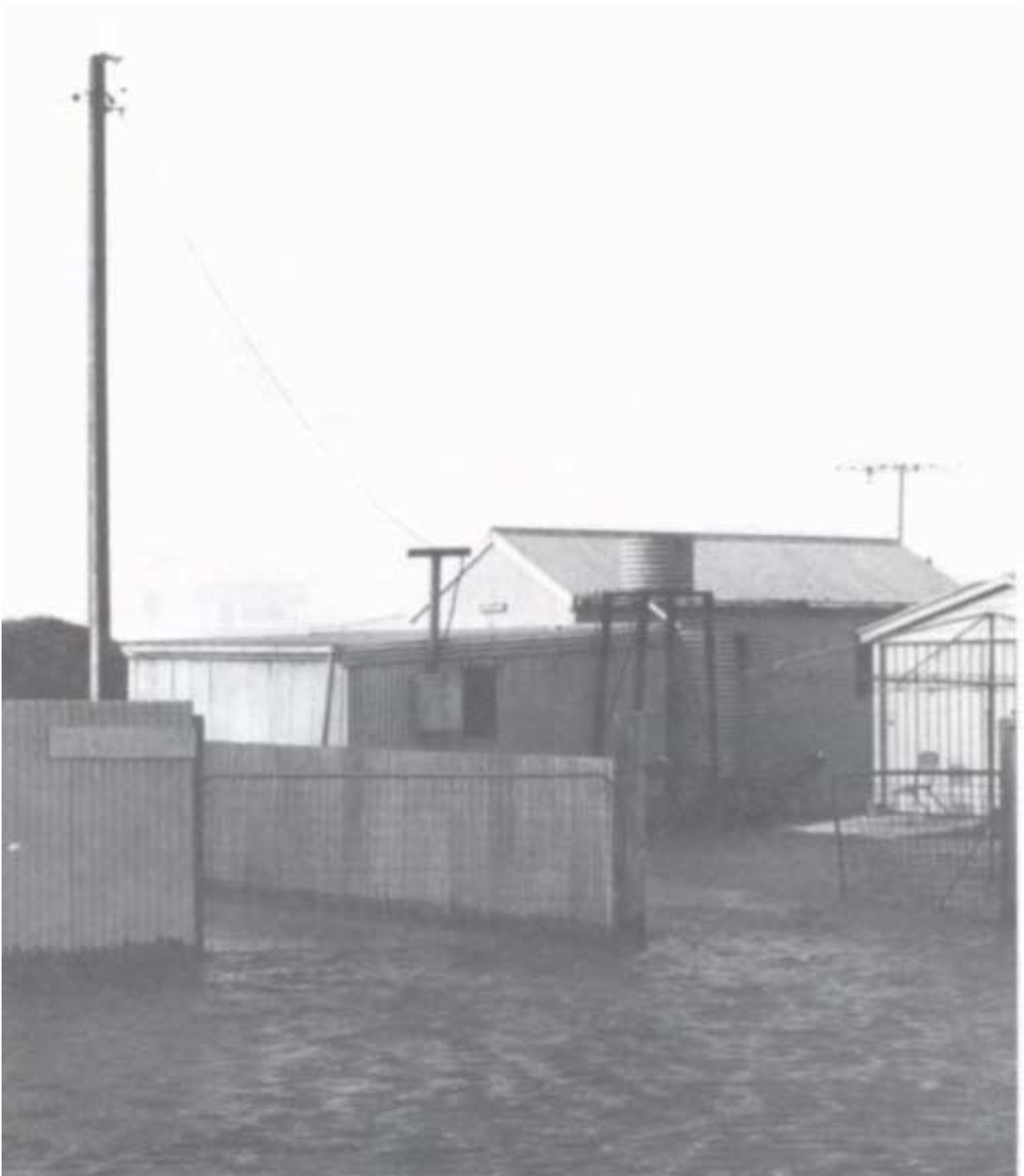


coastline

Coastal erosion, flooding and sea level rise standards and protection policy

SOUTH AUSTRALIAN COAST PROTECTION BOARD

No. 26
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INTRODUCTION

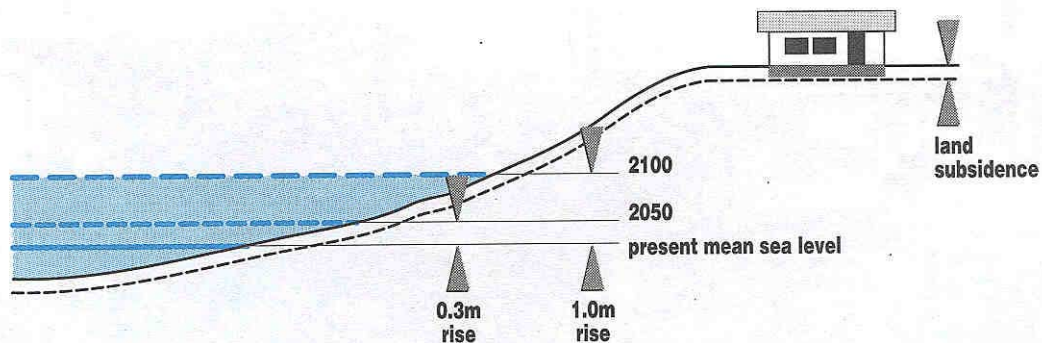
In May 1991 the South Australian Government endorsed policies which the Board had recommended on sea level rise and on standards for new coastal development. The purpose of this Coastline is to illustrate and explain those policies that set technical and environmental standards.

A major aim is to avoid protection works which would adversely affect the coast or detract from coastal scenic and recreation values. The policies will therefore be of general interest as well as being relevant to people who may be planning to build at the coast.

Councils and the SA Planning Commission seek the Board's advice and take the policies into account when development applications are assessed. The policies are also applied in assessing and designing coast protection works.

Although some seaside councils have already included the policies as principles in local supplementary development plans, many councils have not yet done so, and there is little consistency in coastal principles from one council area to another. Consequently, a Minister's supplementary development plan is being prepared to give State wide effect to the policies. This is being discussed with councils and, in accordance with the Planning Act, public comment will be sought and considered before it is authorised.

