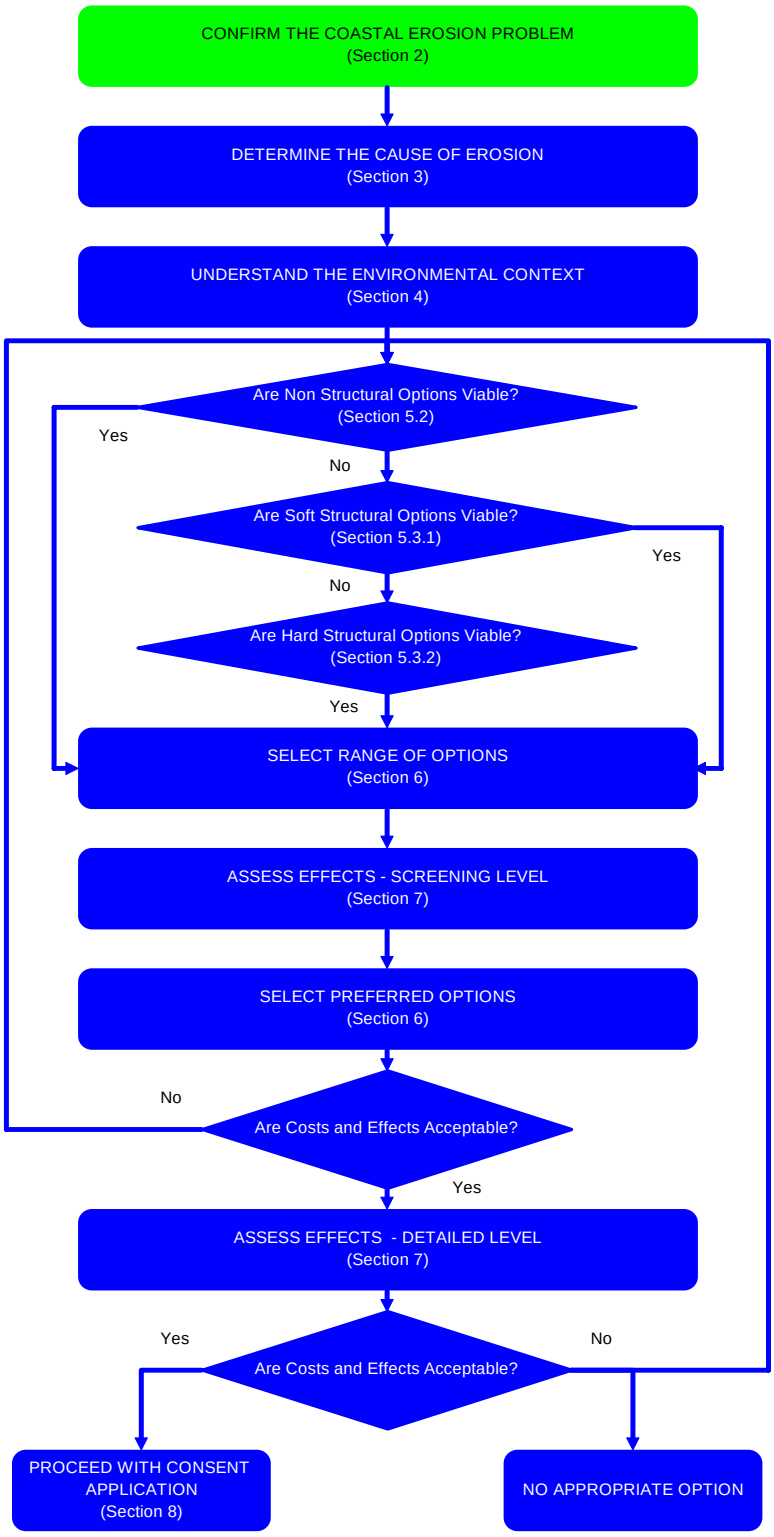


SECTION 2 – IS THERE A COASTAL EROSION PROBLEM?

EXPECTED OUTCOME OF THIS SECTION:

To determine if coastal erosion is occurring at a site and that it is a problem.

COASTAL EROSION MANAGEMENT MANUAL

2. IS THERE A COASTAL EROSION PROBLEM?

2.1 WHAT IS COASTAL EROSION?

Coastal landforms exist because hydrodynamic and aeolian processes erode, transport and deposit sediment particles. Consequently fluctuations in the position of the coastline (advance, retreat or dynamic equilibrium) are a normal and expected process on virtually every part of the region's coastline. The change in position or shape of the coastline invariably is the result of both anthropogenic activities and natural processes.

For coastal management purposes it is useful to distinguish between short term and long term coastal erosion. Short term coastal erosion is associated with the dynamic coastline fluctuations which occur on all beaches. Averaged over time these fluctuations do not result in permanent coastline retreat. In these situations the coastline affected by such movements is properly regarded as part of the active beach and is commonly referred to as the "dynamic envelope".

