

STRATEGIES FOR MANAGING COASTAL EROSION HAZARDS ON THE KAPITI COAST

A report for Kapiti Coast District Council



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LIST OF ABBREVIATIONS USED

RMA	Resource Management Act 1991
NZCPS	New Zealand Coastal Policy Statement 1994
NIWA	National Institute of Water and Atmospheric Research
CZM	Coastal Zone Management
CHMA	Coastal Hazard Management Area
MSL	Mean Sea Level
ENSO	El Niño-Southern Oscillation
IPCC	International Panel on Climate Change
WD	Wellington Datum (tidal)
AEP	Annual Exceedance Probability
GCM	General Circulation Model
HAT	Highest Astronomical Tide
MHWS	Mean High Water Spring (tide)
CERC	Coastal Engineering Research Centre (US Army)
PDS	Primary Development Setback
SDS	Secondary Development Setback
masl	metres above mean sea level
mbsl	metres below mean sea level
KCDC	Kapiti Coast District Council
WRC	Wellington Regional Council
CEMS	Coastal Erosion Management Strategy
LGA	Local Government Act 2002

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1 Introduction

1.1 Background

1 The Kapiti coastline is approximately 40 km long and, as well as being the location for significant urban development, it is an important community asset that has many unique characteristics and natural qualities. The Kapiti coast has, historically, undergone long-term accretion since sea levels stabilised following the last post-glacial rise around 6,500 years ago. This accretion has created the present coastal plain, and the growth has been most pronounced at Paraparaumu where the off-shore presence of Kapiti Island creates a zone of reduced wave energy, thus allowing a greater accumulation of sediment.

South of the Waikanae River there are three distinct communities: Paekakariki, Raumati and Paraparaumu, each adjoining a part of the coast that, despite the historical evidence of accretion, has suffered periods of active erosion during at least the last 100 years. Each of these communities, and their adjacent shorelines, has unique characteristics that influence coastal planning. In particular, the proximity of development to the coastline in each case, and the hazard risk that this introduces, has become a significant factor in the management of the coastal zone.

Settlements on the coast to the north of the Waikanae River include Waikanae Beach, Peka Peka, Te Horo and Otaki. The coastline here is largely unmodified and, until recently, this part of the Kapiti coast has tended to suffer less from erosion. For the most part there remains a reasonable buffer zone between the coast and adjacent properties, although the Waikanae Beach shoreline is now being more closely monitored following recent erosion.

The western shores of New Zealand are exposed, for the most part, to a high-energy wave environment. This means that sedimentary (sandy) shores, such as at Kapiti, tend to suffer from erosion during stormy periods. Much of the Kapiti coast, however, enjoys significant protection from the worst effects of storm action, lying in part, as it does, in the shelter of Kapiti Island. Nevertheless, under certain climatic conditions on the Kapiti coast, sea conditions are often capable of causing erosion and, when assets are placed at risk, a coastal hazard is created.

The worst such storms in recent history occurred in September 1976, and caused extensive damage along some parts of the Kapiti coast. Significant property damage was sustained, particularly at Raumati and Paekakariki where the Council responded by constructing timber seawalls along the worst-affected parts. The greater part of these walls have since been



reinforced with rock toe protection to improve wave energy absorption and prevent premature failure. More recently, at Paekakariki, parts of the unreinforced timber wall have had a concrete apron installed along the base of the wall to help prevent undermining.

It is now more than 25 years since the Kapiti coast has experienced storms of the intensity of those that occurred in 1976. Although there have been periods when storm activity has caused problems with erosion, by maintaining existing protection works and monitoring changes along the Kapiti coast so as to gain a better understanding of the coastal processes, the Council has minimised the impacts of these events.

There are a number of management issues relating to coastal hazards that need to be resolved.

At Raumati, the seawall was not constructed to its full design height and is, consequently, overtopped by waves from time to time. This has led to a significant number of secondary protection structures of varying integrity having been built by private property owners in an effort to protect the embankment behind the wall. The issue here is not so much the presence of the secondary seawalls but the need for them in the first place, which arises from the inability of the present seawall to adequately mitigate the erosion risk. The backfilled area behind the top of the seawall, particularly at Raumati South, provides an important amenity for the community by allowing access along the shoreline at high tide when the beach itself is mostly under water along the toe of the seawall.

At Paraparaumu, and probably also at Waikanae Beach, the dynamic processes that govern the stability of the shoreline are further complicated by the variable location of the mouth of the Waikanae River. From time to time the mouth of the river is realigned by cutting through the spit, which forms at the mouth, in order to assist in the management of the Waikanae Floodplain. This activity is undertaken by Wellington Regional Council, a Resource Consent having been granted (to the Flood Protection Group ~ Operations) in September 1998 subject to a number of conditions that include detailed monitoring and reporting (twelve months after completion of the diversion) on the effects on the coastal marine area. To date, reporting appears to have been sparse and the effects of this activity on the coastline remain uncertain.

There are also some private seawalls of varying effectiveness just north of the Wharemauku Stream, and also along the toe of the high dune south of The Parade at Paekakariki. Most of these are individual efforts installed in the hope of providing some degree of protection to properties in the event of storm action. Other seawalls on the Kapiti coast include a short length of timber seawall adjacent to Maclean Park at Paraparaumu that has become buried in sand, and temporary block protection works in front of four houses at the northern end of Paraparaumu. The rest of the shoreline south of the Waikanae River, including most of Paraparaumu and Queen Elizabeth Park, remains more or less in a natural state, and where there has been development, it is generally situated far enough



back from the coast to not have given rise to much concern during erosive cycles.

Queen Elizabeth Park, which has a border approximately 3.5 km long on the Kapiti coast, is situated between Paekakariki and Raumati. The park, which is Crown Land, is managed by the Parks and Forests Group, Landcare Division, of Wellington Regional Council, as a Recreational Reserve under the Reserves Act 1977. It is an important public asset with an area of 638 hectares, much of which is leased for farming purposes. Considerable areas remain in a natural state, however, including some 200 hectares of coastal dunes. The dunes are recognised in the Park Management Plan as an important conservation feature and restoration work is proposed. The park shoreline has been suffering net erosion during the last two decades, although net accretion is reported to have occurred during the period 1874-1977. Erosion at Queen Elizabeth Park is known to have accelerated following construction of the Raumati seawall in 1977.

During the development of this project it was recognised that a number of concerns had been identified concerning management of the Kapiti coast. These included:

- Council's liability to protect private property;
- the effectiveness of existing protection works;
- the appropriateness of the District Plan provisions, especially the size of the 'no-build' zone and the effectiveness of the 'relocation' zone;
- approval processes for secondary seawalls;
- the funding of coastal protection;
- Council's on-going liability to maintain the seawalls;
- Council's liability arising out of past approvals; and
- ownership of a strip of land at Raumati, along the seaward side of properties, known as the Old Coach Route, which has largely eroded.

At present the District Plan contains a variety of provisions relating to subdivision and development of the coast. These include 'no-build' and 'relocatable' zones, but Council is concerned that these provisions may not provide adequate protection to either Council or property owners in light of present knowledge. It is important, however, to appreciate that coastal hazard management incorporates a wide range of matters that go beyond the protection of property.

Legal aspects relating to these concerns are outside the scope of this project and cannot be resolved until a rigorous assessment of the risk of



coastal erosion has been completed and appropriate District Plan policies put in place.

1.2 Statutory Framework

The management of natural hazards, including coastal erosion and flooding, is primarily conducted within the framework of the Resource Management Act 1991 (RMA). Hazard management must be undertaken in a manner that is consistent with the purposes and principles of the Act and also with the policies and objectives of subsidiary documents including the New Zealand Coastal Policy Statement (NZCPS) and relevant Regional and District Plans. In particular, these are the Kapiti Coast District Plan and the Wellington Regional Coastal Plan.

The RMA and NZCPS are the principal documents governing coastal management. Certain matters relevant to coastal hazard management are enshrined in Part II of the RMA:

- Avoiding, remedying, or mitigating any adverse effects of activities on the environment (s.5)
- The need (s.6) to recognise and provide for various matters of national importance:
 - (a) The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development.
 - (b) The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development.
 - (c) The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.
 - (d) The maintenance and enhancement of public access to and along the coastal marine area, lakes, and rivers.
 - (e) The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga.
- The need for all persons exercising functions and powers under the (s.7), in relation to managing the use, development, and protection of natural and physical resources, to have particular regard, among other things, to:



- (a) The maintenance and enhancement of amenity values.
- (b) Maintenance and enhancement of the quality of the environment.

The NZCPS also contains policies relevant to coastal hazard management. Among those considered particularly important here are:

- It is a national priority for the preservation of the natural character of the coastal environment to protect the integrity, functioning and resilience of the coastal environment in terms of: (among other things) the dynamic processes and features arising from the natural movement of sediments, water and air, and natural substrate composition (Policy 1.1.4).
- It is a national priority to restore and rehabilitate the natural character of the coastal environment where appropriate (Policy 1.1.5).
- Because there is a relative lack of understanding about coastal processes and the effects of activities on coastal processes, a precautionary approach should be adopted towards proposed activities, particularly those whose effects are as yet unknown or little understood (Policy 3.3.1).
- Local authority policy statements and plans should identify areas in the coastal environment where natural hazards exist (Policy 3.4.1).
- Policy statements and plans should recognise the possibility of a rise in sea level, and should identify areas, which would, as a consequence, be subject to erosion or inundation. Natural systems, which are a natural defence to erosion and/or inundation should be identified and their integrity protected (Policy 3.4.2).
- The ability of natural features such as beaches, sand dunes, mangroves, wetlands and barrier islands, to protect subdivision, use, or development should be recognised and maintained, and where appropriate, steps should be required to enhance that ability (Policy 3.4.3).
- In relation to future subdivision, use and development, policy statements and plans should recognise that some natural features may migrate inland as a result of dynamic coastal processes (Policy 3.4.4)
- New subdivision, use and development should be so located and designed that the need for hazard protection work is avoided (Policy 3.4.5).
- Where existing subdivision, use, or development is threatened by a coastal hazard, coastal protection works should be permitted

only where they are the best practicable option for the future. The abandonment or relocation of existing structures should be considered among the options. Where coastal protection works are the best practicable option, they should be located and designed so as to avoid adverse environmental effects to the extent possible (Policy 3.4.6).

1.3 Scope of the Project

In April 2000, Kapiti Coast District Council issued a brief seeking tenders for Contract 348: Coastal Management Project. The contract was subsequently awarded to J L Lumsden, Coastal Management and Engineering Consultant, Christchurch, in association with, Boffa Miskell Limited (Wellington), Cuttriss Consultants Ltd. (Paraparaumu), Hunter Hydrographic Services (Timaru), and NIWA (Wellington and Hamilton). Later, Precision Aerial Surveys (Auckland) were engaged to carry out an aerial photographic survey of the coastline from Otaki to Paekakariki, and GeoEnvironmental Consultants (Lyttelton) were commissioned to report on the tsunami risk.

The required outputs were as follows:

- Make robust and defensible recommendations concerning coastal hazard management that meet the requirements of the Resource Management Act 1991, including Section 32 in particular, for changes to the District Plan Objectives, Policies, Rules and Standards for Subdivision development adjacent to the coast of Kapiti Coast District Council (Paekakariki to Otaki inclusive).
- Make recommendations on strategies for managing erosion including design where appropriate e.g., coastal protection measures, managed retreat, do nothing, beach renourishment, etc., for each part of the coast, to protect Council property and privately-owned property.
- Make recommendations for an ongoing monitoring and review programme for the entire Kapiti coast identifying trends/trigger points that will require Council to review its policies or take some other form of action.

For the purposes of this study, the influence, monitoring and management of all stream and river mouths was included in so far as they affect erosion of the land in the coastal zone.

The effects of, and issues arising from, climate change and sea level rise was specifically included in the study for periods consistent with the expected life of any development on the coast. This includes the changes expected by 2050 and 2100. Consideration was also required to be given



to the effects of seasonal changes in weather patterns, e.g., La Niña effects and resulting changes in wind patterns.

This report describes the investigations that have been carried out and presents the results of the erosion hazard analysis and the development of coastal management strategies leading to recommended changes to the District Plan. Potential hazards such as flooding from inland sources, liquefaction from earthquake and/or landslips are outside the scope of this study and have not been considered.



2 Methodology

This section describes the zones into which the Kapiti coast has been sub-divided for management purposes, and the work undertaken to provide the information necessary to adequately assess the coastal erosion hazard. This includes an outline of the findings of the wave study and details of the bathymetric survey. This leads to development of appropriate management strategies.

2.1 Coastal Hazard Management Areas

The coastal zone is an area of dynamic transition where land and sea interact. Although it has no precise definition, the coastal zone includes:

- the adjacent land whether developed or undeveloped;
- beaches, dunes, estuaries, tidal inlets and other inter-tidal areas; and
- the coastal marine area.

Proper coastal zone management (CZM) is the process that brings together all those involved in the development, management and use of the coast within a framework that facilitates the integration of their interests and responsibilities to achieve common objectives.

There is no single framework for coastal zone management. Different parts of the coast may reflect very different circumstances, and require quite different management responses. Management responses, however, need to be developed within a context that takes account of the growing awareness of environmental issues and the desire to achieve a proper balance between ensuring future economic security and maintaining environmental quality. Consistent with this approach is the promotion of sustainable management of natural and physical resources, a matter enshrined in the Resource Management Act (1991) as its essential purpose.

In managing the coast there are a number of key points relating to accepted good practice that are relevant here:

- work with rather than seeking to resist natural forces;
- aim to conserve biodiversity;

- integrate plans, strategies and activities, whilst respecting individual desires and responsibilities;
- take a long-term strategic approach when considering development options and management decisions;
- establish a clear vision that identifies genuine issues and real needs for action;
- promote consensus through early consultation with stakeholders;
- make reliable information available to all parties;
- achieve action through the establishment of attainable timetables supported by clear responsibilities and adequate funding; and
- set up system for monitoring of agreed parameters to measure success from the start.

It is hoped that this study, and the planning recommendations that arise out of it, have been, and will continue to be, consistent with these points.

The Kapiti coast is some 40 km long and, for management purposes, it has been divided into seven Coastal Hazard Management Areas (CHMAs) that each reflect the need for a different management approach.

The Coastal Hazard Management Areas are defined as follows:

- CHMA-1 Paekakariki** ~ From north end of Centennial Highway (SH1) to southern end of QE Park (but not including the Park).
- CHMA-2 Queen Elizabeth Park** ~ From north end of The Parade, Paekakariki to the southern end of Raumati.
- CHMA-3 Raumati South** ~ From northern boundary of QE Park to Wharemauku Stream mouth.
- CHMA-4 Raumati North** ~ From the Wharemauku Stream mouth to the southern end of Marine Parade, Paraparaumu.
- CHMA-5 Paraparaumu** ~ From and including Marine Parade at the south to the Waikanae River mouth.
- CHMA-6 Waikanae to Peka Peka** ~ From the mouth of the Waikanae River north to Peka Peka.



CHMA-7 Peka Peka to Otaki ~ From Peka Peka north to the northern boundary of Kapiti Coast District Council at the Waitohu Stream.

Maps showing each of these hazard management areas are included in Section 6.

2.2 Data Acquisition

In order to be able to adequately assess the erosion hazard risk on the Kapiti coast, certain fundamental data was considered necessary. As with much of the New Zealand coast, at Kapiti there was a shortage of information relating to wave conditions, water levels, off-shore currents and bathymetry. Accurate information relating to these parameters is essential input into any recognised analytical methods used for estimating the effects of the ocean on the shoreline. This includes hazard assessment as well as design of coastal structures.

Collection of ocean data can be time-consuming and costly. Invariably, a compromise has to be reached between obtaining data of sufficient reliability for the purpose intended and the reasonable cost of obtaining such data. The time available to collect data is also an issue as accurate wave data, for example, might take months of field wave measurement before a reliable record is obtained. A case in point is the modelling of storm-induced erosion scenarios. There are a number of mathematical models of varying complexity available that will, among other things, enable the erosion profile to be modelled for various scenarios. The quality of the results obtained in New Zealand has been mixed. Sometimes this is because the model has not been suited to the particular task but often it has been because either the input data is not of a quality consistent with the sophistication of the model or it has not been possible to properly validate the model against actual events. Sometimes both these reasons prevail.

For this Kapiti study it was decided on this occasion that the appropriate course of action was to firstly review existing information on waves, tides, storm-surge and sea level, and to synthesise additional information on waves and storm-surge as necessary based on historical climate records. This is often referred to as wave hindcasting. It was considered that this would provide a base of information suitable for use in assessing the erosion hazard. National Institute of Water and Atmospheric Research Ltd (NIWA), Wellington, were commissioned in June 2000 to do this work and the results of their study are discussed below. A copy of the NIWA report is included in the Appendices in Volume II.



The other essential data requirement was for accurate information concerning the off-shore bathymetry, combined with beach profiles. The seabed from the beach to a depth of 15-20 metres was surveyed in 1981 by R W Morris and Associates Consulting Engineers Ltd. The area surveyed extended from the southern end of Paekakariki to just south of the Waikanae River. While this information was helpful at the time, its accuracy was not sufficient to provide reliable enough data for the current study, and it did not include the area from Waikanae north to Otaki. And since the data was nearly 20 years old, there was also uncertainty as to whether or not significant changes in the seabed might have occurred in the interim. A new bathymetric survey, covering the whole Kapiti coast, out to a depth of 20 metres was, thus, commissioned and Hunter Hydrographic Services Ltd., Timaru, were awarded the contract for this work in June 2000.

The on-shore surveys, which extended from a fixed point on the shore to approximately 1 metre below low tide level were carried out by Cuttriss Consultants Ltd, Paraparaumu. A total of 26 beach cross-sections were surveyed, each of which was later blended with the relevant off-shore survey to give a continuous profile from a known point on the shore out to a water depth of 20 metres. An outline of the bathymetric work is included below and details of each cross-section are included in the Appendices in Volume II.

The other work that was carried out as part of this study included an assessment of the tsunami risk and an aerial photographic survey of the Kapiti coastline. The tsunami report was prepared by GeoEnvironmental Consultants, Lyttleton, and a summary is included in Chapter 4. The full report is also included in the Appendices in Volume II. The aerial photographic survey of the coastline was carried out by Precision Aerial Surveys, Auckland.

In order to assess the erosion hazard risk, the data obtained has been used to calculate potential cut-backs using a geometric model developed for use on the west coast beaches in Oregon (US) that is based on beach characteristics and extreme water levels. This work and the analyses that have been derived from it are described in more detail in Chapter 4.

1 Niwa Report

As noted above, NIWA were commissioned to undertake studies of wave conditions, tides, storm surge and sea-level along the Kapiti coast. Wave conditions were assessed and new information generated by modelling local wave growth. A 20-year record was synthesised from a time-series of representative winds. Corresponding time-series for ten shallow water sites along the coast were then inferred by applying a refraction model.



It was found that wave heights rarely exceed 3 metres. The highest deep-water significant wave height (the average of the highest one-third of the waves) estimated for waves off the Kapiti coast was 4.5 metres in early November 1995. Waves refract into the coast and a large proportion of their energy reaches the 10 metre isobath. Swells from Cook Strait and the Tasman Sea may reach the Kapiti coast, but it is substantially attenuated, with less than 15% of the energy reaching the coast.

NIWA have recommended that, to verify the estimated results from this study, a programme to physically measure the waves and currents near the shore should be considered. Such data are required to verify the local wave conditions, and to quantify the longshore drift. This would be best served by deploying a directional system such as an S4 current meter for at least 6 months in about 10 metres of water off the most vulnerable location (Raumati). NIWA advise that the cost of such a project would require a budget of around \$50,000. The actual cost could vary considerably from this amount depending on such things as the number of times the meter is recovered during the six-month period of deployment for servicing and extraction of data; whether or not an acoustic release is required for security; and who provides the vessel during deployment and recovery of the meter.

Analyses of known historic storm events, a 3-year sea-level record from Kapiti Island, and nearly 30 years of barometric pressure data from Paraparaumu Airport, have also been completed. The lowest recorded barometric pressure of 973 hPa would have produced an inverted barometer set-up of just over 0.4 metre due to pressure drop alone. The highest observed storm surge was 0.7 metre set-up accompanied by a 2.6 metre wave set-up and run-up in the 11-13 September 1976 storm. During this event, the estimated significant wave height (H_s) offshore reached 3.6 metres with a peak period of 9.4 seconds.

The highest predicted tide for the next 100 years will be 1.27 metres above Wellington Mean Sea Level (MSL) Datum (1953). This corresponds to Waikanae Beach and the tide range reduces as one moves south along the Kapiti coast, so high tides to the north (Otaki Beach) need to be scaled up by as much as 112%, and those to the south (Pukerua Bay) need to be scaled down to as little as 68%.

Design sea-level set-up for 50-year return period and 100-year return period scenarios are estimated to be 3 metres and 3.5 metres respectively above Wellington MSL Datum (1953) for Waikanae Beach. An additional factor for wave run-up needs to be included on a sit-by-site basis, plus the tidal range factor for beaches to the north and south of Waikanae Beach. No account has been included for any predicted increase in windiness over the next 100 years.



The interannual (year-to-year) elevation of background sea level at Kapiti could peak at +0.15 metre for periods of a month or so during strong La Niña episodes and warm summer months. For the purposes of a combined design storm-surge event, a nominal +0.1 metre set-up should be added to the design water levels for both the 50-year and the 100-year return periods. While El Niño-Southern Oscillation (ENSO) episodes are not expected to change significantly, the global circulation models are predicting a 15% increase in windiness for the next 50 years, and by another 15% for 50 years after that. What effect this will have on the magnitude and frequency of extreme storms is still unclear.

According to the 1995 International Panel on Climate Change (IPCC) predictions, there is a 50% chance that sea levels around New Zealand will rise by +0.20 metre by 2050 and by +0.45 metre by 2100.

In the latest IPCC predictions (March 2001) two scenarios and a worst-case are proposed. Projections for global sea-level rise by 2100 are 38 cm for scenario 1 and 29 cm for scenario 2, but considerable uncertainties are attached to these estimates. The IPCC 1995 predictions are not inconsistent with the 2001 predictions and are recommended by NIWA for use in this study.

2 Bathymetric Survey

The results of the bathymetric survey are presented graphically in the map, Fig 2.1. This shows the seabed contours as at the time of the survey in July 2000. Although the accuracy of the 1981 survey was not good enough to be able to make quantitative comparisons, the new survey did confirm that changes off-shore have probably not been significant in the almost 20-year period. The new survey did confirm the existence of the off-shore shoal that was identified in 1980, and its apparent growth to the south of the Paraparaumu headland. This is a significant feature in so much as any continuing growth will provide increased protection to the coastline south of Paraparaumu, and particularly at Raumati North.

The survey work provides an important and reliable database against which future changes can be assessed with better precision.

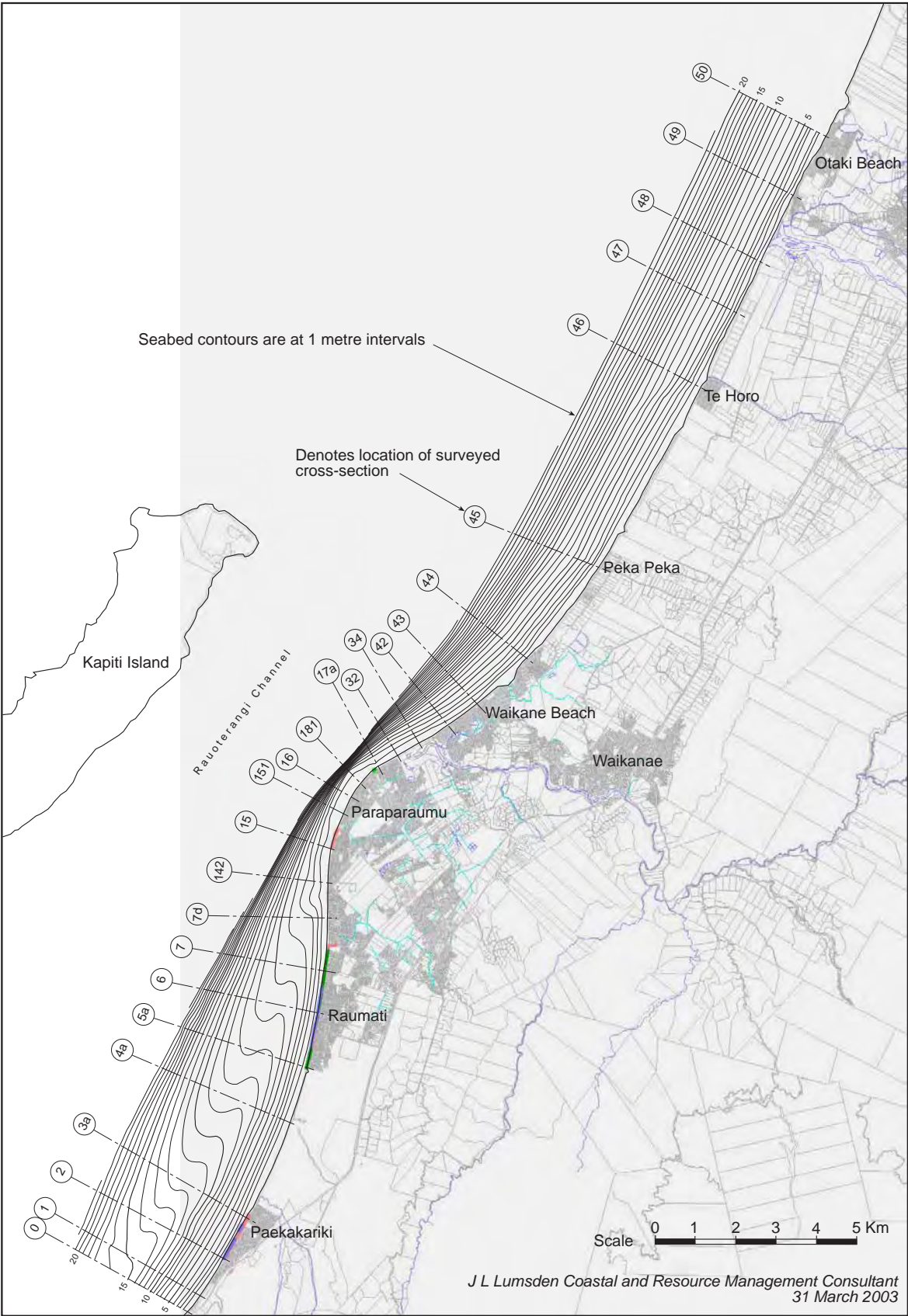


Figure 2.1: Kapiti Coast: Bathymetry as Surveyed July 2000



2.3 Development of Management Strategy

A management strategy is a set of co-ordinated actions and programmes for addressing a specific issue or problem to achieve a desired outcome. The strategy must be based on:

- a sound understanding of the issues and factors;
- an articulation of the objectives for achieving the outcomes sought;
- a rigorous assessment of the different options available for achieving the outcomes, taking into account their effectiveness, costs and benefits, acceptability and environmental impacts;
- a programme of actions for implementation; and
- a process for monitoring, reviewing and revising the implementation of the strategy over time.

The process of developing a strategy must also be based on good consultation with all parties affected by or with an interest in the outcomes. This process requires consultation at an early stage, responsiveness to the feedback received and fresh consultation as the strategy is developed.

The development of the coastal erosion management strategy was based on the following approach:

1. Initial overview of issues, including existing database, review of historical records, and consultation with stakeholders;
2. Acquisition of data through surveys, aerial photographic analysis and erosion risk assessment (see subsection above);
3. Preparation of preliminary management strategy, including summary of issues and erosion risks, management options, and preliminary recommendations;
4. Stakeholder and community consultation over the preliminary management strategy, including media releases, display days, public meetings, and submissions process;
5. Review of consultation feedback, and further development of draft management strategy.

It is intended that the draft hazard management strategy, once accepted in principle by Council, will be referred back to the community for further consultation before it is finalised and adopted.



The outputs from the management strategy should include a programme of actions that will feed into the Council's overall operations and works programmes, as well as the preparation of a change to the District Plan to make such changes to the objectives, policies, rules and other provisions as are necessary to implement the strategy. Both these actions will also require appropriate consultation and opportunity for public feedback.

The management strategy, once adopted, will become the basis for a long-term series of programmes, regulations and activities, some which could have significant implications in terms of funding controls over property development and the quality of the coastal environment. Thus the management strategy must be based on a robust technical foundation and subject to rigorous public scrutiny and an evaluation of options.

As much of the framework of the coastal hazard management strategy, including regulatory methods, is to be implemented through the District Plan, the strategy must also meet the relevant requirements of the Resource Management Act (1991), particularly s.32, which imposes a duty on local authorities to identify and evaluate alternative approaches for addressing issues when preparing Plans and Changes to Plans.





3 Coastal Erosion Hazards

3.1 Erosion: What does it mean?

The Kapiti coastline is approximately 40 km long and extends from the north end of Centennial Highway at Paekakariki to just north of Otaki. It is essentially a sandy coastline.

In a natural environment on a sandy coast the interface between the sea and the land moves freely as erosion and accretion (sedimentation) take place according to the forces of nature. Nothing is actually wrong with erosion, until public or private property is threatened. During extended periods of stability and/or accretion, people may begin to feel secure enough to begin to develop along the coastal margin for residential, commercial and other purposes. When erosion occurs and assets are placed at risk, the question arises as to whether or not the land should be protected, and if so, at what cost. If the economic activities threatened by the erosion are only marginal it will probably make sense to abandon the land. On the other hand, if urban or commercial development has occurred, the decision may well be otherwise. In such circumstances, erosion becomes a hazard.

The pressures for land development in coastal areas continue to grow and have escalated in recent times. This, in turn, increases the value of the coastal assets, thus making a decision to allow nature to take its course without human intervention including, if necessary, removal of buildings, increasingly more difficult.

These days, sensible coastal management practice requires new development to be set back a certain distance from the coast. The setback distance should reflect the coastal hazard risk, but other factors such as natural character, amenity, and/or cultural values, may also be relevant considerations. This is fine for “greenfields” developments but, where infrastructure, commercial development, housing, etc., already exists, the establishment of planning restrictions such as setback lines becomes problematical both in a practical sense as well as from a personal perspective.

There is, also, the often ignored but nevertheless important matter of the economic value of beaches to consider. When taken into account, this may have a direct bearing on how the coast is to be managed and dictate the sorts of mitigation that might be considered. For example, more people come to the beaches in Florida than visit all the National Parks in the USA in any one year. The economic value that these visitors bring, particularly



to coastal cities and towns, is such that the costs of dredging large volumes of sand to maintain those beaches is considered money well-spent, and is far preferable to building structural coastal defence systems, such as seawalls, etc., to stop the serious erosion, which would otherwise occur. Preservation of the beach at Paraparaumu is worth considering in these terms albeit, perhaps, at a different scale.

In simple terms, the erosion of coastal land occurs when elevated water levels combine with the action of waves and currents to attack beaches, and the cliffs or dune systems bordering the hinterland. The extent to which property (land) is lost depends, principally, on the elevation of the water relative to the level of the beach. It will also depend on the energy remaining in the impacting wave, which affects run-up, as well as the duration of the storm event. It is also worth noting that erosion of sandy coastlines can occur, albeit at a less spectacular rate, even when there is only modest wave action, providing water levels are sufficiently elevated relative to the beach.

On ocean coastlines the water level is influenced by astronomical tides, and various oceanographic and atmospheric processes, such as climate-related events and El Niño conditions, that may alter predicted water levels. In addition, there may also be a rise in water level produced by waves, including the set-up that elevates mean shoreline position, and the run-up swash of individual waves beyond that mean level.