Sea level rise and land subsidence



Land subsidence is common in low-lying areas where soft sediments may still be consolidating, and can also be influenced by extraction of groundwater. For most of the SA coast the rate of land subsidence is very small and can be ignored. However rates of 1 to 2mm/year are known to be occurring at some places, for example on the Adelaide coast, and in these locations subsidence should be taken into account. Uplift of coastal land is only known to be occurring in the Upper Spencer

SEA LEVEL RISE AND FLOODING

The Board is recommending an allowance of 0.3m for sea level rise to the year 2050, which is consistent with internationally agreed projections. This replaces the 0.15m figure which had been applied in South Australia since the early 1980s.

Projections beyond 2050 are less certain. The best estimates available indicate a possible range of 0.35m to 1.10m by 2100, with a midrange figure of 0.65m.

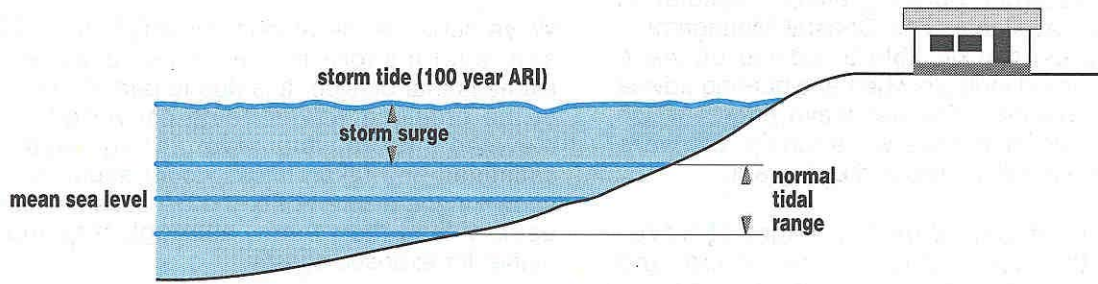
Under the policies development which could not reasonably be protected against sea level rise beyond 0.3m needs to be on higher land or set far enough back from the coast to be safe for a 1 m rise by 2100. This 1.0m includes a small margin for greater than expected increase and for weather changes that could result in more storm surge and higher tides.