Coastal erosion is the long term (for the purposes of this manual 20 years or more) landward translation of the coastline. The fundamental principal of coastal erosion management is to identify, understand and quantify existing and historic coastline behavior and causes of change. This Section describes the coastline types of the Auckland region, their erosion characteristics, and explains how to identify whether coastal erosion is occurring.

Refer Section C.2, Coastal Geomorphology

To aid the discussion of coastal erosion in this manual, three coastline types are defined; hard, semi-hard and soft. Generic erosion characteristics vary between these types.

2.2 COASTLINE TYPES AND EROSION CHARACTERISTICS

2.2.1 HARD COASTS

2.2.1.1 DESCRIPTION

Refer Section C.2.3, Hard Coasts

Hard coasts are those made of 'hard' resistant materials. They generally adopt a cliff and platform structure, and typically have little or no beach at high tide as illustrated in Figure 2.1 and Figure 2.2. In the Auckland Region hard coasts consist mainly of sedimentary rock (e.g. Waitemata Series) and sometimes of volcanic rock (e.g. intrusive or basalt lava flows).

2.2.1.2 EROSION CHARACTERISTICS

The processes that cause changes in the form of cliff's are varied and complexly interrelated, with no single process predominant. All cliff's however have at least one thing in common, the loss of material is a one way process and once the cliff has been eroded it does not reform. The effect is a regression of the coastline.

In Auckland, intrusive volcanic rocks are generally hard and massive, resulting in low rates of erosion, for example Meola Reef and Rangitoto Island are relatively resistant to erosion, whereas cliffs comprised of Waitemata Series rock are much softer and more susceptible to the various erosion processes acting upon them. Lithology and geologic structure however only partly explain the variable cliff erosion rates around the region. It is equally important to consider the processes related to geology, sub-aerial erosion, mass movement and coastal processes.

There are two components to the erosion of hard coasts, as illustrated in Figure 2.3:

- gradual changes to cliff morphology (primarily resulting from weathering and the hydraulic and mechanical action of waves); and
- slope instability resulting in an episodic failure of the cliff.