A further factor that is relevant to coastal erosion is the morphology and shape of the beach and dune system, and its capacity to act as a buffer between the attacking waves and coastal assets. Important factors are sediment size and supply, beach slope and elevation, dune volume and wave characteristics. Sand can also be removed from a beach by other mechanisms such as wind, or sand-mining. Under the right conditions, of course, sediment may also be transported on to a beach, and there are a variety of mechanisms, both natural and unnatural, by which this can occur.

In the longer term, the behavioural trend on any beach is determined by its so called 'sediment budget'. Where a beach, over a period of time, receives more sediment than it loses, the beach system and the shoreline will move seaward (accretion or progradation) and it is said to have a positive sediment budget. Similarly, if the system is losing more sediment than it gains there will be a net landward movement and the coast is said to be in recession, or eroding. Some beaches, of course, will exhibit a stable coastline over many years, a state often referred to as dynamic equilibrium. That means that while the shoreline position may fluctuate about an average position, long-term changes are not significant.

It is also important to note that long-term trends can be masked by shorter-term, often cyclical, changes that may extend over a decade or more. These may be more noticeable than any underlying trend of accretion or



erosion. Climate variability, discussed in 3.3, will often be a significant causative factor.

The factors that affect the level of the sea at the shoreline are discussed in the following sections. Much of this has been summarised from the study of waves, tides, storm surge and sea-level rise, carried out for this project by National Institute of Water and Atmospheric Research Ltd. (NIWA). The complete NIWA report is included in the Appendices (Volume II) where readers can obtain more detailed information.

3.2 Sea-level Variability

The term “Mean Sea Level” is somewhat misleading. Although it is often referred to as a datum, implying that it is constant, it does in fact vary according to seasonal, inter-annual (year-to-year) and decadal time-scales. These variations have an important role in determining the “background” sea level, or vulnerability to storm activity, present in any given month. If the background sea level is elevated, it will exacerbate storm surges and tides that operate according to hourly and daily schedules. In this study, Mean Sea Level refers to the Wellington datum, WD-53.

Whereas recent research has raised the level of understanding of seasonal, inter-annual and decadal variability in sea level around New Zealand (e.g., Bell and Goring, 1997; Bell *et al.*, 2000), there remains a serious lack of long-term open coast sea-level data, and the Kapiti coast is no exception. In general, researchers have to rely on tide gauges located in various ports.

Generally, the annual cycle in sea level is small around the New Zealand coast. The mean variation from the 3-year record obtained from the Kapiti Island tide gauge is just under ± 0.04 m, generally peaking in February.

The year-to-year variation is greater than the seasonal cycle as it is more closely associated with the El Niño-Southern Oscillation (ENSO) system. Around the North Island, sea level is elevated above normal during La Niña episodes (e.g., 1989 and 1998-99). Conversely, El Niño events tend to suppress sea level. At Kapiti, the inter-annual elevation of background sea level at Kapiti could be up to 0.15 m for a few months during strong La Niña episodes (Bell *et al.*, 2000). For design purposes it is sufficient to add a nominal +0.1 m set-up to both the 1% and 2% AEP (Annual Exceedance Probability) design levels to account for elevated seasonal and La Niña sea levels.

The trend in sea level rise for the past 100-150 years is small, with a global mean of +1.8 mm/yr. Over the last century, this equates to an increase in sea level of 0.18 m and the on-going rise gradually increases the probability of exceedance of any specified hazard datum (relative to the



landmass) from coastal inundation events. Sea-level rise should, thus, be factored into any long-term plans for the coast.

An analysis by Hannah (1990) of sea-level trends from 1900-1988 from tide-gauge data at New Zealand's four main ports produced a national average rise in sea level of +1.7 mm/yr. This is similar to the global average and, so far, there has been no apparent acceleration in the rate of rise (Bell *et al.*, 2000).

Predictions of future sea-level rise, within the context of climate change in response to human-induced changes in atmospheric composition (e.g. "greenhouse gases"), are regularly addressed by the Intergovernmental Panel on Climate Change (IPCC). In the latest IPCC predictions (March 2001) two scenarios and a worst-case are proposed. Projections for global sea-level rise by 2100 are 38 cm for scenario 1 and 29 cm for scenario 2, but considerable uncertainties are attached to these estimates. The worst-case scenario considered by the IPCC would result in a sea-level rise of up to 88 cm by 2001. The IPCC 1995 predictions (a 50% chance that sea level around New Zealand will rise by +0.20 m by 2050 and 0.45 m by 2100), are not inconsistent with the 2001 predictions and are recommended by NIWA for use in this study.

Long-term projections of sea-level rise and its impacts for New Zealand are complicated by two additional factors. These concern the rising New Zealand land mass (about 4 cm per century) and tectonic plate movements (potentially of the order 0.5-1.0 m), which can have a much larger impact on relative sea levels. Major tectonic changes tend to occur in discrete and localised jumps and, thus, their effect on long-term relative sea levels is difficult to generalise.

Although the Wellington-Kapiti region contains complex faulting structures and recent evidence of an active off-shore fault running north of Kapiti Island, estimates of a rate of uplift (0.5-0.4 mm/yr) remain somewhat uncertain and the conservative approach is to ignore such phenomena when considering the effects of sea-level rise until such time as further quantitative information becomes available.

3.3 Climate Variability

Although much of the focus is on sea-level rise, it must also be noted that changes in weather patterns may, potentially, have much greater effect on coastlines, particularly in the shorter term.

The IPCC provides climate simulation results for a number of coupled atmosphere-ocean general circulation models (GCMs). Outputs from these models have been analysed for the present-day climate and for projected



future changes over the next century (Mullan et al., 2000). All models simulate most of the broad-scale features of the observed present-day climate, although only four of the six produce realistic El Niño-Southern Oscillation (ENSO) patterns in the New Zealand region.

For the one hundred year period 1980s-2080s, all models show a strengthening (or at least no weakening) in typical westerly wind circulation over New Zealand associated with an increase in mean Equator to Pole temperature difference (i.e., the polar regions are not expected to warm to the same extent as the equatorial regions). It should be noted, however, that the magnitude of predicted change does vary from model to model.

Averaged over all GCMs, the strength of the background westerly circulation over central New Zealand is predicted to increase by around 15% over the next 50 years, and by another 15% during the subsequent 50 years.

More particularly, there is little agreement between the models on the projected changes in El Niño-Southern Oscillation (ENSO) behaviour (Mullan et al., 2000). At present, there is no strong evidence of significant changes in ENSO, at least over the coming 50-100 years.

Research suggests that the behaviour of ENSO is modulated on the 20-30 year time scale by what has become known as the “Interdecadal Pacific Oscillation” (IPO). The IPO conditions the tropical Pacific towards extended periods of predominantly El Niño conditions, followed by periods of more evenly balanced La Niña and El Niño events.

Of more direct interest to the Kapiti region is the fact that the last 25 years have been dominated by El Niño conditions. These have resulted in an average increase in westerly winds over central and southern New Zealand, compared to the previous 30 years. Similarly, the 1950s was also a period of enhanced westerly wind activity that coincided with a spate of erosion along the Kapiti coast (Donnelly, 1959).

Despite the GCM predictions, it is possible that the IPO may reverse over the next 2-5 years, which could bring in two or more decades of somewhat lighter westerlies and more La Niña episodes than have been experienced during the last two decades. Such decadal-scale variability in the wind climate of New Zealand must be taken into account and should be seen as overlaid on the greenhouse gas changes discussed above. It is also important to distinguish the difference between weather (e.g., a particular storm event) and climate, which provides the background or context in which adverse weather-related events occur. Severe storms can occur during any ENSO episode.



3.4 Storm Set-up and Tide Levels

As is commonly the case in New Zealand, there is a shortage of good quality, long-term sea level and wave information for the coast, making quantitative estimation of extreme sea levels, and their return periods, difficult. The various components (highest tide, biggest storm surge, La Niña conditions plus heavy seas) that contribute to sea level cannot simply be added together to form a “worst case” scenario, as the probability of occurrence is so small as to have no practical significance.

In the NIWA study of waves, tides, storm surge and sea level rise on the Kapiti coast, (Appendix 3 in Volume II) a more realistic extreme sea level was produced for Waikanae Beach to which projected climate change factors (sea-level rise and windiness) can be added. From this, an estimate of extreme sea levels along the Kapiti coast can be made after making due allowance for tide range differences and wave run-up exposure.

Storm surge is normally defined as the temporary elevation of sea level, above the predicted tide by a varying combination of:

- Low barometric pressure that results in a regional rise in sea level; and
- Adverse winds that cause seawater to “pile up” against the coast.

At the shoreline, a further elevation in sea level arises from wave set-up in the surf zone and subsequent wave run-up. These wave-derived set-ups are dealt with separately from storm surge.

The critical aspect for coastal hazard assessment is not just how big the storm surge set-up is, but also how big the high tide is likely to be. In other words, the coast is at its most vulnerable whenever a moderate to severe storm surge coincides with a high spring or perigean tide. It is also important to realise that the occurrence of a storm surge does not necessarily imply severe coastal erosion as the latter also depends to a great extent on the approach angle of the waves, wave height and period, and tide level.

1 Storm surge

In the last 50 years, the September 1976 event stands out as the highest known storm surge along the Kapiti coast, estimated at ~0.7 m (Gibb, 1978). Minimum daily barometric pressures, at or below 975 hPa have occurred 4 times at Paraparaumu Airport since 1962. Such events produce an inverted barometer set-up of just over 0.4 m in sea level. If such low pressures coincided with strong on-shore winds similar to those experienced in 1976, an additional set-up of 0.2 to 0.3 m, imposed by wind stress, could be expected.



Historic analysis of other, lesser events, suggests that a storm surge of 0.7 m would have a reasonably low annual exceedance probability (AEP) of around 2% for the Kapiti coast. This is not dissimilar to other parts of the New Zealand coast where the upper limit for storm surges is considered to be ~1 m, with an AEP of less than 1%. The NIWA report suggests that, until a longer sea-level record is obtained, a storm surge set-up of 0.85 m (excluding wave set-up and run-up) provides a suitably conservative estimate of a 1% AEP, and 0.75 m for a 2% AEP, for Kapiti.

2 High Tide Levels

Mean high water spring (MHWS) tide level for the Kapiti Island sea-level recorder is 1.06 m above MSL (Wellington datum: WD-53). The highest astronomical tide (HAT) exceeded by only 1% of tides is 1.16 m. These levels also apply to Waikanae Beach, directly east of the recorder. The implication of the considerable spatial variation of tides along the Kapiti coast is that estimates of extreme tides made using data from the sea-level recorder on Kapiti Island need to be scaled to obtain the corresponding high-water level along the coast. Thus, extreme tides to the north of Waikanae at Otaki Beach need to be scaled up by as much as 112% and those to the south at Paekakariki need to be scaled down by 70%.

3 Wave Set-up and Run-up

The only known estimate of the combined wave set-up and final run-up (across the beach), is the observation by Gibb (1978) of an average of 2.6 m vertical movement in the driftwood line during the September 1976 storm.

Wave set-up is dependent on the breaking wave height, wave period, and also the slope of the beach and nearshore zone and will, generally, be 8-15% of the incident breaking wave height. For example, consider regular breaking waves with a 10 second period approaching normal to the Kapiti coast with a typical nearshore slope of 0.02 (1 in 50). Estimated deepwater significant wave heights of 5 m and 6 m (for 50 and 100 year return periods) could produce wave set-ups of 0.75 m and 0.90 m, respectively, at the shoreline, based on the method outlined in CERC (1984). However, natural waves at the coastline exhibit “groupiness” or a surf beat, where a group of larger waves is followed by smaller waves and so on. These groups of larger waves may “pump” significant quantities of seawater towards the shore, so a further 0.1 m can be added to the above wave set-up values calculated for regular waves.

Wave run-up, defined as the time-varying location of the shoreward edge of water on the beach face, is more difficult to generalise for a particular



stretch of coast, as it is strongly dependent on the site-specific beach and foredune profiles, and the associated substrate (e.g., walls, rocks, gravel, sand) at each site. Therefore, a site-by-site appraisal is needed for each different section of the coastline. With a suitable run-up model, one can use measurements of wave heights and periods, and knowledge of beach morphology, to develop extreme-value distributions of the run-up for the particular coastal site of interest.

Based on laboratory data of wave run-up obtained by various investigations, Battjes (1974) demonstrated a dependence between the maximum vertical run-up elevation, R_{max} , normalised by the deep-water significant wave height, H_s , and the Iribarren “surf similarity” parameter, ξ_0 , giving the relationship:

$$R_{max}/H_s = C\xi_0 \quad (1)$$

Where C is an empirical constant, established by measurement, that is dependent on the characteristics of the beach (slope, porosity and roughness), and ξ_0 is the dimensionless Iribarren “surf similarity” number, defined as:

$$\xi_0 = S/(H_s/L_o)^{0.5} \quad (2)$$

where S is the slope of the beach face and L_o is the deepwater wave length given by $L_o = (g/2\pi)T^2$, where g is the acceleration due to gravity and T is the wave period.

Using an extensive set of field measurements, Holman (1986) and others also showed that run-up on natural beaches depends on the Iribarren number in accordance with equation (1). When run-up elevation is expressed as the 2% exceedance value of run-up maxima, $R_{2\%}$, it was found that the dimensionless constant, C , in equation (1) is approximately equal to 0.9. Conditions during which 2% of the wave run-up maxima reach or exceed the elevation of the beach-face junction can similarly be taken to be a reasonable proxy for potential erosion.

Combining equations (1) and (2) yields:

$$R_{2\%} = CS(H_s L_o)^{0.5} = C(g/2\pi)^{0.5} . S(H_s)^{0.5} . T \quad (3)$$

for the run-up elevation as a function of the deep-water significant wave height and period, and of the beach slope. Equation (3) accounts for the total run-up elevation due to the presence of waves, that is, it combines the wave-induced set-up, which raises the elevation of the mean shoreline, and the swash elevation of individual waves beyond that mean shoreline. Run-up calculations for each Coastal Hazard Management Area are shown in Table 3.1 (50 year return period) and in Table 3.2 (100 year return period), below.



4 Design High Water Levels

Combining the above estimates, proposed design high water levels for a 1% and 2% AEP, are shown in Table 3.3 (50 year return period) and in Table 3.4 (100 year return period), below. Note that heights are in metres above Wellington Mean Sea Level datum WD-53.

Coastal Hazard Management Area	Beach Slope S (Tan β)	Significant Wave Height H _s (metres)	Wave Period T (Secs)	Deepwater Wave Length L ₀ = (g/2π)T ² (metres)	Iribarren Number ξ ₀ = S/(H _s /L ₀) ^{0.5}	Beach Constant C	Wave Run-up R _{2%} = C · H _s · ξ ₀ (metres)
1. PAEKAKARIKI	0.057	3.60	9.40	137.97	0.353	0.90	1.14
2. QE PARK	0.040	3.60	9.40	137.97	0.248	0.90	0.80
3. RAUMATI SOUTH	0.025	3.60	9.40	137.97	0.155	0.90	0.50
4. RAUMATI NORTH	0.028	3.60	9.40	137.97	0.173	0.90	0.56
5. PARAPARAUMU	0.025	3.60	9.40	137.97	0.155	0.90	0.50
6. WAIKANAE to PEKA PEKA	0.028	3.60	9.40	137.97	0.173	0.90	0.56
7. PEKA PEKA to OTAKI	0.024	3.60	9.40	137.97	0.149	0.90	0.48

Table 3.1: Wave runup levels ~ 2% AEP (50 yr return period)

Coastal Hazard Management Area	Beach Slope S (Tan β)	Significant Wave Height H _s (metres)	Wave Period T (Secs)	Deepwater Wave Length L ₀ = (g/2π)T ² (metres)	Iribarren Number ξ ₀ = S/(H _s /L ₀) ^{0.5}	Beach Constant C	Wave Run-up R _{2%} = C · H _s · ξ ₀ (metres)
1. PAEKAKARIKI	0.057	4.50	10.00	156.15	0.336	0.90	1.36
2. QE PARK	0.040	4.50	10.00	156.15	0.236	0.90	0.95
3. RAUMATI SOUTH	0.025	4.50	10.00	156.15	0.147	0.90	0.60
4. RAUMATI NORTH	0.028	4.50	10.00	156.15	0.165	0.90	0.67
5. PARAPARAUMU	0.025	4.50	10.00	156.15	0.147	0.90	0.60



6. WAIKANAE to PEKA PEKA	0.028	4.50	10.00	156.15	0.165	0.90	0.67
7. PEKA PEKA to OTAKI	0.024	4.50	10.00	156.15	0.141	0.90	0.57

Table 3.2: Wave runup levels ~ 1% AEP (100 yr return period)

Coastal Management Zone	Storm Surge	High Tide	ENSO (La Niña)	Wave Set-up	Wave Run-up	Sea-level Rise	TOTAL WL
1. PAEKAKARIKI	0.75	0.74	0.10	0.85	1.14	0.20	3.78
2. QE PARK	0.75	0.80	0.10	0.85	0.80	0.20	3.50
3. RAUMATI SOUTH	0.75	0.90	0.10	0.85	0.50	0.20	3.30
4. RAUMATI NORTH	0.75	0.95	0.10	0.85	0.56	0.20	3.41
5. PARAPARAUMU	0.75	0.98	0.10	0.85	0.50	0.20	3.38
6. WAIKANAE to PEKA PEKA	0.75	1.06	0.10	0.85	0.56	0.20	3.52
7. PEKA PEKA to OTAKI	0.75	1.09	0.10	0.85	0.48	0.20	3.47

Table 3.3: Design high water levels ~ 2% AEP (50 yr return period)

Coastal Management Zone	Storm Surge	High Tide	ENSO (La Niña)	Wave Set-up	Wave Run-up	Sea-level Rise	TOTAL WL
1. PAEKAKARIKI	0.85	0.81	0.10	1.00	1.36	0.45	4.57
2. QE PARK	0.85	0.90	0.10	1.00	0.95	0.45	4.25
3. RAUMATI SOUTH	0.85	0.99	0.10	1.00	0.60	0.45	3.99
4. RAUMATI NORTH	0.85	1.03	0.10	1.00	0.67	0.45	4.10
5. PARAPARAUMU	0.85	1.07	0.10	1.00	0.60	0.45	4.07

6. WAIKANAE to PEKA PEKA	0.85	1.16	0.10	1.00	0.67	0.45	4.23
7. PEKA PEKA to OTAKI	0.85	1.19	0.10	1.00	0.57	0.45	4.16

Table 3.4: Design high water levels ~ 1% AEP (100 yr return period)

3.5 Predicting Future Change

In recent decades there have been considerable advances in the understanding of coastal processes, including the mechanics of sediment movement, prediction of storm wave characteristics, and the effects of waves on beaches. Many of these processes have been integrated into numerical models that predict changes in beach morphology enabling assessments to be made of beach profile evolution in response to tides and storms.

Recent research in Oregon (Komar et al., 1999) has focused on analyses of extreme water levels, which result from unusually high tides combining with run-up from storm waves. As shown in Figure 3.1, of interest is the total water level produced by these combined processes, relative to the elevation of the junction between the beach and the base of the foredune. Clearly, dune erosion can only occur if the total water level reaches or exceeds the elevation of the beach/dune junction.

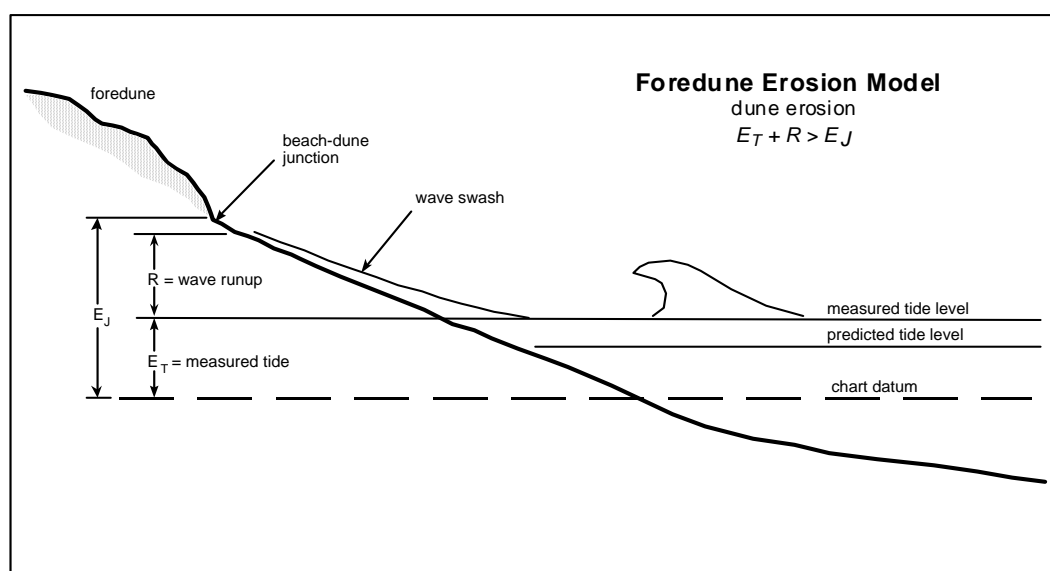


Figure 3.1. Total water level compared with elevation of the toe of the dunes

The extent of the erosion is strongly dependent on the amount by which the beach/dune junction is exceeded.



Much of the Oregon research was directed towards testing various models that have been developed for the assessment of dune erosion when attacked by storm waves superimposed on elevated water levels. Two broad approaches were considered. Those representing geometric models, which assess the maximum possible dune retreat for extreme conditions, and process-based models (such as SBEACH and COSMOS) that evaluate waves and currents, the processes important in causing cross-shore transport of sediment that results in beach and dune erosion. With their ability to account for the lag of actual erosion behind the causative waves and currents, process-based models generally predict smaller rates of erosion than do the geometric models (Komar et al, 1999). However, Komar found, that on the low sloping dissipative beaches of Oregon, the process-based models tended to under-predict erosion during extreme events because of their inability to account for such features as rip currents and long-period infragravity motions that effect run-up on such beaches. This led to the conclusion that, for the purposes of establishing setback distances, it was appropriate to use the more conservative figures given by the geometric models. Furthermore, process-based models require input data of a quality that is not available at Kapiti. Those models that have been used in New Zealand tend to be events-based and of limited use in determining long-term erosion trends. Results have not always been reliable.

The Kapiti coastline is similarly configured with relatively low sloping dissipative beaches and, the use of a geometric model is considered an appropriate method of providing a first estimate of the erosion and total possible retreat of the dune. These models are considered “geometric” in the sense that the analysis involves the upward and landward shift of a triangle, one leg of which corresponds to the elevated water level, and then the landward transition of that triangle and beach profile to account for the extent of the erosion and total possible retreat of the dunes.

The geometric model developed for use in Oregon is depicted in Figure 3.2. The model also includes an assessment of the lowered elevation of the beach due to the presence of a rip current, a phenomenon known to occur at Kapiti and, particularly, along the Paekakariki coast.

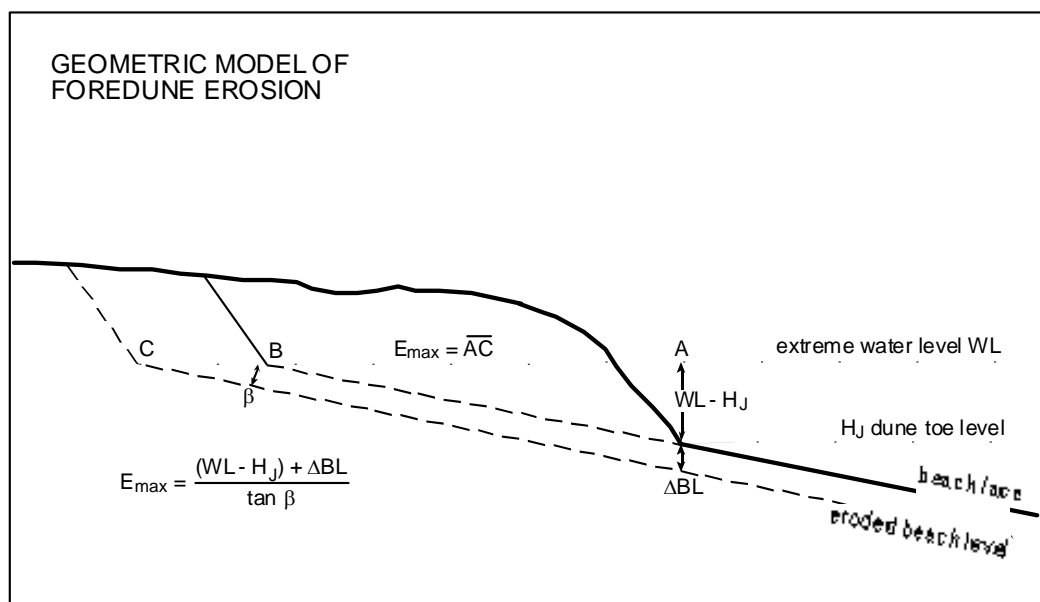


Figure 3.2. Geometric model used to evaluate potential storm erosion

Elevations are given with respect to Mean Sea Level. Important is the total water level, WL, which is the combined result tidal elevation and storm-wave run-up. The erosion of the foredune is dependent on the water-level elevation compared with the elevation of the toe of the foredune, E_j , the junction with the beach face (Figure 1). At any particular location, the beach face dominated by wave swash has a typical uniform slope angle, β (Figure 3.2). The model assumes that this slope is maintained as the dunes are eroded back so the analysis focuses on the right triangle depicted in Figure 3.2 where erosion due to high water alone cuts back the foredune to point B. Additional erosion could result from the lowering of the beach due to the presence of a rip current or general beach erosion during the storm. This vertical shift in the profile is represented by the beach-level change ΔBL , which results in a further retreat of the dunes to point C in Figure 3.2.

The total retreat of the foredune is now given by the line segment AC, which is taken as the equivalent to E_{\max} (the theoretical maximum dune erosion during extreme storms). From the right triangle formed by this erosion, Figure 3.2:

$$E_{\max} = \{(WL - H_j) + \Delta BL\} / \tan \beta \quad (4)$$

For the purposes of this exercise, the beach profiles obtained from the hydrographic and beach survey work carried out in July 2000 have been used to represent a typical profile. The results of the analyses for each



coastal hazard management area are shown for 2% AEP in Table 3.5 and for 1% AEP in Table 3.6 below.

It should be noted that the foredune retreat analyses, the results of which are shown in Tables 3.5 and 3.6, provide theoretical maximum values for coastal retreat. For a number of reasons, actual values will be less than these amounts. For comparison the historical shoreline movements over a 100-year period, as determined by Gibb (1978), are also shown in the right-hand column, and it will be noticed that there is a considerable difference in the values. The geometric model used here provides a mathematical assessment of, in this case, the capacity of a shoreline to erode. Even the most sophisticated models can, however, only ever give a crude representation of what happens in nature. No allowance, for example, has been made for the sediment budget, which determines whether the coast is in long-term accretion or erosion, or the sheltering effects of Kapiti Island. As such, the figures obtained provide a useful guide in establishing sensibly conservative construction setback distances on an undeveloped coast, and the amount by which they vary from the actual figures recorded in Gibb (1978) is a function of other influences. Where there already exists high density urban development and community infrastructure, as is the case along much of the Kapiti coast, allowance has to be made for other factors. This is discussed further in the next section.

Coastal Hazard Management Area	Maximum Runup Elevation WL	Equivalent Dune Toe Level H_j	Rip Current Scour Depth ΔD	Beach Slope S	Theoretical Foredune Retreat $(WL-H_j+\Delta D)/S$	Historical Foredune Movement 1874-1975
1. PAKAKARIKI	3.78	2.50	1.50	0.057	48.83	18-60 m retreat
2. QE PARK	3.50	2.20	1.20	0.040	62.56	0-30 m accretion
3. RAUMATI SOUTH	3.30	2.00	0.50	0.025	72.06	24-37 m retreat
4. RAUMATI NORTH	3.41	2.00	0.00	0.028	50.42	24-37 m retreat
5. PARAPARAUMU	3.38	1.80	0.00	0.025	63.26	171-195m accretion
6. WAIKANAE to PEKA PEKA	3.52	2.00	0.00	0.028	54.34	49-171 m accretion
7. PEKA PEKA to OTAKI	3.47	1.80	0.00	0.024	69.64	50-95 m accretion

Table 3.5: Theoretical maximum foredune retreat ~ 2% AEP (50 yr return period)



Coastal Hazard Management Area	Maximum Runup Elevation WL	Equivalent Dune Toe Level H_j	Rip Current Scour Depth ΔD	Beach Slope S	Theoretical Max. Foredune Retreat $(WL-H_j+\Delta D)/S$	Historical Foredune Movement 1874-1975
1. PAEKAKARIKI	4.57	2.50	1.50	0.057	62.63	18-60 m retreat
2. QE PARK	4.25	2.20	1.20	0.040	81.36	0-30 m accretion
3. SOUTH RAUMATI	3.99	2.00	0.50	0.025	99.46	24-37 m retreat
4. NORTH RAUMATI	4.10	2.00	0.00	0.028	74.93	24-37 m retreat
5. PARAPARAUMU	4.07	1.80	0.00	0.025	90.66	171-195m accretion
6. WAIKANAE to PEKA PEKA	4.23	2.00	0.00	0.028	79.57	49-171 m accretion
7. PEKA PEKA to OTAKI	4.16	1.80	0.00	0.024	98.44	50-95 m accretion

Table 3.6: Theoretical maximum foredune retreat ~ 1% AEP (100 yr return period)

3.6 Risk-based Setback Analysis

Parts of the Kapiti coast have been heavily developed, particularly during the last 40-50 years. Some of this development has encroached on the natural dynamic zone of the beach system and, consequently, coastal assets, in the form of housing and roads, are at risk from erosion. Along significant lengths of the coast at Paekakariki and Raumati, structures have been built along the shoreline for the purpose of protecting such property. While these structures have been sufficient to stabilise the shoreline during the past two decades, their ability to withstand major storm action is limited in all cases.

It is now generally accepted that improperly considered coastal protection works may adversely affect the beach and prevent or detract from people's enjoyment. In recent years, as the level of understanding of coastal processes has improved, there has been a trend towards so called 'softer' solutions such as beach renourishment and dune conservation.

Furthermore, current wisdom also now demands that construction be set back a suitable distance from the coastal boundary so as not to interfere, or come in conflict, with natural processes. In some cases, particularly in the case of new developments, the maintenance of natural character and/or



amenity values may also influence the extent to which buildings are set back from the coastline.

Construction setbacks have been used as a planning tool to manage development along the coastal margin at Kapiti since 1980. For example, a 20 m wide “Building Line Restriction” area, where no new construction is permitted, presently exists along most of the Kapiti coastline within the urban areas of Paekakariki, Raumati and Paraparaumu. In the rural areas to the north of the Waikanae River the restricted area is 100 m wide and there is currently a 70 metre wide building restriction area at Peka Peka. Behind the urban 20 m ‘no-build’ area, from the southern boundary of the district to the intersection of Wharemauku Rd and Marine Parade at Paraparaumu, there is also a 30 m wide area where new construction is required to be ‘relocatable’.

On the following pages, construction setbacks and their role in the management of the Kapiti coast, will be discussed and appropriate, recommendations for adjustment will be made.

In establishing hazard areas, it is important to ensure that the setback lines are measured from an identifiable and logical baseline. Here, the edge of the undisturbed land, as determined from the aerial photographic survey, undertaken in 2002, has been adopted. This can be expected to mean land that is stable and not land that has recently accreted as part of a natural cycle. It also generally means the top of any embankment rather than the toe of a sloping face. The position from which the setback is measured, nevertheless, may vary with the location of the shoreline and periodic reassessment will be necessary in the event that an extended period of erosion prevails.