The water level to be applied for building site and floor levels will usually need to include an allowance for wave effects as well as for storm tides and sea level rise. It may also need to take account of stormwater backed up by high tides, existing or proposed flood control measures, and any future land subsidence at the site. These factors are illustrated and explained in the diagrams and notes.

Gulf area. Information on land subsidence for a specific location may be available from the Coasts and Marine Section of the Environment Protection Agency of the Department for Environment, Heritage and Aboriginal Affairs, or Department of Primary Industries and Resources.

Reclamation and building on unconsolidated coastal sediments can also lead to subsidence. A geotechnical report and appropriate design would normally be expected for such projects.

Storm surge (storm tides)



Storm surge is the amount by which meteorological conditions cause a tide to rise above the predicted astronomic tide. It is caused by changes in barometric pressure and by wind stress on the sea surface. While storm surge seldom exceeds 1 m on the State's open ocean coastline, surges of 1.4m and 2.0m above predicted high tides have been recorded at Port Adelaide and Port Pirie respectively.

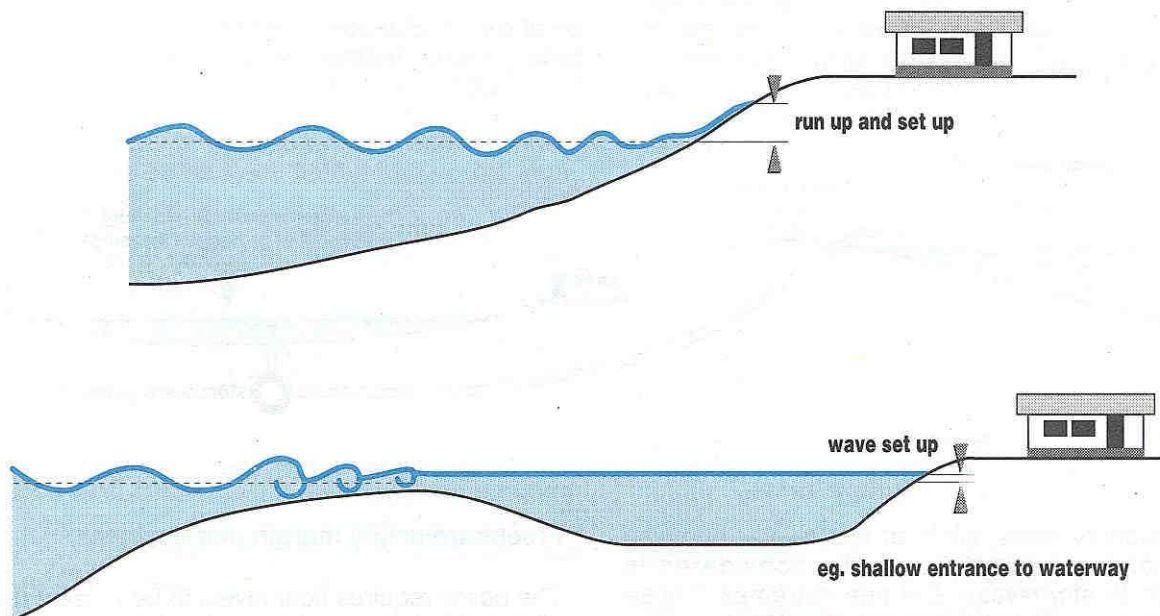
A large storm surge occurring coincident with a high spring tide will cause the highest tides. Conversely an intense storm may not cause damage if it occurs during a period of neap tides or is of short duration and co-incides with low tide. It is rarely necessary to design a development to be safe against the highest possible tide, because there is such low probability of this occurring. However there needs to be an agreed risk level,

which should be consistent with risks accepted for other hazards, such as urban flooding.

