm inundation, and*
- *areas at risk from long to medium term erosive trends, including areas vulnerable to erosion in the event that near shore seagrass meadows are damaged.]*

**Identify
public risk**



Courtesy Coastal Protection Branch

3. PROTECTION WORKS

One of the Board's duties, as set out in the Coast Protection Act, is to protect the coast from erosion, damage, deterioration, pollution and misuse. If read out of context, this suggests a greater responsibility and funding role than in fact applies. These duties, and especially the coast protection one, are mostly carried out jointly with and through Local Councils, and the Act provides for the Board to make grants to assist Councils in this. It also provides for the Board to carry out works and recover a portion of the cost from a Council.

**Duty
To
Protect**



Protection against flooding and erosion is usually carried out to remedy the consequences of past planning, through the building of protective structures, such as seawalls, or through schemes of beach nourishment. It is also used to protect redevelopment where relinquishing a development site is impractical or uneconomical.

Protection Policies cont.

Most coast protection works are carried out by Councils or privately. With the exception of renourishing the Adelaide beaches, the Board provides Councils with grants of up to 80% of the cost of approved coast protection works and up to the same amount for storm damage repairs.

Grants

The Board has assumed full responsibility for funding beach re-nourishment at Adelaide. This was necessary because several sea front Councils benefit to varying degrees, because the cost and benefits cannot be apportioned, and because of the large scale of the projects and the co-ordination required. Nourishment for purely recreational purposes attracts a lower grant level, if funded at all.

**Beach
nourishment**

The Board's interpretation is that its funding is intended for situations that have arisen because of some previous mistake or lack of understanding about coastal processes. It does not consider that State Government funds should be available for protection of new development approved unwisely and against the Board or Department's advice. The Board considers it beneficial to retain the nexus between authority for approving coastal development (usually with Councils) and responsibility for the consequences of decisions made.

**Coordinated
Protection
Strategy**

The Board requires that any protection works, towards which it provides a grant, have outcomes that benefit the general public, such as maintenance of public accesses along the coast.

The policy not to protect private property was affirmed by State Government in 1980, and has been applied since then. Although there will be exceptions, as noted in the policy, there can be little justification for the State to act as a free insurer of seafront property - to do so would encourage inappropriate development and unreasonable public expectations.

Protection Policies cont.

Policy 3.1 The Board will **encourage** the maintenance of adequate beach levels, both to prevent storm damage and to provide adequate beach recreation space.

Adequate beaches

Courtesy Coastal Protection Branch.



Policy 3.2 The Coast Protection Board **will not oppose** the construction of beach and near-shore structures (such as seawalls, groynes and breakwaters) where:

Protection structures

- (a) there is a demonstrated need in the public interest,
- (b) a comprehensive investigation to an appropriate standard has been carried out, and it can be demonstrated that on balance:
 - there will be no unacceptable impacts on natural physical processes or ecosystems
 - there will be no increase in coastal flooding or erosion hazard to neighbouring property or foreshore.

[Refer to Development Policy 1.5.(f)]

Robe Groyne
Courtesy Coastal Protection Branch.



Protection Policies cont.

Policy 3.3 The Board **will provide grants** to Local Councils toward approved coast protection works in accordance with the Coast Protection Act.

[In doing so, the Board will take into consideration state wide priorities and the availability of funds within the Coast Protection Fund. The grant shall not exceed 80% of the total cost of the works.]

Policy 3.4 The Board **will not provide funds** or grants for;

- (a) The protection of private property unless;
 - there is an associated public benefit
 - there is simultaneous protection of public property
 - a large number of separately owned properties are at risk, or
 - where the cause cannot be easily identified

- (b) outlets or other works associated with stormwater drainage.

Grants

Funding limitations



Protection Policies cont.

Policy 3.4 The Board **will not provide funds** or grants for;
(Continued.)

- (c) protection of coastal property and installations owned by other Government agencies.

[Where Government installations (eg ports or drainage outlets) adversely affect the coast, such as by interrupting alongshore sediment movement, the agency responsible will be expected to arrange and fund remedial measures, such as sand bypassing.]

**Funding
limitations**

4. CONSERVATION

South Australia's temperate seas contain many unique species of plants and animals on the land, within the ocean and the sheltered environments in the two gulfs. Further detailed knowledge of these environments is needed, but it is clear that marine biodiversity is an important heritage and resource for the state.

South Australia has few large rivers and few estuaries: however the distinctive environments of the estuaries make them significant, particularly to numbers of fish species. Important coastal wetlands are found within and adjacent to the estuaries, most notably the Murray Mouth and the Coorong. Pressures on the estuaries, particularly from land based discharges and water use, make the conservation of these areas a high priority.

**South
Australia's
unique
coast**



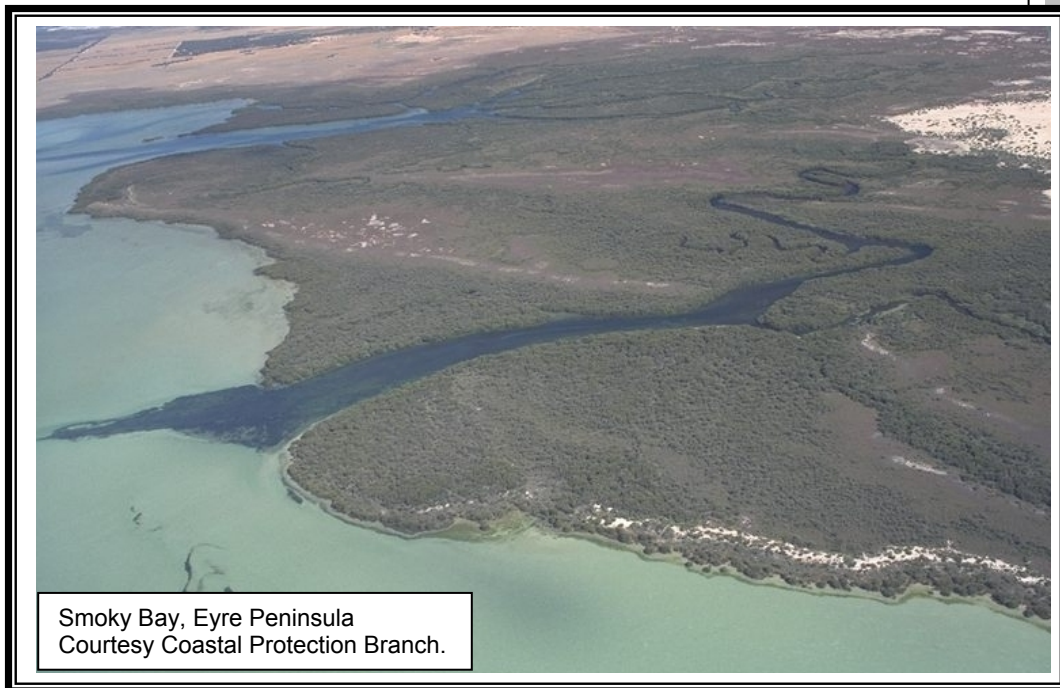
South Australia is fortunate that many significant terrestrial coastal areas and near-shore islands are within the state's parks system or Crown reserves. Nevertheless work remains in ensuring that significant coastal heaths, samphires (salt-flats) and mangroves are properly represented within the protected area system. While beaches and dunes are common in South Australia (59% of the shoreline length), their fragile nature makes them also an issue of concern.

Conservation Policies cont.

The interface between sea and land is a very active area, rich in plants and animals, both marine and terrestrial and is an important breeding ground for many species. Such a biologically diverse environment is important in sustaining the biological resource base. Areas of conservation significance should be protected from development and zoned accordingly. If necessary, the conservation effectiveness of coastal areas can be enhanced by linking them to other natural environments with linear parks.

Within the terrestrial parts of the coastal zone, the area and shape of allotments can be important for facilitating the management of environmentally sensitive areas and minimising the impact of development on the coastal environment.

The coast is continually at risk of being damaged by pollution as it is at the receiving end of land drainage systems. Experience has shown that this poses a significant risk to estuarine and marine life and resources. Wetlands, which are often found behind sand dunes, and tidal flats not only provide a rich wildlife habitat, but are known to be a valuable natural treatment area for many pollutants carried by rivers. However, their capacity to treat pollutant loads is limited. Excess nutrient loads can damage or alter the ecosystem.



Smoky Bay, Eyre Peninsula
Courtesy Coastal Protection Branch.

Conservation Policies cont.

Policy 4.1 The Board will **instigate and/or participate** in the;

- (a) conservation of the diversity of plant, animal and marine species within coastal areas.

Conservation



- (b) investigations into the impacts of development on coastal, marine and estuarine environments.

**Investigations
on
development
impacts**

[in doing so the Board will seek to improve and build capacity for such investigations. But the Board's actions will not relieve the responsibility of developers in this regard.]

[Refer to Section 2 Development Policies 1.2(b), 1.3, 1.4(a), 1.4(d), and 1.5(c).]

Conservation Policies cont.

Policy 4.2. The Board will **seek to**;

- (a) identify, protect and manage coastal environments with high conservation values.

[In doing so the Board will have regard to coastal environments including coastal dunes and heaths, samphires (salt-flats), mangroves, reefs, algal forests, seagrass meadows, estuaries, threatened and/or endangered native plants and animals and coastal wading bird habitat.]