The use of appropriate terminology in defining the hazard areas, is also important. The present terminology is considered unsatisfactory. While the ‘no build’ area is clear enough, it is somewhat limiting in that minor structures could be allowed without significantly exacerbating the risks (such as decks and garden structures). The term ‘relocatable’ is known to cause difficulty as a planning instrument. While the term is defined in the District Plan, there are, quite clearly, areas where the topography, or existing buildings, or lack of access, among other things, means the notion of relocatability is unrealistic. It has also been uncertain as to whether or not “relocatable” means it is necessary for space to be available on the property to relocate the building, or whether demolition or removal from the property is also an acceptable option.

The writers believe it is time some consistency was introduced into coastal management practices in New Zealand. This includes terminology and definitions relating to coastal hazards. In this respect, Environment Waikato (2002) has recently reviewed and revised the construction setbacks used to control development within the identified hazard areas on Coromandel Peninsula beaches. The terminology developed by Environment Waikato is recommended for use on the Kapiti coast. The



seaward set-back line, is described as the ***Primary Development Setback (PDS)***, and this delineates land at risk from fluctuations in natural beach erosion under existing conditions. The second set-back line is called the ***Secondary Development Setback (SDS)***, which delineates additional land that may be at risk from the effects of storms, sea-level rise, and climate change over the next 100 years: i.e., land at moderate risk from coastal erosion. Within these hazard areas rules, appropriate to the conditions, can be imposed to manage subdivision and development accordingly.

The essential purpose of the Primary Development Setback is to identify that area along the seaward boundary of coastal property where, because of the level of risk from erosion, it would be prudent to prevent the erection of buildings (other than minor accessory features such as decks and garden structures) to avoid the exacerbation of risk from coastal erosion. In the PDS, therefore, construction should not be permitted. Normally, this will mean not allowing construction for habitation or commercial use, but structures in connection with landscaping such as pools, fences, walls, and decks, or structures for certain public use, may be permitted in some circumstances, and rules relating to this need to be clearly described in the plans. Note: there may be other controls imposed on such structures for other reasons such as the need to restrict building heights for visual amenity purposes. In other cases, for reasons such as preservation or restoration of natural character (a Part II matter under the RMA), no development at all may be permitted. In establishing the width of the PDS, from an erosion perspective, the object is to ensure that development adjacent to the coast is set back a sufficient distance to avoid being inundated by erosion. Such a distance, of course, is not only time related, but it is also risk related. Since new buildings have a life expectancy of around 100 years, this is a suitable period to apply to the hazard area. In other words, the risk of inundation or collapse (due to coastal erosion) beyond the hazard area should be acceptably low within this period.

The purpose of the Secondary Development Setback is to identify a further area where there remains a moderate risk of erosion within the 100-yr period but there is sufficient uncertainty about this to allow construction to take place, subject to conditions that may be imposed with respect to proposed use, floor levels, ability to resist the effects of erosion, and removability.

In assessing the risks, consider the accepted definition:

$$\text{RISK} = \text{PROBABILITY} \times \text{CONSEQUENCE}$$

This simple relationship shows that, to achieve a low risk when the consequences (resulting from inundation or collapse) are high, a low probability is required. However, while the consequences are easily understood and, in specific cases, quantifiable, the measure of probability is more elusive.



Despite the simplicity of the above equation, the notion of “risk” is not always well understood. While risk is a mathematical concept and can be quantified when appropriate data is available, it does necessarily relate to a future event and, therefore, any expression of risk must rely on a degree of supposition. Risk thus becomes an estimate, and is therefore uncertain. The level of certainty can only be improved when there is a balance between information and analysis.

Another way of looking at risk that is, perhaps, more relevant to coastal hazards, is:

$$\text{RISK} = \text{THREAT} \times \text{VULNERABILITY}$$

It is useful here to distinguish between hazard and risk. In reality, the two expressions mean quite different things. A hazard is a threat, in other words a possibility of something happening that could be harmful, while risk relates to the likelihood of the harm itself. A hazard may, therefore, be a component of risk. One approach to risk management is to manage hazards; another is to manage vulnerability. No matter how likely the hazard, however, it will not be serious unless the consequences are serious. If risk is to be controlled through management of the hazard, quantification of the hazard is a necessary step in the process. In this case, it is necessary to deal with the vulnerability. Analysis of the hazard enables measures to be taken to reduce the vulnerability and, therefore, the risk. Where coastal hazards are concerned, this means improving coastal defences and/or setting construction back from the coast.

The objective is to determine setback distances with a suitably low probability that, say, in 100 years time, the coastline will not have retreated (eroded) beyond that point. Some analysis is necessary and this has been discussed in the preceding section (3.5). The factors that effect coastal stability are relatively straightforward. These lead to a determination of extreme water levels for a 50-yr and 100-yr return periods at each of the coastal hazard management areas and the results are shown in Tables 3.3 and 3.4. Using the simple geometric model, as described in Section 3.5, the potential maximum retreat can be determined and these results are summarised in Tables 3.5 and 3.6, again for 50-yr and 100-yr return periods. As noted, these results are conservative and need to be adjusted according to various influences specific to the location.

An assessment of the recommended setback distances that will define the two hazard areas can, thus, be made based on the results from the model, tempered by the historical erosion rates and the influence of Kapiti Island, existing protection works and the expectation that these will be maintained or improved, a presumption of sound coastal zone management practice in the future, and other factors such as river mouths. It is important to realise that these distances are not precise. Even with the best data in the world and the most sophisticated models, it is just not possible to predict nature and the response to natural forces, with certainty. At best, the setback



provisions represent a compromise based on available information coupled with an understanding of the nature and impacts of future events.

The setback distances also reflect present risk based on the status quo. It is necessary to point out that the setbacks need to be subject to regular review at not more than 5-yearly intervals so as to reflect new knowledge and conditions. Clearly if a community decides, for example, that the standard of coastal defence should be improved by any of the recognised means, including seawalls, beach replenishment, etc., in a manner that effectively reduces the vulnerability of the coast and, therefore the risk, then a case can be made for reducing the width of the setback areas. Conversely, on-going recession of the coast would undoubtedly necessitate moving the setback lines further inland.

It should be emphasised that a building setback restriction imposed as a District Plan control can have a number of purposes, and not solely for hazard management reasons. In the coastal environment, for example, a setback requirement may also be used to avoid or lessen the effects of structures on the natural character of the coast, and on the amenity values of beaches. In determining appropriate setback distances, therefore, other factors may need to be included to rationalise development controls and, as appropriate, to minimise the extent of controls. If setback controls are used for multiple purposes, however, the reasons for the controls need to be outlined in the District Plan, supported by appropriate assessment criteria for resource consent applications.

1 CHMA-1: Paekakariki

From Tables 3.5 and 3.6, the theoretical 50-year erosion is 49 metres and the 100-year erosion is 63 metres. Gibb (1978) found that the erosion at Paekakariki between 1874 and 1975 varied between 18 and 60 metres with the greater amount occurring towards the south along the present high dune adjacent to Ames Street.



Fig 3.3: High Dune at Paekakariki



The Paekakariki Coastal Hazard Management Area consists essentially of two parts, firstly the southern section extending from The Parade, south to the northern end of Centennial Highway, which includes the high dune (Fig 3.3) along Ames Street and, secondly, the northern section adjacent to The Parade (Fig 3.4).



Fig 3.4: Rock and Timber Seawall Along The Parade

The issues are quite different in each of the two sections. Along the southern part there is housing along Ames Street on top of a substantial dune that is partially protected by various private attempts at constructing seawalls, and then there is several hundred metres of high dune that is more or less in a natural state, with a small housing development along the northern part, and a restaurant at the southern end. Along the northern part, The Parade is reasonably well-protected by existing seawall structures, except at the northern end where coastal protection is planned.

In establishing setback requirements within the CHMA, it is necessary to be mindful of the factors that will influence erosion risk. The high dune south of The Parade, although vulnerable, contains a relatively high volume of sand and, therefore, can be expected to provide some resistance to wave attack. In other words, the inward lateral movement of the shoreline during an erosive event will proceed at a slower rate than would be the case where the dune system is lower. Recovery, however, is also likely to be slower, again, because of the volume of sand involved. Along The Parade, the existing protection works, although not adequate to resist major storms, will still provide significant resistance to coastal erosion, having effectively fixed the position of the coastline for over 20 years. On balance, it is considered appropriate to increase the width of the coastal hazard management area along the Paekakariki coast to 60 metres and to revise the constraints on building and sub-division within the area according to the Primary Development Setback and Secondary Development Setback definitions above. For CHMA-1, the recommended PDS is 25 metres, measured from the seaward edge of the undisturbed land, and the SDS is 35 metres. Along The Parade, the PDS includes the



roadway and, as long as this is protected from erosion and remains viable, there is no need for the SDS.

2 CHMA-2: QE Park

Queen Elizabeth Park (Fig 3.5) presents, essentially, an undisturbed coastline with important natural character and amenity values. Although the loss of park land through erosion may be inconvenient, that is the only loss and the cost is limited to the value of the land itself. There are no infrastructural assets of any significance at risk.



Fig 3.5: QE Park Shoreline

The theoretical erosion potential is quite high at 63 metres and 81 metres (50-yr and 100-yr return periods, respectively), but accretion of up to 30 metres occurred during the 100 years prior to 1975. The fixing in position of the Raumati coastline by construction of the seawall immediately north of the park is almost certainly a contributing factor in the erosion at QE Park.

Given the importance of maintaining the natural character of the park coastline, and its similar exposure to storm waves as Paekakariki, it is considered that the width of the QE Park CHMA should also be 100 metres and that the whole of this width should be subject to the same constraints as defined above for Primary Development Setbacks. The prospect of increasing this setback on aesthetic grounds may be justified, and should be discussed with Wellington Regional Council.

3 CHMA-3: Raumati South

In terms of assets at risk, this part of the coastline is the most vulnerable on the Kapiti coast (Fig 3.6). It includes extensive and concentrated urban



development along the coast, plus a public roadway (The Esplanade). From a theoretical point of view, the potential erosion is high at 72 metres and 99 metres (50-yr and 100-yr return periods, respectively) and this mostly reflects the fact that there is practically no beach remaining, particularly at the southern end, and thus the effective junction between the beach and the toe of the dune is low. If it were not for the presence of the seawall, it is reasonable to assume that a considerable amount of this erosion would have already occurred. It is noted that in the 100 years prior to 1975 the coastline at Raumati South retreated 24-37 metres.



Fig 3.6: Rock and Timber Seawall at Raumati South

In assessing setback distances in this CHMA it is necessary to recognise that there is an existing seawall, that despite its deficiencies, has adequately protected the coast against moderate storm action for the past 25 years. Providing it continues to be maintained, it will serve to reduce the erosion risk, but not completely. There should be no doubt that the existing works will be inundated and may prove largely ineffective when required to withstand a major storm such as last affected the Kapiti coast in 1976. On that occasion erosion of up to 15 metres was recorded at some sites despite there being some limited protection works present.

Because the inshore seabed at Raumati South is already low, it can be said that, to some extent, this part of the coast is on “borrowed time” and, thus, the risk is higher than if the coastline was more in equilibrium. This needs to be reflected in setback distances and for this reason it is recommended that the width of the CHMA at Raumati South be 60 metres with a PDS of 30 metres and an SDS of 30 metres also. The “no build” hazard area, thus, will effectively increase from 20 to 30 metres, from a baseline that will, generally, be the top of the undisturbed embankment..

The PDS includes The Esplanade, which as long as it is protected and remains a viable roadway, means there is no need for SDS restrictions on properties on the landward side of The Esplanade.



4 CHMA-4: Raumati North

North of the Wharemauku Stream, the coastline becomes progressively under the influence of Kapiti Island. The nearshore seabed is much flatter than it is further south and there remains a viable beach. The erosion risk, whilst still very real becomes less. Along this part of the coast the extent of residential development is also significant, but coastal protection works are limited to various privately constructed works, most of which are of doubtful value in terms of their ability to resist storm action (Fig 3.7)



Fig 3.7: Raumati North Shoreline

Here, the theoretical erosion potential is moderate at 50 metres and 75 metres, for 50-yr and 100-yr return periods, respectively and it is noted that foredune retreat in the 100 years prior to 1975 was stated in Gibb (1978) to be 24-37 metres at Raumati. Because of the more sheltered nature of Raumati North, it is reasonable to assume that the erosion would have been towards the lower end of this range.

It is considered that the appropriate width of the Coastal Hazard Management Area at Raumati South should be 50 metres and it is recommended that both the PDS and the SDS should each be 25 metres wide. The seaward margin of the PDS should be the edge of the undisturbed land.

5 CHMA-5: Paraparaumu

The Paraparaumu Coastal Hazard Management Area, CHMA-5, includes Marine Parade and extends north to the mouth of the Waikanae River. It is considered that the behaviour of the river mouth and its associated spit affects coastal processes along the northern Paraparaumu coastline. While the exact mechanisms are not entirely clear, it is apparent that until some consistency is achieved in the location of the river mouth, forward coastal management planning along the northern Paraparaumu coastline will be somewhat conjectural. This is a matter to be resolved with Wellington



Regional Council but the more obvious solutions are either to construct training walls (jetties), or to realign the opening by cutting through the spit on a more regular basis. The former could provide a navigable waterway for small craft while the latter would be a less costly option and allow easier mitigation of any adverse effects.



Fig 3.7: Dune Erosion at Marine Pde, Paraparaumu

The Paraparaumu coastline is more or less, physically, in a natural state in that coastal processes are, for the most part, unaffected by human occupation. The coastline is an accretional feature and Gibb (1978) reported that between 171 and 195 metres of accretion occurred during the 100-yr period prior to 1975. Nevertheless, erosion cycles do occur from time to time, and Marine Parade (Fig 3.7), and along the north end of Manly Street, are current examples of this. Wind erosion can also be a problem, and blowouts do occur (Fig 3.8).

Modelling suggests erosion potentials of up to 50 metres and 91 metres for 50-yr and 100-yr return periods, respectively. In view of the long-term accretional nature of the coastline, coupled with Council policy of utilising modern coastal management practices, a coastal hazard management area width of 50 metres is considered appropriate. It is recommended that both the PDS and the SDS should each be 25 metres.

Note that, where the seaward property boundary lies landward of the PDS, the present 3 metre (inside the seaward boundary of the property) building restriction would be retained.



Fig 3.8: Wind Blowout at Paraparaumu

6 CHMA-6: Waikanae to Peka Peka, and CHMA-7: Peka Peka to Otaki

Although the foreshore along the coastline north of the Waikanae River mouth is not an accretional feature to the same extent as the headland at Paraparaumu, a similar approach should be taken to managing erosion risks at Coastal Hazard Management Areas 6 and 7 (Figs 3.9 and 3.10).

In the urban areas of the coastline, a 50 metre wide hazard area is recommended (with both the PDS and the SDS each being 25 m wide), except at Peka Peka where it would be prudent to retain the current 70 metre wide building restriction for aesthetic reasons. Consideration should be given to creating a 100 metre wide Primary Development Setback, for the same reasons, along all rural coastlines, and requiring the 50 metre CHMA, with a PDS of 25 metres and an SDS also of 25 metres, where there is urban development.

Note that, at Waikanae and at Te Horo there is an existing 7.5 metre building restriction (inside the seaward boundary of the property) and this would be retained where it lies landward of the proposed PDS.



Fig 3.9: Shoreline at Peka Peka



Fig 3.10: Gravel Beach at Otaki

3.7 References

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4 Tsunami Risk

Tsunami risk in New Zealand has, in the past, tended to be associated with the east coast, such events originating from earthquakes in the Pacific region. More recently it has become clear that there is also significant risk to the west coast of New Zealand from nearshore earthquakes. This section discusses this risk as it applies to the Kapiti coast.

4.1 Introduction

A recent report to Wellington Regional Council (GeoEnvironmental Consultants, 2001) suggested that, contrary to general opinion, the west coast of the Wellington region is a relatively high tsunami risk area. The report noted that, off the Horowhenua coast, prominent faults have been identified, associated with a zone of faulting that extends off-shore from Kapiti Island to onshore Manawatu. Because of this, the west coast of Wellington should be considered to be potentially at risk from a locally generated tsunami (the most hazardous distant sources lie to the east of New Zealand).

According to the WRC report, the return period for waves higher than 10 m is about one in 400 years. This, and the characteristics of the likely tsunami waves, has serious implications for the Kapiti coast, all urban areas along the west coast being at relatively high risk from inundation.

The authors argued that some mitigation measures fall within the Regional Council's jurisdiction and they noted that three types of approaches can be used:

- Policy and management measures that reduce the likelihood of damage.
- Preparedness and response planning to deal with consequences of an event.
- Engineering design measures that reduce vulnerability.

Because of the concerns raised in the WRC report, GeoEnvironmental Consultants were asked to report in more detail on the tsunami risk along the Kapiti coast. The relevant text from the tsunami report follows and the reader is referred to the full report included in the Appendices (Volume II) for further details, including various references to statements included in the text, and illustrations.



The objectives of the brief were to:

- To assess the frequency and impact of different sized tsunami along the Kapiti District.
- To include descriptions of the likely effects, warning times, and potential run-up heights for different sized tsunami along the Kapiti Coast, with particular attention given to the District's waterways.

As part of the process, an assessment was made of the uncertainties in the available information, and of the gaps that exist in the current knowledge. Some recommendations as to how best these gaps and uncertainties can be addressed in the future, were included

4.2 Tsunami Hazard

The initial measure of potential tsunami hazard is the run-up. This is the height of the tsunami above a specified datum, which is normally the tidal elevation at the time of the tsunami. The maximum potential run-up provides an indication of the hazard. The higher the run-up, the greater the hazard. However, the maximum elevation of run-up is also dependent upon the sea level at the time of inundation.

When a wave comes onshore, it is normally as a non-breaking wave, or rapidly rising tide, forming bores only within rivers and estuaries. While breaking waves and their associated turbulence are more damaging, the run-up and backwash associated with non-breaking waves induces strong currents that are extremely destructive and life-threatening. The backwash is equally or more destructive and life-threatening because the water may contain an assortment of loose debris ranging from houses to small artifacts.

The run-up is often fast-moving and sediment laden, and causes death and injury by sandblasting, crushing (against more resistant objects such as trees and buildings), and dismemberment. On the other hand, the backwash is generally associated with drowning as people are swept into deep water by the return flow and injured by floating debris.

The effects of tsunami in estuaries and rivers are two-fold. Firstly, they can generate rapid changes in water level, inducing strong currents, eddies and seiches that break moorings, scour and redeposit sediment, erode supports from road and rail bridges, undercut and overtop banks. Secondly, tsunami can form bores. These are particularly destructive because they are generally at their strongest at the upper limit of the tidal



influence where the opposing currents of river and sea may result in the greatest steepness of wave.

Tsunami inundation also introduces saltwater into the coastal area. The effects on coastal farmlands are unknown but they are probably dependent upon the salt tolerance of individual plants. In the case of monoculture farming or forestry, the effects could be catastrophic.

4.3 Potential Tsunami Sources

There are two source areas of tsunami generation that have the ability to affect the Kapiti Coast; distant and local. Distantly-generated tsunami are generated beyond the New Zealand continental shelf and have long wave periods, persist for several days, and can affect most of the New Zealand coast. Locally-generated tsunami are generated on or from the New Zealand continental shelf, have shorter periods, do not last long, affect a limited section of the coast, but are likely to have localised peak run-up heights well in excess of any distantly-generated tsunami.

Distantly-generated tsunami have occurred more frequently in our historical database than their locally-generated counterparts, but they tend to be of lower magnitude. Parts of North America such as Alaska and Oregon represent moderate to high hazard areas, whereas the west coast of South America is a high hazard area for tsunami inundation in New Zealand.

While locally-generated tsunami are less common in the historical record they currently comprise all the tsunami recorded in the prehistoric and pre-human record. Historically, terrestrial and probably submarine landslides occurred during the 1855AD earthquake, although their precise contribution to tsunami propagation is unclear, the 1855AD tsunami reached 2-3 m in height along parts of the Kapiti Coast.

Earthquake-generated tsunami (possibly in association with landslides) are undoubtedly a hazard for the Kapiti Coast. The Hikurangi Margin represents the active plate boundary between the Australian (western) and Pacific (eastern) plates. This is a broad zone of active faulting more than 200 km wide from approximately 100 km east of the Wairarapa coast (the Hikurangi Trough) to D'Urville Island. Therefore, there are many active faults that have the potential to generated tsunami; some are fully submarine, others partially so. South Island faults also have a bearing on tsunami hazards for the Kapiti Coast. The Wairau Fault extends offshore from the Kapiti coast about as far as the Manawatu River, but there are numerous additional faults to the west of Kapiti Island that are currently under investigation. Furthermore, the Alpine



Fault and several others were responsible for generating a c. mid 15th Century tsunami that affected the whole of the New Zealand coastline. The estimated recurrence interval for such clusters of large earthquakes and associated tsunami affecting the Nation's coastline was tentatively put at about once every 500 years.

4.4 Warning Times and Frequency

Warning Times

Warning times for tsunami vary depending upon their sources, local or distant. With regards to distant tsunami sources, these can be broken down into the areas most likely to generate tsunami that may prove to be of a hazard to New Zealand and as such, the Kapiti Coast. There are some areas where a zero to minimal hazard applies. These areas are not considered further but are listed for reference purposes (*No hazard*: Hawaii, New Guinea, Solomon Islands, Indonesia, The Philippines, Antarctica, and Central America; *Minimal hazard*: Kamchatka, Japan, Kuril Islands, South Pacific Islands, New Zealand's Exclusive Economic Zone beyond the continental shelf).

Moderate to extreme hazard source areas include parts of North America (Alaska to Oregon – 1 historical event in 1946) and the west coast of South America. The latter being the source for most of the historically documented events reported (4). In both cases there are long warning times of at least 12 to 17 hours. Although the resulting wave was small, the recent Peru tsunami sourced from a large earthquake off the coast of Peru on 23rd June 2001 arrived at New Zealand's east coast 16.5 hours after generation, having travelled approximately 8000 km across the Pacific Ocean at about 500 km per hour.

Locally sourced tsunami generated by either landslide or fault rupture will have considerably less warning time. The only locally-generated event to have occurred in historic time was the 1855AD tsunami. This was generated by rupture of the Wairarapa Fault in Palliser Bay. The time taken from fault rupture (and/or landslide) to tsunami inundation will be extremely variable depending upon the specific source. However, in general terms the main local faults of concern are the Alpine, Ohariu, Shepherd's Gully/Pukerua, Wairarapa, Wairau and Wellington, although there are clearly many other faults for which little or no data are available. If one assumes an average tsunami speed of about 500 km per hour, most tsunami generated by local fault ruptures would arrive within a matter of minutes.



There would not be any effective warning time for the public. The requirement from the Council's perspective would be to ensure that the public were suitably "tsunami-aware" in order to be able to take care of themselves. It is worth reiterating that locally-generated tsunami are normally larger than their distantly-generated counterparts. Therefore when a large earthquake is felt, it is the immediate saving of life as opposed to property that is essential.

It is improbable that locally and distantly-generated tsunami would occur at the same time. However, it is highly likely that a tsunami generated by a local fault rupture could caused local landsliding (sub-aerial or submarine) which may either follow or amplify the existing tsunami. Therefore, to the extent that it is possible to do so, the public should understand the need to move inland and/or uphill immediately after a large earthquake, and to stay there for at least an hour, or until advised that it is safe to return.

Frequency

Allowing for incompleteness in available records it is probably fair to say that the frequency, or return period, for small (0-1.0 m) events is underestimated and is probably closer to once every 20 years or so. Equally, it is possible that medium-sized events are underestimated, although this is less likely. However, there are few reports for the Kapiti Coast for historically-documented accounts and thus estimates of wave height have been made. It is likely that one or more of the distantly-generated events exceeded 1.0 m making the frequency once every 70 years or so. The palaeo record is undoubtedly incomplete and estimates for large tsunami must be viewed as a minimum. Recent reconnaissance work for this report identified several sites that require further investigation in the Kapiti District and these are discussed in more detail below since they are of importance to run-up and impact.

Acknowledging that these frequencies (return periods) are a minimum, they are useful as a guide until further work can be completed. It is likely that there is more potential (see below) for progress to be made in the immediate future by adding to the palaeo record, particularly since this tends to record events 5 m or more in height. At present, the return period of once every 400 years is of concern to the construction of buildings at or near the coast.

A combination of (*the incomplete*) palaeo and historical data would give no useful frequency data, but a comparison between 0-5.0 m waves (small and medium tsunami from the historical data) and >5.0 m waves (large tsunami from the palaeo data) is instructive.

- Historical data - Six 0-5.0 m tsunami recorded since 1855AD:
Return period = once every 24 years



- Palaeo data - Five >5.0 m tsunami identified in 2000 years:
Return period = once every 400 years

4.5 Impact And Run-up

Impact and run-up vary with every tsunami and it is therefore difficult to generalise.

There are several points to note:

- Run-up height is relative to the sea level at the time of inundation.
- Run-up is highly dependent upon nearshore bathymetry and onshore topography.
- Run-up AND backwash are both hazardous.
- At velocities up to 70 km per hour the damage and destruction can be enormous.

Tsunami may not necessarily overtop coastal dunes, but they can penetrate inland by running up waterways and low points, often scouring channels and eroding banks, causing the subsequent destabilisation of dunes and riparian land. Furthermore, they could penetrate behind dunes, inundating low-lying areas. Larger tsunami will not only be able to penetrate further inland in between the dune ridges, but will also overtop seaward dunes scouring their surfaces. Material entrained as a result of tsunami inundation is either carried inland near to the maximum run-up height forming a “high tide mark” or is also incorporated in the high-energy backwash causing more crushing injuries and fatalities, and inflicting considerable damage to structures and infrastructure.

A small (0-1.0 m) tsunami coming onshore at low tide will most likely have no impact since it will “inundate” nothing more than the normal tidal range. However, people need to be cautioned against entering the sea when the negative waves, or trough, arrive since strong currents may be generated. The rapid drawdown of water will expose areas of foreshore, but water will also rapidly advance when the positive wave arrives. Furthermore, the energy and momentum of the waves will most likely be extremely high and depending upon tidal and sea conditions at the time can cause run-up beyond the normal high tide range. It is difficult to generalise about specific run-up heights, but the best “rule of thumb” is to suggest that a 1 m high wave can run-up to an elevation of 1 masl, in other words the wave height represents the elevation it will inundate inland. However, much depends upon tidal and meteorological conditions, and topographic variations both onshore and offshore, but for



planning purposes this provides a pragmatic benchmark. While it is acknowledged that wave run-up can be greater along waterways, the exact extent is also highly variable. It is suggested that the lower end of this scale, around 1 km, be considered a pragmatic “rule of thumb” for the majority of events although this will vary considerably.

A medium (1-5.0 m) tsunami can cause considerable damage that may be only partially offset by tidal conditions. In areas of the Kapiti Coast where dune and/or storm ridge height is less than 5.0 m there is cause for concern. The types of impact discussed above are likely, with scouring of dunes but also the entrainment of storm ridge material and the deposition of large quantities of debris (sediment, vegetation, any objects that can be easily transported, glass, wood, cars, building material, etc...). A considerable quantity of this debris may also block drains, enter sewage systems, and cover roads. Nearer the coast road, surfaces may be lifted, bridges may collapse or be structurally damaged as may nearshore houses, large objects such as cars and houses may be carried inland and impact other structures, water supplies may be contaminated, pipelines uplifted and broken, and telecommunication linkages disrupted.

The wave height range in this class is probably the most critical because it spans the height range of most nearshore morphology (dunes, storm ridges) that may serve to offer some protection. The potential penetration inland by running up waterways will be greater than for smaller events, and a 1km “rule of thumb” is suggested. Clearly any structures or land immediately adjacent to waterways will be at risk from inundation and/or destruction (partial or complete), but the effects of tsunami inundation should rapidly tail off away from the river channel. Whether or not waves overtop the coastal dunes, tsunami penetration inland along waterways has the potential to access low-lying land between dunes and spread out like a rapidly rising wall of water to inundate and destroy structures and land. The extent of possible damage is difficult to assess. However, if one assumes that water could inundate to a depth of 1-5 m (the wave height) above sea level up to about 1 km inland this gives an approximation of the likely area of damage. It is worth noting though that the extent of inland penetration of water is likely to diminish quite rapidly because dune topography and the built environment will provide considerable friction and reduce wave energy.

The need for detailed coastal and nearshore topography at a metre or sub-metre scale cannot be overstated since this will give an indication of the possible extent of damage that could be caused, and areas that are vulnerable to inundation. One area of concern for possible inundation by both small and medium tsunami is south of Paekakariki where both State Highway 1 and the railway are immediately adjacent to the coast. As key communication and transport links they are not only vital for day-to-day activities, but also in the event of a civil defence emergency.



Large tsunami (>5.0 m) are likely to both overtop coastal dunes and storm ridges and inundate areas further inland. Run-up along waterways could extend to 1 km inland or possibly further, and major scouring, erosion and deposition could occur within the first few hundred metres of the coast. It is probable that most buildings within this strip will be either completely or partially destroyed, blocking communication routes, hindering rescue and emergency services. Most, if not all, utilities will be compromised with loss of electricity, contamination of water supplies, damage to sewage systems, destruction of bridges, and significant loss of life.

The Kapiti Coast is low-lying and susceptible to tsunami inundation. While the inland extent and site-specific nature of tsunami inundation varies between events, the absence of a detailed coastal and nearshore topography hinders further interpretation. The full report in Volume II offers an approximate 10 m inundation contour (the current topography is only available at 20 m intervals) and provides an indication of run-up along the Waikanae River based purely upon elevation. Penetration to this distance inland is not anticipated, but it highlights the need for more detailed topographical analyses to be undertaken to provide better estimates of the inundation zone.

4.6 Brief Reconnaissance of The Kapiti Coast

Several points of interest were identified between just north of Otaki Beach to Te Horo Stream. At Waitohu Stream there was evidence of storm deposits up to 3 metres above mean sea level (masl) deposited behind the coastal dunes, within the stream mouth. These indicate the susceptibility of the waterways to channelling high-energy events, although it must be borne in mind that a tsunami of equal height would have considerably more momentum and energy than a 3 m storm surge. Furthermore, if a tsunami occurred at a time of elevated sea levels caused by storm surge, the damage would be considerable. It seems likely that a 1 m tsunami arriving at high tide would easily penetrate behind the dunes at this location and inundate some of the riparian properties of Otaki Beach. These properties lie adjacent to the Waitohu wetland which is one of only a few locations along the Kapiti Coast that has the potential to record evidence of past tsunami inundations. It is recommended that KCDC urgently consider financially and/or logistically supporting (or seek funding from other sources) the geological investigation of these wetland sediments. It should be noted that other sites are mentioned below, and these should form part of an overall strategy to ascertain the past record of tsunami inundation in the District.



At Te Horo Beach, the storm beach is approximately 2+ masl. Photographic and survey evidence indicates that many properties within a few hundred metres of the beach are occupying ground that is lower than the storm ridge. While storm surge inundation is most likely rare, even a small to moderate tsunami such as the 1855AD event is likely to overtop the ridge and inundate nearshore properties and infrastructure. The adjacent Mangaone Stream will provide a suitable conduit for tsunami penetration inland with the possible inundation of new properties built on lower lying dunes on the landward side of Te Horo. It is recommended that wetlands on the landward side of Te Horo are considered for incorporation in a geological study of past tsunami inundation in conjunction with those of the Waitohu wetland.