Figure 2.1
Typical Profile - Hard Coast

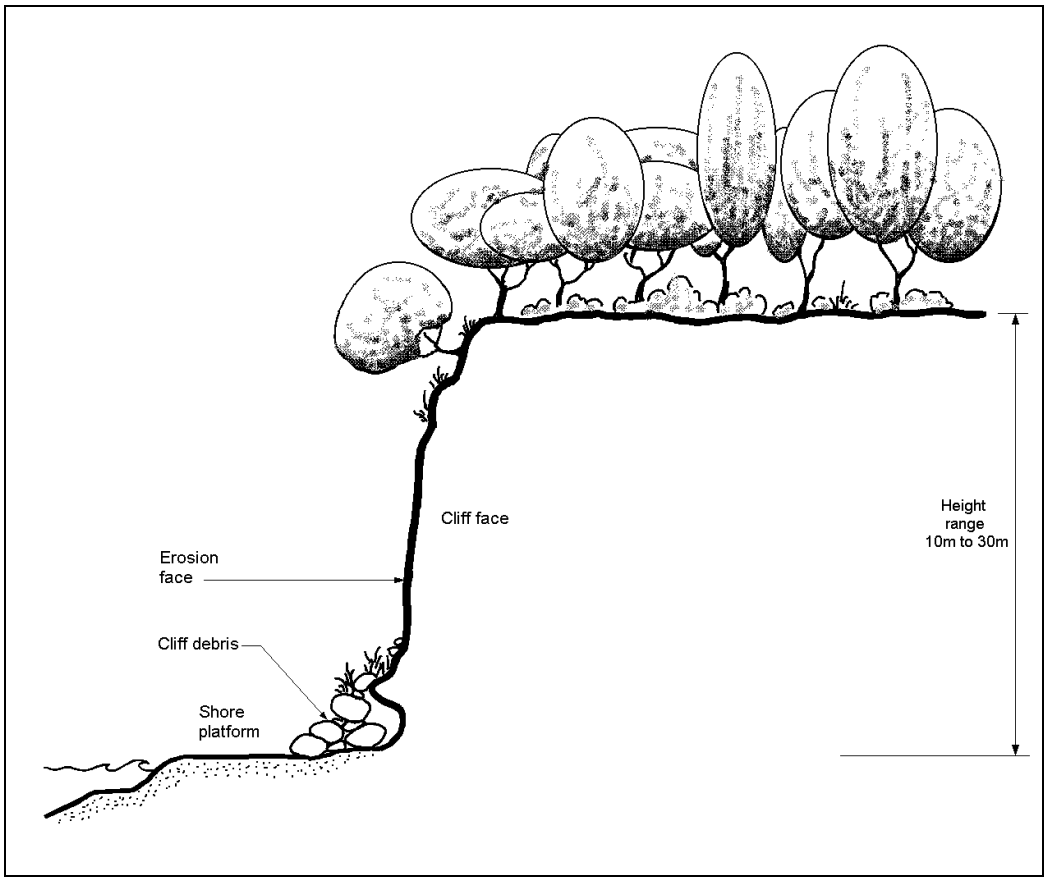
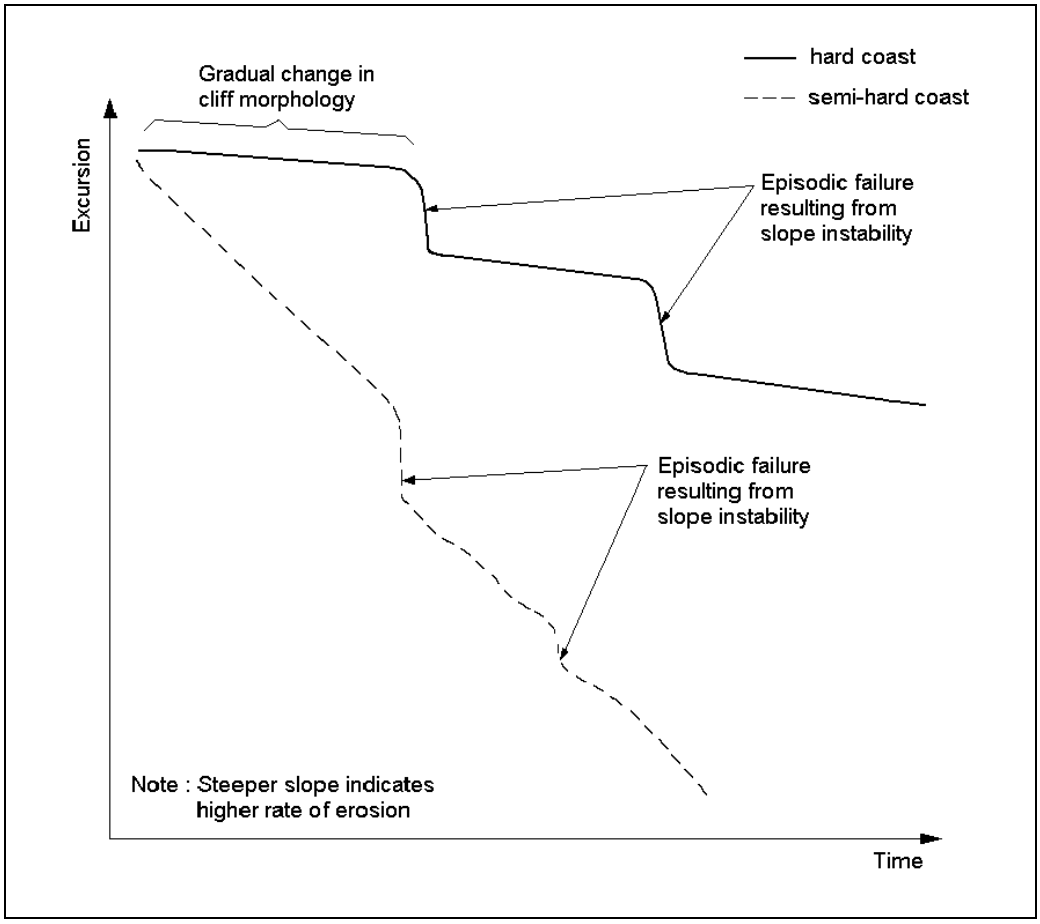


Figure 2.2
Typical Hard Coast in the Auckland Region

Figure 2.3
Excursion Plot - Hard and Semi-hard Coastline Types.



2.2.2 SEMI-HARD COASTS

2.2.2.1 DESCRIPTION

Refer Section C.2.4, Semi-Hard Coasts

Semi-hard coasts consisting of cohesive soils (clayey) are common in the Auckland region, particularly along estuarine coastlines, and in places along the backshore of beaches. See Figure 2.4 and Figure 2.5.

2.2.2.2 EROSION CHARACTERISTICS

Semi-hard coastlines commonly have steep (often near vertical) banks, ranging from 0-5m in height, as illustrated in Figure 2.3. Immediately following coastal erosion events eroded sediments may be deposited on the foreshore to be further eroded and transported away by coastal processes. As for hard coasts, erosion of semi-hard coasts is a one way process.

The rate of coastal erosion of semi-hard coasts is relatively high compared to that of hard coasts. This is primarily because the material that semi-hard coasts are comprised of are weaker and less erosion resistant than that of hard coasts. The primary natural processes that cause changes in the form of semi-hard coasts are coastal processes, weathering, and loss of vegetation cover.