- (b) acquire land, where it is necessary to ensure protection of areas of high conservation value.

[In doing so the Board will consider the land management actions necessary to protect and conserve the environmental values and will consider ongoing land management arrangements, which preferably will be undertaken by others.]

Policy 4.3 The Board will provide grants to Local Councils towards approved conservation projects that comply with these policies and the Coast Protection Act 1972

[In doing so the Board shall have regard to overall state wide priorities and the availability of funds. The grant will not exceed 80% of the total cost of the project.]

(*New policy - Board meeting 20/12/02 Item 10)

**Identification,
Protection
and
Management**

**Land
acquisitions**

Grants

5. HERITAGE AND LANDSCAPE

The coastal areas of the State are important for their landscape and heritage values. Many significant landscapes and sites are recognised through reserve status; many others have less secure or specific recognition within the principles and objectives of the Development Plan or within the Register of the National Estate. The intrinsic attractions of coastal areas include aesthetic qualities, which are significant both to tourism and recreation, as well as



providing a sense of identity and well being for local people. The economic opportunities and the social values of South Australian coastal landscapes in part depend upon its diversity of natural and semi-natural landscapes. Maintaining this richness of diversity poses a challenge in setting priorities for the development of the state's terrestrial, estuarine and marine coastal areas. For this reason the Coast Protection Board seeks to establish a state wide assessment of coastal landscape quality.

Marine and terrestrial coastal areas are rich in cultural and heritage significance and many groups are involved in identifying and protecting these sites. The Coast Protection Board has a role in working with such groups to ensure that such sites remain to be appreciated and understood by present and future generations.

**Significant
Coastal
Sites**

Heritage and Landscape Policies cont.

Policy 5.1 The Board will **facilitate and support** the identification, recognition and protection of coastal areas with a;

- significant landscape value,
- marine archaeological heritage,
- cultural significance, and
- scientific significance.

[In doing so the Board will attempt to have such areas recognised in the Council's Development Plans and in other plans, where appropriate. In this process the Board will have regards to the standards and principles contained within "The "Natural heritage Charter" and "The Burra Charter".]

*(*Amended policy - Board meeting 20/12/02 Item 8)*



Policy 5.2. The Board **opposes** development that;

- (a) has a significant visual impact on coastlines with significant landscape value.

[In doing so the Board will have regard to both the visual impact from the land and the sea.]

**Identification,
recognition
and
protection**

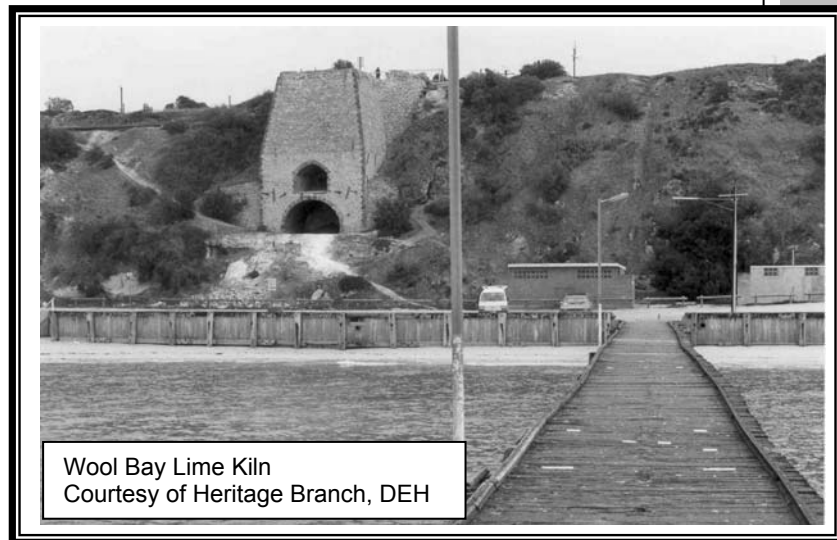
**Visual
impact**

Heritage and Landscape Policies cont.

Policy 5.2. The Board **opposes** development that; (Continued)

- (b) results in the disturbance or devaluation of sites of;
- marine archaeological heritage,
 - cultural significance, and
 - scientific significance.

[Refer to Section 1 Development Policies 1.2(b), 1.3, 1.4(e), 1.5(b) and 1.5(g).]



Disturbance and devaluation of sites of significance

Policy 5.3 The Board **recognises** the rights and needs of Aboriginal peoples and will encourage Aboriginal input into decisions which affect sites of Aboriginal significance and native title.)

[In doing so the Board will have regard to the Commonwealth Native Title Act 1993.]

Indigenous Participation

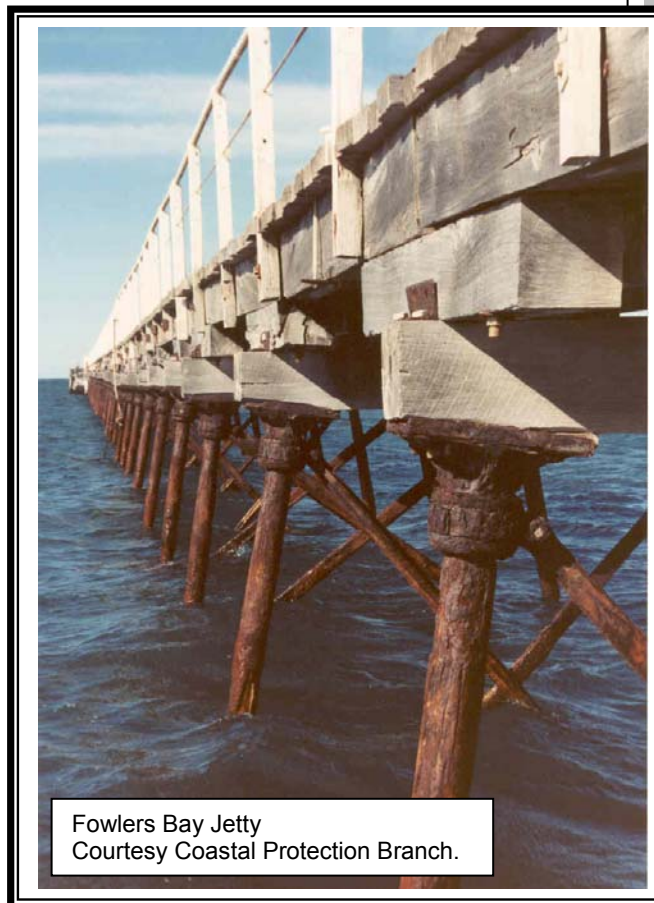
Heritage and Landscape Policies cont.

**Purchase
land**

Policy 5.4. The Board will **seek to** acquire land, where it is necessary to ensure protection of areas of

- significant landscape value,
- marine archaeological heritage,
- cultural significance, and
- scientific significance.

[In doing so the Board will consider actions necessary to protect and conserve the heritage and landscape values and will consider ongoing land management arrangements, which preferably will be undertaken by others.]



Heritage and Landscape Policies cont.

Policy 5.5 The Board will provide grants to Local Councils towards approved heritage and Landscape projects that comply with these policies and the Coast Protection Act 1972.

[In doing so the Board shall have regard to overall state wide priorities and the availability of funds. The grant will not exceed 80% of the total cost of the project.]

*(*New policy - Board meeting 20/12/02 Item 10)*

Grants



Cape Borda Lighthouse
Courtesy Coastal Protection Branch.

6. ACCESS

South Australia is fortunate because early surveyors reserved much of the coastline for public use and the majority of these reserves remain today, despite ongoing coastal erosion.



Coastal visits for recreation far exceed the attendances at any other organised sporting activities. Coastal pedestrian and vehicular access is needed for a variety of reasons including walking, diving, swimming, recreational and commercial fishing, sightseeing, boating, aquaculture, and tourist ventures. In the past this demand was most evident near towns and cities, however, in later times with improved vehicles and increased leisure time, beach access demand has spread to the remotest parts of the coast.

It is important that the right of access is maintained, but it is also important that access is managed to minimise impact.

**Public
Reserves**

**High
visitation**

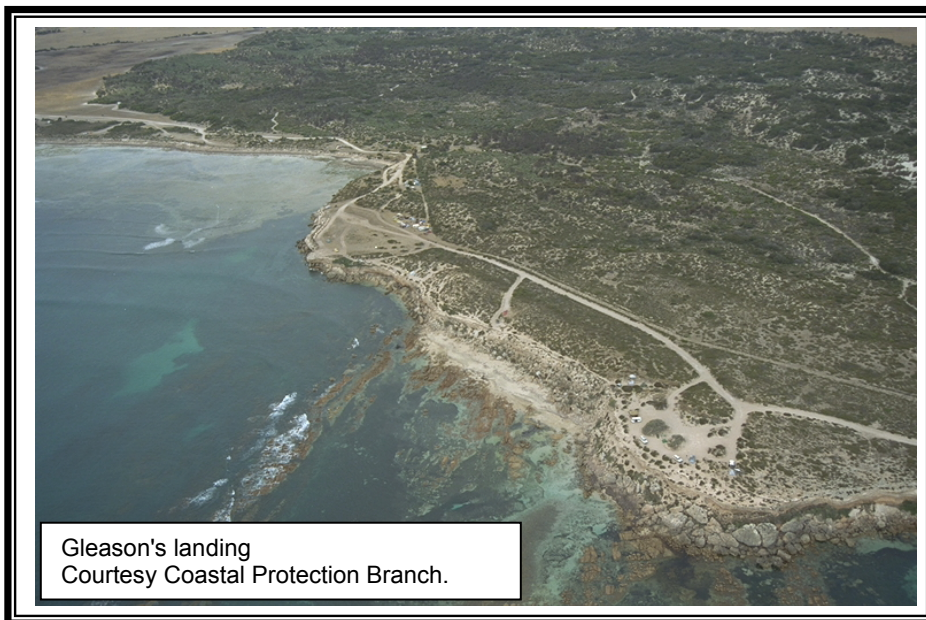
**Right to
access**

Access Policies cont.