The policy establishes the 100 year average return interval (ARI) water level as the standard for coastal development in South Australia. The 100 year ARI event has a 1 in 100 chance of occurring or being exceeded in any year. It is usually obtained by statistical analysis of tide records. However other methods and data may need to be considered if the site is a long way from the nearest tide recorder.

The Coasts and Marine Section will usually be able to advise -on the level to be adopted. For some sites, or where levels are especially critical (such as for a major coastal development) advice may need to be obtained from the National Tidal Facility or from a private oceanographical specialist.

Wave effects



The highest waves will usually reach the coast during extreme tides - partly because the same weather conditions contribute to both and partly because the deeper water allows waves closer to

shore before they break. Co-occurrence of the highest waves with the 100 year ARI tide will be assumed unless expert advice supports a lower combined water level.

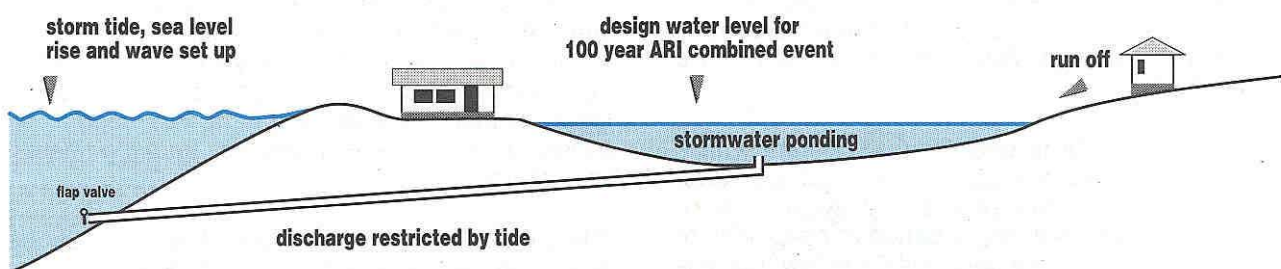
Wave heights vary enormously around the coastline. Although there are few wave records for the South Australian coast, reliable calculation methods are available. The Coasts and Marine Section will usually be able to advise on wave allowances or will indicate when engineering advice should be obtained. The two wave effects which need to be considered are wave run-up and wave set-up. These are illustrated in the diagram.

Wave run-up depends on the height of waves reaching the coast and on the slope and permeability of the coast in question. Values in

South Australia are commonly in the range 0.5m to 1.0m, though may exceed 3m in places.

Wave set-up is the amount by which the stillwater sea level inshore of the breaking wave zone exceeds that outside. It is due to part of the energy in the breaking waves being converted into an elevated inshore water level. It may need to be estimated and taken into account separately - as shown in the diagram. For the SA coast, values are usually less than 0.4m, although they may be higher for exposed coasts.

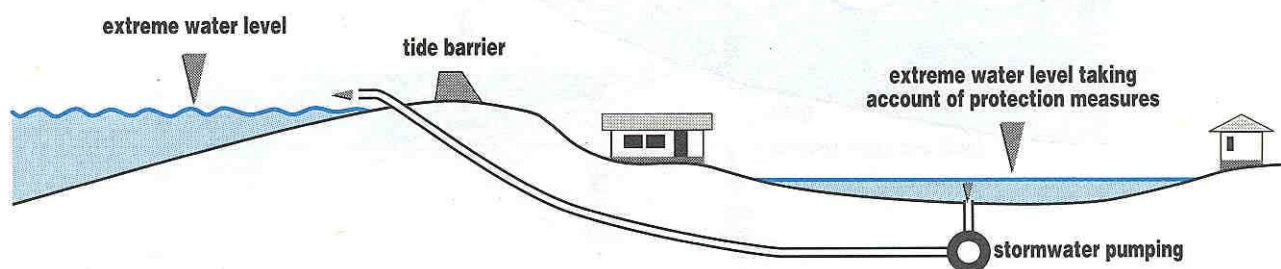
Tide and stormwater combined



This situation usually requires expert assessment. Even where drainage and tidal information is available, the statistical combination of extremes is

not straightforward. Studies would usually be undertaken by local councils using consultants, and would be eligible for coast protection grants.