Figure 2.4
Typical Profile - Semi-Hard Coast

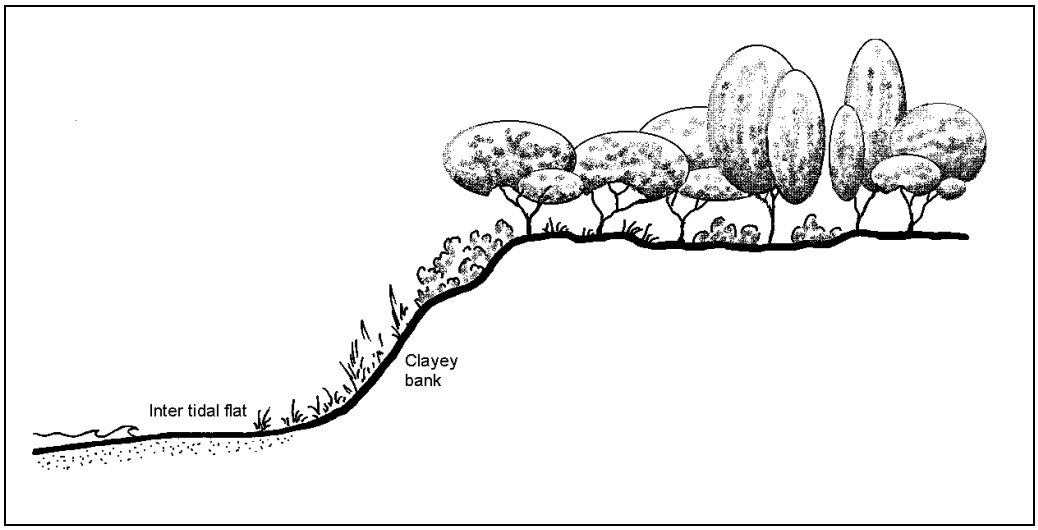


Figure 2.5
Typical Semi Hard Coast in the Auckland Region

2.2.3 SOFT COASTS

2.2.3.1 DESCRIPTION

Refer Section C.2.5, Soft Coasts

Soft coasts, or beaches as they are commonly referred to, are areas of unconsolidated materials such as sand, cobbles or shell, that have formed at the interface between land and sea. As a general rule, beaches composed of fine sand are broad and have a gentle seaward slope, whereas beaches comprised of coarse sand, shell or gravel are relatively steep. There are many variations in beach-profile forms, depending on wave form, wave energy, and the composition of the beach, see Figure 2.6 and Figure 2.7.

Beaches can be found almost anywhere along the coast, from open coast environments, e.g. Pakiri and Muriwai Beaches, to sheltered low energy environments, e.g. Pt. Chevalier Beach in the Waitemata Harbour.