South Australia has some very sensitive portions of coast such as intertidal reefs, islands, estuaries, wetlands, dunes, and cliffs. Access management and/or control is one of the most important instruments for management of these areas. Uncontrolled pedestrian or vehicle access may not only physically degrade many landforms, but often results in the introduction of pest plants and animals.

Roads constructed along and parallel to the coast, to maximise access to coastal facilities, usually encourages ribbon development. Ribbon development tends to result in serious deterioration of the coastal reserve and detracts from the visual quality of the coast.

**Potential
for damage**



Access Policies cont.

Policy 6.1 The Board will encourage and support;

(a) environmentally sustainable access to the coast.

[In doing so the Board will take into consideration:

- *the ability of the particular landform to cater for uses without undue adverse environmental effects;*
- *preference to public use over private use;*
- *preference will be given to those uses which by their nature, need to be located close to the coast, and*
- *public safety.]*

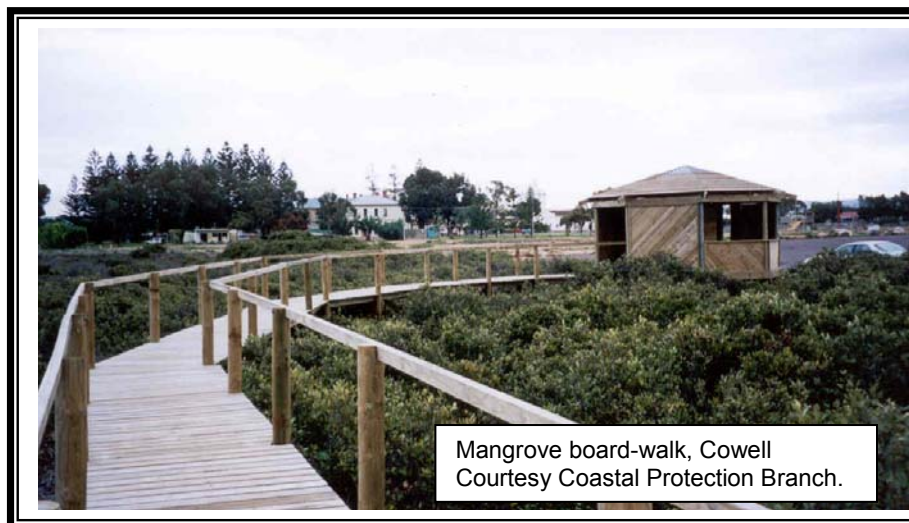
(b) rationalisation of existing and planned roads that provides nodal access to the coast.

[In doing so the Board will discourage roads that run parallel to the coast.]

[Refer to Section 1 Development Policies 1.2(b), 1.3, 1.4(f), 1.5(a), 1.5(b) and 1.5(c)].

Sustainable access

Road planning



Access Policies cont.

Policy 6.2. The Board opposes;

- (a) vehicular access to beaches

[In doing so the Board acknowledges that vehicle access to the beach is required for certain recreational and commercial activities. Balancing public uses to ensure they are managed wisely, safely and in a manner that minimises environmental impacts to the beaches.]

- (b) new development that restricts or limits existing public access to the coast.

[In doing so the Board acknowledges that certain developments by their very nature limit public access, in such circumstances attempts will be made to ensure the best outcomes for the public.]

**Limit
vehicle
access to
beach**

**New
development
that restricts
public access**



Courtesy Coastal Protection Branch.

Access Policies cont.

Policy 6.3 The Board will provide grants to Local Councils towards approved access projects that comply with these policies and the Coast Protection Act 1972.

[In doing so the Board shall have regard to overall state wide priorities and the availability of funds. The grant will not exceed 80% of the total cost of the project.]

Grants



Courtesy Coastal Protection Branch.

Appendix 1

STANDARDS APPLYING TO NEW DEVELOPMENT WITH REGARD TO COASTAL FLOODING AND EROSION AND ASSOCIATED PROTECTION WORKS

Endorsed by the Coast Protection Board at its meeting on 22 May 2012

APPENDIX I

1. STANDARDS

STANDARDS APPLYING TO NEW DEVELOPMENT WITH REGARD TO COASTAL FLOODING AND EROSION AND ASSOCIATED PROTECTION WORKS¹

[NOTE: Detailed standards on coastal erosion and flooding hazard follow below. Presently such standards are written into Council PARs, since the standards are enforced through the Development Act. The Coast Protection Act does not directly provide for the enforcement of these or other standards within the coastal zone].

On the evidence the Board is satisfied that sea level is presently rising at a rate of approximately 1.5mm/year at most parts of the SA coast - the rate differs at a few locations because of local land subsidence or uplift. It is accepting that there will be a global warming due to increases in greenhouse gases and that this will result in more rapid rise in sea level. On the basis of the IPCC projections the Board is recommending that a mid-range sea level rise of 0.3m by the year 2050 be adopted for most coastal planning and design. It should be noted that the 0.3m figure includes continuation of the present rate of rise and is not additional to it.

While sea level rise due to climate change is likely to continue beyond 2050, projections for the following 50 years to 2100 are less certain. The Board has adopted a 1m rise to 2100 for coastal policy, in the sense that this will only be applied for development, which could not reasonably be protected against this greater rise.

The Board is of the view that in most coastal flooding applications the 100-year average return interval (ARI)² standard is appropriate.

Coastal flooding may be either directly due to a storm tide or by a combination of this with stormwater backed up by the tide. It will therefore sometimes be appropriate to consider the coincidence of tidal and rainfall events and to estimate the combined water level probability.

Coastal erosion around the South Australian coast is, in many places, quite significant in planning time frames resulting in significant coastal recession.

Accelerated sea level rise will generally cause an increase in the rate of recession, though would interact with local coastal processes in quite complex ways.

¹ This appendix is largely taken from the 'Hazard Risk' section of the previous policy document. These standards were the subject of considerable expert discussion and public consultation in the period 1991 - 2000 and revision was not seen as appropriate at this stage.

² Average Return Interval (ARI) is the average interval in years between events equalling or exceeding a given magnitude.

The recession/erosion standards are similar to the flooding ones in that they require development to be safe from the effects of a 0.3m sea level rise and to be capable of being protected against additional recession due to a further 0.7m of rise.

The following standards apply -

- S1 Site and Building Levels. Except as set out in standard S2 and elsewhere in this document, development should not be approved where building sites are lower than a height determined by adding 0.3m to the 100 year ARI water level and making a local adjustment (if appropriate) for land subsidence or uplift to the year 2050. For commercial or habitable buildings, floor levels should be no less than 0.25m above this minimum site level. Development should not be approved unless it is capable, by reasonably practical means, of being protected or raised to withstand a further 0.7m of sea level rise.

For residential development within existing low-lying vulnerable settlements, elevated floor levels may be considered as an alternative option to raising site levels provided adjacent land and buildings are uniformly low lying, and where the integrity of adjacent land and buildings will not be compromised if the site of the development is inundated (e.g. by scouring as a result of site inundation). This may include such settlements as Cowleds Landing, Chinaman Wells, and Foul Bay.

Furthermore, elevated floor levels may be considered as an alternative to raising site levels provided the following criteria is met:

- The finished floor level is no lower than a height determined by adding 1.25m to the 100 year ARI water level and making adjustment (if appropriate) for land subsidence or uplift to the year 2050.
- Underside areas are not enclosed (to allow for the potential flow through of water whilst supporting the house above).
- Service facilities vulnerable to flooding are raised above the finished floor level (i.e. electrical power outlets, switchboards, hot water systems, air conditioning units, water pumps etc).

The application of this alternative option (i.e. raising floor levels only) recognises that such existing settlements are perhaps in inappropriate locations in regards to coastal hazards, and that elevated floor levels do not alleviate long term coastal hazard risks, nor does it lessen the requirement for whole of settlement coastal hazard adaptation strategies. New settlement should either avoid such hazards or address the more substantial site and floor level protection requirements by the other standards.

The 100 year ARI extreme water level should be based on the best information available, usually recorded extremes from the closest tide gauges. It should take into account site specific factors such as wave set-up and run-up and stormwater heights during extreme tides. Similarly the best available information should be used for predicting land subsidence or uplift.

- S2 Flood Protected site and building levels. Where flood protection measures exist or are to be provided as part of a development, building sites should be no lower than the design flood level within the development taking into account the mitigating effect of the protection measures. Floor levels should be at least 0.25m above this level. The design flood level is to be determined taking into account 0.3m of sea level rise and, depending on the situation, either the 100 year ARI extreme tide in adjacent coastal waters together with stormwater and wave effects within the development or the 100 year ARI stormwater event with due allowance for the effect of tidal surge on this.