Protected situations



Protection systems, such as stormwater pumping and holding basins, should be considered in relation to stormwater and tide extremes. These situations require careful engineering study.

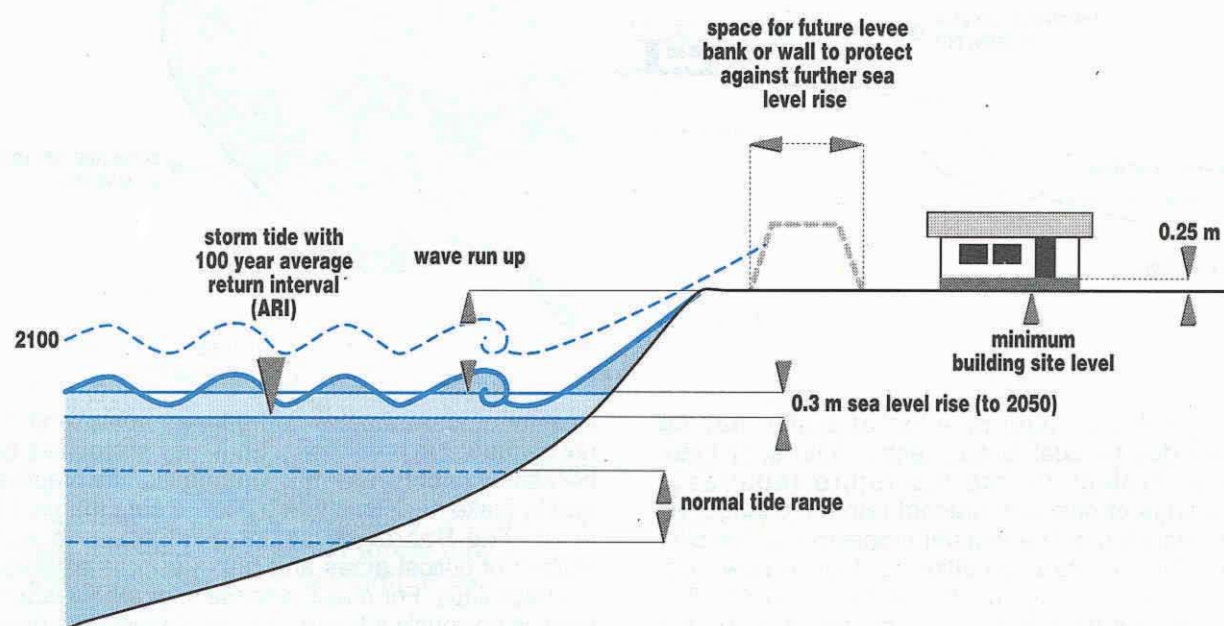
Under the policy the risk of failure of protection devices must be minimal and they must be adequately maintained.