The 900 year-old shoreline was identified further south at Pukenuamu, indicating that records from the Te Horo and Waitohu wetlands are probably only likely to provide evidence of events that have occurred over the past few hundred years. Investigation of a sand dune blowout approx. 3 masl and 500 m inland revealed a site containing marine shells, pumice and marine pebbles. It is possible that such deposits have previously been misinterpreted as midden sites because of the large number of marine shells, but the presence of pumice and marine pebbles indicates deposition from a high-energy event. While no dating or further research was carried out on this site, the locations of known midden sites from the Historical database have been included for reference purposes. In the context of assessing the tsunami hazard for the Kapiti Coast, the need for careful and correct interpretation of such sites (midden or otherwise) cannot be overstated.

Reconnaissance of the section of coast from Peka Peka to Whareroa Stream revealed that many areas had either been built over or structurally altered. This is unfortunate because it lies in the lee of Kapiti Island where tsunami resonance would be expected and covers the most built up areas of the District, namely Paraparaumu and Waikanae. However, reconnaissance indicates that it may be possible to produce a record of past tsunami by “bracketing” the area. It is recommended that a geological study be undertaken of wetlands near the oxidation ponds at the northern end of the section (between Peka Peka and northern Waikanae), and by examination of deposits in coastal dunes adjacent to the Whareroa Stream. There are numerous waterways along this stretch of coast, all of which are bounded by properties and coastal development. These include:

- Waimeha Stream
- Waikanae River
- Tikotu Creek



- Wharemauku Stream

The need for these studies is paramount because:

- i) There is ongoing development of potentially useful study sites at the northern end of this section.
- ii) Tsunami resonance can occur between Kapiti Island and the mainland.
- iii) There are several waterways along this section of coastline.
- iv) This is the most develop stretch of coast in the District.

Several shell, pumice and coarse sand units were identified in sand dune deposits to the south of Whareroa Stream. Again, there is the possibility that such deposits could be misinterpreted as middens, which they are not. Similarly, while they may be storm-deposited as opposed to tsunami-related, further analysis is needed to ensure correct interpretation. They are undoubtedly related to catastrophic, high-energy events. A brief reconnaissance revealed three such deposits. Further study in conjunction with coring of wetlands further inland from the site is recommended. Analysis of these wetlands, in conjunction with those discussed above, could provide a record of past tsunami inundation dating back several thousand years that can be compared with the existing work from Kapiti Island.

No further evidence was found to the south of Whareroa Stream either because of urban development, road construction, or a narrow coastal strip.

4.7 Gaps And Recommendations

Three key information gaps and recommendations can be identified:

- More palaeotsunami studies need to be undertaken at key sites. This is particularly important because of the decreasing number of sites from which suitable records might be obtained. Careful examination of coastal sites indicates that suitable coverage could be achieved by analysing:
 - i) Core samples from wetlands at Te Horo, Waitohu, near oxidation at northern Waikanae, and inland from Whareroa Stream.
 - ii) Deposits in coastal dunes adjacent to the Whareroa Stream, Pukenuamu, and other possible sites.



- iii) Possible midden sites - this could include all possible midden sites uncovered during site development work in the future.
- A detailed coastal and nearshore topography for the Kapiti Coast District is needed. This should be at 1.0 m intervals (preferably less) up to 30 masl and 30 metres below mean sea level (mbsl). Tidal limits should also be indicated. This would provide a base map to which residential, commercial, shoreline facilities/structures, service networks, and communication pathways could be added to provide an indication of areas most at risk. This would assist with decision-making processes for coastal development and for emergency management. An interim measure would be for a tsunami expert to walk the coastline and produce an inundation map of the estimated inundation zone along the coast based upon their geomorphological experience.
- An inundation map is needed to provide the template for an evacuation route map. The evacuation route map is would provide one source of education material for the public.
- There is a need for increased tsunami awareness within the community. Historical, palaeo and modelling data all indicate that the area has a reasonably high tsunami hazard and this needs to be understood by both the general public and local authority.



5 Consultation

This section provides an outline of the consultation process and the community's feedback to the issues and response to some of the preliminary recommendations. The assessment is in two parts: (1) an outline of the consultation process, and (2) a summary of the main issues and concerns raised by the community during the consultation process.

5.1 The Process

Consultation with the community and with key stakeholders has been a critical part of the development of the Hazard Management Strategy through the different stages of its formulation to date, namely:

- during the initial **information gathering** phase;
- as part of the **assessment of risks** and other erosion management issues; and
- in obtaining feedback to the **preliminary findings** on erosion management.

It is intended to continue to consult with the community in the further development of the strategy leading up to its finalisation, including:

- in regard to the proposals in the **draft strategy**;
- as part of the development of **any changes to the District Plan** needed to implement the Strategy; and
- as part of the **Annual Planning process** for funding of coastal erosion management initiatives.

This section sets out an outline of the consultation process undertaken to date, and summarises the main issues, ideas and concerns of stakeholders and the community that have been raised.

5.2 Consultation Process

1 Stakeholders

A number of groups and organisations were identified as being key stakeholders in the District's coastal management. At the commencement of the study, the stakeholders were informed about the aims of the project and invited to meet with consultants to discuss relevant matters and provide input. The results of feedback to date include the following:

- **Iwi** - Ngati Raukawa emphasised the importance of kaimoana, and highlighted the need to identify any impact of coastal erosion management on kaimoana resources. Other iwi reserved comment until the draft strategy is released.
- **Wellington Regional Council** - several meetings have been held between the project team and the Wellington Regional Council. The Council supports the aim of the strategy, and will have an input into the draft strategy once completed.
- **Department of Conservation** – The project team have met with the Department on two occasions, with the Department responding by letter on 4 December 2001. The Department of Conservation's primary interest in the study is to ensure that the character of the coastline is maintained and that where works are required, the technique selected is the best practicable option.
- **New Zealand Historic Places Trust** – The Trust has raised no specific issues to date, except to bring attention to the need to notify archaeological sites along the coast that may be identified during any physical earthworks.

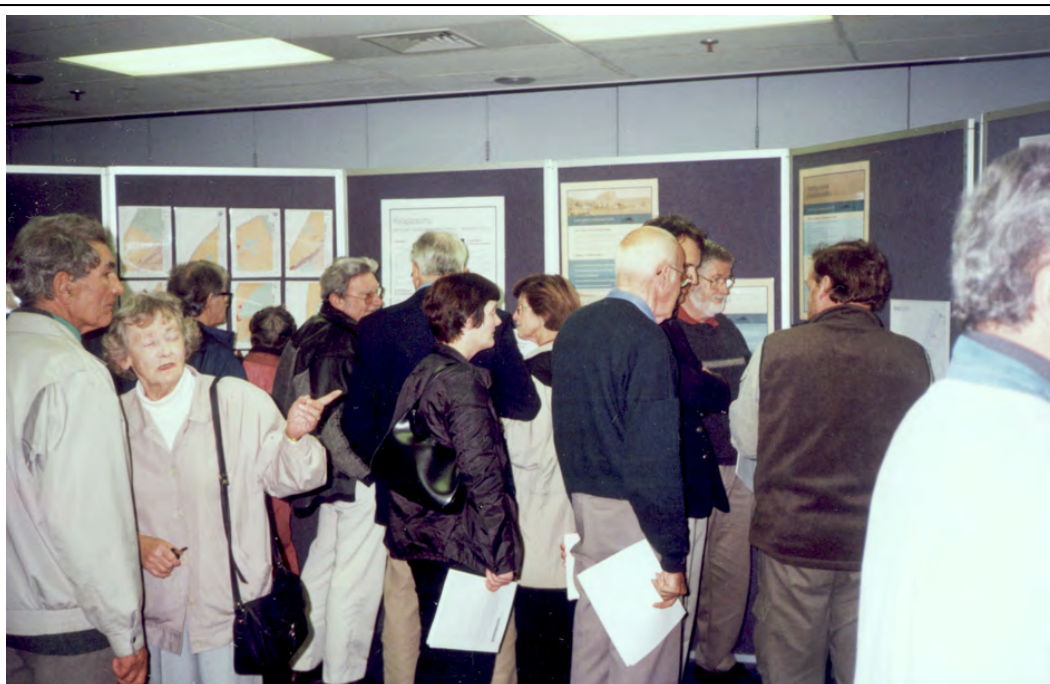
2 Kapiti Coast Community

The focus of consultation with the Kapiti Coast community to date has been on providing a range of opportunities for residents, property-owners and community groups to give feedback and information, not only on the issues associated with coastal erosion, but also on ideas and comments on erosion control methods. While property-owners and residents living in the immediate vicinity of the coastal margin were contacted directly, the consultation process has been open to anyone in the community to contribute.

The considerable level of interest received so far indicates the importance of coastal erosion to residents, not only in areas where there is an historic or current erosion risk, but also along the entire coastline. The project team has appreciated the level of interest in the project and, particularly, the helpful nature of the feedback received.

The community consultation process has involved the following:

- **Resident Mail-out** – property-owners and residents living in the immediate vicinity of the coastline received a letter regarding the project and an invitation to become involved in the preliminary draft management strategy. The letter provided a background to the study, and details of the community display days and public meetings.
- **Media Release** - A media release about coastal erosion issues and the strategy was printed in local newspapers in October/November 2001. The item also set out the process for consultation and the ways people could provide input, including written submissions.



Residents at one of the Display Days, 11 to 16 November 2001.

- **Display Days** - Six public displays were held from 11-16 November at venues in Waikanae, Paekakariki, Paraparaumu, Otaihangā, Otaki and Raumati. The displays provided background information about coastal erosion, focusing on the particular area in which the venue was located. They also set out preliminary options and recommendations for coastal erosion management (see photograph). Attending residents were provided with submission forms, on which a series of questions were set out.
- **Public Meetings** – three public meetings were held on three consecutive evenings from 26–28 November, in venues at Waikanae, Paraparaumu, and Paekakariki. These meetings provided the opportunity for residents to hear about the preliminary findings of the study, and to discuss their concerns with the project team. Comments were recorded. Residents were also invited to submit written submissions.

5.3 Community Feedback

A total of 95 submissions were received in response to the first round of consultation on the coastal erosion management strategy, with those areas facing the most pressing erosion issues providing the largest numbers of submissions:

Table 1: Source of Submissions

Paekakariki	16
South Raumati	26
North Raumati	6
Paraparaumu	17
Waikanae to Peka Peka	11
Peka Peka to Otaki	7
Unspecified or multiple areas	12

1 General Comments on Preliminary Management Strategy

Submitters were asked if they supported the preliminary management recommendations made for that part of the coast in which they had an interest.

Exactly half of the total submissions stated support for the preliminary management recommendations, while 28% did not support the preliminary management recommendations (22% did not indicate a view). Table 2 sets out the levels of support from each of the coastal management areas. The only area in which most respondents expressed opposition to the preliminary recommendations was Paraparaumu, and, drawing on comments expressed during display days and public meetings, this opposition is most likely based on a perception by many residents with property on the seafront that not enough has been done, and that more urgent action is required than that apparent from the preliminary strategy. It is noted that no specific consultation exercise was undertaken with respect to QE park. Rather the owner of the park, being Wellington Regional Council, was consulted.

Table 2: Response to Preliminary Strategy	<i>Response (percentage of submissions from each area)</i>		
	<i>Yes</i>	<i>No</i>	<i>No response</i>
<i>Coastal Management Area</i>			
<i>Paekakariki</i>	56	31	13
<i>South Raumati</i>	52	32	16
<i>North Raumati</i>	50	33	17
<i>Paraparaumu</i>	29	53	18
<i>Waikanae to Peka Peka</i>	82	0	18
<i>Peka Peka to Otaki</i>	43	14	43
<i>Unspecified or multiple areas</i>	33	25	42
<i>Total</i>	50	28	22

Two-thirds of submitters (63%) said that a “do nothing” approach was not supported, and that immediate action is necessary to prevent further degradation and continued uncertainty and risks. The remaining third preferred the status quo in terms of maintaining the current level of protection. However, whatever their preference, many submitters wanted the Council to commit itself to improved management of the coastal area in the future.

Residents identified the following matters as important issues to address as part of managing the risks from erosion:

- Recognising the coast is an *asset to the wider district* and region;
- The protection and preservation of *public access* to the coast, balanced with private rights (for example, privacy);
- Ensuring a *co-ordinated approach* to erosion management, between beachfront landowners, ratepayers and councils (regional and district).

Table 3 sets out the support for the main erosion control methods that were outlined in the preliminary strategy: wooden seawalls, rock revetments or beach renourishment.

Table 3: Support for Erosion Control Methods	Erosion control methods					
	Wooden Seawall		Rock Revetments		Beach Renourishment	
	Yes	No	Yes	No	Yes	No
Paekakariki	31		19	25	13	25
South Raumati	36	4	24		32	16
North Raumati	17				33	33
Paraparaumu	18	12	6	6	29	18
Waikanae to Peka Peka		9			27	
Peka Peka to Otaki						14
Unspecified or multiple areas	25		17		8	17
Percentage of total comments made	25	5	13	6	28	24

(Percentage of submitters who commented on particular method)

Common comments made by submitters included:

- Support for methods to accelerate sand accretion, such as planting and driftwood.
- Concern over effect of 'hard structures' on erosion processes.
- Need for a prohibition/restriction of vehicles on beach area.

- Need immediate resolution of issues relating to Old Coach Road.

In terms of funding, many submitters considered that ratepayers at large should make a contribution to erosion management given the asset of the beach to the wider community. A smaller number considered the region should make some contribution, for similar reasons. Many submitters wanted more information on the benefits and costs of erosion management options.

5.4 Paekakariki Coastal Management Area

Sixteen submissions were received from the Paekakariki area.

The preliminary draft strategy proposed maintaining and extending the seawall, and regulatory changes.

Over half supported the preliminary recommendations for erosion management in this part of the coastline, while a third opposed the proposals. The main issues were the need to retain public access to the beach and the reduction of available beach area.

Many submitters stated that they do not want to see the area of beachfront being reduced in order to accommodate erosion protection measures. The responses varied with respect to whether rock revetments or wooden seawalls were the preferred method of protection. Proponents of a tiered seawall believed that such an approach would allow people to move freely between the beach and the road; that the platforms would naturally collect sand and would also provide spaces to develop natural dune vegetation.

Comments were submitted with respect to reducing the width of The Parade roadway, which would provide extra space for protection measures and for recreation and dune formation.

Some submissions were concerned about the negative effect that hard structures would have on the beachfront by accelerating erosion processes. It was identified that the ends of seawalls create a similar effect, by scouring around the corners and behind the walls. It was requested that measures be taken to prevent such effects.

The use of beach renourishment was generally not seen as a viable option within the community.



The issue of funding attracted a variety of responses with respect to who pays.

Individual responses were received concerning; opposing the importation of sand from the Tasman sea; requesting the extension of the existing seawall along to the surf club; the creation of an artificial reef formed by sinking ships out from the beach; and the use of groynes as an erosion protection method.

5.5 Raumati South Coastal Management Area

A total of twenty-five submissions were received in regard to the Raumati South Coastal Hazard Management Area, the most from any area, an indication of the recent and ongoing erosion issues along this stretch of coastline.

About half of all submitters agreed with the preliminary recommendations for this area of coastline (being the upgrade of the seawall and raising of height to 2m, regulatory changes, emergency response and owner and resident agreement). Most submitters urged prompt and effective action to reduce the risks of erosion along this section of coastline. Only a small number of submitters requested a continuance of the status quo.

The principal concern for submitters, even for many in support of the proposal, was the proposed increased height and width of the existing seawall/rock revetment. For those opposing the recommendations, the main concerns were the potential reduction in private and public access to the beach, reduced aesthetic values, reduced privacy for beachfront properties, and the cost to ratepayers and property-owners. Some concern was also expressed that a higher seawall would “block in” lower-lying properties, with adverse effects on views, visual amenity, and safety (in regard to flooding and emergency responses).

Some submitters suggested that a walkway should be formalised along the top of the wall as a necessary compensation for the reduced width of the beach as a result of a widened rock revetment.

However, there was support for improving the existing seawall through the use of a widened rock revetment at its base, provided it was maintained.



The funding of protection works was a critical issue, and most property-owners along the beach considered that ratepayers had a major role to play given the importance of the beach as a District-wide asset. Some submitters stated that detailed information regarding cost-sharing options was needed before a decision could be made.

Some submitters urged a commitment to the continued maintenance of the seawall by the District Council.

A number of submitters recommended the use of secondary seawalls (at a higher level, and separate to the primary wall), including one suggestion that secondary seawalls be a compulsory requirement for beachfront properties, subject to standards relating to construction and maintenance.

In regard to beach renourishment, both submissions in support and opposition were received, with those in support noting the benefit of restoration to the amenity value of the beach, and those in opposition questioning the viability.

In regard to present and future management of the coastal area, other points raised by submitters referred to the need for a co-ordinated approach between landowners and the council; development of an emergency response plan; address end wall erosion issues; consider the use of an artificial reef, or rock groynes along the existing wall; resolve the Old Coach Road issue; retain the no build zone for aesthetic reasons; and suggest an annual assessment similar to the Waikanae River annual walk with KCDC that local residents take part in.

5.6 Raumati North Coastal Management Area

A total of six submissions were received in regard to the Raumati North Coastal Hazard Management Area; half of these were in support of the preliminary draft strategy (being monitoring, beach care, and building restrictions).

Half of the submitters were in support of a higher level of protection for erosion within the Raumati North Coastal Hazard Management Area. One submitter did not see a need for higher protection in this area at this place in time and the other submitters did not comment on this issue.



The main issue was in regard to the erosion management practices used by residents and encouraged by the Council. Some submissions supported relocating or retaining large driftwood on the beach to encourage sand accumulation in order to protect residential and public land from erosion. Submissions also suggested increased planting along dunes to increase stabilization and encourage sand accumulation.

One submitter supported beach renourishment as a positive action in regard to the ecosystem, aesthetic values and further protection of sand dunes. Another submitter requested trials before offering support. Two submitters opposed renourishment due to the likelihood of work being undone by a high tide. The suggestion of foredune maximizing was made as an alternative.

One submitter has observed the beginning of a spit forming to the southeast of Paraparaumu, and possibly along the stretch of beach in front of Wharemauku Road. This may explain the relative stability of the fore dune in this area.

Other points raised in submissions included: identification of at-risk areas; request for more information on the sand budget; restrict access (including vehicular access) on beach; maintain zoning restrictions; undertake dredging of sand; Councils should provide technical advice and encouragement on coastal erosion management and use their own resources; introduction of groynes; resolve Old Coach Road issue; and educate school children of the environmental consequences of playing on sand dunes.

5.7 Paraparaumu Coastal Management Area

A total of 17 submissions were received from this area. The draft preliminary strategy proposed beach renourishment, monitoring, beach care, avoid use of seawalls, and reassessment of building restrictions.

While a third of the submitters indicated support for the preliminary draft strategy for the Paraparaumu Coastal Hazard Management Area, just over a half (53%) of submissions were not 'happy' with the preliminary management recommendations. Some of the reasons for opposing the preliminary draft strategy were:

- The draft strategy was considered too simplistic, in that it did not recognize the four different situations within



Paraparumu being: Marine Parade North (erosion), Manly Street South (accretion), Manly Street North (erosion) and Waikanae River (significant 'control' factors).

- The taking of sand from behind Manly Street and placing it at Marine Parade, which is then taken by the tide, has deprived the beachfront of the necessary sand needed here.
- There is a need for a more precise risk assessment to be completed before a full strategy can be prepared.
- There is a need to reassess building restrictions, such as the relocatable zone.

Submissions in support of the strategy stated that there was agreement for beach renourishment as a preferred option compared to seawalls, provided that suitable sources are identified and that the sand is not moved from one part of the beach to another.

A common issue was the potential use of beach renourishment through importing sand onto the Paraparumu coastline from other areas. Submitters were fairly evenly divided in regard to this issue. Some supported renourishment especially as an alternative to seawalls. However, other submitters opposed it as they considered that experience indicates a probable lack of success caused by high tides removing large volumes of the imported sand.

In general, submitters were opposed to seawall type structures due to the accelerating effects that 'hard' structures have on erosion processes, especially the effects caused by wall ends. This issue was also raised in regard to stormwater pipes crossing the beach.

Two submitters supported the 'do nothing' approach, allowing nature to take its course and hoping for increased accretion cycles.

Half of the Paraparumu submitters wanted a higher level of erosion protection and half of these submitters supported the relating rate increase, seeing it as the responsibility of the whole community. Other submitters felt that rates were already high enough and some felt that the cost of protection was a regional issue.

Almost all submitters commented on the Waikanae river mouth management, the main theme of their comments was that increased information in regard to the impact the cutting of the river mouth



has on sand movement must be provided before decisions are made. Some submitters stated that the management of the river and bar is a crucial factor in regard to erosion at Manly Street North and Marine Parade. Submitters commented that allowing the river to drift so far south interferes with the beach's ability to raise itself, therefore the beach remains in a low state, with the sea hitting the dunes, leading to erosion. Some submitters also said that dredging the river reduces natural beach renourishment processes. One submitter stated that they were pleased to see the river mouth being diverted.

Many submissions indicated support for increased beach monitoring and beach care groups if the District Council provided the necessary assistance.

Other options/comments raised by individual submitters concerned: looking at overseas experiences, particularly Zeeland; re-instate bylaws preventing removal of large logs from the beach, improve stormwater drainage; introduce a wave break offshore; undertake dune planting; restrict activities on the dunes; create accessways between boulders; restrict sand removal; provide signage of quicksand areas; improve relationship between the council and ratepayers/landowners; and a query as to the effect the sizeable forests north of Kapiti are having on sand flow.

5.8 Waikanae to Peka Peka Coastal Management Area

There were 11 submissions received in regard to this area.

There was a large measure of support for the recommendations in the preliminary strategy (being building restrictions, monitoring, avoidance of hard structures, dune rehabilitation, and beach care). 82% of submitters supported the proposals, and no submitters opposed the strategy (the remaining 18% did not answer). The comments in support indicated that submitters commended positive action being taken to prevent erosion and that the recommendations reflect recent experience of an erosion event (1976) and subsequent natural replenishment since which has substantially rebuilt lost dunes. One submitter commented that the proposed controls on residences might need further debate.



Two thirds of submitters supported an increase in the level of erosion protection in their area. One third of submitters supported the resulting increase in rates and another third saw the funding as the responsibility of beachfront property owners. A couple of submitters indicated support for the status quo.

One submitter supported beach renourishment as a first line of action due to environmental reasons. Another submitter commented that this could be done naturally through management of dunes and of the river mouth. Submitters requested the Wellington Regional Council prove that it is not compounding dune erosion through cutting the river mouth and some argued that river diversion was simply moving the problem north.

Observations were made that the sand dunes at the Waimeha Stream estuary are bigger now than 35 years ago and that the dunes in front of Tutere Street have also increased over the last 3-4 years.

Further comments were made regarding: the need for tighter control of the Waikanae River; need for a management plan incorporating restrictions on vehicles along the beach, undertake planting and light fencing, promote education, and driftwood retention; undertake monitoring; leave nature to take its own course; address effects of hard structures such as boat ramps and stormwater pipes; opposition to seawalls and other hard structures; restrict new buildings; and concerns about beachfront residents dumping garden rubbish onto the dunes.

5.9 Peka Peka to Otaki Coastal Management Area

There were a total of seven submissions received for this area.

The preliminary management recommendation included building restrictions, monitoring, avoidance of hard structures, dune rehabilitation, and beach care.

Just under half of the submitters did not indicate support or otherwise for the preliminary management recommendations for their area. One submitter stated they were not happy with the draft management strategy while the remaining submitters indicated their support. One supporting submitter added that the Otaki area also needs active management.

Only two submitters responded in regard to the need for higher erosion protection in their area and both stated that this was not necessary.

Submissions in relation to possible extensions of stormwater pipes at Otaki commented that the pipes are in poor condition, are constantly blocked by sand and pollution, and are exposed due to winds and high tide and that the current pipe system is inadequate. It was suggested that they be removed altogether and stormwater be drained to land based sumps. One submitter highlighted the problem of the stormwater outlet in front of the Otaki surf club stating that it needed urgent diversion as it is aesthetically unacceptable in addition to the health problems it could cause in a heavily used recreational area.

Other points, suggestions and comments from submitters included references to: undertake education on appropriate recreational use; adopt and enforce stricter controls on vehicles on the beach and replace pole barriers; remove pollution from, and divert stormwater drains; address health issues arising from beach pollution; need for pedestrian access from car parks to the beach; undertake planting, ensure monitoring; retain restrictions on hard structures within 20-30 metres of high tide; let nature take its course; consult with the community; implement a beach care programme; and avoid taking sand from below high tide mark to increase dunes.

5.10 Preliminary Strategy Consultation Summary

ISSUES RAISED THROUGH SUBMISSIONS:	KAPITI COAST AREA SUBMISSION RELATES TO:						
	Paekakariki	Raumati South	Raumati North	Paraparaumu	Waikanae to Peka Peka	Peka Peka to Otaki	Unspec or multiple area
'Do nothing' option not supported							
Protection of means and right to access beach							
Protection works must consider amenity values and natural character.							
Support protection along north end of The Parade							
Support increased height and width of seawall							
Oppose increased height and width of seawall							
Support for creation of secondary seawall to create a tiered system							
Support new seawall to							

replace existing if financing options are explained							
Need for increased maintenance of rock revetments							
Support building rock revetments							
Oppose rock revetments due to rubble on beach							
Support for wooden seawall							
Opposed to wooden seawall							
Support beach renourishment							
Oppose beach renourishment							
Suggest use of groynes for coastal protection							
Suggest creation of artificial reef							
Concern for accelerated erosion effect caused by 'hard structures'							
Concern for end effects caused by seawalls							
Oppose moving of sand from one area to another							
Support dredging to replace sand							
Retain large driftwood on beach to encourage sand accumulation							
Encourage planting along dunes to encourage sand accumulation							
Ensure river mouth cutting and dredging is not having negative effect on beach							
Suggest reducing The Parade to one-way							
Reassess/remove 'relocatable buildings' zone							
Immediate and clear resolution of issues relating to Old Coach Road is necessary							
Prohibition/restriction of vehicles on beach to protect dune							
ISSUES RAISED THROUGH SUBMISSIONS:	Paekakariki	Raumati South	Raumati North	Paraparaumu	Waikanae to Peka Peka	Peka Peka to Otaki	Unspec or multiple area
Stormwater system requires repair, replacement or new design							
Protection of QEII park similar to residential areas							
Support creation of beach care programmes							
Increase public education of beach value and protection methods							
Co-ordinated approach between landowners and council							
Develop natural disaster response plans							
Request for cost and financing of all option to be explained/made available							
Support 'do nothing' approach - let nature take its course							

6 Hazard Management

In this section, the range of methods available to manage the risks from coastal hazards within Kapiti District are identified and assessed. The assessment is in two parts: (1) an overall assessment of the range of management methods to determine those methods that are generally suitable to the circumstances of the District, and (2) an assessment of the methods that are most appropriate to each of the coastal management zones.

6.1 Management Options

The importance of the coastline in New Zealand has been emphasised by the attention given to it in the Resource Management Act 1991. New Zealand, of course, has many important natural features – rivers, mountains, forests and so on – all of which should be accorded proper conservation values. Nevertheless, the coastline has been singled out for special attention under the Resource Management Act, in that it is subject to the only mandatory national policy statement to date.

The coastline is under increasing pressure for development, and land values along much of our coast have been steadily rising, putting pressure not only on its natural character but also on the levels of risks from coastal hazards. In addition, the potential effects of climate change are considered likely to have significant repercussions for the use and management of our coastline, increasing the uncertainties involved in an area already subject to variability.

Furthermore, the coastal environment is of traditional importance to Maori, to which due recognition must be given in preparing management policies under the Resource Management Act.

It is not surprising then, that the management of the coastline provides ongoing challenges for both regional and local authorities.

In the past, when considering a management response to coastal erosion, the most common response was often the use of engineering structures such as seawalls and groynes. With the benefit of hindsight and a greater understanding of coastal processes, it is apparent that such devices were not always used wisely. More recently, it has been realised that there are,



in fact, a suite of options that need to be considered and that there are a number of other, often preferable, solutions.

Modern coastal management practice demands that strategies for managing coastal erosion hazards must, as far as possible, be in sympathy with the prevailing natural processes, and hence the emergence of so called "soft" engineering solutions such as beach renourishment. But even this option can raise environmental concerns because of potential problems related to sand supply, impacts on marine life and the need for on-going maintenance.

Naturally, most people would prefer to see a sloping sandy dune at the back of an ample beach along the shoreline. Where the shoreline is eroding, however, such an ideal may not be feasible unless the underlying sediment deficit can be overcome, or the beach otherwise maintained through one of the "softer" solutions. In cases where protection of public or private assets is a priority and relocation is not practical, some form of structural solution may become necessary. In these circumstances, construction of a seawall, designed to protect the assets at risk will be the most commonly adopted solution. The value placed on the beach will be an important factor in this decision.

The economic value of beaches is discussed briefly in Section 3.1. It basically refers to the economic value that the beach brings to the community and, although not always recognised, it is nevertheless an important consideration when assessing appropriate methods of erosion control. But a beach will also have other values of a less monetary kind. There are many who will say that the nation's coastal areas are special places, providing such intangibles as human inspiration, spiritual renewal and irreplaceable recreational and educational opportunities. Beaches also provide important habitats for flora and fauna as well as being of special significance to *tangata whenua*. To protect these values, such issues as public access, amenity and maintenance of natural character are enshrined in the legislation.

1 Minimising Coastal Erosion Hazards

There are three primary management strategies that may be used to plan for and respond to coastal erosion: hazard avoidance, relocation, and coastal protection. The maximum potential efficacy and acceptability of these strategies can best be determined with multi-disciplinary project planning, design, monitoring and evaluation.

Hazard Avoidance – A Commonsense Approach

The most logical method for preventing potential damage to new public or private development in the coastal zone is to not build where coastal erosion will impact such development. This concept, referred to here as hazard avoidance, could circumvent many subsequent consenting and



legal challenges. Hazard avoidance has proven effective when used in a number of ways:

- Designing public infrastructure to discourage development in high natural hazard areas along the coast.
- Creating construction setbacks to reduce the risk to structures in the vicinity of coastal hazard areas that may be vulnerable to damage.
- Although not common in New Zealand, in some countries tax and other economic incentives are sometimes used to encourage potential developers to avoid building in areas where there is high natural hazard risk.
- Acquiring and conserving undeveloped coastal property in high hazard areas.

Relocation – Moving Development Out of Harm’s Way

All too often in New Zealand, and Kapiti is no exception, existing development is sited in unstable, erosion-prone areas that eventually may be damaged or destroyed by natural processes acting on the coast. In some cases, relocating existing public or private development away from erosion-prone areas may be the most effective long-term option when responding to the eventual or imminent threat of damage.

While relocating coastal development away from hazardous areas would be the most direct way to eliminate the risk of damage and the need for coastal protection, this response may not always be technically feasible or the most cost-effective alternative from the property owner's perspective. There is often little incentive for property owners to pursue this option since they are likely to have to fully finance the relocation of the structure. Conversely, if the structure is destroyed during a natural disaster, government or privately-held disaster insurance may assist to partially or fully cover reconstruction costs.

Another approach to consider under certain circumstances is the concept of “managed retreat”. This is the gradual relocation or removal of development from areas of high hazard risk. In the context of coastal management, the notion of managed retreat acknowledges the natural erosive processes at work along the coastline. Rather than working against nature by artificially fixing the position of the beach through construction of seawalls, etc., managed retreat advocates the use of many tools to allow development to move inland before erosion damage occurs. Managed retreat is not necessarily a policy of complete abandonment of the land, but is rather a policy of developing (or not developing) land to avoid situations in which public safety is jeopardized and natural processes are impeded.