Development which depends on measures such as levee banks, flood gates, valves, or stormwater pumping will need to demonstrate that there is a very low risk of failure of these devices and that they will be adequately maintained.

For residential development within existing low-lying flood protected settlements, where there is uncertainty about the adequacy of the existing protection, or it is known to be dilapidated, requiring upgrade, elevated floor levels may be considered as an alternative option to raising site levels provided adjacent land and buildings are uniformly low lying, and where the integrity of adjacent land and buildings will not be compromised if the site of the development is inundated (e.g. by scouring as a result of site inundation).

Furthermore, elevated floor levels may be considered as an alternative to raising site levels provided the following criteria is met:

- The finished floor level is no lower than a height determined by adding 0.25m to the 100 year ARI water level, making an allowance for 0.30m of sea level rise, and making adjustment (if appropriate) for land subsidence or uplift to the year 2050.
- Underside areas are not enclosed (to allow for the potential flow through of water whilst supporting the house above).
- Service facilities vulnerable to flooding are raised above the finished floor level (i.e. electrical power outlets, switchboards, hot water systems, air conditioning units, water pumps etc).

The application of this alternative option (i.e. raising floor levels only) recognises that elevated floor levels do not alleviate long term coastal

hazard risks, nor less the requirement for urgent upgrade of existing flood protection works.

- S3 Sea Level Rise for Major Developments. For major coastal developments the Board recommends that in addition to standard 1 above, the full range of possible climate change and sea level effects be considered. The Board will encourage designs that enable later modification for further sea level rise. However it recognises that it may be appropriate in some instances not to provide these but rather to accept that there may be higher modification or rebuilding costs later.
- S4 Setback for Erosion. Development should generally not occur on sand dunes or close to soft, erodeable coastal cliffs. Except where the development site is clearly safe against coastal recession and storm erosion, development should not be allowed unless appropriate studies have been carried out and demonstrate that the following criteria are satisfied. Alternatively the developer should include coast protection works and show that these would provide the required protection. In cases of doubt the Board will advise as to whether or not studies are required.

Development should be safe against coastal recession and storm erosion and the effect that a 0.3m rise in sea level would have on these. Also, development should not be approved unless it can be protected by practical measures against additional erosion that would be caused by a further 0.7m sea level rise.

Each situation will be different and will need to be considered on its separate merits. As a general guide, design and/or setbacks should take into account 100 years of erosion at a site (taking into account local coastal processes and assuming a sea level rise of 0.3m by the year 2050), and also taking account of storm erosion from a major storm or series of severe storms. For major developments, especially those establishing entire new communities, 200 years of recession should be considered, and also the effect of sea level rise on this over the longer period. Consideration should also be given to whether an additional set-back is desirable to provide for public use after recession has occurred or to preserve the natural appearance of the coast.

- S5 Impact of Protection Works. Development should not be located where it will create or aggravate coastal erosion or if it will require coast protection works, which will cause or aggravate coastal erosion. The Board will not recommend approval of private coast protection works where these would be likely to cause loss of public beach amenity, erosion of adjacent land owned by others, or other adverse effects on the coastal environment.
- S6 Responsibility accepted by owner. The Board will not oppose isolated single owner developments where it is satisfied that adequate

arrangements have been made to ensure that any erosion or flooding damage to the development, provision of future protection works, or relocation or demolition of threatened structures will be the sole responsibility of the developer or future owners. The Board may also seek assurance that funding for such measures is guaranteed or, alternatively, that agreements provide a mechanism for recovery of public costs that may be incurred. This would be subject to standard 5 above and that protection works would be likely to obtain approval at the appropriate time.

- S7 Existing protection works. The Board will not oppose development behind existing protection works where the Board's and the Local Council's intention is to maintain or upgrade these. The Board will recommend against approval where protection is provided by beach replenishment and the development would rely on continuation of this for its safety.
- S8 Existing coast protection needs and infill development. The Board will not oppose development where there is already a need for protection of existing development, where this is likely to be provided by Local or State Government and where the new proposal would not add to this need, nor to the cost. This would include development behind esplanade roads or other public property where these are likely to be protected in the future. However it will not always be practical or cost effective to protect public foreshore property and it may be undesirable to do so if this means losing the beach.
- Each case will be considered on its merits and this policy may not apply where the new development represents a large increase in investment, or where protection may not be the optimum long-term strategy.
- S9 Lesser criteria for some beach facilities. Lesser engineering criteria may be applied, as appropriate, to public amenity structures such as beach shelters, toilets, change sheds and car parks, some of which may need to be considered expendable. Investment in such structures should be minimised, or they should be relocatable.
- S10 Minor Structures. Certain minor non-residential and non-commercial structures may not be required to meet the Board's coastal hazard standards. However the approving authority should ensure that the owners are aware of the risk of damage to the building and contents and accept all responsibility for loss, and that future owners would also be informed. Structures in this category might include garden sheds, boat sheds, carports, low cost swimming pools, and small jetties.
- S11 Development advice. The Board may make its own assessment of coastal hazards and coast protection proposed for a development and provide advice to the planning approval authority. For projects where the Minister

has requested an Environmental Impact Statement, the Board will provide advice to the Minister.

Appendix 2

DRAFT DEVELOPMENT GUIDELINES AND RISK ASSESSMENT CRITERIA FOR COASTAL ACID SULFATE SOILS IN SOUTH AUSTRALIA,

Endorsed by the Coast Protection Board at its meeting on 26 July 2002

APPENDIX 2

1. Coastal Acid Sulfate Soils Strategy

A full description of the Coast Protection Board's Coastal Acid Sulfate Soils Strategy 2002 is detailed in three reports: 1) Interim Strategy for Implementing CPB Policies on Coastal Acid Sulfate Soils in South Australia; 2) Interim Development Guidelines and Risk Assessment Criteria for Coastal Acid Sulfate Soils in South Australia; and 3) Interim Checklist for Development in Coastal Acid Sulfate Soils, South Australia. A Review of Existing State and Local Planning Approaches is also available.

Interim Strategy Statement

The Coast Protection Board will seek provision of the following for any proposed development in coastal acid sulfate soils areas before its advice will be provided to the Development Assessment Commission:

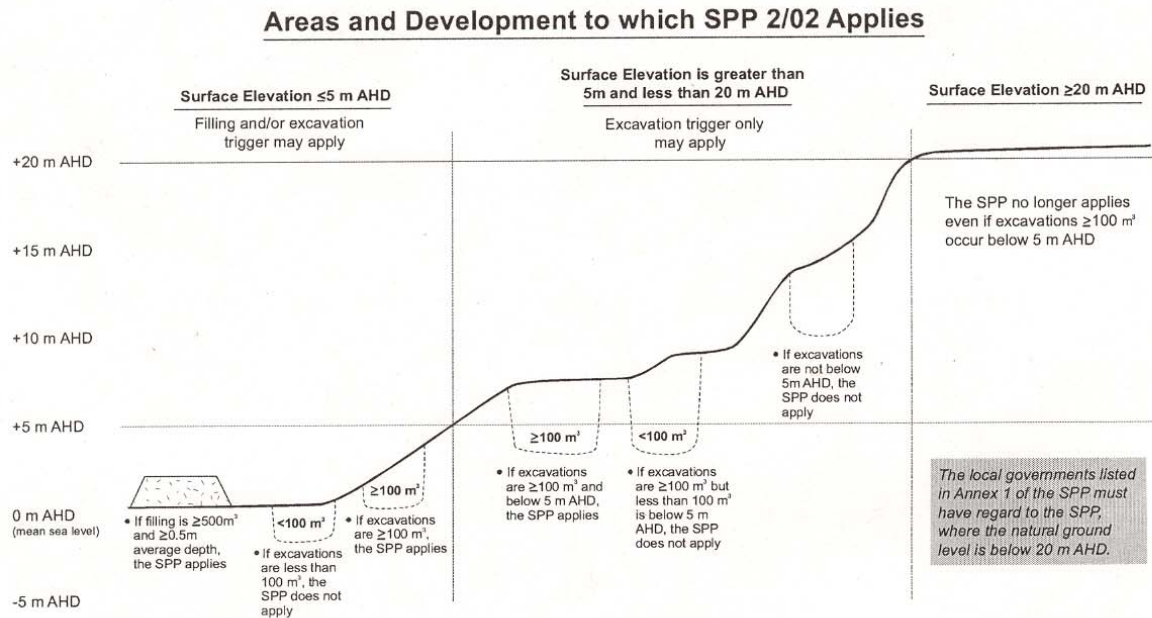
1. An assessment of the site including the natural ground surface relative to Australian Height Datum (AHD), and the amount of excavation or fill that is required;
2. Information on whether potential or actual coastal acid sulfate soils or ground-water are at risk of being disturbed as a result of the development;
3. Where there is a risk of acid sulfate soil disturbance:
Consideration of mitigation strategies, and a standardised investigation of the soil, surface water and ground-water at the site; and
4. Where coastal acid sulfate soils are confirmed:
a management plan of ongoing monitoring and best-practice management of the area so that coastal acid sulfate soil disturbance is minimised and remediated.