Figure 2.6
Typical Profile - Soft Coast

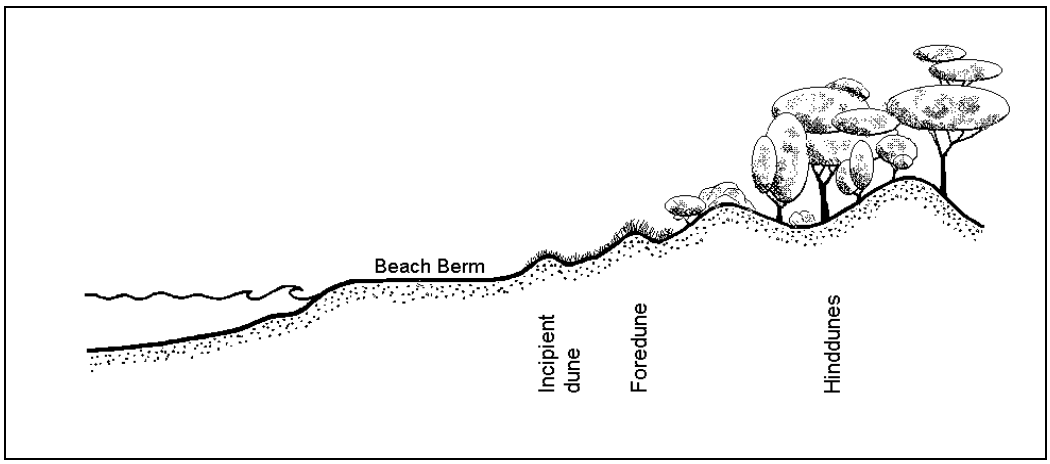


Figure 2.7
Typical Soft Coast in the Auckland Region

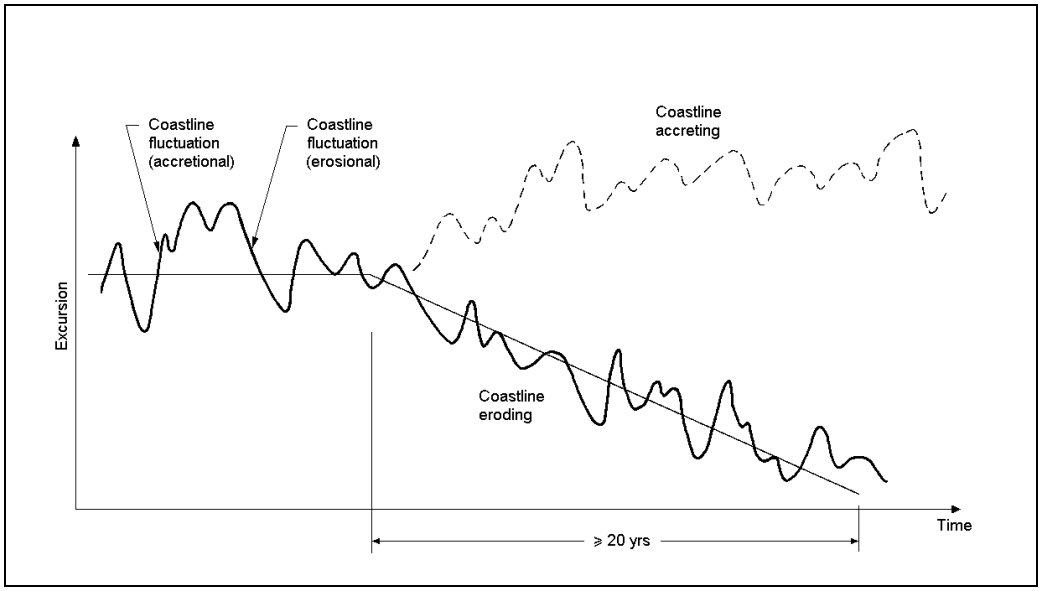
2.2.3.2 *EROSION CHARACTERISTICS*

Beaches adjust their profiles to provide the most efficient means of dissipating incoming wave energy. This is often seen during and after storm events, where strong winds generate high, steep waves which frequently result in the seaward transport of beach material to an area where the water velocities allow sediment deposition. Typical characteristics of an eroded beach include a lowered beach face slope, the absence of beach forms such as berms, erosion scarp(s) along the backshore/foredune, diminished or non-existent nearshore bar, and a concentration of heavy minerals as a lag on the beach face. Following the return to more 'normal' conditions with relatively lower wave energy, waves transport sand from offshore back to the beach. Winds may then dry and transport the sand landwards to rebuild the upper beach and foredune (if eroded).

The occurrence of short term fluctuations on a soft coast does not necessarily mean that an erosion problem exists. See Figure 2.8. By definition, a long term translation in coastline must be identified for soft coasts to be classified as eroding.

Generally the rebuilding process takes much longer than erosion events, and sometimes the beach does not have sufficient time to rebuild between erosive episodes.