Managed retreat may also mean different things at different places and a number of different physical, economic and planning tools can be used to implement managed retreat in different areas. The most effective use of managed retreat has been in areas where future problems have been anticipated and arrangements made in advance to move development from eroding bluffs, sand dunes and other high hazard areas. Tools for implementing managed retreat include:

- Relocateable structures.
- Construction setbacks to avoid risks posed by structures located close to, or within, areas where the coastal erosion risk is high.
- Rules in Plans that allow structures to be developed subject to conditions requiring their removal if necessary to allow for natural coastal processes.
- Creating tax and other incentives when viable, to encourage property owners in high-risk areas to relocate out of harm's way.
- Full hazard disclosure on property titles in high erosion hazard areas.
- Prohibitions against rebuilding damaged structures in high erosion hazard areas.
- Acquiring and conserving endangered or undeveloped property for conversion to public parkland.

Coastal Protection Strategies – Hard and Soft Methods

Relocation and hazard avoidance strategies address the effects of erosion on development, but do not address beach loss. In situations where hazard avoidance and relocation are not viable options, coastal protection strategies can be used to reduce the potential for beach loss and coastal erosion. There are two general types of coastal protection, hard and soft. So called “hard” protection usually involves structural works that utilises concrete or rock, and sometimes timber, in a variety of configurations to absorb or dissipate storm wave energy, generally in the form of seawalls, revetments or bulkheads. “Soft” protection primarily involves dune or beach restoration or enhancement to reduce the chances of storm waves reaching the backshore. A hard protection device differs substantially from most soft erosion response alternatives in that it does not add sand to the sediment system. As noted by the US National Research Council:

“No device, conventional or unconventional, creates sand in the surf zone. Any accumulation of sand produced by a structure is at the expense of an adjacent section of the shore. This fact



distinguishes structures and other devices from beach nourishment, which addresses the basic problem in coastal erosion—the shortage of sand” (US National Research Council 1995).

Soft Protection

Soft protection methods include a variety of non-structural approaches, the most common being beach nourishment. The width of beaches can be increased or maintained by depositing sand up or down the coast (depending on currents), directly on beaches, or in the nearshore waters offshore from beaches (beach nourishment).

The benefits derived from beach nourishment can be substantial. They include wide sandy beaches for recreation, wildlife habitat, and often backshore protection by reducing the impact of the ocean on the dune system. In many cases, investment in order to maintain beaches will help support revenues from recreation and tourism. Challenges associated with beach nourishment include initial installation and maintenance costs, finding suitable sand sources, difficulty in transporting and placing sand, the possibility of significant environmental effects, and sometimes complicated consent procedures.

Beach nourishment can be an effective tool but, nevertheless, it is one that will not always be technically, economically, or environmentally justified for all sites, especially those with high rates of beach erosion.

Other soft protection solutions include beach care programmes that focus on dune restoration or enhancement, planting and fencing, nearshore sand berm construction, and methods to reduce bluff failures by limiting the rates of groundwater infiltration and surface water runoff.

A technique known as ‘beach drainage’, originally developed in Denmark in the early 1980s, has recently been brought to the attention of local authorities in New Zealand. The method, which is reported to facilitate beach accretion and, therefore, improve coastal stability, consists of laying one or more drainage pipes beneath the beach surface and removing water to, in effect, lower the water table. Energy in the backwash is then lost due to increased infiltration. Providing the energy loss is sufficient to reduce the total energy of the surge to below that required for sediment transport, then sand deposition occurs. While the theory is sound, experience overseas has been mixed with success dependent on the type of beach and its exposure to storms, and also the robustness of the system.

Hard Protection

Constructing hard protection works has been, historically, the most common approach to reducing coastal erosion and protecting development. These devices can minimise wave attack and backshore erosion, and are often used to protect public infrastructure. The seawall



at Raumati, although not a particularly sound example, is a case in point. Although hard protection works have been relatively successful, they are usually expensive to construct and maintain.

Hard protection devices do have benefits, yet the potential adverse impacts of these structures can be substantial, including limiting public access to the shoreline, increasing erosion along adjacent areas, restricting sand input from armored dunes, reducing public beach area with a structural footprint, and disrupting the visual character of the coast. Additionally, protection devices are sometimes constructed on an emergency basis during intense storm activity without proper engineering or appropriate materials. This can lead to eventual failure of the protection works and may create subsequent public nuisances or hazards along the beach. Alternatively, it may lead to reliance on permanent protection works.

The potential adverse impacts of continuing to place hard protection devices along the coast have been well documented. For this reason, it is sensible to limit the use of hard protection devices to only those situations where there is no viable alternative (note: this approach is one of the policies contained within the New Zealand Coastal Policy Statement and applied through the Wellington Coastal Regional Plan—refer to Chapter 7).

The Resource Management Act (s.106) places restrictions on the ability of consent authorities to grant consent for new subdivision in areas likely to be subject to material damage by erosion, subsidence, slippage, or inundation from any source. Nevertheless, the Act does allow a subdivision consent to be granted if these effects can be avoided remedied or mitigated by rules in the district plan, conditions of a consent, or in particular, by works. It will be apparent from the foregoing that reliance on the use of works may not always be a wise decision where new development is concerned.

If hard protection methods are needed, they must be designed to eliminate or mitigate adverse impacts on local shoreline sand supply. However, rarely would one method by itself be the most appropriate action, either for the whole coastline or even for one section of it. Usually, an effective hazard management regime comprises a number of actions, some short-term or long-term, some reactive or proactive (preventative).

2. Methods Used at Kapiti

A range of methods have been used to manage the risks from hazards along the District's coast. Many of these actions have evolved since 1976, in response to the erosion and subsequent damage from several winter storms that year, particularly at Raumati and Paekakariki.

At Kapiti, coastal hazards have been managed by the following methods:



- **Seawalls** – Seawalls have been built along parts of the coast, including a timber seawall along The Parade at Paekakariki, and another at Raumati (from Queen Elizabeth Park to Wharemauku Stream), which replaced earlier structures damaged in 1976.
- **Rock revetment/toes** – Rocks, placed in front, have been used to absorb wave energy and to reinforce the timber seawalls in Raumati and Paekakariki. This was mainly to lower the risk of premature failure.
- **Beach renourishment** – Trials in renourishing sand supplies in some parts of the beach have been undertaken, but not on a permanent or regular basis. The most significant of these was 6,000m³ added to the beach system along a 200 metre length adjacent to the south end of Marine Parade, Paraparaumu in 1994.
- **Beach management** – Actions to protect foredunes from erosion, such as planting, fencing, and path formation have been undertaken, on an irregular basis, mostly at Paraparaumu.
- **Emergency works** – Have been undertaken in response to emergencies. Such structures may be either temporary or may become part of the longer-term response. Examples include the use of rock rip-rap to replace a short length of timber seawall at Paekakariki after it was destroyed by a rip current. The rock revetment constructed at the time has now become part of the permanent works. Concrete blocks have also been used as temporary protection works in front of houses at the northern end of Manly Street, Paraparaumu.
- **Private works** – Works undertaken by private landowners, including retaining walls that function as secondary seawalls (at Raumati South), and various other works such as, concrete or timber walls, stacked tyres and stockpiled driftwood, etc., examples of which can be seen at Raumati North and along the southern part of the Paekakariki coastline.
- **District Plan rules** – Controls on subdivision and land development and use, typically in the form of *development standards* (for example, setback requirements for buildings), *consent processes* to manage activities that might exacerbate the risks from hazards (for example, for non-conformance with standards), *prohibitions* (for example, no-build zones in significant hazard areas). All *subdivision* is controlled through the resource consent process, under which hazard issues are assessed.



- **By-laws** – Powers under the Local Government Act controlling certain activities such as the use of vehicles on the beach.
- **Building Act 1991** – Regulates the construction of buildings through the Building Code, building consent process and other various powers under the Act.

3. Purpose of Methods' Analysis

The overall purpose of the analysis process is to ensure all methods are given due consideration and the most appropriate method is adopted. This analytical process is a requirement under section 32 of the Resource Management Act 1991, which requires the Council, before adopting any objective, policy, rule or other method (or any combination thereof), be satisfied that it is:

- necessary in achieving the purpose of this Act; and is
- the most appropriate means of exercising the function, having regard to its efficiency and effectiveness relative to other means.

In reaching such a decision, an assessment of the principal options is required, with regard to:

- the extent (if any) to which any such objective, policy, rule, or other method is necessary in achieving the purpose of this Act; and
- other means in addition to or in place of such objective, policy, rule, or other method which, under this Act or any other enactment, may be used in achieving the purpose of this Act, including the provision of information, services, or incentives, and the levying of charges (including rates); and
- the reasons for and against adopting the proposed objective, policy, rule, or other method and the principal alternative means available, or of taking no action where this Act does not require otherwise; and the need to
- carry out an evaluation, which that person is satisfied, of the likely benefits and costs of the principal alternative means including, in the case of any rule or other method, the extent to which it is likely to be effective in achieving the objective or policy and the likely implementation and compliance costs.

The appropriate method(s) adopted for each coastal hazard management area will depend on a number of factors such as the nature and degree of risk from the particular hazard, the extent and value of existing



investments at risk, the effectiveness of the methods in mitigating the risks, the state of the particular environment (its natural character, amenity values, cultural values) and the effects of the methods on environmental values.

Other important factors are the cost of the proposed method, any maintenance or other ongoing requirements, and the economic impact of the method. The community's attitudes and response to any particular method is another important factor in terms of ascertaining a method's acceptability and impact on values.

It has been evident throughout the study and consultation undertaken to date, that there are wide variances in the nature and scale of coastal erosion hazards in each zone, as well as the expectations and desire of the communities to address these issues.

4. Analytical Approach

The analysis for this study took a two-staged approach:

Methods Scoping

To identify and review all principal options for hazards management that may be appropriate for the Kapiti coastline. Through this process, two outcomes were sought: first, to discard those options that would not be effective methods in the District generally; and, second, to identify those circumstances in which other methods may be appropriate along different sections of the Kapiti Coast.

Assessment

To assess the various methods that may be appropriate to the various Coastal Hazard Management Areas within the District, taking into account the levels of risk, community response, the cost and benefits of particular methods, environmental impact and other factors.

5. Principles

To assess the potential methods for implementing the management strategy, a number of guiding principles were established to compare the advantages of one method (or a combination of methods) over others (in no particular order):

PREVENTATIVE PRINCIPLE

A preventative approach is best where the risks from coastal hazards are currently minimal but potentially significant, or not fully understood.

Where the current risks from coastal erosion hazards are low, it is preferable to avoid further exacerbation of the risks, given the dynamic nature of coastal processes, and the costs and problems associated with the risks to land, property and human safety. The precautionary approach requires that, where there is not strong scientific or other information, and the risks are potentially significant, a preventative response is preferable.

COORDINATIVE PRINCIPLE

A coordinated approach is more effective than individual approach.

Coastal erosion processes do not recognise property boundaries and government responsibilities. There are usually inter-relationships, often little understood, between different sections of coastline – for example, erosion along one section may be keeping another section stable, and, therefore, mitigating erosion risks on one part of the coast may create adverse effects elsewhere. For instance, while the council is under no obligation to protect private properties, a coordinated approach to protecting a group of properties under the aegis or with the support/assistance of the council, is liable to be more effective and efficient than dealing with the problem on a property by property basis.

PARTICIPATORY PRINCIPLE

Take into account the views and perspectives of all relevant stakeholders through collaborative involvement.

Involvement builds commitment and shared responsibility, harnesses local knowledge, helps to ensure the identification of real issues and tends to lead to more robust solutions. It can also help different interests understand the concerns and views of other interests, which is important if compromises or sacrifices are required. An indirect result may be helping to change behaviours and values, and encourage individual and group lead initiatives.



NATURAL CHARACTER PRINCIPLE

The protection of the natural character of the coast must be a pre-eminent concern.

The protection of the natural character of the coast is a matter of national importance (section 6(a) of the Resource Management Act). The current objectives and policies of the District Plan reflect and expand upon this principle for the Kapiti Coast. Preference for methods that are consistent with this principle should therefore be given, unless the effectiveness of other methods compared with the level of risk indicates otherwise.

PUBLIC INTEREST PRINCIPLE

Given the national importance of coastal resources, public interest should generally take precedence over private interests.

While it is important to recognise private property rights, where such rights might adversely affect the interests of the community and wider public, then usually precedence should be given to the latter, where no reasonable accommodation can be found.

DYNAMIC PRINCIPLE

The dynamic nature of coastal processes and their interrelationships, both physical (natural) and human, should be recognised.

Coastal zones are complex systems, influenced by a myriad of interrelated driving forces, including geomorphological, hydrological, socio-economic, cultural, and institutional systems. Attempts to sustainably manage the coastal zones will not succeed unless the entirety of factors that have a significant influence on the dynamics of the coast are taken into consideration.

BEST KNOWLEDGE PRINCIPLE

Actions must be based on the best available knowledge at the time.

To be effective, actions to address erosion hazards should be based on a good understanding of the processes and factors influencing the specific characteristics of any section of coastline, including physical, social, cultural, and economic characteristics. This requires the collection of appropriate data, the production of relevant information and indicators, and a proper integration of information in assessing problems and solutions.

6. Methods Scoping

Table 6.1 provides a summary and evaluation of the principal methods available for managing coastal hazards along the Kapiti coastline. This evaluation scopes the principal methods for mitigating the risks from coastal erosion to determine the appropriateness of each method to the district as a whole. From this evaluation, those methods that are not generally effective or appropriate for the circumstances of the District can be eliminated from further consideration. Furthermore, this evaluation can determine those circumstances when other methods may be most effectively or appropriately used along the District's coastline.

It is apparent that no one method will solely address the hazard management issue for the coast as a whole or the individual management zones. The appropriate methods for each management area vary, and will be subject to change in the future as risks, costs, values and development occur.

Table 6.1: Evaluation of Principal Methods

Non-regulatory/Do Nothing	Evaluation
Remove regulatory controls, and discontinue maintenance of existing works and allow recession to occur and/or private landowners to undertake own protection works. In places of continued erosion, this approach might include a "managed retreat", entailing the progressive abandonment of threatened structures and land.	Not generally appropriate along any part of the Kapiti coastline, given the level of investment (private and public) and the economic, amenity and recreation benefits of the coast to the district and region. Even along relatively undeveloped stretches of the coastline, it would be inappropriate to remove preventative controls to limit beachside development given natural character issues, let alone the dynamics of coastal erosion and the significance of adverse effects arising from potential erosion. Doing nothing is only practical in circumstances where there is little



	<p>or no development (existing or potential) at risk and the benefits of allowing erosion to continue (for example, to provide sand to other parts of the coastline to reduce erosion risks) outweigh other costs or, alternatively, where the costs of mitigating the erosion exceed any losses incurred in allowing it to continue.</p>
Status Quo/No Change	Evaluation
<p>The existing regulatory methods comprise varying building, activity and subdivision restrictions throughout the coastal environment. These would be retained, and the existing erosion protection works (seawalls and/or rock revetments) would be maintained at their current level of protection.</p>	<p>The existing regime of controls was promulgated by different local authorities under a different legislation, with less knowledge and data than currently available. The present building setback rules may therefore be inappropriate in some areas where information indicates higher or lower levels of risks, or where other factors, such as amenity values or natural character, are more relevant.</p> <p>The present 30m wide “relocatable” building restriction at some parts of the coast is no longer considered appropriate, given its lack of effectiveness, and the uncertainty and ambiguity of the rule.</p> <p>The 100m setback for the rural zone is greater than would normally be expected solely for hazard management purposes. However, there are other factors that are likely to be important determinants (for example, amenity values and protection of the natural character of the coastline).</p> <p>Current data indicates that the existing structural protection works provide less than acceptable level of risk-mitigation, and therefore a maintenance-only programme is not appropriate. In addition, some works will need replacement or major upgrading in future.</p>
Structural Measures	Evaluation



Seawall

Timber, concrete or rock structures that are generally self-supporting and are designed to restrict the impact of waves on the shore during erosion events (storms) by providing a physical barrier that, effectively, fixes the coastline in place.

A seawall will generally only be appropriate where there is a demonstrated need for a higher level of protection in terms of the cost of the structure itself when compared with the shoreline assets at risk. Ultimately, the type of structure selected will depend very much on the dynamic characteristics of the coastal zone, whilst giving due consideration to amenity and aesthetic values. Timber structures have been widely used at Kapiti but have proven inadequate on their own. Such structures are, generally, not robust enough for use in ocean coast situations. As has been the case at Kapiti they are likely to require facing with rock to improve wave resistance, a practice that suggests that a rock revetment may have been more appropriate in the first place. Seawalls, however, compromise natural character.

Rock Revetments

Layers of rock, concrete blocks or stone-filled mattresses designed to absorb wave energy and protect an underlying embankment from wave action.

Appropriate in some hazard management areas in association with an appropriately shaped sub-grade. Generally, not as robust as a concrete or rock seawall but more effective than a timber seawall. May have significant beach 'footprint' and also raises issues with respect to natural character.

Groynes

Structural barriers usually built from rock or concrete, or sometimes timber, at regular interval along the shore (most often at right angles to the shore).

Can be effective where longshore drift (the lateral movement of sediment) occurs within the beach zone, normally above low tide. However, most sand movement along the Kapiti coast tends to occur in an onshore-offshore direction, with lateral movement taking place further off-shore and groynes, in these circumstances, are ineffective. Groynes also have significant impact on visual values, access and recreation, and may also accentuate problems elsewhere on the coast. Groynes are, therefore, not appropriate along Kapiti coast and have not been considered further as a possible means of mitigating coastal erosion on the Kapiti coast.

Artificial Reefs

Constructed of rocks or sand-filled

Significant costs involved, and effectiveness on the



geotextile bags or other solid material, situated offshore for the purpose of deflecting/diminishing wave action and consequently their erosive power. Purpose-built reefs are also sometimes advocated to enhance surfing characteristics.

Private Property Works

Individual property owners responsible for their own protection work, including primary and/or secondary seawalls, driftwood stockpiling, sand bags, and tyre walls.

Roads

Not a protection measure as such except roads alongside the beach will usually be protected when necessary from the effects of erosion.

Kapiti Coast is uncertain. Extensive investigation required to ensure that such a device would be suitable without leading to significant adverse effects. There is not yet sufficient evidence to indicate that artificial reefs are appropriate for use on the Kapiti coast.

Ad hoc works along a beach, in the absence of appropriate controlling mechanisms, may result in unsightly features, and may have consequential adverse effects elsewhere (for example, wave scour around the ends of seawalls). The effectiveness of such works may also be questionable unless designed according to accepted standards. The effects of such structures on adjoining properties is a matter of concern that may be difficult to resolve. Individual structures will generally not be appropriate.

Where it is necessary to maintain existing access, roads alongside eroding beachfronts effectively represent a form of structural protection for land and properties on the inland side of the road. It is appropriate for any hazard zoning to reflect this.

Non-Structural Measures

Evaluation

Rules

Under the Resource Management Act 1991, the Council can impose controls/rules (s.76) on subdivision, land development and use, through its District Plan. For example, it can impose restrictions on the building of structures near the coastline, or require resource consents to audit proposals in terms of hazard mitigation.

Rules are typically a preventative or hazard avoidance method, used to limit the extent of risks from natural hazards through inappropriate subdivision and/or development, either where there is an existing high level of risk, or to limit the potential for future risk. Rules can take many forms and combinations, including prohibitions, building restrictions, development and performance standards, and consent requirements. Rules may therefore be effective according to the circumstances relative to each section of coast, and therefore have to be assessed on a case-by-case basis. Where natural hazards are concerned, such assessments will usually be risk-based.



Beach Renourishment

The practice of importing sand to replace that lost from the beach and dune system through erosion processes, thus maintaining or increasing the amount of sand available as a buffer against future erosion events.

As well as the capital cost involved in rebuilding the beach to a suitable state, there are also likely to be on-going monitoring and maintenance costs. Beach renourishment is, thus, likely to be less effective where erosion rates are high, or where erosion has already taken place to the extent that the capital cost of replacing the lost sand is too high. Most appropriate in areas where there are low erosion rates, high amenity and recreation values, and maintenance costs can be justified. However, prior assessment of the costs, effectiveness and material source is essential. A sensible cost/benefit analysis may include an assessment of the economic value of the beach.

Beach Drainage

This technique has recently been introduced to Council for consideration as an appropriate method of beach stabilisation on the Kapiti coast. It involves the permanent installation of drainage pipes under the beach and a pumping system for the purpose of lowering the water table. This allows a proportion of the wave runup to be absorbed in the beach thereby reducing backwash volume and, hence, a reduction in the potential for sand loss, and in certain conditions, allowing deposition, to occur.

This method originated in Denmark in the early 1980s. There have been some 25 installations around the world since that time. While the theory is sound enough and there have been successful examples reported, the technique has not received widespread acceptance. Practical difficulties in providing and operating a sufficiently robust system, and ensuring there are no adverse effects created elsewhere, are among the issues to be resolved. Nevertheless, a case can be made for considering the economic benefits of conducting a trial on the Kapiti coast.

Managed Retreat

Hazard avoidance through planned progressive abandonment of threatened land and property through adoption of a long-term policy of strategic retreat. Allows natural systems to dominate, the consequences of which need to be considered carefully.

Generally inappropriate where there is existing high density public or private development and other methods are available that can reduce risks to acceptable level on an on-going cost-effective basis, without causing further deterioration of the environmental quality of the coastline. On this basis, this method has not been considered at any of the coastal hazard management areas.

Dune Conservation/Management

Methods used to assist dune growth and increase erosion resistance,

Dunes are Nature's sand reserve and, particularly foredunes, act as buffer strips against erosion as



<p>including planting on the dunes for stabilisation; fencing; driftwood collection; and path formation.</p>	<p>well as having amenity, cultural and ecological values. Dune conservation programmes are therefore generally appropriate for all foredune complexes, particularly those subject to heavy recreational use.</p>
<p>Beach Care</p> <p>Promotes community involvement in voluntary beach and dune conservation programmes and activities, such as fencing and planting of appropriate species.</p>	<p>Appropriate in areas where there is community support for such programmes, but typically needs assistance and coordination by local authority, including financial support, particularly to ensure ongoing interest and continuation of programmes. School children, encouraged by teaching staff and parents, can be enthusiastic participants.</p>
<p>Education</p> <p>Promote increased knowledge and awareness of coastal erosion risks and prevention measures, resulting in changing attitudes and behaviours.</p>	<p>Appropriate at varying levels throughout the coastal area to educate property-owners and wider public about the risks from coastal erosion, and erosion prevention methods. Most likely would occur as a result of specific Beach Care programmes, but sometimes a wider target audience is necessary.</p>
<p>By-laws</p> <p>The District Council is empowered to impose controls through bylaws on various activities in the public interest.</p>	<p>By-laws are most effective for managing temporary activities on the beach, such as vehicles, but not for managing development. As such, this method has not been assessed against the requirements of the individual hazard management areas. However, it is noted that by-laws can be appropriate in combination with other methods.</p>
<p>Title Restrictions</p> <p>Covenants and consent notices restricting activities on titles.</p>	<p>Although they can be imposed, typically encumbrances on titles are derived through other methods, such as controls on building (under the Building Act) or resource consents (such as subdivision under the Resource Management Act). As title restrictions are a site-specific method, they are not a viable stand-alone method to address the issues. Therefore, this method has not been considered in terms of the requirements for each individual hazard management areas.</p>



Emergency Works

The District Council is entitled to undertake emergency works, such as temporary protection works during storm events.

Works of this nature are available to the District Council during emergency events. However, the Environment Court has indicated that councils would be unwise to rely being granted a retrospective consent for such works where the hazard was known or foreseeable. This is not a suitable method, as such, to rely upon as a long-term management strategy. However, it is appropriate to ensure that potential responses are updated from time to time (for example, to allow for new knowledge or superior types of protection works), that any necessary consents that may be required are in place, and to educate the public.

Monitoring

Monitoring of beach profiles has occurred on an irregular basis since the 1970s with more regular profiling at Paraparaumu and Raumati, since 1994.

Coastal monitoring by regular beach cross-section surveying is desirable at a district-wide level, with those areas with greater risk or uncertainty having a greater requirement for information assessment.

Building Act 1991

Controls over the structural aspect of buildings.

Building Act controls are enshrined in legislation and not subject to change within the scope of this strategy. However, the Act does provide the District Council with powers to address specific property issues as new building occurs. As the Building Act cannot be amended as a result of this strategy, this method has not been applied to management areas.

7. Overall Strategy

As well as preferred methods for the individual hazard management areas, there will be a need for an overall strategy for those methods that are required at a district-wide scale: namely, monitoring, emergency works and beach care.

These methods occur in varying degrees throughout the management areas, being of an on-going nature, and requiring constant monitoring



and assessment. An overall strategy is required to ensure an integrated approach and the fair allocation of resources.

Monitoring

The Kapiti coast has been surveyed (beach profiles) on an irregular basis at least since the early 1970's when Ministry of Works and Development surveyed the beach and part of the offshore zone at Paekakariki, Raumati and Paraparaumu. Later, in 1981-3, the beach and offshore zone was surveyed on behalf of the Council by Morris and Wilson Ltd. Attempts to relate this work to the earlier surveys were only partially successful because of difficulty relocating the original benchmarks. Since 1994, the council has been regularly monitoring the coastline at 3 locations at Raumati North in CHMA-4, and at 12 locations at Paraparaumu in CHMA-5. Since 2000, 3 more survey locations at Waikanae in CHMA-6 have been added.

Each of the coastal hazard management areas requires basic monitoring through the use of regular surveys of beach cross-sections. While the need for this will vary from area to area, with those areas at greater risk and/or uncertainty having a greater requirement for information assessment than others, it is important to have an overall picture of the erosion and accretion processes within the district as the coastline is interlinked with no part working in complete isolation from the others. A district-wide coastal monitoring programme, which should include provisions for development of an appropriate database for easy access of information, will also have the benefit of assessing coastal processes and changes at an integrated level. It is also generally more cost-effective. Furthermore, if such monitoring were carried out at the end of each summer, the state of the beaches could be assessed prior to the more typically stormy winter period thereby giving early warning of potential increased hazard risk. Regular aerial photo surveys (2-yearly) of the coastline are also advisable to monitor coastal changes between the survey points.

Emergency Response

In 1995 it became clear that the courts did not look favourably on those who sought to use Section 330 of the Resource Management Act (1991) to obtain a retrospective consent for construction of emergency coastal protection works when the existence of the erosion hazard risk was known. Accordingly, because of the known risks on the Kapiti coast, the council sought and was granted consents to allow emergency rock protection works, of an approved design, to be installed when public assets, such as roadways, were placed at risk at Paekakariki, Raumati and Paraparaumu. These consents, however, provide no security to private property and there is a need to develop emergency response plans for the more vulnerable parts of the coast.



The strategy has identified Raumati South as requiring a specific emergency response plan. While the need for a specific response plan is less urgent for the remaining hazard management areas, it is important to have in place an overall strategy relating to the district as a whole outlining the emergency response and strategy, and resources available. This function may largely be mandated as a result of the preparation of emergency management plans for the district, as is expected to be required by the forthcoming Civil Defence and Emergency Management Act.

Beach Care

The strategy proposes that Beach Care initiatives should be promoted for those beaches where foredunes require ongoing care and conservation: namely, Raumati North, Paraparaumu, and at appropriate locations along the coastline from Waikanae to Otaki.

The success of a beach care programme will largely be dependent on the level of community support, and Council's willingness to provide funding and resources.

In order to monitor the effectiveness of the respective beach care groups, ensure the fair distribution of Council resources, and facilitate the start-up of new groups, it is important to have an overall strategy relating to beach care programmes.

8. Specific Assessment of Management Methods

Here, the alternative methods that have been applied to each specific zone are discussed. This identifies the coastline characteristics and practical features facing the respective management area, the key comments and findings from the consultation responses, a brief evaluation of the methods available and whether they would be appropriate to the area having regard to the benefit and costs raised in the previous assessment, and finally an evaluation of the preferred methods.

This evaluation is outlined in the following sections.

A brief summary of the preferred method for each management zone is as follows:

Management Zone	Principal Management Methods
Paekakariki	Seawall, Regulatory Controls, Specific Emergency Works (if required).



Queen Elizabeth Park	Regulatory Controls
Raumati South	Seawall and associated works, Regulatory Controls, Education, Emergency Response Plan.
Raumati North	Regulatory Controls, Dune Conservation, Education.
Paraparaumu	Regulatory Controls, Dune conservation, Beach Renourishment
Waikanae to Peka Peka	Regulatory Controls, Dune conservation.
Peka Peka to Otaki	Regulatory Controls, Dune conservation.

Note: Monitoring, Emergency Works and, in some cases, Beach Care will also occur on a district wide level.

6.2 Paekakariki

1 Coastal Hazard Management Area –1

CHMA-1 extends from the boundary with Porirua City at the northern end of Centennial Highway (State Highway 1) to the stream at the southern end of Queen Elizabeth Park (but not including the Park).

2 Coastline Characteristics and Practical Issues

- Highly compromised natural character, particularly where seawall, road and houses immediately adjoin the beach. However, the beach retains amenity and recreational values that should be maintained if possible.
- The erosion risk remains high, despite relative stability during the past 20 years. Council's policy of maintaining protection works adjacent to The Parade has contributed significantly to this stability. However, the beach is prone to sudden temporary lowering over short lengths (50-150m) as a result of rip currents, and this sometimes causes localised seawall/embankment failures.
- The coastline south of The Parade adjoins private property and leads to a high dune along Ames Street. Much of this length of the coast is partially protected along the toe of the dune face by privately built structures of variable age, quality and effectiveness. A further several hundred metres to the south is largely unprotected, except for a Reno Mattress revetment with rock toe protection near Fisherman's Table Restaurant.



Properties along this section of the Kapiti coast are vulnerable to erosion.

- Along The Parade, the beach is mostly backed by a timber seawall (approximately 60% of which is reinforced with rock toe protection) that protects the roadway, which is the main access to about 80 houses. The existing timber seawall is nearing the limit of its design life and is approximately 1m too low to provide full protection. In severe storm conditions, the roadway is vulnerable to erosion. Maintenance costs are likely to increase in the future as the wall deteriorates.
- The northern end of The Parade is presently unprotected along a 300 m length and recent erosion is threatening a car park.
- Erosion occurring at QE Park supplies the beach with sand: any reduction of this supply would have an adverse effect, particularly at the northern end of Paekakariki.

3 Consultation Response

Main Points

- Sixteen submissions were received, with half in support of the draft preliminary strategy and a third in opposition.
- Important to retain public access to the beach and avoid reducing available beach area as a result of accommodating erosion protection measures. The “do nothing” approach is not considered a suitable option for this area because of the need to upgrade the wall, the level of risk, the number of properties at risk, and the value of the beach as a community, district and regional asset.

General Comments

- Submitters were equally divided about whether rock revetments or wooden sea walls were the preferred form of protection. Suggestions were made for a ‘tiered’ style seawall.
- Consider reducing The Parade to one-lane to provide extra space for dune protection works.
- Concerns were expressed about the negative effect that hard structures would have on the beachfront by accelerating erosion processes.

- Concerns were expressed about the cost, effectiveness, and effect of beach renourishment on shellfish beds.

The issue of costs and who pays received a variety of responses.

4 Response Methods

Methods Available	Evaluation
Do Nothing Remove Controls	Not appropriate given high erosion risk and high social amenity values of the area. In addition, the Council has a duty to provide viable access to the houses that rely on access from The Parade. In this respect the road has to be maintained and therefore protected from destruction by coastal erosion.
Status Quo No Change	Appropriate to continue maintenance of existing works. The costs are known and are likely to increase as the seawall continues to age. Present system does not provide full erosion or storm protection. Support from community for removal of the relocatable building zone.
Structural Measures	
Seawall	Appropriate as an effective means of providing physical erosion protection. Maintaining public access to beach to be taken into account.
Rock Revetment	Appropriate as a means of protecting the roadway embankment adjacent to The Parade if properly designed and constructed. Negative aspects include visual impact and infringement (footprint) on remaining beach area. May also present risks to small children and elderly people. Provision of proper accessways important.
Road	Appropriate and necessary to maintain The Parade. Given the number of houses (80) served by the road, as well as its wider public use, reduction to one lane is not considered practical.
Emergency works	Appropriate if and when required. Consents in place. A specific emergency response plan for Paekakariki would be recommended.