Interim Guidelines for Development Proposed in Coastal Acid Sulfate Soil Risk Areas

For proposed developments in South Australian coastal areas, elements of the NSW (Ahern *et al* 1998) and Queensland (Queensland Government 2002) acid sulfate soils approaches are utilised:

- 1) Any coastal region or subsoil <5 m AHD, where the natural ground level is <20 m AHD, will be subject to coastal acid sulfate soil risk assessment.
- 2) If acid sulfate soils (either potential or actual acid sulfate soils) are present, then acid sulfate soils provisions will apply to developments involving:
 - a. extraction or removal of >100 m³ material, or
 - b. filling of >500 m³ of material at >0.5 m average depth.
- 3) Any building, plumbing, drainage or operational works involving less than the relevant amount of excavation or filling is not assessable by the Coast Protection Board. However, in acid sulfate soils risk areas, standard building or works assessment criteria should be devised.
- 4) ASS risk maps for South Australia will need to be consulted to determine the probability of acid sulfate soils occurrence and potential disturbance at the proposed development site. These will be available through the South Australian Coastal Atlas: www.atlas.sa.gov.au.

Figure 1. Elevations and amount of excavation or fill in the Queensland State Planning Policy 02/2



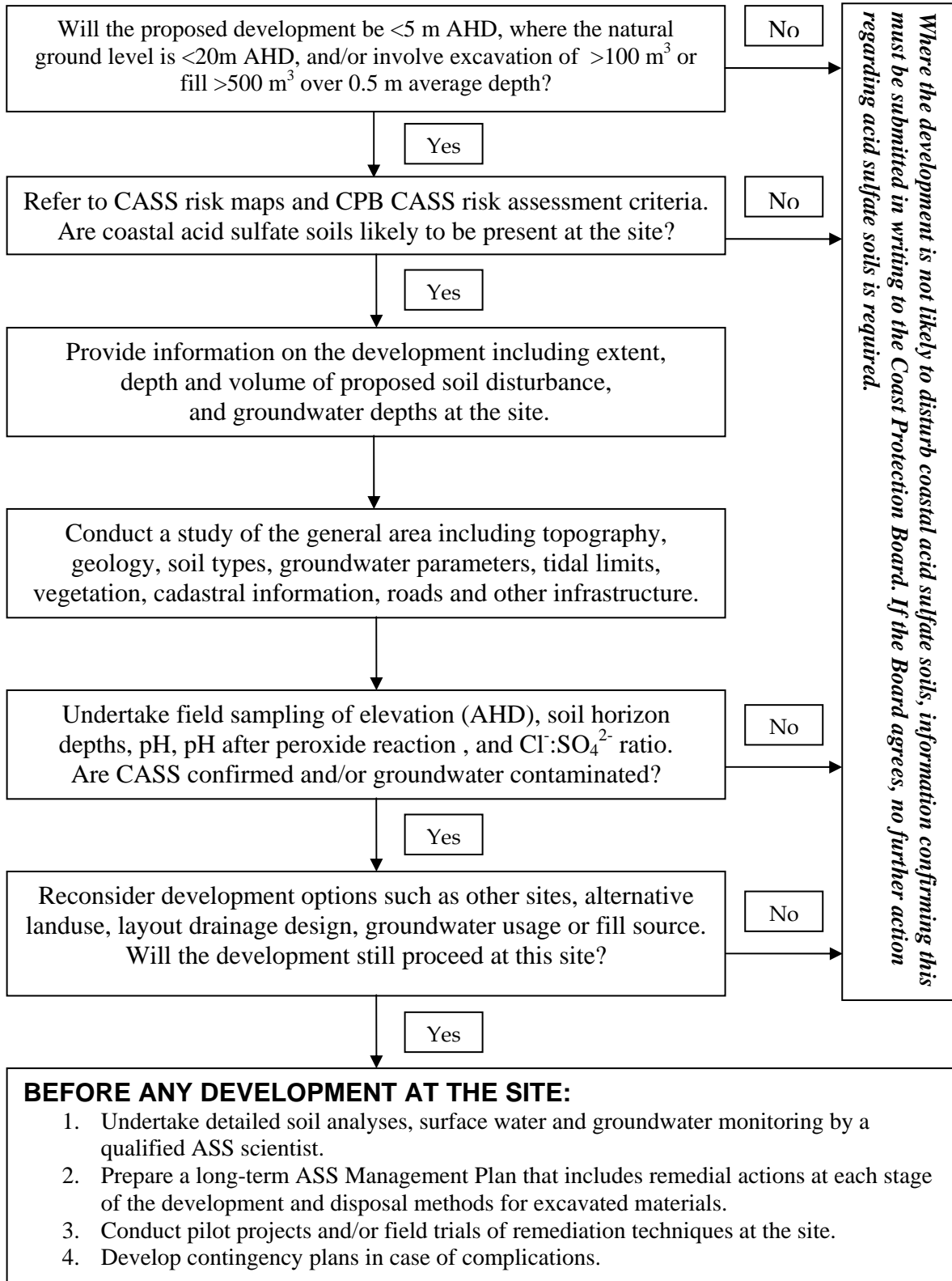
Developments can be defined as any material change intrinsic to the proposed use that involves excavation, filling, drainage, dewatering or other modification. Such uses include agriculture, aquaculture, infrastructure, industrial, urban and tourism developments. Activities³ in coastal regions where acid sulfate soils or ground-water are likely to be disturbed include:

- **excavation, filling and acid sulfate soils disturbance** – construction of roads, foundations, drainage works, laser levelling, land-forming works, flood mitigation works, dams and aquaculture ponds, sand or gravel extraction, dredging, and where excavated material is placed or used;
- **drainage, de-watering and lowering the watertable** – new drainage works or deepening or existing drains, use of ground water, de-watering of dams, wetlands or quarries, and dredging works lowering riverbeds;
- **use of acid sulfate soils** – aquaculture pond walls, dams, flood mitigation works, imported fill material, reclamation or foreshore works;
- **habitat modification for mosquito control** – runnelling, drainage and selective ditching for water removal or to allow access for predatory fish.

(Ahern *et al* 1998)

³ Activities listed in the *Environmental Protection Act 1993* as Prescribed Activities of Environmental Significance include any activities producing listed waste (Part B of the Schedule), such as acids or acidic solutions, other than any activities including building, plumbing or gas fitting and agriculture or horticulture. In these circumstances, where significant risk to the environment can be identified, provisions need to be considered to limit these activities or provide alternative options.

2. Acid Sulphate Soils Decision Tree for Proposed Development in The Coastal Zone



3. Information Required for Proposed Developments in Coastal Acid Sulphate Soil Risk Areas of South Australia

3.1 Will any part of the proposed development be less than 5 m Australian Height Datum, where the natural ground level is less than 20 m AHD?

This applies to ground surfaces and subsoils below 5 m AHD in coastal areas where the natural ground is less than 20 m AHD. Coastal acid sulfate soils form mostly in low-lying coastal regions that have been subject to seawater inundation. In the Recent geologic history of South Australia, this inundation does not appear to have exceeded 5 m AHD. Even so, acid sulfate soils may also occur at some distance from the existing coastline in low-lying coastal sediments covered by younger geologic material. For this reason, coastal areas with elevations up to 20 m AHD natural ground surface are included in the CPB strategy.

3.2 Will the proposed development involve excavation greater than 100 m³ or fill greater than 500 m³ over a 0.5 m depth?

Only developments of this size or greater are covered by the CPB coastal acid sulfate soils strategy. Smaller developments, e.g. building or operational works in individual premises, are not assessable under the strategy. However, a duty of care should be carried out for any developments in coastal acid sulfate soil risk areas, and standard building or development assessment criteria should be devised to address smaller developments.

For proposed developments in the coastal zone:

If all of the proposed development is to occur in soils *above* 5 m AHD and/or *does not* involve excavation of more than 100m³ or fill of more than 500m³ over an average 0.5m depth, written information confirming this should be provided to the CPB and no further action regarding the coastal acid sulfate soils strategy will be required.

If any part of the proposed development is to occur in soils *less than* 5 m AHD and/or *will* involve excavation of more than 100 m³ or fill of more than 500 m³ over an average 0.5 m depth, it will be necessary to consult the coastal acid sulfate soil risk maps and the CPB risk assessment criteria to determine if coastal acid sulfate soils are likely to be present in the region.

3.3 Coastal Acid Sulfate Soil Risk Mapping and Risk Assessment Criteria

Coastal acid sulfate soils risk mapping has been undertaken to assess the probability of acid sulfate soils occurrence in coastal regions of South Australia. The South Australian Coastal Atlas GIS maps (<http://www.atlas.sa.gov.au>) were used as base maps and ten classes of acid sulfate soils risk probability were assigned to them (Table 1). These coastal acid sulfate soils risk maps can be used for planning purposes and to guide development by merging the

ten classes into three main risk assessment categories depending on the probability of coastal acid sulfate soils occurrence (Table 2).