Freeboard/safety margin (not illustrated)

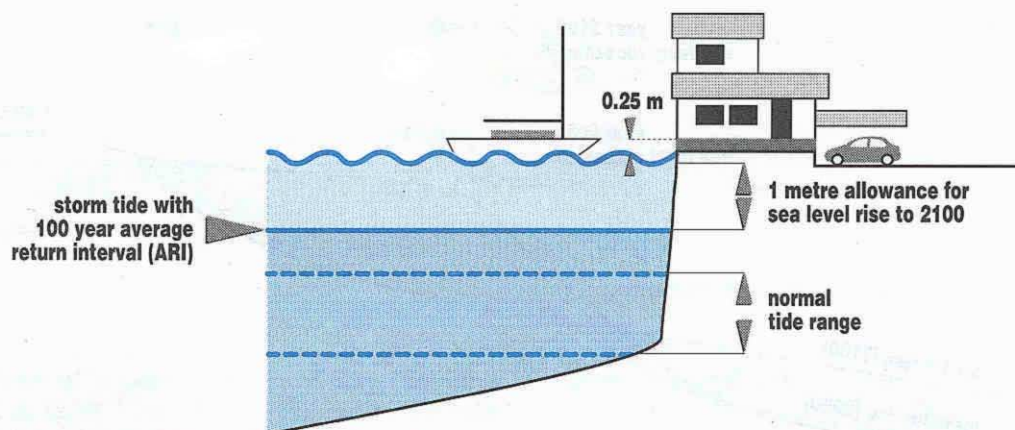
The policy requires floor levels to be at least 0.25m above the design water level (taking into account the above factors). This is intended to provide a small margin of safety and to cover the range of error in the statistical calculation of the extreme tide. An additional allowance may be necessary if the margin of error in the extreme tide calculation exceeds 0.25m, or if wave effects are uncertain.

Sea Level and Flooding Standards

The policies on sea level rise and flooding standards are set out in the policy insert with this Coastline, and are illustrated below.



Minimum elevation for buildings set back from the water's edge

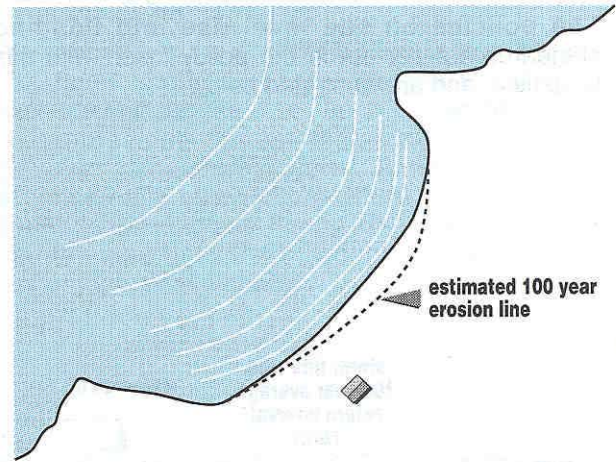
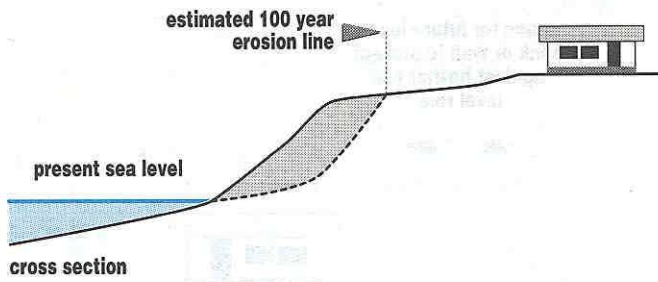


Minimum elevation for buildings on the water's edge, or over the water

Ideally new development should not be located where it will need to be protected. This is because coast protection works usually interact with natural processes in environmentally adverse ways, and because they frequently have high initial and ongoing costs. The policies are intended to avoid the need for protection. Where protection is appropriate, they aim to ensure that costs are met by the developer and not the community.

In deciding on how far building should be set back from the coast an estimate needs to be made of how far the coast is likely to retreat during the next 100 years. Local erosion or accretion trends need to be considered, and also storm erosion and likely change due to sea level rise. Space for construction of protection works and for future reserves may also need to be provided. These are explained in the following diagrams and notes.