Non Structural Measures	
Regulatory	Appropriate to have some form of regulatory control over activities within CHMA-3 to prevent or mitigate exacerbating effects of erosion where there is insufficient protection, or where a moderate level of risks remains even with protection works. Such controls would be in accordance with s.31 and the Second Schedule of the Resource Management Act 1991.
Beach Renourishment	Not appropriate within this zone because of the capital costs and potentially high cost of maintenance. Depending on the source of sand, which would most likely have to be dredged from offshore, the capital cost of re-building the beach along The Parade would be in the order of \$3.5 million. With losses of the order of 20% possible each year, the cost of maintaining the beach volume at a satisfactory level could be as much as \$500,000 per year although top-ups would probably only happen every 3-4 years because of the cost of mobilising suitable dredging equipment.
Beach Drainage	The viability of this technique for use on the Kapiti coast has yet to be proven. Paekakariki is one of the four sites recommended for further investigation (Vesterby, 2003).
Dune Conservation	Not appropriate as a stand-alone method given costs (resources, information, community support and guidance), the present lack of a foredune along The Parade, and the immediate need for regulatory and physical methods to control erosion. Not identified by the community as a desired method and therefore may lack community support. The present dune embankment south of The Parade is well-vegetated and efforts should be made to ensure that it remains in this state.
Beach Care	Not appropriate as a stand-alone method given costs (resources, information, community support and guidance), the present lack of a foredune along The Parade, effectiveness, risks and need for regulatory and physical methods of erosion control. Not identified by the community as a desired method and therefore may lack community support.
Monitoring	Ensure monitoring of beach profiles is established on a regular basis.
Emergency Works	Specific Plan required.



Education

While community education about the coast is important and should be encouraged, this will not be sufficient on its own given the immediate need for regulatory and physical methods of erosion control.

Preferred Method	Explanation, Costs, Action Required
Seawall	<p>Council has a significant investment in the present timber/rock seawall protection works along The Parade. Although failures do occur from time to time and the remaining life of the seawall is probably around 10–15 years, it remains appropriate to maintain the existing sea wall structure for the time being, and replace sections with rock protection when failure occurs.</p> <p>Replace failed sections with full strength protection works to +4m above sea level. Rock would be the logical choice although the viability of other materials such as concrete and alternative designs should be considered. Present costs can be expected to increase at around 10% per annum as the structure deteriorates. This amount should be sufficient to allow for periodic replacement of short section as failure occurs.</p> <p>The Council has a duty and responsibility to maintain the road as it provides access to some 80 houses.</p> <p>Extend protection works 300m to the north end of The Parade (over 3–5 year period). If this is not done, the road at this end will ultimately be placed at risk. This work is expected to cost approximately \$400,000 if a rock revetment is used. A timber seawall, as has been used previously, would cost around \$350,000 but would probably require rock reinforcement in the future.</p> <p>The prospect of a tiered structure built from concrete was raised during the consultation process. While most people would consider such a structure more aesthetically pleasing than rockwork, as well as generally providing better access and requiring less beach area, the cost is likely to be 50–80% higher than a rock seawall. Details of an appropriate configuration for a concrete structure should be developed, however, and actual costs presented to the community for debate as a possible long-term solution.</p> <p>The adequate provision of public access along the beach will need to be addressed in the design of the works.</p> <p>With respect to properties south of the Parade, (housing adjacent to Ames Street) the Council has no obligation to provide coastal protection works. Given that properties remain vulnerable, a emergency response plan should be developed. This should include discussion of options for protecting the properties in the event that erosion occurs at some time in the future. If the community decided in that full-strength protection works were justified to protect the dune face, it is anticipated that the width of the Primary Development Setback area (see below) could be reduced to 20 metres and there</p>

	<p>would be no need for a Secondary Development Setback area.</p> <p><i>Action Required: Develop plans in conjunction with community and obtain any necessary consents. Consider options for funding works to protect private property.</i></p>
Regulatory Controls	<p>Under the District Plan (Permitted activity standard D1.1.1 (iii) and (iv)), an existing restriction imposes a 20m 'no-build' building zone in front of a 30m wide relocatable building zone on residential properties within the management zone. This affects properties adjoining The Parade and Ames Street.</p> <p>It is proposed to replace the previous restrictions at Paekakariki with a 60m wide hazard management area. Within this area there would be a 25 m Primary Development Setback (PDS) in which subdivision would be prohibited and no new construction for habitation or commercial use would be permitted. Certain exceptions such as structures in connection with landscaping or outdoor living areas such as pools, decks, and patios subject to minimum setback and height restrictions would be provided. The remaining 35 m would provide for a Secondary Development Setback area (SDS) where construction activities would be permitted subject to certain conditions, and provided a qualified structural engineer certifies to the effect that, in the event that it is threatened by coastal erosion, the building can be removed (appropriate access must therefore be available), or that it is robust enough to ensure that it is capable of withstanding the effects of such events without collapsing. Within the SDS, subdivision would be a discretionary activity.</p> <p>Along The Parade, the PDS includes the roadway and as long as this is to be protected from erosion and, therefore, remains viable, it is not reasonable to impose SDS restrictions on the properties on the landward side of the road.</p> <p>The seaward boundary of the hazard zone shall be the edge of the undisturbed land.</p> <p>The District Plan Permitted Activity Standard for Earthworks also restricts earthworks within 20m of coastal water as a discretionary activity. It is proposed this remain unchanged, largely for aesthetic reasons and dune/beach protection.</p> <p>Associated Costs: Cost associated with the plan change. This will depend on the number of submission lodged and whether the provisions are appealed. Cost to land owners of the resource consent process. There may be some cost associated with the prevention of further subdivision, but this would be less than the principal options (i.e., risk exacerbation and protection works).</p> <p><i>Action Required: Undertake changes to the plan in accordance with the Resource Management Act 1991 requirements. Need to further define the appropriate rules.</i></p>
Monitoring	<p>Establish a more regular survey programme to monitor coastal profiles.</p> <p><i>Associated Costs: To establish and undertake monitoring on a regular basis.</i></p> <p><i>Action Required: Determine degree of monitoring, establish programme and</i></p>

Emergency Works

put procedures in place.

A specific emergency response plan is appropriate for Paekakariki, with works to occur if and when required.

Associated Costs and Action Required: To establish the plan and inform the community.

6.3 Queen Elizabeth Park

1 Coastal Hazard Management Area – 2

CHMA-2 extends along the coastline of the Queen Elizabeth Park, from the north end of The Parade, Paekakariki to the southern end of Raumati. This park, which is an important regional asset, is classified as a Recreation Reserve under the Reserves Act, 1977 and is administered by Wellington Regional Council.

A Management Plan for the park has been prepared by Wellington Regional Council (1993) and this sets out the basis for management of the park and provides a reference for resolution of management issues. Its aim is to provide for the sustainable management of QE Park for outdoor recreational use while preserving natural, historical and cultural values.

2 Coastline Characteristics and Practical Issues

- The Beach has significant amenity and recreational values.
- The coast is largely in its natural state.
- Erosion occurring at QE Park supplies sand to the beach to the south at Paekakariki. Administration of QE Park is the responsibility of Wellington Regional Council.
- Significant erosion has occurred at the northern end of the park after construction of the Raumati seawall in the late 1970's. While not of particular concern as far as the park itself is concerned, continuing erosion could lead to destabilisation of properties abutting the park.

3 Consultation Response

There was no consultation specifically relating to QE Park. However, reference to the Park was made during the consultation process for the Paekakariki and Raumati South management zones:

- Concerns were expressed regarding the erosion adjacent to the end of the Raumati seawall.
- It was commented that the Park should have the same protection as residential properties.

4 Response Methods

Methods Available	Evaluation
Do Nothing	Not appropriate given significant erosion that has occurred at the northern end of the park, following construction of the Raumati Seawall.
Status Quo No change	In part, this is an appropriate policy as the administration of the park is the responsibility of the Wellington Regional Council. The park currently supplies sand to the Paekakariki beach and, therefore, is important in reducing the erosion risks, particularly in front of the surf club building and along northern end of The Parade.
Structural Measures	
Seawall	Not appropriate given the park itself is not developed and the low value of existing investments.
Rock Revetment	Not appropriate given the park itself is not developed and the low value of existing investments.
Emergency works	May be appropriate if required. To occur as part of an overall emergency works strategy for the district.
Non-Structural Measures	
Regulatory	Appropriate to have some form of regulatory control over activities within CHMA-2 to prevent or mitigate exacerbating effects of erosion



	where there is insufficient protection or where a moderate level of risks remains even with protection works. Such controls would be in accordance with s.31 and the Second Schedule of the Resource Management Act 1991.
Beach Renourishment	Not appropriate given costs, and low value of existing investment within the Park.
Dune Conservation	This is an appropriate coastal management option and requires such measures as dune planting and provision of access ways to the beach. Fencing may also be used to facilitate dune growth and protect new plantings. It is understood that Wellington Regional Council have been reviewing plans for managing the park and its coastline.
Beach Care	Not appropriate given that the land is managed as a regional park. However, the low value of existing investment within the Park and the low level of development increases the relevance of maintaining natural character.
Education	Appropriate if consistent with maintenance of amenity values and natural character, and Wellington Regional Council park management plans. To some extent the principles conveyed for other zones concerning dune conservation would be adopted for this management zone.
Monitoring	Ensure monitoring of beach profiles.
Title Restrictions	Not applicable as the park is a Recreation Reserve. Wellington Regional Council is responsible for the administration of the Park.

Preferred Method	Explanation, Costs, Action Required
Regulatory Controls	<p>Under the District Plan, QE Park is identified as Open Space. While the District Plan maps feature a 20m "no build" line and a 30m relocatable building area along the seaward boundary of the Park, these restrictions are not included in the zone performance standards. As such the lines drawn on the planning maps have no corresponding rules.</p> <p>To ensure the continued protection of the Park in its natural state, a 100m wide coastal management area (as for rural areas elsewhere along the Kapiti coast) is proposed along the length of the management zone, effectively being</p>



Monitoring

the length of the Park. Subject to liaison with Wellington Regional Council, building restrictions within the zone are expected to be the same as for a Primary Development Setback. The seaward margin of the zone should be the edge of the undisturbed land at the top of the bank. Ultimately, the importance of maintaining or enhancing natural character values along the boundary of QE Park is expected to over-ride hazard requirements.

The District Plan Permitted Activity Standard for Earthworks also restricts earthworks within 20m of coastal water. This may remain unchanged given the importance of retaining the natural character of the Park.

Associated Costs: Cost associated with the plan change.

Action Required: Undertake changes to the District Plan in accordance with the Resource Management Act 1991.

Establish a monitoring programme to monitor coastal profiles on a regular basis at appropriate locations. The purpose of this would be to monitor the effect of the Raumati seawall on the park and how this is affecting adjoining properties and also to monitor beach changes at selected points along the QE Park coastline.

A component of the monitoring programme would be to also monitor the natural character of the coastline.

Associated Costs: Cost associated with implementing and operating a monitoring programme

Action Required: Consult with the WRC as to a possible joint monitoring programme.

6.4 Raumati South

1 Coastal Hazard Management Area – 3

CHMA-3 extends from the northern boundary of QE Park to the Wharemauku Stream mouth at Raumati Gardens.

2 Coastline Characteristics and Practical Issues

- Properties, including The Esplanade, vulnerable to wave attack. Previous experience (1976 storms) has shown that erosion of up to 15m (horizontal) is possible in severe storm conditions.
- A timber seawall extends along the full 3km length of the Raumati South coast. The southern 2 km of the timber seawall is protected by rock. Timber/rock seawall is approximately 2m



too low to provide adequate storm protection during sustained major storm wave attack.

- Low seawall and over-topping has led property-owners to erect secondary retaining walls of varying quality.
- Beach at South Raumati is only marginally accessible at low tide, and its recreational/amenity values are , therefore, highly compromised.
- Beach receives little or no sediment, and although there has been no significant change in beach level in recent years, any further lowering of shore at South Raumati will tend to destabilise the seawall.
- There are on-going development pressures, particularly as land values rise.
- Restricted access to coast means ability to install emergency protection works during storm conditions may be seriously limited.
- Ownership of land behind primary seawalls (Old Coach Rd) is yet to be clarified.

3 Consultation Response

Main Points

- Twenty-five submissions were received, with half in support of the preliminary strategy for the area.
- The majority accepted and recognised the need for a higher level of erosion protection.
- The proposal to increase the height of the existing seawall/rock revetment was a matter of concern to many in terms of reducing access to the beach, affecting aesthetic values and privacy, and adding an extra cost to residents.

General Comments

- Some support for walkway along the top of the seawall.
- Regional value of coast should be taken into account when apportioning costs. The issue of costs needs further details and investigation.

- Continued maintenance of seawall by the District Council was supported.
- Effective action urged to reduce the risks of erosion along this section of coastline.
- Some support and opposition to beach renourishment. Trial suggested.

4 Response Methods

Methods Available	Evaluation
Do Nothing Remove Controls	Not appropriate given high erosion risk and social amenity values of the area. To do nothing would likely result in coastal retreat, leading eventually to removal of housing from the shore. The community does not accept the "Do nothing" approach. However there is some support for the 20m no-build zone.
Maintain Status Quo	Given the high erosion risk, it is appropriate to continue maintenance of existing works until appropriate alternative works are put in place.
Structural Measures	
Seawall	Appropriate as an effective physical erosion protection means within CHMA-3 given the existence of the present wall, the level of erosion risks, and the present density and value of development along the coastline.
Rock Revetment	Could provide suitable coastal protection but visual impacts similar to existing works. No advantage over existing works.
Road	The Esplanade roadway will continue to be maintained and protected, as required, against erosion. The Old Coach Road issue needs resolving in terms of ownership.
Emergency works	Appropriate to formulate a specific emergency response plan for this management area in conjunction with other methods.
Non Structural Measures	

Regulatory	Appropriate to have some form of regulatory control over activities within CHMA-3 to prevent or mitigate exacerbating effects of erosion where there is insufficient protection or where a moderate level of risks remains even with protection works. Such controls would be in accordance with s.31 and the Second Schedule of the Resource Management Act 1991.
Beach Renourishment	Significant volumes of sand would be required to replenish the beach. Not considered appropriate at this stage given implementation and maintenance costs, issues over source of material, and questions about the long-term effectiveness. Nevertheless, there was some support (and opposition) evident during the consultation process and the community may elect to examine the feasibility of beach renourishment in more detail. Refer also to notes referring to beach renourishment at Paekakariki in CHMA-1.
Beach Drainage	The viability of this technique for use on the Kapiti coast has yet to be proven. South Raumati is one of the four sites recommended for further investigation (Vesterby, 2003).
Dune Conservation	No existing foredune suitable for conservation. Not appropriate as a stand-alone method given costs (resources, information, community support and guidance) and need for regulatory and physical methods for erosion control. Not identified by the community as an appropriate method.
Beach Care	Similarly, not appropriate as a stand-alone method given costs (resources, information, community support and guidance) and need for regulatory and physical methods for erosion control. Not identified by the community as an appropriate method.
Education	Appropriate to educate residents and landowners concerned of the potential risk. Method to be used in conjunction with other methods.
Monitoring	Ensure on-going programme to monitor beach profiles is established.
Private Property Works	There are a number of secondary seawalls, which have been constructed by property owners behind the council-maintained timber/rock seawall. While some of these are effective, the varying standards of design, and interface issues between such structures and adjoining properties may reduce the effectiveness of these protection works in a severe storm. While Council could provide for secondary seawalls as a controlled activity subject to design guidelines for



effectiveness and aesthetics, Council cannot require private property owners to undertake such works. They can only control such works should the owner wish to build them. Therefore interface issues and aesthetic values would remain of issue. As such this method is not appropriate without other structural measures. Reliance on secondary seawall/retaining walls would become less if the primary seawall is upgraded.

Preferred Method	Explanation, Costs, Action Required
Maintain Existing Seawall	<p>Maintain existing seawall through a programme of remedial works, as required. Note, this is the status quo. It is, essentially, the pragmatic solution since to make any significant change will take time. It also involves the least cost in day to day terms, but carries with it the almost certain risk of future failure, and the somewhat indeterminate costs that such events might incur. Therefore, this report will recommend that the viability of upgrading the existing seawall be properly investigated.</p> <p><i>Associated Costs: Present annual cost.</i></p> <p><i>Action Required: Continue to maintain present works while seawall upgrade is studied and until such time as any upgrade is complete.</i></p>
Seawall Upgrade Study	<p>Working with the community, examine the feasibility (cost/benefit) of progressively upgrading the existing protection works. This would include raising the height of the existing seawall to RL 4m (above MSL), starting at the southern end of existing seawall. This will involve adding rockwork to increase the height of the seawall by approximately 2m. The increased height of the seawall is necessary if full protection of properties, and The Esplanade roadway, against wave attack and erosion is to be provided.</p> <p>While a higher seawall would be visually more intrusive, it is anticipated that visual impacts would be offset by appropriate landscaping and establishment of a public walkway. This is consistent with community response.</p> <p>Apart from the greater level of protection provided, a robust seawall would also allow building and subdivision restrictions on shoreline properties to be relaxed. This aspect is discussed further below.</p> <p>The adequate provision of public access along the beach would also need to be addressed.</p> <p>Upgrading the existing protection works is a community issue that will impose potential costs for each property. While no funding programme has been put in place, it is likely to be made up of contributions from the Kapiti Coast District Council, private property owners and, potentially, Wellington Regional Council.</p>

Regulatory Controls

Associated Costs: Cost associated with the Seawall upgrade – obtaining appropriate consent, design, material, labour, implementation, maintenance, landscaping and walkway. Approx \$2500 per linear metre [depending upon scope and extent of landscaping] or \$2.5 million per km.

Action Required: Feasibility study including cost/benefit analysis, initiate design, obtain appropriate consents, and resolve Old Coach road issue.

Under the District Plan (Permitted activity standard D1.1.1 (iii) and (iv)), an existing restriction imposes a 20m no-build building zone in front of a 30m wide relocatable building zone on residential properties. As a planning tool these restrictions pose practical difficulties for property owners, potential developers as well as the council, and the matter is further complicated by the presence of The Esplanade, which in effect acts as a “no-build” zone along that section of the coast.

While the present seawall remains as it is, it is proposed to replace the present restrictions with a 60-metre wide coastal hazard management area along the length of CHMA-3, except as noted below, with restrictions on subdivision and secondary dwellings within the hazard area. Within CHMA-3 there would be a 30 m Primary Development Setback (PDS) in which subdivision would be prohibited and no new construction for habitation or commercial use would be permitted. Certain exceptions such as structures in connection with landscaping or outdoor living areas such as pools, decks, and patios subject to minimum setback and height restrictions would be provided. The remaining 30 m would provide for a Secondary Development Setback (SDS) where construction activities would be permitted subject to certain conditions, and provided a qualified structural engineer certifies to the effect that, in the event that it is threatened by coastal erosion, the building can be removed (appropriate access must therefore be available), or that it is robust enough to ensure that it is capable of withstanding the effects of such events without collapsing. Within the SDS, subdivision would be a discretionary activity.

As at Paekakariki (The Parade), where the PDS includes a public roadway, in this case The Esplanade, and as long as this is to be protected from erosion and, therefore, remains viable, it is not reasonable to impose SDS restrictions on the properties on the landward side of the road.

The width of the Coastal Hazard Management Area would be reviewed when and if the coastal protection works have been upgraded. Aesthetic considerations are one issue that would need to continue to be addressed should the hazard restriction be relaxed. It is anticipated that, if the seawall is upgraded to full design strength, the width of the PDS could be reduced to 20 metres and building restrictions within the SDS, removed.

Furthermore, it is anticipated that upgrading the seawall to full strength would satisfy the requirements of s.106 in terms of allowing subdivision.

The boundary shall be the seaward edge of the undisturbed land, which effectively means the top of the coastal embankment (or dune face).

A further issue is that of secondary seawalls/retaining walls. This could be a controlled activity subject to design guidelines controlling structural and aesthetic design. These guidelines would need to address effects on adjoining properties. A control on the size and length of structures is required. Note, as

	<p>they stand at present, these walls have only limited value as an erosion protection measure and, in some cases, no value. The need to place any reliance on such structures for erosion protection would be reduced following upgrading of the primary seawall.</p> <p>The District Plan Permitted Activity Standard for Earthworks also restricts earthworks within 20m of coastal water as a discretionary activity. It is proposed this remain unchanged, largely for amenity reasons.</p> <p><i>Associated Costs: Cost associated with the plan change, increasing if appealed.</i></p> <p><i>Action Required: Undertake changes to the District Plan in accordance with the Resource Management Act 1991.</i></p>
Monitoring	<p>Establish a monitoring programme to monitor coastal profiles on a regular basis at appropriate locations.</p> <p><i>Associated Costs: To establish and undertake monitoring on a regular basis. Allow \$10,000 pa.</i></p> <p><i>Action Required: Determine degree of monitoring, establish programme and put procedures in place.</i></p>
Emergency Response	<p>Develop a specific emergency response plan, with monitoring for Raumati South. This would also incorporate education.</p> <p><i>Associated Costs and Action Required: To establish the plan, and inform the community. Costs associated with emergency response resources.</i></p>
Education	<p>Provide an educational programme on the erosion issues facing the management zone and what individual landowners can do to lessen erosion effects. Part of the education programme will be to inform residents of the emergency response plan.</p> <p><i>Associated Costs and Action Required: Establish plan and informing the public.</i></p>

6.5 Raumati North

1 Coastal Hazard Management Area – 4

CHMA-4 extends from the Wharemauku Stream mouth to the southern end of Marine Parade, Paraparaumu.



2 Coastline Characteristics and Practical Issues

- Residential development close to beach.
- The northern part of the Raumati coastline is less vulnerable to storm damage because of the sheltering effect of Kapiti Island and the consequential development of a flatter seabed immediately off-shore, which means that in most cases wave energy reaching the shore will be reduced. This part of the coastline, however, has eroded in the past and a moderate risk remains.
- Some coastal damage possible during high energy storm events from a southerly direction as the largely unprotected coastal margin and limited dunes means there is little reserve capacity.
- Residents have constructed protective measures of varying effectiveness along the beachfront. Not built to any standard, and most are likely to be ineffective during a major storm event.
- Properties along this part of the coast are privately owned, and the Council, thus, has no obligation to provide protection works. Council's existing consent to allow for provision of emergency protection does not extend to this part of the Kapiti Coast.

3 Consultation Response

Main Points

- Six submissions were received to the preliminary draft strategy.
- The main issues raised concerned erosion management practices.

General Comments

- 50% of submitters supported preliminary strategy – however the other 50% supported a higher level of erosion protection.
- Present management practices were considered unsatisfactory.
- Dune conservation and growth strategy supported. Submissions suggested increased planting along dunes to improve stabilization and encourage sand accumulation.

- Mixed views on beach renourishment. Potential for sand loss a concern.
- 'At risk' areas should be identified to residents/land owners so they can work together to reduce erosion risk. Little support for a seawall.
- Limiting vehicular access to beach requested.
- Create 'no-go' areas of beach as a means to protect the beach environment.
- Favour an integrated 'beach care programme' with a sound strategy for foredune maintenance.
- Maintain zoning restrictions.
- Action must be taken on the Old Coach Road issue immediately.

4 Response Methods

Methods Available	Evaluation
Do nothing / No Change	As the properties within this hazard management area are privately owned, Council has no obligation to provide protection works. However, despite the low erosion rates over the last decade, given that Council's existing consent to allow for provision of emergency protection works does not extend to this part of the coast, past experience, and the intensity of shoreline development, the "do nothing/no change" approach is not considered acceptable. The response from consultation supported this conclusion.
Structural Measures	
Seawall	Not an appropriate measure at the present time as there is no indication that seawalls are either necessary or desirable. This should be monitored.
Rock Revetment	Not an appropriate method at this time as there is no demonstrated need or desire.
Road	The Old Coach Road issue needs resolving in terms of ownership.
Emergency works	The forthcoming CDEM Act may require emergency response plans to be provided for this management area. To extend emergency works to



Private Property Works	<p>this part of the coast would require resource consent.</p> <p>Private seawalls of limited effectiveness have been constructed. The varying standards of design, and interface issues between such structures and adjoining properties reduces the effectiveness of these protection works in a severe storm. A community response is preferred in the event that coastal protection works become necessary.</p>
Non Structural Measures	
Regulatory	<p>Appropriate to have some form of regulatory control over activities within CHMA-5 to prevent or mitigate exacerbating effects of erosion where there is insufficient protection or where a moderate level of risks remains even with protection works. Such controls would be in accordance with s.31 and the Second Schedule of the Resource Management Act 1991.</p>
Beach Renourishment	<p>Method to be reviewed in terms of its effectiveness in the area. Could be implemented at a later date.</p>
Dune Conservation	<p>Identified by the consultation responses as an appropriate method in combination with other methods.</p>
Beach Care	<p>Appropriate as a method to increase awareness and improve the visual amenity of the beach. To be used in combination with other methods.</p>
Education	<p>Appropriate to educate residents and the community of effects of activities in the sand dunes.</p>
Monitoring	<p>Ensure continued monitoring of beach profiles.</p>

Preferred Method	Explanation, Costs, Action Required
Regulatory Controls	<p>Under the District Plan (Permitted activity standard D1.1.1 (iii) and (iv)), an existing restriction imposes a 20m no-build zone in front of a 30m wide relocatable building zone on residential properties.</p> <p>It is proposed to replace this restriction with a 50-metre wide coastal hazard</p>



management area along the length of the CHMA with restrictions on subdivision and secondary dwellings within the hazard area. Within CHMA-4 there would be a 25 m Primary Development Setback (PDS) in which subdivision would be prohibited and no new construction for habitation or commercial use would be permitted. Certain exceptions such as structures in connection with landscaping or outdoor living areas such as pools, decks, and patios subject to minimum setback and height restrictions would be provided. The remaining 25 m would provide for a Secondary Development Setback (SDS) where construction activities would be permitted subject to certain conditions, and provided a qualified structural engineer certifies to the effect that, in the event that it is threatened by coastal erosion, the building can be removed (appropriate access must therefore be available), or that it is robust enough to ensure that it is capable of withstanding the effects of such events without collapsing. Within the SDS, subdivision would be a discretionary activity.

As with the other hazard areas, it may be appropriate to provide further controls on properties adjoining the beach and Old Coach Road for to maintain or enhance amenity values.

The seaward boundary of the CHMA shall be the edge of the undisturbed land.

The reasons for the 50-metre restriction are two fold – hazard protection and aesthetics. Although the width of the CHMA is primarily governed by hazard risk, aesthetics are also an important consideration to consider in this area.

Although the beach and coastline has enjoyed a period of stability in recent years, it is apparent that erosion has occurred here in the past and, no doubt, will do so again in the future. Should this be serious enough to warrant consideration of seawall construction, these should be a controlled activity subject to guidelines controlling structural and aesthetic design. These guidelines would need to address effects on adjoining properties. A control on the size and length of structures is required. Consents for individual seawalls are unlikely to be supported and a community response is preferred.

The District Plan Permitted Activity Standard for Earthworks also restricts earthworks within 20m of coastal water as a discretionary activity. It is proposed this remain unchanged, largely for aesthetic reasons and dune/beach protection.

Associated Costs: Cost associated with the plan change, increasing if appealed.

Action Required: Undertake changes to the District Plan in accordance with the Resource Management Act 1991.

Monitoring

Undertake continued programme to monitor coastal profiles and visual amenity issues. This will assist in determining appropriate future actions, such as the provision of protection works should such structures become necessary.

Associated Costs and Action Required: To undertake the monitoring programme.



Dune Conservation	<p>A programme should be developed incorporating a planting implementation and maintenance, path formation and possibly fencing to improve stabilization and encourage sand accumulation. This method would operate in conjunction with Beach Care and Education. Some importation of sand may be appropriate to facilitate dune construction.</p> <p><i>Associated Costs: Drawing up a plan, materials, labour, on-going maintenance costs.</i></p> <p><i>Action Required: To establish the plan, undertake planting and fencing, inform the community and facilitate the ongoing maintenance. Some monitoring will be required.</i></p>
Beach Care	<p>Introduce and implement a programme to involve the community in the management of the beach and dune system. This method would involve raising awareness about the risks of erosion, and improving the visual amenity of the beach by encouraging private initiatives to remove unsightly and ineffective protection works and maintain planting and other measures initiated under the Dune Conservation programme. The success of the method will largely be dependent on the level of community participation.</p> <p><i>Associated Costs and Action Required: To establish and facilitate a programme, raise community awareness and encourage involvement. On-going technical assessment with respect to effectiveness of dune/beach programmes and any future need for hazard mitigation.</i></p>
Education	<p>Provide an educational programme on the erosion issues facing the hazard management area and what individual landowners can do to lower erosion risks. The education programme could also be directed at schools to raise community awareness of the environmental effects of activities on the dunes.</p> <p><i>Associated Costs: Labour, information material, venue, on going support.</i></p> <p><i>Action Required: To establish the educational programme and inform the community and target audience (i.e. schools). On-going support role required.</i></p>

6.6 Paraparaumu

1 Coastal Hazard Management Area – 5

CHMA-5 extends from the southern end of Marine Parade at Paraparaumu to the Waikanae River mouth.



2 Coastline Characteristics and Practical Issues

- Residential, commercial development and community assets close to the beach.
- The beach is an important local and regional asset that brings considerable economic benefit, and has significant recreational and amenity values for the community.
- An erosional cycle during the decade leading up to 1994 has left Marine Parade vulnerable to coastal erosion.
- Adjacent to the south end of Manly Street there is a reserve of sand that can potentially be used as a source of beach renourishment. This sand reserve is a result of significant coastal accretion since 1994.
- Stormwater outfalls within the accretion zone require on-going sand clearance to remain viable and this activity provides a useful source of sand for beach replenishment purposes elsewhere.
- Approximately 10 years ago, houses were constructed on the dunes at the north end of Manly Street. These houses are now very vulnerable as a result of erosion that has occurred at the north end of the Paraparaumu coastline since 1995. Temporary block protection was installed in June 1999 but a long-term solution is required.
- From time to time, Wellington Regional Council cuts through the sand spit at the mouth of the Waikanae River to provide a more direct outlet to the sea. The effects of this on the coastline at the north end of Paraparaumu are uncertain and on-going monitoring is necessary.

3 Consultation Response

Main Points

- Seventeen submissions were received.
- General opposition to hard protection works such as seawalls.
- The variable nature of coastal processes in the area was noted.



General Comments

- 30% submitters indicated support for the preliminary draft strategy.
- 53% were not satisfied with the draft strategy and recommendations.
- Submissions concerning beach renourishment as a preferred option were equally divided. While some saw this as a preferred method, they felt the issue of sand source needed investigation. Those opposed expressed concerns with the cost and effectiveness.
- General opposition to hard protection works such as seawalls.
- More information of effects of cutting Waikanae River mouth requested with almost all submitters commenting on this issue. [It is noted that Wellington Regional Council are required to monitor the effects as a condition of the consent.]
- Beach care programmes and associated dune stabilisation practices were encouraged.