Table 1. CSIRO CASS Map Classes for South Australia (Fitzpatrick *et al* in press)

	Map Legend	Class Description
1	(a) Actual ASS (disturbed)	Actual acid sulfate soils (existing AASS) Very high risk. Only found in this mapping unit in the Port-Adelaide – Gillman, Barker Inlet area and in the adjacent “Other Soils” mapping unit.
	(b) Potential ASS (disturbed)	PASS in subsoil below 20 cm (up to 1 metre thick with surface monosulfidic black ooze (MBO), intertidal (mainly in samphire). Moderate risk because carbonate layers usually occur above and below.
2	Potential ASS (mangrove)	Thick PASS - mangrove soil (potential acid sulfate soils) Mainly in mangroves with high risk.
3	Potential ASS (tidal stream)	PASS of tidal streams (PASS underlying tidal streams, not extensive laterally). Moderate risk.
4	Potential ASS (intertidal)	PASS in subsoil below 20 cm (up to 1 metre thick) with surface monosulfidic black ooze (MBO), intertidal (mainly in samphire). Moderate risk because carbonate layers usually occur above and below.
5	Potential ASS (supratidal)	PASS in subsoil below 50 cm (up to 1 metre thick) with some surface MBO – supratidal (Mainly in samphire, salt bush, blue bush, or saltpan associated with hyper saline soils where there is less frequent tidal inundation). Moderate to low risk.
6	Sand	Soils of sand dunes, ridges (No PASS and ASS within 1 metre of surface). Low risk of PASS below watertable.
7	Calcarenite	Calcareous soils and hardpans (No PASS, high neutralising). No or very low risk.
8	Marine Soils	Marine soils – subtidal and intertidal marine (PASS may be present; ASS neutralised by tides and carbonates) No or very low risk.
9	Other Soils	Soils associated with other land uses within coastal landforms. Risk requires individual investigation; guided by adjacent mapped units.
10	Soils Not Classified	Soils outside area of mapped coastal landforms.

Table 2. CASS Risk Assessment Criteria for South Australia (adapted from Stone and Hopkins 1998 – Appendix 1: Acid Sulfate Soil Model LEP)

CSIRO Acid Sulfate Soil Map Class	Risk Assessment Categories	Risk Assessment Criteria
1-3	1	Strategy applies to all developments.
4-6	2	Strategy applies to developments that involve excavation or filling beyond 1 metre below natural ground surface or affect the watertable.
7-10	3	Strategy applies to developments within 500 metres of adjacent Category 1 or 2 land or which are likely to affect the watertable on adjacent Category 1 or 2 land.

Any proposed development in the acid sulfate soils risk assessment categories will require CPB approval. In areas mapped as Risk Assessment Category 1 or 2, where there is a probability of acid sulfate soils disturbance by the proposed development, it will be necessary to identify the

areas at greatest risk. In areas mapped as Category 3 and within 500 m of adjacent Category 1 or 2 areas, verification will be necessary as to whether acid sulfate soils are present or ground water is likely to be affected. If so, the actions to be taken will be similar to those for Category 1 or 2 areas. In areas where it is assessed accurately that the proposed development will not disturb acid sulfate soils or ground water, no further action relating to acid sulfate soils management will be required.

3.4 Where a Risk of Coastal Acid Sulfate Soil Disturbance is Identified

3.4.1 Provide general parameters of the proposed development

Describe the nature of the development to determine whether acid sulfate soils would be disturbed. Are earthworks to be undertaken? If so:

- What is the depth of soil disturbance?
- What is the volume of soil to be disturbed?
- Can exposure to air of disturbed soil be minimal?
- Is the ground water level likely to be lowered?
- Is the ground water drawdown rate or flow direction likely to be altered?
- Is the soil or ground water disturbance likely to be short or long term?

3.4.2 Conduct a study of the area

A site description can be compiled from topographic maps/aerial photographs to include:

- delineation of the area to be disturbed on an appropriately scaled map;
- physical and biological nature of the area – topography, geology, soils, hydrogeology/ground water, tidal limits, and vegetation communities; and
- human infrastructure in the area – land zoning, roads, population density, associated activities.

If acid sulfate soils (Table 3) are likely to be present in the area of the proposed development and are at risk of being disturbed, soil and/or ground water sampling at the site will be necessary.

Table 3. Acid Sulfate Soils Site Characteristics (sourced from Ahern *et al* 1998)

Soil Type	Soil Characteristics	Water Characteristics	Other Characteristics
Actual Acid Sulfate Soil	<ul style="list-style-type: none"> field pH ≤ 4; jarositic horizons (pale yellow mineral deposits). Where the watertable fluctuates, jarosite may precipitate along cracks or root fissures in the soil); iron oxide mottling in soil left exposed to air (e.g. excavated or dredged material); presence of shell. 	<ul style="list-style-type: none"> pH < 5.5 in surface ponding, drains, ground water or adjacent streams; clear or milky blue-green water flowing within or from the site (aluminium released from acid sulfate soils can act as a flocculating agent); iron stains on drain or pond surfaces, or iron-stained water deposits. 	<ul style="list-style-type: none"> scalded or bare low-lying areas; corrosion of concrete and/or steel structures.
Potential Acid Sulfate Soil	<ul style="list-style-type: none"> pH usually neutral but may be acidic – positive peroxide test; waterlogged soils –blue-grey or dark greenish grey unripe muds, mid to dark grey estuarine silty sands or sands or dark grey estuarine/tidal lake bottom sediments; presence of shell. 	<ul style="list-style-type: none"> pH usually neutral but may be acidic. 	

3.4.3 Field sampling

Field investigations for coastal acid sulfate soils and associated ground water will be required in areas where it is assessed there is a risk of disturbance. An experienced and accredited soil consultant should be engaged when undertaking any acid sulfate soils investigation program.

a) Sampling sites

The number of sampling sites to be chosen will vary depending on the type of disturbance proposed, site variability, soil characteristics and the sensitivity of surrounding areas. The *Australian Soil and Land Survey Field Handbook* (McDonald *et al* 1990) should be consulted when planning site locations. As a guide, sites should be located every 0.25 ha for areas up to 4 ha, and every 0.5 ha thereafter. Down the soil profile, samples equal to 0.5 kg or more should be collected at intervals of 0.25 m depth or minimally every 0.5 m or different horizon. The upper and lower depth of each horizon should be recorded and samples should not be taken across horizon boundaries. The depth of sampling should continue to either at least one metre below the proposed excavation depth or estimated reduction in watertable height, or a minimum of two metres below the land surface whichever is greater. Where the site characteristics

indicate that CASS may be present, the number of sampling sites and intervals down the soil profile should be increased in those areas.

b) Sample layout

Extensive projects:

For extensive projects, e.g. housing developments, highway construction or agriculture, large areas of coastal acid sulfate soils may be disturbed. For these types of projects, sampling should generally cover the whole area of the proposed development on a grid of every 0.25 ha or less. More intensive sampling of every 50-75 m should be undertaken in areas of potentially greater coastal acid sulfate soils disturbance. Where the likelihood of coastal acid sulfate soils is reduced e.g. above 5 m AHD, this sampling intensity is not necessarily expected although some confirmatory sampling and analysis will be required.

Linear projects:

Linear development, e.g. drains, service trenches or narrow roads, will require sampling along the proposed line of disturbance every 50 to 100 m, or at lesser intervals in areas where the risk of coastal acid sulfate soils disturbance is greatest.

Dredging projects:

For projects involving dredging of material from estuaries, coastal lakes and wetlands, samples should be taken along transects every 50 to 100 m (or lesser where appropriate) and collected to at least one metre below the expected depth of extraction. Care must be taken to collect all of the sediment sample as the fine fractions may drain away during retrieval or, in some wet dredging operations, separate from the bulk material during stockpiling. Seawater or shells in the sample may complicate the analysis of the dredged material by neutralising any acids present.

c) Sampling equipment

The choice of soil equipment will depend on site access, soil texture and wetness, and sample depths. As a general rule, core or sample diameters should be greater than 50 mm to allow for representative soil sampling. Manual sampling equipment types include tapered-tip push tubes, tapered gouge augers, jarret augers or piston samplers, whereas mechanical equipment and techniques include hydraulic push tubes, hollow flight screw augers, vibrocorers or wash bore drilling combined with driven Standard Penetration Test spilt tube sampling. Some types of equipment are more suitable than others for different soil types. Further information on sampling equipment suitability is given in the NSW ASS *Manual Assessment Guidelines* (Ahern *et al* 1998). A record of the type of sampling or drilling equipment together with the drilling operator's contact details should be kept. An acid sulfate soils-trained soil consultant must be present to supervise drilling and handling of samples. Between each sample, equipment should be washed to avoid contamination of samples.

d) Soil field pH

Soil field pH gives a quick indication of the likely presence and severity of actual acid sulfate soils. pH readings should be taken from each horizon of the soil profile. Readings of $\text{pH} \leq 4$ generally indicate actual acid sulfate soils (and acid pore water) are present. Readings of $\text{pH} > 4$ may indicate actual acid sulfate soils are absent although potential acid sulfate soils may still be present. pH values > 4 and < 5.5 may be the result of

previous or limited oxidation of sulfides. Other factors such as organic acids, leaching or strong overuse of fertiliser can also cause pH >4 and <5.5. At these pH values, substantial exchangeable/soluble aluminium and hydrogen ions are usually present.

Field pH equipment

Field pH can be measured by a battery-powered field pH meter with a spear-point double reference pH electrode probe. The probe should be inserted directly into either soft wet soils or soil mixed into a paste with deionised water. It should be standardised prior to and regularly during use against standard solutions according to the manufacturers instructions. Similarly, a 1:5 ratio of soil:de-ionised water suspension can be mixed in a small tube, hand shaken and the pH of the solution measured using pH test strips. These will give an approximate pH value ± 0.25 .