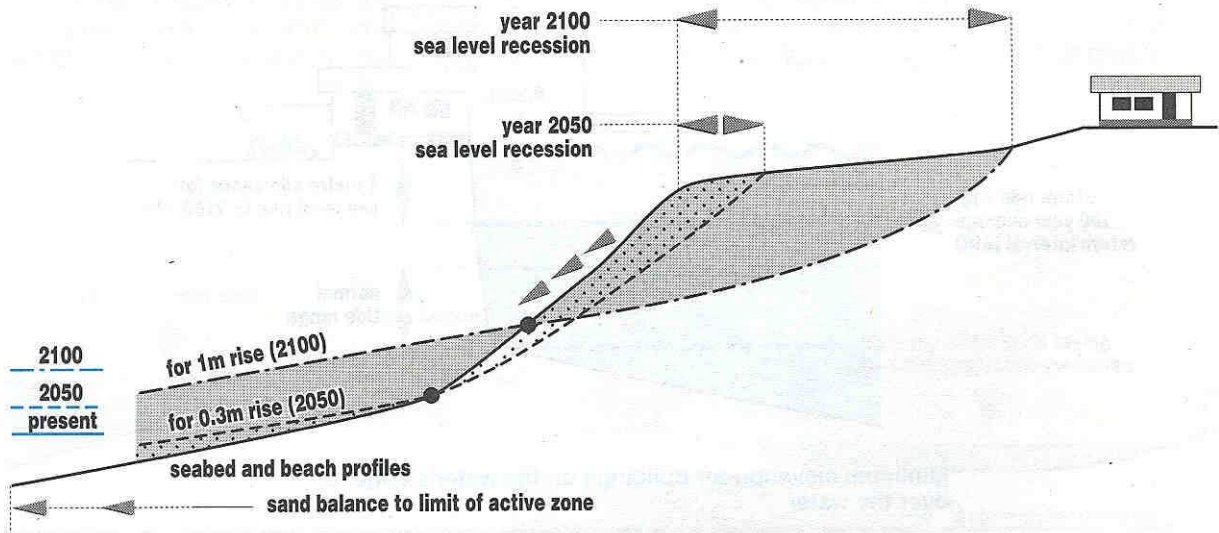
Changes due to local coastal processes



Change in coastline position at a site may be mainly due to local factors, either natural or man made. Projection into the future requires a knowledge of past and present rates of change, an understanding of the coastal processes at the site, and sufficient site information to deduce how local factors will impact on the erosion rates. For example, future erosion may be modified by the presence of underlying hard strata.

Coastal process studies can be very costly and do not give precise predictions. So it may sometimes be necessary to obtain as much information as practical and to make decisions which allow a safe margin for error. The Board will assist local councils with studies of critical areas and help Councils establish set-back lines. For major proposals, or others where there is obviously a future risk, developers may need to commission specialist studies.