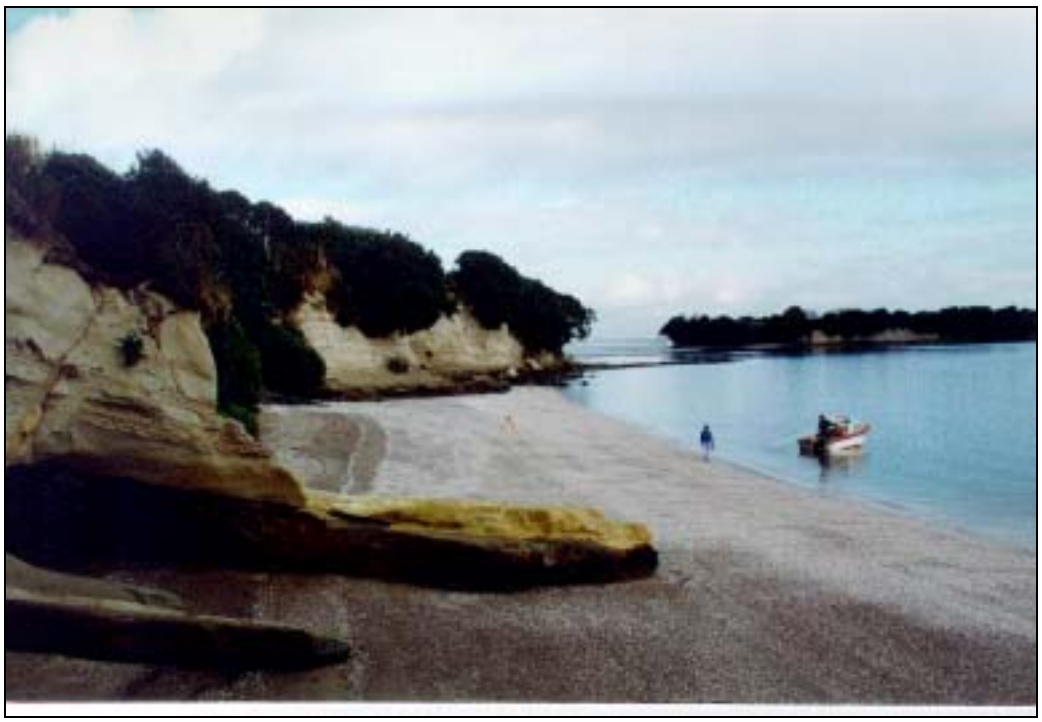
Figure 2.8
Excursion Plot – Soft Coast



2.2.4 COMBINATION OF COASTLINE TYPES

In reality some coastline's can not readily be distinguished as being of a particular type, rather it may be some combination of these categories, such as a semi-hard coast fronted by a beach, or a pocket beach perched between headlands, such as illustrated in Figure 2.9. Where a combination of coastline types occurs it is necessary to consider the erosion of each component before an erosion trend can be confirmed.

Figure 2.9
Combination of Coastline Types - Soft and Hard



2.3 IS COASTAL EROSION OCCURRING?

2.3.1 IDENTIFYING COASTAL EROSION ON SITE

Refer Section A, What to Look For on a Site.

It is often possible to identify whether coastal erosion is occurring by undertaking a site inspection. The evidence of erosion is usually plain to see, e.g. cliff debris at the toe of a cliff or an erosion scarp along the seaward face of the foredune. As a guide, common visual indicators of coastal erosion are summarised in Table 2.1. Discussion with people associated with a particular part of the coast, e.g. with property owners, will also give an indication of what is happening along that coast, and perhaps also identify when and what changes have taken place.

Table 2.1 VISIBLE INDICATIONS OF POTENTIAL EROSION ON SITE

All Coastline Types	Hard Coasts (See Section A.2)	Semi-hard Coasts (See Section A.3)	Soft Coasts (See Section A.4)
• Object (e.g. fence, shed or tree which has fallen into the sea • Presence of existing coastal erosion management works (particularly poor condition of structures)	• Very steep cliff faces • Shore Platforms • Sea Caves, notches, stacks • Debris at toe of cliff • Leaning pohutukawa and other trees.	• Leaning pohutukawa and other trees • Non vegetated clayey banks • Slumping slopes. • Dislodged vegetation in coastal area • Erosion scarps	• Stable backdune vegetation in active zone • Damaged vegetation in active zone (exposed roots) • Erosion scarps • Discontinuous vegetation cover on foredunes • Irregular foredune crest, blow outs • Very steep dune formations • Mobile sand on back dunes or other landward areas

The determination that a long term change is taking place however needs to be based on the careful analysis of a number of factors, including the interpretation of coastal processes, and the evaluation of the effect of past human activities at the site, e.g. the clearance of vegetation or the re-alignment of a stream may be the cause of erosion. In some instances specific investigation may be necessary to augment the information that can be discerned via observation and discussion.

The correct identification of whether an erosion problem exists is a matter of skill and expertise. For example an erosion scarp along a foredune may be a short-term temporal feature that may be explained as a short term fluctuation in beach volume, and attributable to recent storm and swell regimes, i.e. part of a recognised process. Research has demonstrated that beach volumes can also fluctuate over much longer time scales (decades) in response to shifts in controlling processes, such as the frequency of storms. Furthermore research has demonstrated that beach systems do not necessarily possess finite reserves of beach material (sand, shell, gravel) but can exchange material alongshore, offshore and landward.

The fundamental matter is to discern between a short-term incident and a long-term trend.

2.3.2 CONFIRMING COASTAL EROSION

2.3.2.1 INFORMATION REQUIRED

Refer Section A, What to Look for On a Site

In addition to making on-site observations and obtaining anecdotal evidence, comparative analysis of historical and contemporary information is necessary to determine whether a coastal erosion problem exists. Typical sources of information include:

- land surveys, cadastral plans;
- engineering reports or plans, such as for the construction of previous coastal management works, roads, bridges or other structures;
- survey data (e.g. beach profiles, field measurements);
- aerial photographs (older photos will need to be rectified);
- photographs (e.g. snapshots);
- newspaper reports;
- charts and maps;
- historical reports (e.g. subdivision consent reports);
- information on adjacent or similar areas; and
- scientific investigations (physiography, lithology, beach sediment preparations, wind, wave and tidal current data).