Field peroxide test

To test for unoxidised sulfides and therefore potential acid sulfate soils, place a small amount of soil into a clean glass container and drop a small volume of 30 % hydrogen peroxide onto the soil. 30 % hydrogen peroxide is a strong oxidising agent and it should be handled carefully using eye and skin protection. The test should only be undertaken by a trained operator. In some cases the reaction may be instantaneous but in others it may take 10 minutes or more. Heating over hot water may be necessary to start the reaction on cool days. Following a reaction, allow time for the solution to cool as pH probes will only measure to 60 °C.

The pH of the peroxide should be between 4.5 and 5.5. Analytical grade peroxide can be as low as 3 as manufacturers stabilise technical grade peroxide with acid. Therefore, first determine the pH of the peroxide and if necessary adjust it with a few drops of 0.1 M NaOH before taking it into the field and undertaking a field peroxide test.

(sourced from Ahern *et al* 1998)

Field pH alone cannot indicate potential acid sulfate soils as they may be neutral to slightly alkaline when unoxidised. For potential acid sulfate soils that contain unoxidised sulfides, a peroxide test – 30 % (100 volume) hydrogen peroxide - can be used to rapidly oxidise the iron sulfides, resulting in the production of acid with a corresponding drop in pH. Indicators of a positive reaction include:

- effervescence;
- a change in soil colour from grey to brown tones;
- sulfurous odours;
- a lowering in pH below pH_F (field pH); and
- pH <3.5.

The peroxide test is most reliable on clays and loams with low levels of organic matter and least useful on sands and gravels with low levels of sulfidic material (e.g. <0.05 % S). Care must be taken when interpreting the results since soils containing a high level of organic matter or other constituents such as manganese oxides can also cause a reaction (Ahern *et al* 1998).

3.4.4 Microscopic soil analysis

Soil samples can be examined microscopically to provide evidence of sulfide framboids (small nodules) or individual crystals. A small amount of soil should be mixed into a paste with deionised water, placed on a glass slide, and viewed under a microscope. Where framboids or crystals are observed, 30 % hydrogen peroxide can be dropped onto the slide. An effervescence reaction would indicate sulfidic matter. If no framboids or crystals are observed, this does not necessarily suggest their absence as sulfidic particles may have been lost during preparation or may not be represented in such a small sample.

3.4.5 Ground water analysis

The pH and EC (electrical conductivity) of ground water should be recorded at each borehole or sample site. Samples may also need to be submitted for laboratory analysis. Each sample should be labelled and coded, and its depth and location of the site marked on a map with grid references.

In general, seawater has a Cl^- concentration of approximately 19,400 mg/L and a SO_4^{2-} concentration of approximately 2,700 mg/L, giving a $\text{Cl}^-:\text{SO}_4^{2-}$ ratio of 7.2:1. As the ratio of the dominant ions in saline waters remains approximately the same even when diluted with freshwater, estuaries, coastal saline creeks and associated ground water should have similar ratios to that of seawater. Thus, any elevated levels of sulfate ions relative to chloride ions can indicate the presence of acid sulfate soils in the region. A $\text{Cl}^-:\text{SO}_4^{2-}$ ratio <4:1 and particularly <2:1 provides a strong indication of additional sulfate from previous sulfide oxidation. However, the $\text{Cl}^-:\text{SO}_4^{2-}$ ratio is less predictive when waters become predominantly fresher, and care must be taken when interpreting results from areas where large freshwater inputs can occur (Ahern *et al* 1998).

Piezometers

A properly installed piezometer assists in accurately determining ground water depth and monitoring water quality. A simple piezometer can be constructed from a 3 m length of 40 mm diameter PVC pipe that has had thin slots cut into and around the lower 1m of the pipe. A filter sock can be secured to the pipe at its base by a PVC end cap and with duct tape above the slots so these do not become clogged with soil or other material. To position the piezometer, a hole should be dug about 100 mm in diameter to about 2.8 m, and sand poured into the bottom of it so that the top 0.2 m is protruding. The hole should be back-filled with coarse sand or gravel and packed tightly using a dowel rod until all the slots are covered. Backfill the hole a further 0.2 m with bentonite or dry clay to deter surface water from draining down; follow that with the excavated material until 0.2 m from the surface, and then use bentonite or concrete to the surface. The height of the piezometer should be determined relative to AHD using nearby survey benchmarks.

Ground water depth can be measured from the top of the piezometer using a measuring stick with a tape and plunger device attached to record when it hits the ground water. An alternative is to install an electronic water-level recorder to record depths at regular intervals. Water quality monitoring in the field usually involves pH and electrical conductivity, which can be undertaken using electronic probes calibrated for each set of

measurements. Samples can also be collected for dissolved iron, aluminium, chloride and sulfate, and sent to a water-quality testing laboratory.
(adapted from Schmidt *et al* 1998)

Table 4. Summary of Field Analyses (adapted from Ahern *et al* 1998)

Characteristics	Sample no	Sample no	Sample no	Sample no	Sample no
Field sample number					
Location/site number					
Map reference and grid					
Elevation/ Depth (m AHD)					
Site observations					
Soil horizon type & depths					
Field pH					
Peroxide reaction					
pH after peroxide					
Microscopic identification					
Cl:SO ₄ ²⁻ ratio					

3.4.6 Interpretation of results

Following the field investigation, where there is a strong likelihood of coastal acid sulfate soils disturbance in the region, alternative sites and/or mitigation strategies will need to be considered. In addition, detailed sampling and chemical analyses will be required, particularly in those areas found to have the highest probability of coastal acid sulfate soils (i.e. hot spots) being present. Depending on the results of these analyses, a management plan for the site may be necessary.

In cases where the investigation concludes that coastal acid sulfate soils are not likely to be disturbed, the proponent will be required to submit the results of the analyses to the Coast Protection Board. If the Board responds in writing that it is satisfied that coastal acid sulfate soils will not be disturbed as a result of the proposed development, no further actions will be required.

4. Mitigation Strategies

Major developments should not proceed in areas of high coastal acid sulfate soil risk. The cost to the surrounding environment and inevitably to the development itself of releasing acid and metal ions in the soil and ground water outweighs any short-term gain. Where acid sulfate soils have been disturbed in the past, structures have subsided, building materials have been corroded or agricultural/aquacultural productivity has been markedly reduced (NWPASS 2000).

To avoid disturbing coastal acid sulfate soils, and therefore the need for subsequent remedial works or rehabilitation, alternative approaches should be considered before any earthworks are undertaken (Table 5). The mitigation strategy that is chosen should represent the lowest risk to the environment. Not all strategies will succeed in some regions or under certain conditions. In such cases, site-specific pilot projects will need to be set up and monitored over the long term to determine the suitability of the mitigation strategy and allow for any design improvements.

If all of the alternative options have been considered carefully and the proposed development is still to proceed, the proponent will need to submit standardised soil, surface water and ground water analyses to the CPB, as well as a proposed development management plan. This is so that: 1) minimal soil disturbance will occur during and after completion of the development, 2) excavated materials will be disposed of or neutralised correctly, and 3) remedial strategies will be implemented.

Table 5. Alternatives before Undertaking Development in Coastal Acid Sulfate Soils Risk Areas (sourced from Ahern *et al* 1998)

Mitigation Strategies	Examples and Benefits
Alternative low risk sites	Agriculture/aquaculture venture – avoid loss of product yield and ongoing acid sulfate soil management costs.
Alternative uses of land	Urban subdivision – reserve areas of high acid sulfate soil risk for environmental protection.
Alternative site layouts	Construction of roads or pipelines – redesign routes to avoid acid sulfate soil hot spot areas.
Alternative drainage designs	Drains, levees or floodgates – consider wider, shallower drainage options or floodgate operations that suit variable flow conditions to reduce the likelihood of acid sulfate soil disturbance.
Alternative ground water usage	Ground water discharge and recharge – consider using alternative water supplies; avoid decreases in ground water levels associated with the use of levees or floodgates.
Alternative sources of fill	Do not use fill sourced from acid sulfate soil areas –consider using clean imported fill to avoid remedial works.

5. Detailed Soil, Surface Water and Ground water Analyses

For areas where there is a high risk of coastal acid sulfate soils disturbance, detailed soil and water sampling and analyses are required; the higher the level of risk, the greater the sampling and analysis program. A qualified acid sulfate soils consultant will be required to conduct a well-planned approach to the investigation and qualified laboratories will need to be used for the soil analyses. In situations where samples exceed acceptable sulfur or carbon results, a management plan will be required.

5.1 Soil Analysis Program

Analytical procedures are currently being developed by CSIRO for temperate acid sulfate soils in South Australia. These include:

- Total soil carbon and total sulfur by LECO furnace;
- Carbonate carbon – to determine the neutralising capacity, i.e. there is sufficient capacity to neutralise all the potential acid if the CaCO_3 content is 3 times that of total sulfur;
- Sulfide sulfur – to determine how much reduced sulfur is present;
- Total sulfur/sulfide sulfur – to indicate the amount of sulfate sulfur present;
- Total carbon/carbonate carbon – to estimate the amount of organic carbon present applicable as food for bacteria; and
- Bulk density of soil samples from below the watertable – to calculate values in tonnes/ha.

The two main methods used to analyse soil samples in NSW and Queensland are:

- Total oxidisable sulfur – TOS; and
- Peroxide oxidation combined acidity and sulfate – POCAS.