Recession due to sea level rise

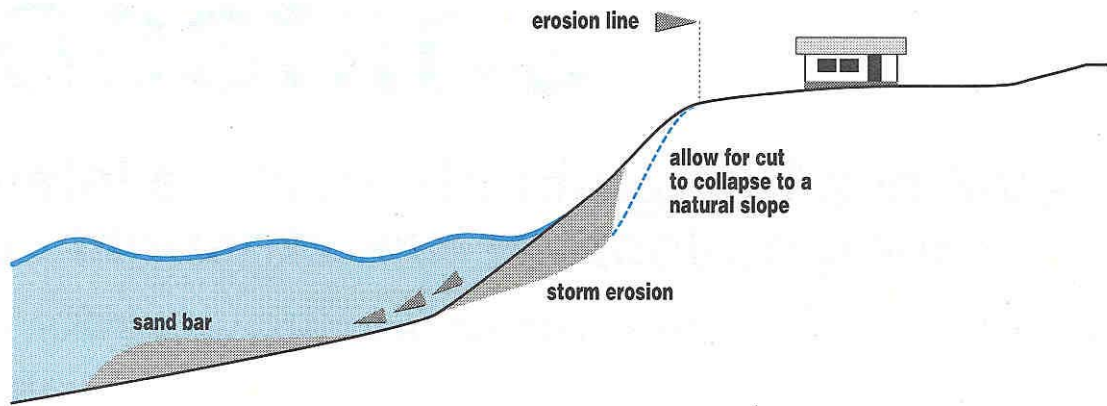


In the absence of other factors and assuming no change in wind and wave conditions, a sandy coast adjusts to increased sea level by maintaining nearshore water depth. The extra sand - to enable the nearshore seabed to follow the sea level rise - is obtained from erosion of sediments behind the beach. Most methods for estimating coastal recession due to sea level rise are based on this sand balance. Typically a sandy coast will erode a distance equal to 50 to 100 times the amount of sea level rise,

though this depends on the width of the active beach zone and the height of sand dunes, and the figure may be much lower or higher.

Allowance needs to be made for recession due to a 0.3m sea level rise if future protection would be practical and environmentally acceptable. Otherwise, the effects of a 1.0m rise should be considered. In some situations local coastal processes and sea level rise can be considered separately. In others they interact and need to be assessed together.

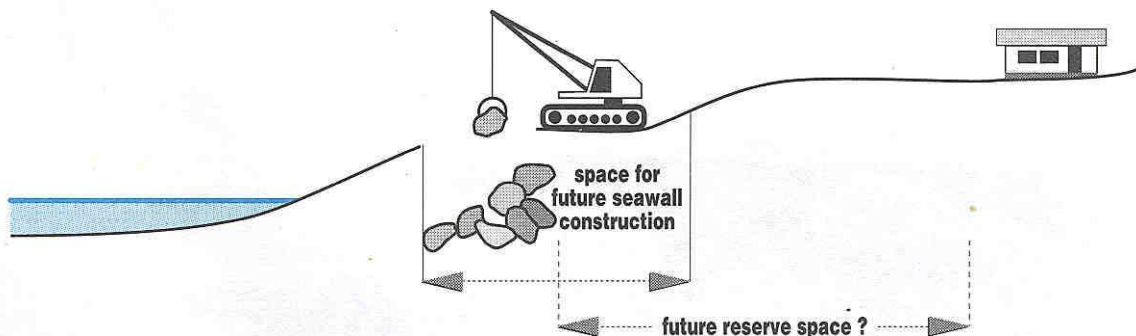
Storm erosion



Although coastal recession due to sea level rise and local processes will usually happen during storms, a severe storm or series of storms will also cause a further temporary erosion. Sand is removed from the beach and dune-face and moved onto an offshore sand bar. During calmer conditions it is returned by the action of swell waves and onshore winds. Because this storm erosion may occur near the end of the planning period, it needs to be added to the total erosion estimate and taken into account in determining building setback.

For more exposed parts of the South Australian coast, dunes may erode by up to 20m or 30m during a severe storm. More typically, storm erosion in a single year might be up to 10m. In some instances experience from the location, or a similar one, may provide the best guide. In others calculation methods, which take into account local beach factors and storm wave conditions, may be more useful.

Space for building future protection and for a future reserve



Construction of a seawall will generally require a space of at least 10m beyond the estimated total erosion line. The provision of additional reserve space will depend on needs at the location. The draft Minister's SDP mentioned in the introduction provides principles on reserve width.

Erosion standards

The erosion standards and policies on protection works are set out in the policy insert with this Coastline.

FURTHER INFORMATION

The insert is an extract from the policy document and only covers the flooding, sea level, setback and protection policies discussed here. Other policies cover

- special exceptions
- providing information and assessing risk for new
- development
- responsibility for protection of public and private
- property, and
- criteria for grants to Local Councils.

The complete policy document may be inspected at offices of coastal Councils and at Department for Environment, Heritage and Aboriginal Affairs regional offices. Copies may be obtained from the Environment Shop, 77 Grenfell Street, Adelaide.

Cover Photograph: Tidal flooding at Mundoo Channel, Hindmarsh Island on 14 May 1987.