4 Response Methods

Methods Available	Evaluation
Do nothing / No change	Proper erosion management is paramount. The beach is an important local and regional asset that brings considerable economic benefit, and has significant recreational and amenity values for the community. To do nothing in terms of coastal management is not an appropriate option.
Remedial Works	Existing works involve the on-going sand clearance of stormwater outfalls and maintenance of beach profiles, as required, adjacent to Marine Parade. This will continue.
Structural Measures	
Seawall	Not an appropriate option within the zone and general opposition from

	<p>submitters due to aesthetic considerations, and the potential effect "hard" structures may have on coastal processes, especially the accelerated effects caused by wall ends. Seawalls may be considered as an emergency/backstop method providing provision is made to ensure that they remain buried in sand in all but severe storm conditions. This will normally require that the amount of sand on the beach be maintained at a level sufficient to keep the sea away from the base of the wall most of the time.</p>
Rock Revetment	See remarks referring to seawalls, above.
Road	Ongoing maintenance of Marine Parade is required and this will provide effective protection along this part of CHMA-5.
Emergency works	Appropriate as and when required for protection of public assets. Consents in place. This will occur as part of the overall strategy.
Private Property Works	Private coastal protection works not supported on an individual property basis. Council prefers community-based solutions
Non Structural Measures	
Regulatory	Appropriate to have some form of regulatory control over activities within CHMA-5 to prevent or mitigate exacerbating effects of erosion where there is insufficient protection or where a moderate level of risks remains even with protection works. Such controls would be in accordance with s.31 and the Second Schedule of the Resource Management Act 1991.
Beach Renourishment	Preferred method for stabilisation or enhancement of the coastal zone.
Beach Drainage	The viability of this technique for use on the Kapiti coast has yet to be proven. Paraparaumu has two of the four sites recommended for further investigation (Vesterby, 2003).
Dune Conservation	Refer to Beach Care programme, below. Requires planting programmes and effective mitigation of wind damage (blow-outs).
Beach Care	Appropriate as a method to increase awareness and enhance the natural character of the coastline. To be used in combination with other methods including dune conservation.



Education	Not an identified method. To some extent will occur as part of the Beach Care programme.
Monitoring	Ensure monitoring of beach profiles, and effects of cutting through the sand spit at the mouth of the Waikanae River.

Preferred Method	Explanation, Costs, Action Required
Regulatory Controls	<p>Under the District Plan (Permitted activity standard D1.1.1 (iii) and (iv)), an existing restriction imposes a 20m no-build area on residential properties within the zone. It is noted that the maps also show the line relating to commercial/retails zoned properties, however there is no corresponding rule or performance standard.</p> <p>It is proposed to replace this restriction with a 50-metre wide coastal hazard zone along the length of the entire management zone with restrictions on subdivision and secondary dwellings within the hazard zone. Within this hazard zone there would be a 25 m Primary Development Setback (PDS) in which subdivision would be prohibited and no new construction for habitation or commercial use would be permitted. Certain exceptions such as structures in connection with landscaping or outdoor living areas such as pools, decks, and patios subject to minimum setback and height restrictions would be provided. The remaining 25 m would provide for a Secondary Development Setback (SDS) where construction activities would be permitted subject to certain conditions, and provided a qualified structural engineer certifies to the effect that, in the event that it is threatened by coastal erosion, the building can be removed (appropriate access must therefore be available), or that it is robust enough to ensure that it is capable of withstanding the effects of such events without collapsing. Within the SDS, subdivision would be a discretionary activity.</p> <p>Along Marine Parade the PDS includes the roadway and as long as this is to be protected from erosion and, therefore, remains viable, it is not reasonable to impose SDS restrictions on the properties adjacent to the road.</p> <p>The seaward boundary shall be defined as the edge of the undisturbed land.</p> <p>The reasons for the 50-metre restriction are two fold – hazard protection and aesthetics. Although the width of the CHMA is primarily governed by hazard risk, aesthetics are also an important consideration to consider in this area.</p> <p>Seawalls are not a preferred response in this zone. Consent for individual seawalls is unlikely to be supported. A community response is preferred.</p> <p>The District Plan Permitted Activity Standard for Earthworks also restricts earthworks within 20m of coastal water as a discretionary activity. It is proposed this remain unchanged, largely for aesthetic reasons and dune/beach protection.</p>



Beach Renourishment

Associated Costs: Cost associated with the plan change, increasing if appealed.

Action Required: Undertake changes to the District Plan in accordance with the Resource Management Act 1991.

The preferred method for stabilisation of the coastline in this coastal hazard management area. Trial beach renourishment at the south end of Marine Parade in 1994 demonstrated that this is a viable method of maintaining the Paraparaumu coastline. However, some residents are concerned that erosion issues subsequently developed at the location from where the sand was taken. This method requires regular surveying of the beach to ensure the volumetric changes are monitored. The viability of the material source needs to be established, along with effects of removing the source material. These issues would normally be addressed during the consent process.

Associated Costs: Assessing viability, sourcing material, moving material, monitoring affects, and consent costs.

Action Required: Assess viability and material source. Obtain consents. Arrange movement.

Monitoring

Ensure continued monitoring of the beach profiles, and adjusting/maintaining the beach volumes as required. This includes monitoring of the effects on the northern end of Paraparaumu beach of cutting through the sand spit at the Waikanae River mouth, by Wellington Regional Council. As noted, Wellington Regional Council is required to report on this matter as a condition of their consent.

Associated Costs and Action Required: To establish and implement the monitoring programme. Liase with Wellington Regional Council.

Beach Care

Introduce, and establish a beach care programme within the community with the purpose being to involve property owners in the management process and encourage initiatives to enhance the natural character of the coastline. A component of this programme would be to educate owners of erosion risks, and to focus on improving the visual amenity of this section of the beach through encouraging private initiatives to avoid unsightly and ineffective protection works, and planting and maintaining the foredune. Dune conservation assists in dune stabilisation and accretion.

Associated Costs and Action Required: To establish and facilitate a programme, raise community awareness and encourage involvement. On-going technical report with respect to secondary seawalls, planting etc.

Note:

A separate issue within the Paraparaumu management zone is that of the houses erected on the dunes at the north end of Manly Street. These properties are vulnerable to erosion. Temporary block work has been placed to the front of the properties although a long-term solution is needed. An issue arising out of the installation of the temporary blocks is erosion at the ends and the effect this is having on adjoining properties. This is a very site-specific issue, which although it is outside the ambit of this strategy, will require a solution that is consistent with the strategy.

6.7 Waikanae to Peka Peka

1 Coastal Hazard Management Area – 6

CHMA-6 extends from the Waikanae River Mouth to, and including, Peka Peka settlement.

2 Coastline Characteristics and Practical Issues

- Management of the mouth of the Waikanae River, under the control of the Wellington Regional Council, has impacts on coastal processes and, thus, influences sediment behaviour on either side.
- The coastline between the Waikanae River and Waimeha Stream has been eroding over the last 3-4 years, with some housing potentially at risk if this trend continues.
- Lack of long-term monitoring of the coastline north of Waikanae River means assessment of the erosion risks is difficult.
- Erosion of the south shore of the Waimeha Stream estuary places some properties at risk from time to time. This erosion is more directly related to the position of the stream mouth than to wave action from the sea.
- The coastline north of Waimeha Stream is not presently of concern. Periodic erosion does occur but any development is generally set well back from the coastline, and thus the risks are not significant.



3 Consultation Response

Main Points

- Eleven submissions were received.
- There was general support for the preliminary draft strategy with 82% in support and none in opposition.
- There was general support for an increase in the level of erosion protection within the zone.

General Comments

- Two thirds of submitters supported an increase in the level of erosion protection in their area. One third of submitters supported the resulting increase in rates and another third saw the funding as the responsibility of beachfront property owners.
- Submitters requested that Wellington Regional Council prove that it is not compounding dune erosion through cutting the river mouth.
- The area needs a management plan, which must be agreed on by the beachfront owners.
- A beach care programme is supported with an emphasis on dune protection, public education and restrictions on vehicle usage.
- Opposition to use of seawalls and other hard structures as a form of erosion protection.
- Review how to reduce negative impact of 'hard' structures on beach such as stormwater pipes and boat ramps.

4 Response Methods

Methods Available	Evaluation
Do nothing / No Change	While the area is not presently subject to a high erosion risk, the community in general has voiced support for an increase in the level of erosion protection within the area.



Structural Measures	
Seawall	Not an appropriate option within CHMA-6 as not necessary or desired given community opposition, the existing building setback and the present lack of serious erosion risk. Effect on natural character and amenity values would be important considerations.
Rock Revetment	See above remarks referring to seawalls.
Road	Not applicable as there is no road fronting the beachfront.
Emergency works	Provision for emergency works not presently required. Allowance for such works in the future can be included in management plans and consents sought if considered necessary. In the meantime, it will be sufficient to rely on the provisions of S330 of the Resource Management Act (1991) with regard to any necessary retrospective consent for such works should they be required in future.
Non Structural Measures	
Regulatory	Appropriate to have some form of regulatory control over activities within CHMA-6 to prevent or mitigate exacerbating effects of erosion where there is insufficient protection or where a moderate level of risks remains even with protection works. Such controls would be in accordance with s.31 and the Second Schedule of the Resource Management Act 1991.
Beach Renourishment	Preferred method for coastal stabilisation, subject to further investigation.
Dune Conservation	See Beach Care programme, below. Requires planting programme and appropriate management of wind erosion including dune blowouts.
Beach Care	Appropriate as a method to increase awareness and enhance the natural character of the coastline. Requires community support and commitment. To be used in combination with other methods including dune conservation, above.
Education	Not an identified method in itself. To some extent will occur as part of



Monitoring	<p>the Beach Care programme.</p> <p>Ensure monitoring of beach profiles and extend beach monitoring to include Waikanae and appropriate points further north. Also include Waikanae River Mouth.</p>
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Preferred Method	Explanation, Costs, Action Required
Regulatory Controls	<p>Under the District Plan (Permitted activity standard D1.1.1 (iii)), an existing restriction imposes a 7.5m no-build area, measured from the seaward property boundary, on residential properties within Waikanae and 70.0m from the seaward edge of the existing Esplanade Reserve within the residential areas of Peka Peka.</p> <p>With respect to residential properties in Waikanae, it is proposed to replace the present requirements with a 50-metre wide coastal hazard area, with restrictions on subdivision and secondary dwellings. Within this hazard zone there would be a 25 m Primary Development Setback (PDS) in which subdivision would be prohibited and no new construction for habitation or commercial use would be permitted. Certain exceptions such as structures in connection with landscaping or outdoor living areas such as pools, decks, and patios subject to minimum setback and height restrictions would be provided. The remaining 25 m would provide for a Secondary Development Setback (SDS) where construction activities would be permitted subject to certain conditions, and provided a qualified structural engineer certifies to the effect that, in the event that it is threatened by coastal erosion, the building can be removed (appropriate access must therefore be available), or that it is robust enough to ensure that it is capable of withstanding the effects of such events without collapsing. Within the SDS, subdivision would be a discretionary activity.</p> <p>The seaward boundary of the setback shall be defined as the edge of the undisturbed land.</p> <p>The reasons for the 50-metre restriction are two fold – hazard protection and aesthetics. Although the width of the CHMA is primarily governed by hazard risk, aesthetics are also an important consideration to consider in this area.</p> <p>Given the natural character of the area it may also be appropriate to consider imposing additional setback requirements for aesthetic and natural character purposes.</p> <p>The 70 metre PDS zone at Peka Peka would remain, essentially for aesthetic reasons. Here, also, a 50 metre wide CHMA is sufficient from to meet hazard risk requirements.</p> <p>The 100-metre setback for rural properties would remain unchanged. While erosion along undeveloped parts of the coast is not presently a matter of concern, amenity values and natural character remain the determining issues.</p> <p>The District Plan Permitted Activity Standard for Earthworks also restricts earthworks within 20m of coastal water as a discretionary activity. It is proposed this remain unchanged, largely for aesthetic reasons and dune/beach protection.</p>



	<p><i>Associated Costs: Cost associated with the plan change, increasing if referred to the Environment Court.</i></p> <p><i>Action Required: Undertake changes to the District Plan in accordance with the Resource Management Act 1991.</i></p>
Monitoring	<p>Ensure continued monitoring of beach profiles, with appropriate consideration to adjusting/maintaining the beach volumes as required. Extend this programme to include Waikanae and points further north. This would provide data to enable quantification and assist in future management of the erosion risk between Waikanae River and Waimeha Stream.</p> <p><i>Associated Costs and Action Required: To establish and implement the monitoring programme, Liaise with Wellington Regional Council.</i></p>
Beach Care	<p>Introduce, and establish a beach care programme within the community with the purpose being to involve property owners in the management process and encourage initiatives to enhance the natural character of the coastline and maintain sand dunes. Techniques for stabilising sand dunes and promoting growth include, planting and fencing, and may also involve importing sand from elsewhere to augment dune volumes. In circumstances where there has been a build-up of sand on the beach, dune rehabilitation by means of beach scraping (scraping sand, generally from below Mean Sea Level, and placing on or in front of the foredune) may be considered. The associated cost with these measures will need to be considered by the Council in conjunction with the beach care group.</p> <p><i>Associated Costs: Facilitating the establishment of a beach care programme, promotion of the group, providing initial materials and on-going technical support.</i></p> <p><i>Action Required: Establishing the group, promoting community awareness, providing on-going guidance and direction.</i></p>

6.8 Peka Peka to Otaki

1 Coastal Hazard Management Area – 7

CHMA-7 extends from Peka Peka to the northern boundary of Kapiti Coast District at the Waitohu Stream, and includes Te Horo and Otaki.



2 Coastline Characteristics and Practical Issues

- Lack of monitoring of the coastline north of Peka Peka means quantification of the erosion risks is difficult.
- The coastline north of Peka Peka is not presently of concern. Periodic erosion does occur but any development is generally set well back from the coastline, and thus the risks are not considered significant.
- Coastline has important features in relation to its natural character.

3 Consultation Response

Main Points

- There were seven submissions from people concerned about this zone. Support for the preliminary strategy was variable.

General Comments

- Problems with stormwater outlets were noted.
- Highlight to visitors, ratepayers and residents, the problems that cause beach erosion and damage with emphasis on appropriate recreational use.
- Impose stricter enforcement of vehicular access onto the beach by using present by-laws.
- Better access from car parks requested.
- Annual monitoring of beach changes requested.
- Planting of native plants in sand dunes requested. Encourage improvement of dune areas.
- Prohibit 'hard' structures within 20-30 metres of high tide.
- Support of a local residents' beach care group(s).
- Erosion management is presently not a problem and is unlikely to become one under current planning approaches.



3 Response Methods

Methods Available	Evaluation
Do nothing / No Change	While the coastline is not currently of concern, and the erosion risk is low, the area does have physical qualities, high amenity values and other characteristics worthy of protection. In residential areas (Te Horo and Otaki Beach) it is preferable to take a precautionary approach to risk management, given the level and value of development and community use.
Structural Measures	
Seawall	Not an appropriate option within the CHMA as not necessary or desired given the low level of development, building setback and the lack of significant erosion risk. Effect on natural character and amenity values would be important considerations.
Rock Revetment	See comments regarding seawalls, above.
Emergency works	Provision for emergency works not presently required. Allowance for such works in the future can be included in management plans and consents sought if considered necessary. In the meantime, it will be sufficient to rely on the provisions of s.330 of the Resource Management Act (1991) with regard to any necessary retrospective consent for such works.
Non-Structural Measures	
Regulatory	Appropriate to have some form of regulatory control over activities within CHMA-7 to prevent or mitigate exacerbating effects of erosion where there is insufficient protection or where a moderate level of risks remains even with protection works. Such controls would be in accordance with s.31 and the Second Schedule of the Resource Management Act 1991.
Beach Renourishment	This is the preferred method for coastal stabilisation should mitigation measures become necessary.
Dune Conservation	See Beach Care programme, below. Requires planting programme and appropriate management of wind erosion including dune blowouts.



Beach Care	Appropriate as a method to increase awareness and enhance the natural character of the coastline. Requires community support and commitment. To be used in combination with other methods including dune conservation, above.
Education	Not an identified method itself. However, to some extent will occur as part of the Beach Care programme.
Monitoring	Extend monitoring programme for beach profiles.

Preferred Method	Explanation, Costs, Action Required
Regulatory Controls	<p>Under the District Plan (Permitted activity standard D1.1.1 (iii)), an existing restriction imposes a 7.5m no-build area (measured from the seaward property boundary) on properties within the residential area of Te Horo. Residential properties in Otaki are not subject to any Coastal Building Line restrictions above the standard side front and rear yard requirements.</p> <p>A minimum setback standard within the CHMA-7 should be applied to be consistent with the precautionary approach to risk management, given the variability in coastal processes. It is proposed to replace the present rules with a 50-metre wide coastal hazard management area for residential zoned-properties restricting subdivision and secondary dwellings, taken from MHWS. Within this hazard area there would be a 25 m Primary Development Setback (PDS) in which subdivision would be prohibited and no new construction for habitation or commercial use would be permitted. Certain exceptions such as structures in connection with landscaping or outdoor living areas such as pools, decks, and patios subject to minimum setback and height restrictions would be provided. The remaining 25 m would provide for a Secondary Development Setback (SDS) where construction activities would be permitted subject to certain conditions, and provided a qualified structural engineer certifies to the effect that, in the event that it is threatened by coastal erosion, the building can be removed (appropriate access must therefore be available), or that it is robust enough to ensure that it is capable of withstanding the effects of such events without collapsing. Within the SDS, subdivision would be a discretionary activity.</p> <p>The seaward boundary of the setback shall be defined as the edge of the undisturbed land.</p> <p>The 50-metre restriction is predominantly for hazard management. A further restriction similar to that existing at present may be appropriate for other purposes (natural character and amenity values). To this end, the 100-metre</p>

	<p>setback for rural properties would remain unchanged as is appropriate to retain the natural character of the undeveloped area of coastline.</p> <p>The District Plan Permitted Activity Standard for Earthworks also restricts earthworks within 20m of coastal water. Given the low erosion risk in this management zone, this restriction should remain unchanged as it is unlikely retaining walls are necessary structure and therefore any built should be subject to assessment.</p> <p><i>Associated Costs: Cost associated with the plan change, increasing if appealed.</i></p> <p><i>Action Required: Undertake changes to the District Plan in accordance with the Resource Management Act 1991.</i></p>
Monitoring	<p>Extend beach profile monitoring programme. Although no identified erosion risk, important to gather information for further reference.</p> <p><i>Associated Costs and Action Required: To establish and implement the monitoring programme.</i></p>
Beach Care	<p>Introduce, and maintain a beach care programme within the community with the purpose being to involve property-owners in the management process and encourage initiatives to enhance the natural character of the coastline and rebuild dunes.</p> <p><i>Associated Costs: Facilitating the establishment of a beach care programme, promotion of the group, providing initial materials and on-going technical support.</i></p> <p><i>Action Required: Establishing the group, promote community awareness, and provide on-going guidance and direction.</i></p>
Miscellaneous	<p>Maintain and clear stormwater outlets.</p>

6.9 Coastal Hazard Management Area Maps

The maps included on the following pages show each of the Coastal Hazard Management Areas.



6.10 References

US National Research Council, Marine Board. (1995): Beach Renourishment and Protection, *National Academy Press*, Washington DC, 334 pp.

Vesterby, H. (2003): Kapiti Coastline Coastal Restoration and Stabilization Beach-face Dewatering Site Inspection Report. *Unpublished report to Kapiti Coast District Council*, March 2003.