The purpose of the exercise is to qualify and quantify the extent and rate or erosion. Therefore information should be sought that covers the longest time period possible. Any information that can be confirmed to be a true record, and that it is possible to use for comparative purposes, e.g. aerial photographs with same identifiable reference points, will be of use. Before any comparison of surveyed plans can be made it is necessary to clarify how important features, such as the Mean High Water Mark, were determined, as this can vary from survey to survey.

Aerial photographs are available for most areas in the Auckland Region back to the 1940's. It is therefore uncommon to have no information with which to assess coastal erosion. However, having collected the available existing information a need for further investigations may be identified. In situations where information is limited, coastal erosion management should be undertaken with extra caution.

2.3.2.2 TECHNIQUE

To quantify the extent and/or rate of coastal erosion the position of the coastline in relation to one or more (preferably more than one) fixed reference point needs to be measured, analysed, and compared. The selection of a suitable position with which to reference coastline change is at times difficult, and there is no single natural coastline feature that is appropriate and easily defined at all sites. Common fixed reference points include survey marks, structures or buildings. Visible observations and local knowledge should be checked against the derived data-set, to confirm the validity of both sets of information.

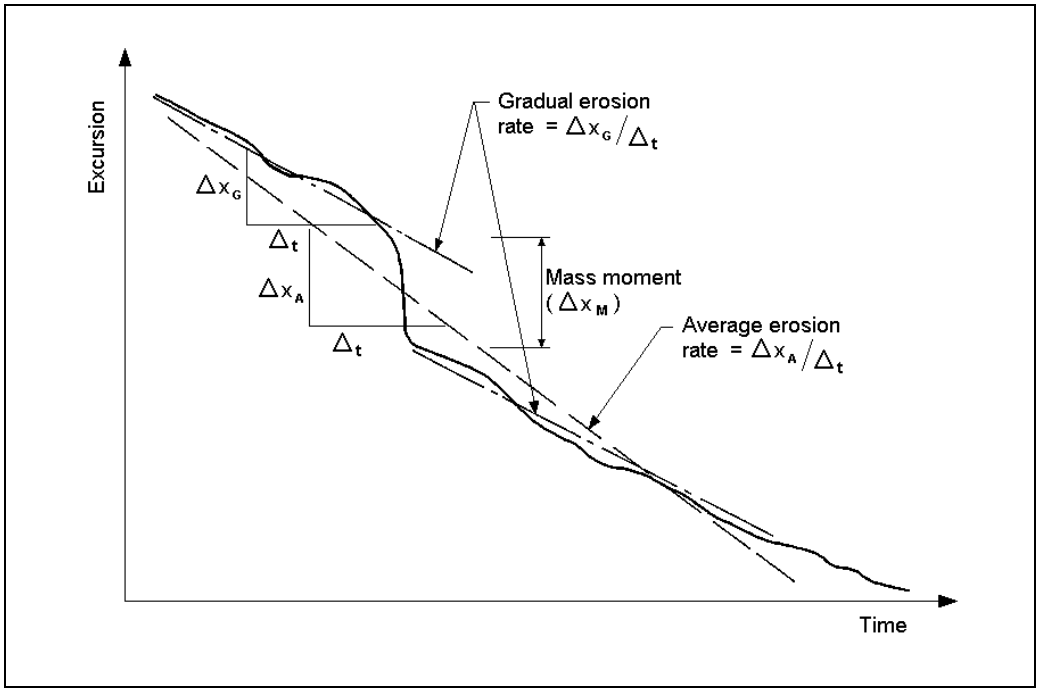
2.3.3 DETERMINING RATE OF EROSION

To establish if coastal erosion is a problem it is necessary to know the probable landward extent of coastline translation over a given time period. A particular difficulty with this is that coastal erosion is rarely linear, instead erosion episodes occur at many coastal sites at inter-annual or decadel periods, and exhibit spatial variability and magnitude differences.

Indications of the probable extent of erosion are obtained by calculating the rate of erosion. This is done by dividing the historical extent of coastline translation (measured in metres) by the time period over which the translation occurred (measured in years), resulting in the erosion rate being expressed as m/yr. A negative value indicates erosion and a positive value indicates accretion.

Episodic erosion events (such as slope failure on hard or semi-hard coasts, or changes in beach profiles due to extreme storms) should, where practicable, be distinguished separately from erosion rate. Separation of the gradual erosion rate (m/yr) with mass movement (m) is illustrated in Figure 2.10.

Figure 2.10
Determining Coastal Erosion Rate



It is important that an episodic event is not used as the sole basis for establishing an erosion rate. For example a 2m retreat in coastline resulting from a single event does not necessarily equate to an erosion rate of 2m/yr. Similarly, because a coast has eroded at a particular rate does not mean that it will necessarily continue to do so. Projections of future changes in the coastline needs to be undertaken with caution as there are a large number of uncertainties involved, such as changes in physical conditions and geomorphic processes.