The TOS procedure is a low-cost screening tool used to determine sulfide levels but does not account for acidity. This method is generally unsuitable for soils containing sands and gravels with low levels of sulfidic material.

TOS results can be complemented with the POCAS procedure to determine the oxidisable sulfur content of soils, particularly those with pH less than 4.5. POCAS analyses provide an indication of the 'sulfur trail' and 'acid trail' of soils. Where a clear relationship between the acid and sulfur trails can be established for a number of samples, only the POCAS acid trail need be used for the analyses. This allows for a quicker turn-around time of samples and therefore earlier liming calculations and management of any disturbed acid sulfate material.

Table 6 outlines action criteria based on the percentage of oxidisable sulfur (TOS) or equivalent total potential acidity (TPA) or total actual or existing acidity (TAA). For any proposed development where the action criteria values are exceeded, a management plan will be needed for the site.

Table 6. Action Criteria Based on Acid Sulfate Soils Analyses (from Ahern *et al* 1998)

Type of Material		Action Criteria for ≤1000 tonnes disturbed		Action Criteria for >1000 tonnes disturbed	
Textural Range (McDonald <i>et al</i> 1990)	Approx. clay content (% <0.002mm)	Sulfur Trail % S oxidisable (oven-dry basis) e.g. S_{TOS} or S_{POS}	Acid Trail Mol H^+ /tonne (oven-dry basis) e.g. TPA or TAA	Sulfur Trail % S oxidisable (oven-dry basis) e.g. S_{TOS} or S_{POS}	Acid Trail Mol H^+ /tonne (oven-dry basis) e.g. TPA or TAA
Coarse sands to loamy sands	≤ 5	0.03	18	0.03	18
Medium sandy loams to light clays	5 - 40	0.06	36	0.03	18
Fine Medium to heavy clays and silty clays	≥ 40	0.1	62	0.03	18

S_{TOS} - sulfur as total oxidisable sulfur; S_{POS} - sulfur as potential oxidisable sulfur; TPA – total potential acidity; TAA – total actual or existing acidity.

Treatment categories have been devised for NSW and Queensland that indicate the amount of pure lime that would be required to treat different weights of disturbed acid sulfate soils if the percentage oxidisable sulfur is known. The quantity of lime recommended is that required to neutralise the acid that could potentially be produced and includes the minimum industry safety factor of 1.5 (Ahern *et al* 1998). An adequate amount of neutralising material such as pure lime should be used to neutralise any acid that may be produced and to bring the pH of the soil above 5.5. In regard to the leachate, its pH should ideally be between 6.5 and 8.5 to remove toxic forms of aluminium and other heavy metals (Ahern *et al* 1998).

5.2 Water Analysis Program

5.2.1 Surface water sampling requirements

Where coastal acid sulfate soils are at risk of being disturbed, a water-sampling program should be devised that takes into account the scale of development proposed, the characteristics of the river or drainage system, and the nature of the potential impacts. The data should give an indication of the current health of the system, whether it is already impacted from acid sulfate soil disturbance, and also provide a benchmark to access any changes that may occur as a result of the development.

Water samples need to be taken both upstream and downstream of the development site, from different depths within the water column, and during different seasons in the

year, particularly the wettest and driest periods. Further information in regard to rainfall patterns and flow characteristics should also be obtained. Samples should be collected in containers of at least 0.5 litres and filled to the top to exclude air. They should also be kept cool to minimise chemical activity.

In regard to acid sulfate soils, the main water quality issues are those of acidity, soluble iron, aluminium and heavy metal concentrations, and changes in dissolved oxygen, carbonate and bicarbonate levels. Water quality measurements should routinely include:

- pH,
- total dissolved solids or electrical conductivity (EC), and
- soluble Cl^- and SO_4^{2-} concentrations (for Cl^- : SO_4^{2-} ratio for ground water or drain water).

pH and EC should be measured in the field as soon as the sample is collected. Samples can also be analysed for soluble iron, aluminium, dissolved oxygen, carbonate and bicarbonate. However, the results of soluble iron and aluminium analyses are often difficult to interpret and these analyses need only be undertaken in circumstances where large volumes of material containing sulfide are to be disturbed or if drainage from the development site directly affects river or drainage systems or natural wetlands. If iron analyses are to be performed, a separate water sample should be collected and acidified with nitric acid to prevent iron precipitation due to oxidation of the sample.

Table 7. Water Quality Criteria for Aquatic Ecosystems Protection (ANZECC 1992).

Indicator	Freshwater	Marine Water
pH	6.5-9.0	< 0.2 unit change
Fe (total)	500 µg/L	NA
Total Dissolved Solids (TDS)	0-15,00 mg/L	> 1,500 mg/L
Al (total)	5 µg/L for pH < 6.5 100 µg/L for pH > 6.5	NA

The pH of most natural freshwater is usually 6–7 and for marine water is close to 8.2 (Table 7). The ANZECC Guidelines (1992) recommend that changes of more than 0.5 units from seasonal maximum or minimum should be investigated. In marine waters, the pH should not vary by more than 0.2 units as these waters are strongly buffered and even small changes in pH indicate a major change to the system. The total alkalinity of seawater is 115-120 mg/L as CaCO_3 . The chemistry of aluminium in natural waters is complex and the solubility of aluminium is pH dependent. If pH is <5.2, total soluble aluminium increases with an increase in the range of dissolved ionic species present. Very low dissolved oxygen levels may result where iron precipitates from acidic water. Dissolved oxygen should not fall below 6 mg/L or 80-90 % saturation, having been determined over at least one diurnal cycle (ANZECC 1992).

Where polluted water is evident at a site, it should be contained and managed within the site boundary. Bunds or levees should be constructed of non-acid sulfate soil material and water should be treated to an acceptable pH level. This is usually in the range of 6.5-8.5 to ensure a reduction in total soluble aluminium and other toxic ion species (Ahern *et al* 1998).

5.2.2 Ground water

Ground water analyses are similar to those for surface water (pH, EC, Cl⁻: SO₄²⁻ ratio). The number of sampling locations and frequency of sampling will be influenced by the scale of the proposed development, and the nature of the ground water resource. Where there is a risk that ground water will be disturbed, appropriate piezometers will need to be installed to monitor its movement and chemistry. Water samples of at least 0.5 litres should be collected from each strata in the water column, and their containers filled to the top and chilled immediately to reduce any chemical activity. If iron analysis is required, a separate sample should be collected and acidified with nitric acid to prevent oxidation and iron precipitation.

Table 8. Site Specific Investigations (sourced from Ahern *et al* 1998)

Type of investigation	Rationale
Watertable depth and seasonal variations	The greater the ground water depth, the less likely ground water levels will change or water quality will be impacted as a result of the proposal.
Aquifer characteristics	e.g. hydraulic conductivity (thickness, porosity and transmissibility), ground-water gradient and flow direction, soil permeability and attenuation/sorption. High permeability increases ground-water infiltration.
Adjoining ground water related environments	e.g. wetlands , springs, rivers, creeks or recharge areas. The likelihood of ground water being affected increases at sites with surface water linkages.
Existing ground water users	e.g. density of bores, uses of ground water, the impact of the proposal on existing ground water supply and quality.

Developments have the potential to substantially affect ground-water by impacting on the generation and export of sulfuric acid. Depending on the characteristics of the aquifer and its interaction with the surrounding environment, a lowering of ground-water levels can lead to oxidation of coastal acid sulfate soils and degradation of ground-water quality. Activities that cause ground-water levels to decline include ground-water extraction, excavation to or below the watertable, construction of deep drains, dewatering of quarries or construction sites, dredging of river beds, and growing trees on cleared land. Alternatively, raising ground-water levels can also result in waterlogging and changes to the hydrology and ecology the area.

6. Proposed Development Management Plan

Where coastal acid sulfate soils are confirmed in an area, a management plan of the site should be prepared for ongoing monitoring and best-practice management to minimise soil and ground water disturbance. It should include an outline of any earthworks and their operational phases to reduce the impacts during any particular stage, and it should also include measures that protect the soil, surface water, ground water, environment and the community in the area.

Table 9. Proposed Development Management Plan Outline (sourced from Ahern *et al* 1998)

An overview of the proposed development and an environmental description of the site and its surroundings.
<p>Consideration of mitigation strategies:</p> <ul style="list-style-type: none"> • alternative sites for the proposed development and/or landuse changes of the site; and • strategies to minimise any impacts during each phase of the construction schedule.
<p>A soil, surface water and ground water monitoring and analysis program:</p> <ul style="list-style-type: none"> • parameters to be monitored, their location and sampling frequency; • analyses to be conducted and laboratories involved; • actions to be taken where thresholds for acid sulfate soils disturbance are exceeded; and • reporting procedures to relevant organisations.
<p>Pilot projects or field trials for managing acid sulfate soils disturbances:</p> <ul style="list-style-type: none"> • trialing of new technologies and management procedures; and • compliance with agreed standards and effective implementation.
<p>A contingency plan:</p> <ul style="list-style-type: none"> • in case of unexpected events, failure to implement a management strategy or ineffective management options.

More detailed management plans for coastal acid sulfate soils risk areas are provided in 3. *Draft Checklist for Development in Coastal Acid Sulfate Soils, South Australia* (2002c).

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