2.4 IS COASTAL EROSION A PROBLEM?

Coastal erosion usually only becomes a problem when subdivision and/or development has been undertaken close to a coast that is migrating in a landwards direction, thereby creating a hazard. As such a coastal erosion hazard is therefore an unwanted interaction of physical and human use systems.

To determine if coastal erosion is a problem, an assessment should be made of:

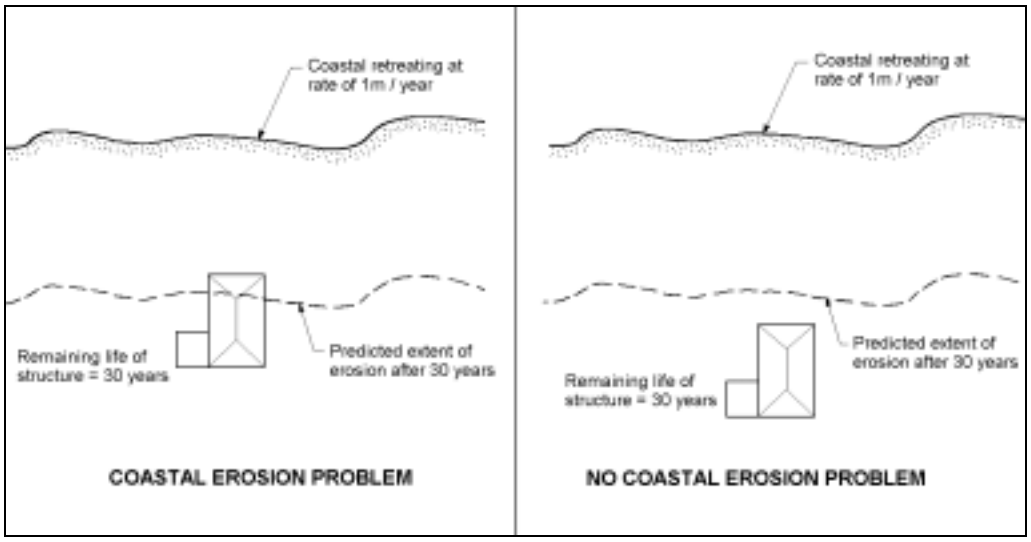
- the values actually or potentially affected;
- the acceptable extent of erosion (i.e. amount of land which could be lost before areas of value are put at risk);
- the time period before this extent is reached (this should be compared to the remaining life of any structures at risk); and
- potential future uses of the land affected.

Allowance needs to be made for the uncertainties involved, which is usually accounted for as a safety factor based on expert judgement. Further information on assessing coastal hazards is given in ARC (2000).

If it can be demonstrated coastal erosion threatens something of value, such that erosion management is warranted then the options to manage that problem need to be assessed, see Figure 2.11. Such an assessment needs to include an assessment of the effects of that activity on the environment.

Concentration of development in areas subject to coastal erosion complicates coastal management and tends to result in a preference for structural solutions to any erosion problem. Such practice however is typically accompanied by adverse environmental effects, e.g. the loss of natural character, as well as being expensive in the immediate (construction) and long-term (maintenance and repair). The loss of land is not always a problem warranting action. In many situations, particularly where there is a low level of development, erosion can take place without any adverse effect. Furthermore by managing the coast in a proactive manner, such as the re-establishment of the native vegetation cover, or ensuring stormwater is discharged of in an appropriate manner will not only manage the erosion but will have a positive effect on the coast.

Figure 2.11
Is Coastal Erosion a Problem?



2.5 WHOSE PROBLEM IS IT?

Refer Section B, Legal Issues

Coastal erosion is primarily the concern of the property owner, whether they are an individual, corporation, regulatory authority or community group. Recent case law has established that common law property rights pertaining to the use of land, including the right of people to protect property from coastal erosion, are subject to the purpose and principles of the Resource Management Act, and that where such rights are inconsistent with the Act they are no longer applicable (J.I. Faulkner & others v. The Gisborne District Council & the Minister of Conservation (AP1/95, HC).

Coastal erosion management therefore needs to be undertaken in a manner that is consistent with a wide range of matters relevant to sustainable coastal management. There is no over-riding right to undertake any particular response, such as the construction of some form of coastline armouring device, nor any presumption in favour of particular management options over others.

Coastal erosion may be of concern to several parties (i.e. where more than one property is at risk). In such circumstances, an integrated approach to coastal erosion management is advisable as many coastal erosion management options are more effective if they cover an entire section of coast instead of one portion. By involving others experiencing the same erosion problem, it may be possible to provide a more effective solution, as well as the sharing of costs.

Where the coastal erosion problem is considered a community concern the relevant TLA may offer assistance. Such instances are assessed on a case by case basis and the TLA is under no obligation to provide any assistance.