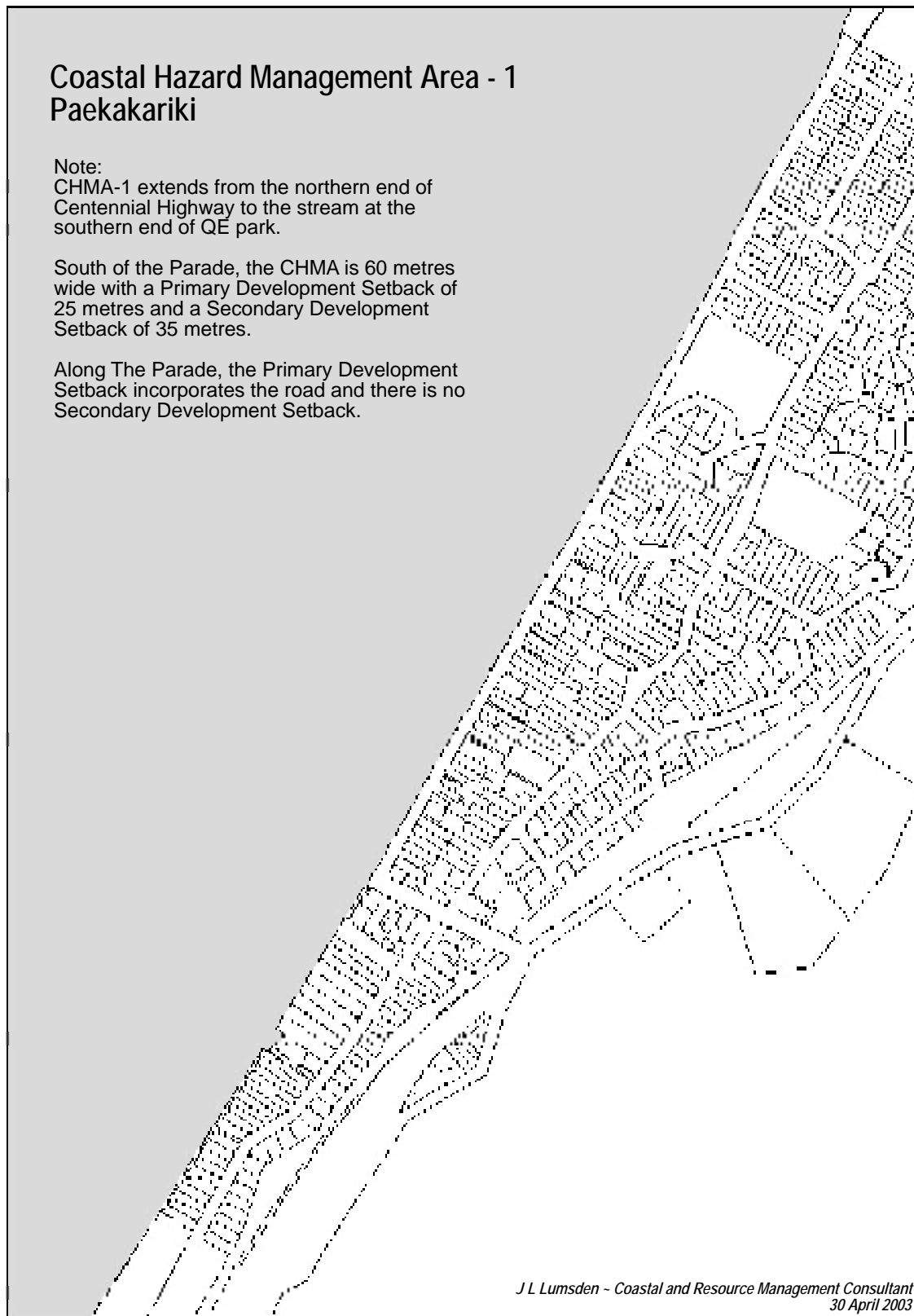


Figure 6.1: Coastal Hazard Management Area – 1: Paekakairiki

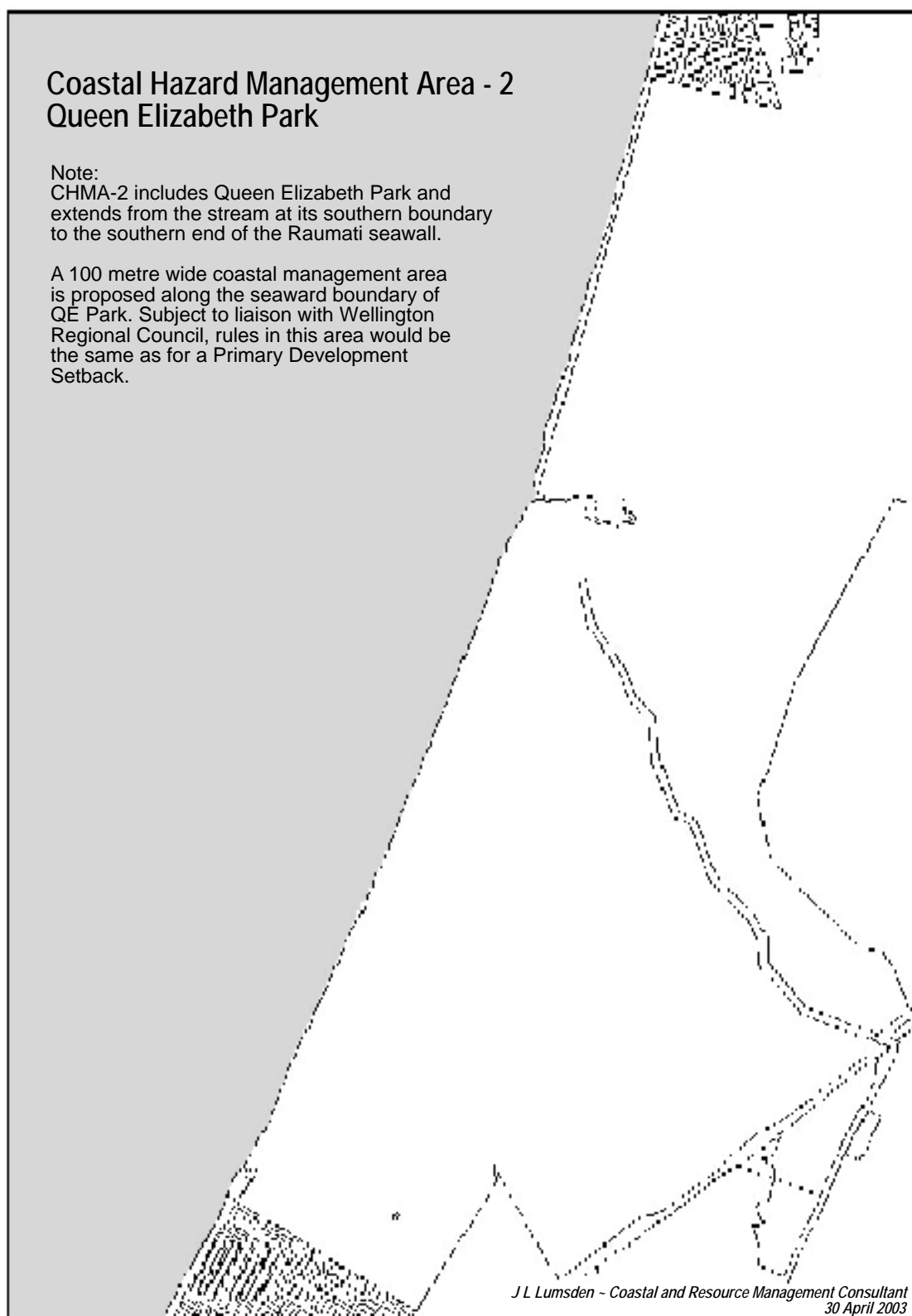


Figure 6.2: Coastal Hazard Management Area – 2: QE Park

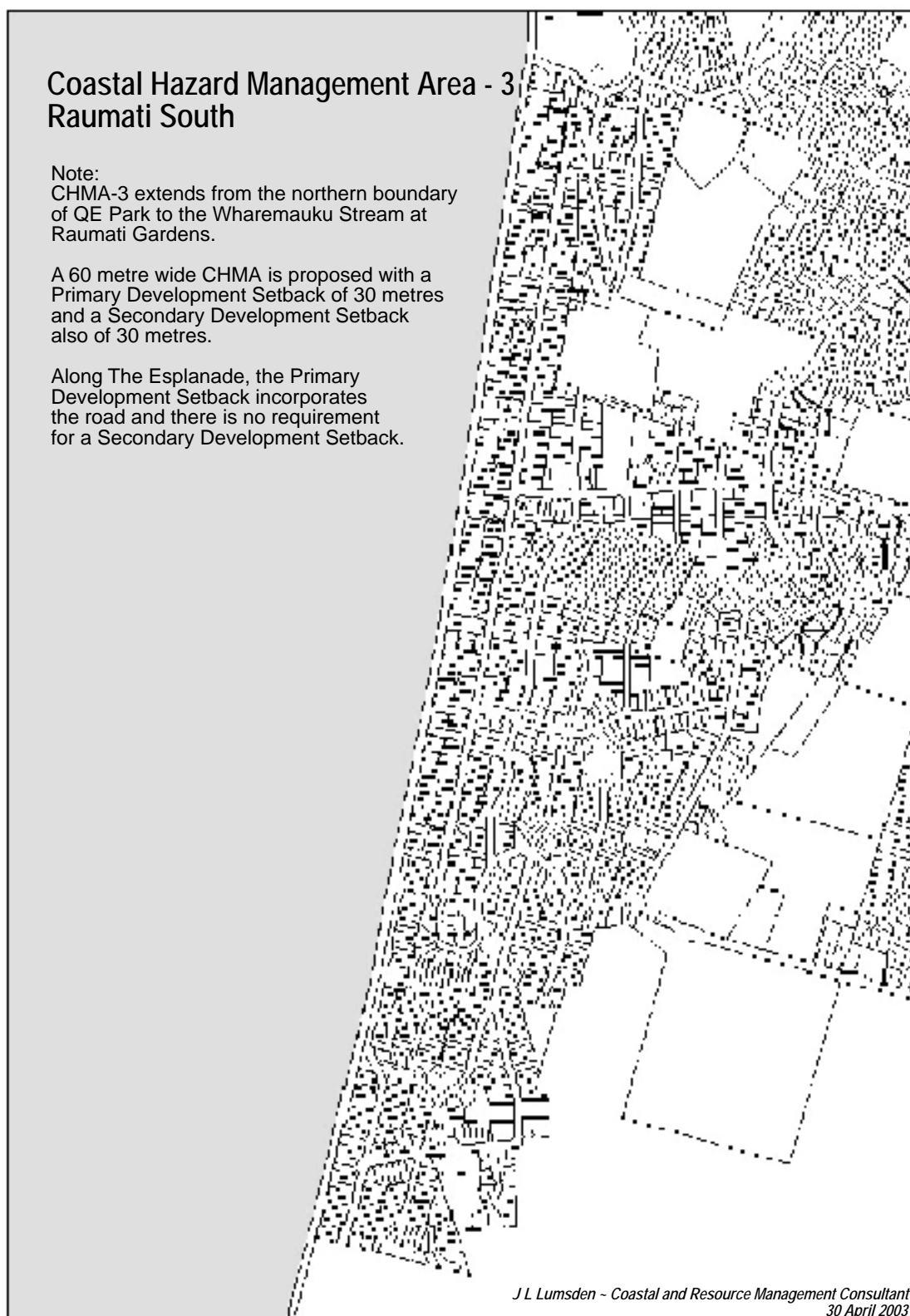


Figure 6.3: Coastal Hazard Management Area – 3: Raumati South

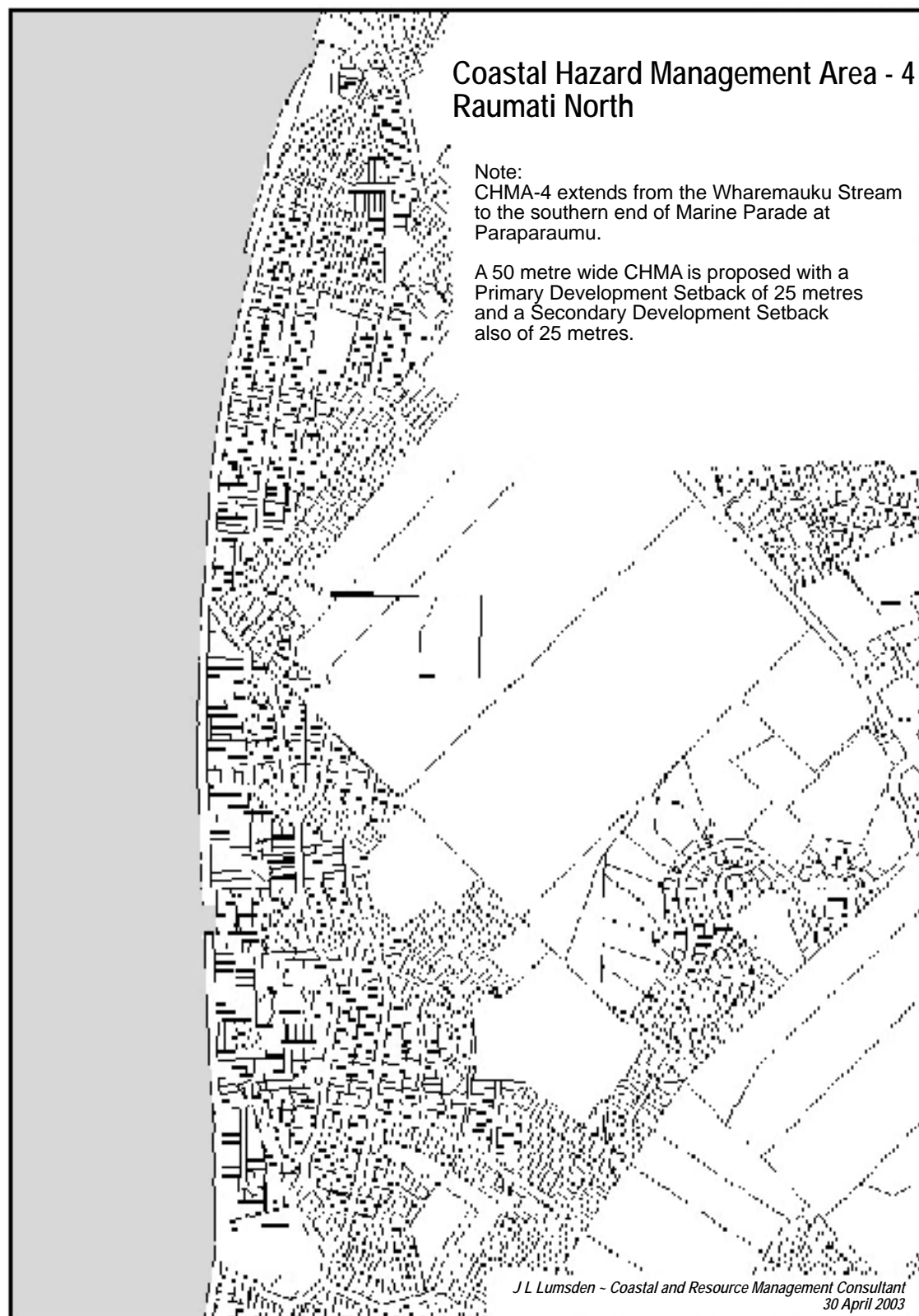


Figure 6.4: Coastal Hazard Management Area – 4: Raumati North

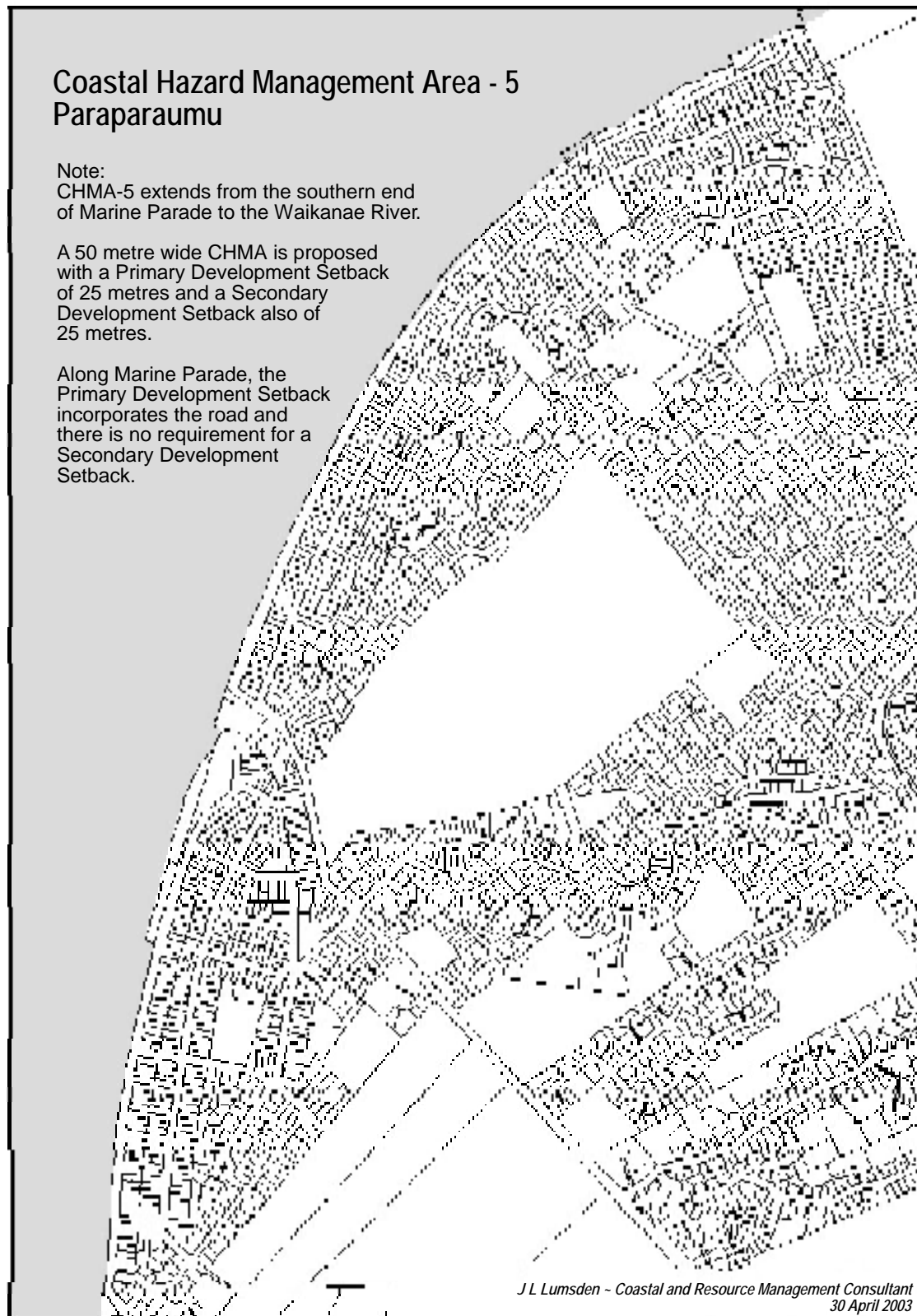


Figure 6.5: Coastal Hazard Management Area – 5: Paraparaumu

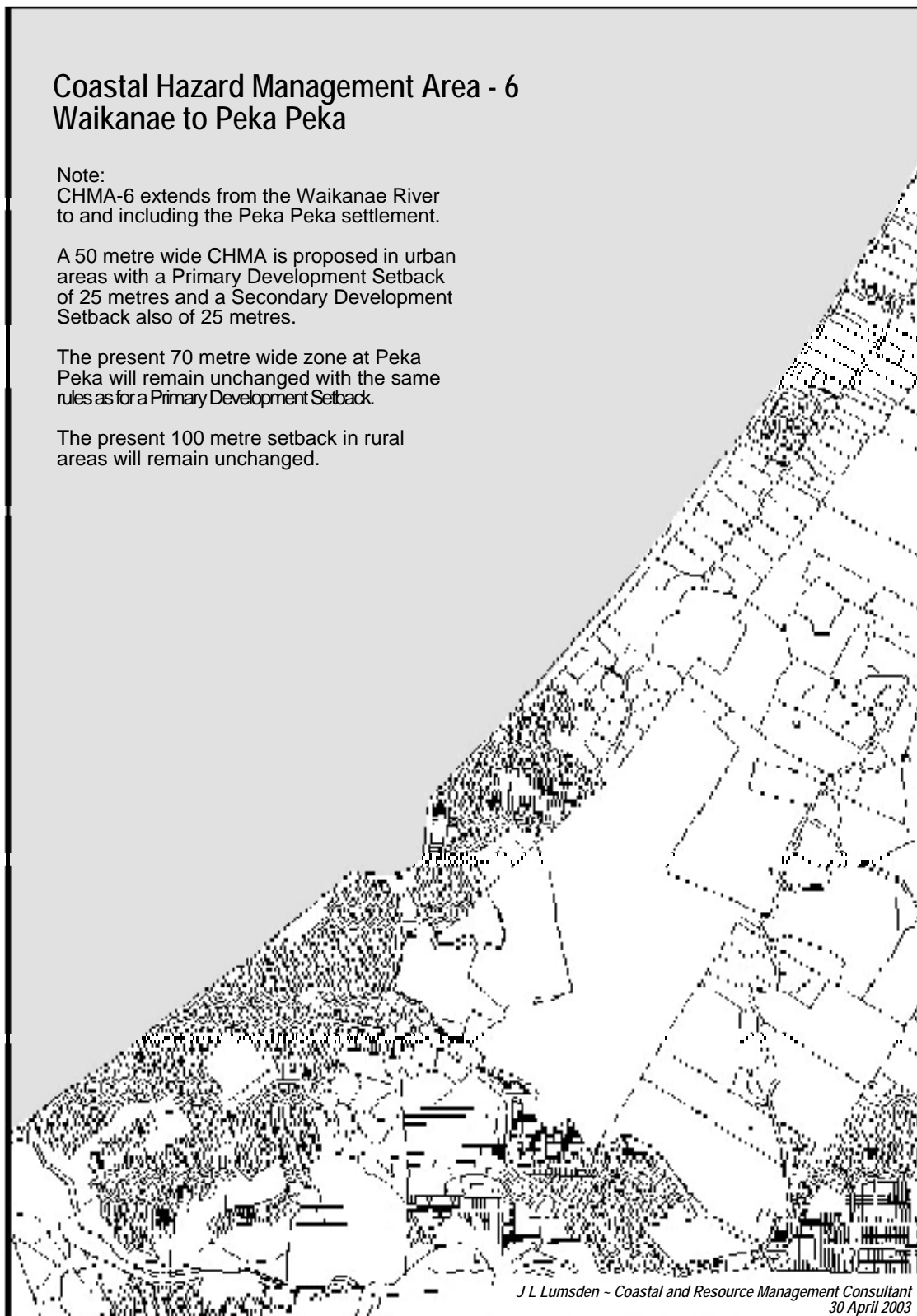


Figure 6.6: Coastal Hazard Management Area – 6: Waikanae- Peka Peka

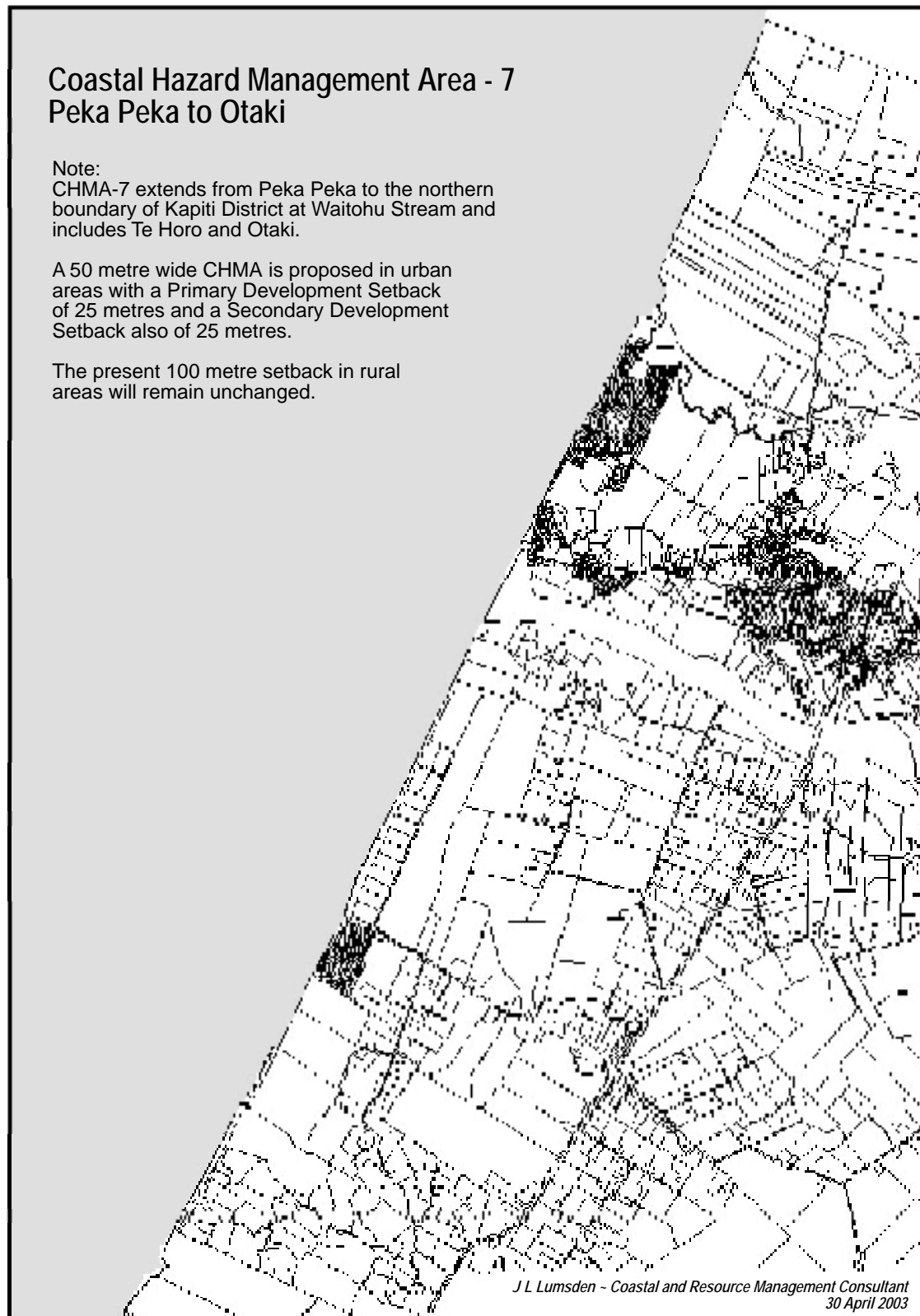


Figure 6.7: Coastal Hazard Management Area – 7: Peka Peka – Otaki



7 District Plan Analysis

This section reviews existing District Plan provisions regarding coastal hazard management. The first part reviews the relationship of the District Plan with the proposed Coastal Erosion Management Strategy. The second part reviews the existing provisions of the District Plan regarding coastal hazard management, and makes some recommendations for changes to those provisions in line with the recommendations of the Coastal Erosion Management Strategy

7.1 District Plan

1. Scope of District Plan Provisions

Under the Resource Management Act, Wellington Regional Council manages all activities occurring below the Mean High Water Spring (MHWS) level, in the area known as the Coastal Marine Area. The Wellington Regional Council's policies and controls for the coastal marine area are set out in the operative Regional Coastal Plan. Erosion control works such as rock revetments, groynes or walls, if located below MHWS, may require resource consent from the Wellington Regional Council. However, it is not within the scope of this review to consider the regional policies and controls applying to any works or activities.

Above MHWS, activities are managed under the provisions of the Kapiti Coast District Plan. Under the Resource Management Act, the Kapiti Coast District Council has the ability to impose controls on activities (land use and/or subdivision) that may result in an adverse effect on the environment, including an activity that may worsen the risks posed by coastal erosion. Such controls – called 'rules' – have the force of regulation, and may be imposed if the District Council is satisfied that such rules are necessary in achieving the purpose of the Act, and are the most appropriate means of exercising the function, having regard to their efficiency and effectiveness relative to other means.

However, outside the Resource Management Act, the Kapiti Coast District Council does have general jurisdiction over the coast: for instance, it can impose bylaws managing activities on the beach. Furthermore it can construct and maintain protection works along the beach, subject to consent from Wellington Regional Council.

2. Relationship between the District Plan and the Coastal Erosion Management Strategy

It is proposed that a Coastal Erosion Management Strategy (CEMS) be established in accordance with the recommendations of this study, to provide a long-term programme for all actions undertaken by the Kapiti Coast District Council in regard to the management of coastal hazards within the District. Such a strategy would be a non-statutory document (i.e., not required by any specific statute), but would be subject to Council approval through a resolution under the Local Government Act. The Strategy would sit outside the District Plan, which is a statutory document, required under the Resource Management Act. Funding for the programmes under the CEMS would occur through the Council's annual planning processes under the Local Government Act.

The District Plan is the principal mechanism for setting out the Council's policies for the management of the coastal environment, including hazards. While the District Plan cannot impose any controls (rules) within the Coastal Marine Area (which is a function of Wellington Regional Council), it can impose controls on the landward side of MWHS. The District Plan can also set out the general policies relating to the Council's other functions and responsibilities along the coast where they have relevance to addressing resource management issues under the District Plan, including coastal hazard management. For this reason, a core means of implementing the CEMS will be through the objectives and policies of the District Plan, as well as through any regulatory controls.

7.2 The Role of District Plans in Hazard Management

The following is an overview of the rationale for resource management controls in regard to coastal erosion hazard management purposes. In particular, it addresses the question of why district councils can and should impose land use controls under the Resource Management Act 1991 (RMA), rather than letting private landowners bear the risk themselves.

1. Part II of the RMA

Part II of the RMA is the starting point for all matters, and sets out the purpose and principles of the Act. In particular, the purpose of the RMA is set out in section 5, namely the promotion of the sustainable management of natural and physical resources.

Section 5(2) of the RMA defines sustainable management as follows (emphasis added):

In this Act, “sustainable management” means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while –

- (a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
- (b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
- (c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment*

It is clear when considering the meaning of sustainable management that the coastal environment, and properties and structures within that environment, are natural and physical resources that are subject to the purposes and principles of the RMA.

In the matters of national importance referred to in Part II of the RMA, the significance and importance of the natural character of the coastal environment in New Zealand must be given recognition by the District Council. In addressing this matter, Plans may limit development on or near the coastline, which would have the (albeit indirect) consequence of reducing the exacerbation of risks from coastal hazards. More important, even when the coastline may be urbanised, managing further development may avoid or reduce the need for protection works, which have a significant impact on the natural character of beaches.

2. Functions and duties of local authorities

Perhaps one of the most compelling reasons why district councils should be involved in land use planning for coastal hazard management purposes is found in section 31 of the RMA, which sets out the functions of territorial local authorities under the RMA. Those functions of particular relevance in this context are the following:

- The establishment, implementation, and review of objectives, policies, and methods to achieve integrated management of the effects of the use, development, or protection of land and associated natural and physical resources of the district;
- The control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the avoidance or mitigation of natural hazards; and
- The control of subdivision of land.

Arising from these statutory functions are a number of matters that, either directly or by implication, relate to coastal hazard management and impose specific obligations on territorial authorities to manage and provide for coastal hazards under the RMA. One important concept is that of *integrated management* of effects throughout the district, which implies a strategic approach is required, rather than "one-off" or *ad hoc* responses. This is particularly important in managing coastal hazards to avoid the adverse "downstream" effects that are caused by protection works.

It is also a duty of every local authority under section 35 of the RMA to gather information, monitor the state of the environment and the exercise of its functions and powers, and keep records regarding these matters. The information that is required to be kept by local authorities includes records of natural hazards. This section ensures that councils monitor the state of the environment in their district, the effect of their policies and decisions, and that they review their district plans where appropriate to respond to new information or environmental issues. Where there is information indicating that there is a significant environmental issue, the Council is obliged to address it.

It is important to note that the extent and type of District Plan controls cannot be isolated from the decision-making process for councils under the Local Government Act 2002 (LGA). For instance, policies requiring active protection from coastal hazards would not sit easily without corresponding funding decisions under the LGA. Similarly, if the community outcomes identified under the LGA include natural hazard mitigation, then there should be some corresponding response through the District Plan.

3. New Zealand Coastal Policy Statement

The New Zealand Coastal Policy Statement (NZCPS) sets out a number of policies that are intended to achieve the purpose of the RMA in relation to the coastal environment of New Zealand. The uncertainty associated with the effects of coastal processes and natural hazards in the coastal environment is specifically acknowledged in the General Principles of the NZCPS as follows:

In addition to the foregoing, to provide for the special context of the coastal environment, regard shall be had to the following general principles:

...

7. *The coastal environment is particularly susceptible to the effects of natural hazards.*

...

12. *The ability to manage activities in the coastal environment sustainably is hindered by the lack of understanding about coastal processes and the effects of activities. Therefore, an approach, which is precautionary but responsive to increased knowledge, is required for coastal management.*

There is further express recognition of the scientific uncertainty associated with the effects of coastal processes and natural hazards in the NZCPS (for example, in policies 3.3.1, 3.4.1, 3.4.2, 3.4.5 and 3.4.6), particularly as it relates to development and protection of land and structures in the coastal environment. These policies are important, particularly when considering the contents of district plans in the overall hierarchy of planning documents.

4. The Regional Coastal Plan

Preparation of these plans by regional councils is mandatory under the RMA, and this will inevitably give rise to interface and potentially overlap issues with district plans. Regional coastal plans can impose restrictions on activities above Mean High Water Springs and give rise to the need for coastal permits for coastal protection works. It is therefore important that there is a degree of consistency between regional coastal plans and district plans.

The Wellington Regional Coastal Plan does not recognise coastal protection works as one of the appropriate forms of structures in the Coastal Marine Area (see Policy 6.2.1). Furthermore, it seeks to avoid structures in the Coastal Marine Area that may have significant adverse effects on, inter alia, coastal processes, the risks from natural hazards (for example, protection works can affect erosion rates elsewhere), amenity values, natural character and existing lawful public access (Policy 6.2.2).

The Plan specifically seeks to discourage ad hoc protection structures and not to allow development of “hard” shore protection structures unless all feasible alternatives have been evaluated and found to be impracticable or to have greater adverse effects on the environment (Policy 6.2.3).

5. District Plans

Every territorial authority is obliged to prepare a district plan under the RMA, in accordance with its statutory functions under section 31. Section 75 provides for a number of matters that district plans must provide for, including matters set out in the Second Schedule to the RMA. To a certain extent, clause 1 of the Second Schedule mirrors section 31 of the RMA, and states that a district plan shall make provision for:

Any matter relating to the management of the use, development, or protection of land and any associated natural and physical resources

for which the territorial authority has responsibility under this Act, including the control of –

- (a) Any actual or potential effects of any use of land described in section 9(4)(a) to (e), including –*
- (i) For the purpose of the avoidance or mitigation of natural hazards...*

One important point relating to the contents of district plans is section 75(2) requires that that they must not be inconsistent with the NZCPS, or regional policy statements and plans. Accordingly, rules in district plans should reflect the relevant policies set out in the NZCPS. Section 32 of the RMA requires such controls to be justified in accordance with that provision.

6. Other Relevant Provisions

Section 106 of the RMA is currently a prohibitive provision which amounts to a jurisdictional barrier against the grant by a district council of a subdivision consent where any land in respect of which a consent is sought, or any structure on that land, is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source – which would include such effects resulting from coastal hazards. A consent authority may however grant subdivision consent in such circumstances if it is satisfied that the effects of the natural hazards will be avoided, remedied, or mitigated by one or more of the following:

- Rules in the district plan;
- Conditions of a resource consent;
- Other matters, including works.

A number of councils identify such hazard prone areas in their district plans (for example, coastal hazard areas, ground shaking or liquefaction areas), and include rules or other provisions in those plans which impose subdivision or development restrictions. Effectively, section 106 requires an applicant to satisfy a council by proposing measures (or providing satisfactory evidence) to enable that council to grant subdivision consent (Note: the Resource Management Amendment Bill (No.2) currently before Parliament does, however, propose a less prescriptive regime with regard to subdivision of hazard prone land).

7. Summary

It can be seen that there are a series of interrelated statutory responsibilities and constraints imposed on councils by the RMA regarding the coastal environment and natural hazards. The scheme of

the RMA is that councils have mandatory statutory functions and duties that impose obligations to address the effects of natural hazards, including coastal hazards. The RMA also appears to recognise that, as a result of their monitoring and information gathering duties, councils are also best placed to formulate and impose land use controls on development in the coastal environment.

In addition to the coastal environment, councils also have wider responsibilities under the RMA to sustainably manage other resources, and are required to achieve the integrated management of natural and physical resources through the district. In these circumstances, it is proper that councils put in place appropriate land use controls under the RMA. In some circumstances, this may result in landowners bearing a certain degree of risk, but this is usually preferable to ad hoc or poorly integrated protection measures being pursued by individuals that could create unforeseen environmental effects or, cumulatively, much larger costs.

7.3 Analysis of Principal Planning Options

Arising from the detailed analysis of alternative methods for coastal erosion management presented in section 6, there appear to be three main options for the District Plan to approach the management of coastal erosion hazards:

- 1 **Remove all regulatory controls** – rely on non-regulatory methods such as protection works, community beach-care schemes, private works, and/or allow development at owners' risk; or
- 2 **Retain existing controls** – rollover the current rules managing subdivision and land use and development within the coastal hazard areas, in conjunction with recommended non-regulatory methods; or
- 3 **Replace controls** – remove existing controls and impose new controls in conjunction with the recommended non-regulatory methods in accordance with the recommendations of the Hazard Management Analysis in section 6.

The advantages and disadvantages (including costs and benefits) of these options are summarised below. It should be noted that it is neither feasible nor appropriate to quantify costs with any specificity, given the enormous number of variables involved, and the dynamic nature of the coastal environment. The analysis is therefore, by necessity, applied at a broad level, with the benefits and costs identified on a comparative basis: i.e., the relative costs between options.

It should also be noted that regulatory controls are only effective in relation to managing the potential for an *exacerbation* of risks from coastal erosion hazards: that is, the intensification of subdivision, land use, buildings and habitation arising from new development (including alterations and additions to existing buildings). It is not generally

effective for *reducing* the level of risks due to existing rights provided under the Resource Management Act (recognising though that stringent controls may inhibit further intensification). The analysis below, therefore, is focused on the effectiveness of the three main approaches at avoiding or reducing the exacerbation of risks from coastal erosion hazards.

1. Non-Regulatory Approach – Remove all Controls

Under this option, all regulatory controls on subdivision and development relating to the management of the hazards from coastal erosion within the existing District Plan would be removed, with full reliance made on non-regulatory methods as outlined in section 6 of this report, including coastal erosion works along some sections of coastline, beach care programmes, emergency works as required, and monitoring.

In addition to the overview provided in the previous subsection (“The Role of District Plans in Hazard Management”), a completely non-regulatory approach would have the following advantages and disadvantages to Council:

Advantages/Benefits

- No costs for implementing controls (for example, consent processing) or for enforcement;
- Liability rests on property-owners (except where existing protection works were built and maintained by and remain the responsibility of the District Council);
- Property-owners responsible for costs of private protection works, including resource consent applications to Wellington Regional Council.
- Removal of controls may increase property-values.

Disadvantages/Costs

- A lack of controls would likely result in a variable and inconsistent approach along the entire coastline and therefore not promote the integrated management of coastal erosion hazards, contrary to the function of the District Council under the RMA;
- It would be difficult to prevent the exacerbation of existing risks;
- Potential loss of amenity values if property owners allowed to build closer to the coast.
- Individual private property protection works generally unlikely to obtain the necessary resource consents from the Wellington Regional

Council, given the policies relating to structures and protection works in the Wellington Regional Coastal Plan (see above);

- As outlined in section 7.2, the Council has a responsibility under the Resource Management Act to proactively address the risks from natural hazards to natural and physical resources, particularly given that –
 - *Section 6(a) of the Resource Management Act* requires that regard be given to protecting the natural character of the coastal environment - protection works would have a significant impact on the natural character of a beach, while a development setback would be consistent with this statutory duty.
 - The policies of the *New Zealand Coastal Policy Statement* reinforce the need to avoid protection works (in particular, Policies 3.4.5 and 3.4.6) and, in general, protect the natural character of the coastal environment.
 - The policies of the *Wellington Regional Coastal Plan* (notably policies 6.2.1-3) that require the avoidance of coastal protection structures within the Coastal Marine Area, unless there are no feasible alternatives.
- Controls ensure that the levels of risk are taken into account at a critical part of the decision-making process for subdivision and development – i.e., addressing regulatory requirements in making decisions on development;
- Council obligated to provide information on known levels of risk from coastal erosion, which may negate effect of removing controls.
- Given the current level of knowledge on risks, the Council may be obligated under section 36 of the Building Act to impose restrictions on property titles.
- It is more cost effective to prevent further exacerbation of risks from coastal erosion hazards than to rely on protection works, given –
 - The costs of protection work, including ongoing maintenance and emergency works;
 - The significant adverse visual and amenity effects of protection works on the coastal environment;
 - The adverse effects of protection works on public access and general enjoyment of the coastal environment, and the consequent economic impacts;
 - The adverse effects that protection works can have on other parts of the coastal processes (such as depleting sand supply to other parts of the beach, and thereby exacerbating erosion rates);
 - There is the potential for large costs to be occurred if uncontrolled development becomes subject to erosion, and the

District Council is required to undertake emergency works and potentially permanent protection works (with all the associated environmental effects).

- There are no effective alternative means of managing the exacerbation of risks arising from further subdivision and development: for example, codes of practice are not enforceable outside the District Plan, and there are no other statutory powers that could appropriately be used to avoid exacerbating risks.
- The recommended Management Strategy is based on an appropriate combination of methods that, collectively, would provide the most effective form of managing the risks from coastal erosion – removal of any controls would require a reconsideration of the strategy, and likely bring about a reliance on a less cost effective combination of methods.
- Given the pattern of property titles along the coast, such controls would not prevent the enhancement of properties and their continued enjoyment in that most properties would be developable outside the PDS, and existing residences can continue to be maintained and used.

Conclusion

While the removal of controls would have some benefits, particularly in terms of property values and regulatory costs, these would be outweighed by the disadvantages and costs, including –

- It would not be consistent with the purpose of the Act, nor with relevant policies on the New Zealand Coastal Policy Statement and Wellington Regional Coastal Plan;
- It would be unlikely to prevent the exacerbation of risks from coastal hazards, which would increase the contingent costs of protection to the community, as well as the need to construct and maintain a greater level of protection works with a subsequent adverse effects on the natural character of the coastal environment, public access and the general enjoyment of the beaches; and
- It would not be consistent with an integrated management approach towards managing the coastal environment, and would adversely affect the use and enjoyment of the coastline for future generations.

2. Regulatory Approach – Retain Existing Controls

The analysis of hazard management options (section 6) determined that it would not be appropriate to retain the existing set of controls along the coastline other than within some of the rural coastline. In reviewing the advantages and disadvantages of this approach, the following findings were made:

Advantages/Benefits

- Current controls are known and familiar;
- In places along the coastline, the existing controls provide more than adequate means of preventing the exacerbation of risks (for example, the 70m and 100m setbacks in the rural areas north of Waikanae).
- No cost to Council to change the present rules.

Disadvantages/Costs

- It would be inappropriate to retain many of the existing setback distances, given that the information and methodologies on which they were based some 20+ years ago have been superseded by current data and knowledge on which this recommended management strategy is based.
- Some of the existing setbacks are inadequate, given the known levels of risk.
- The current controls were implemented under different legislation at different times, and introduced by several local authorities that existed prior to local government amalgamation in 1989 – the current review is in accordance with the purpose and principles of the Resource Management Act.
- The present inconsistencies in approach and rationale among the existing hazard management controls would remain, which would be inappropriate and unreasonable.
- Setback distances need to be correlated with the modified levels of risk arising from the risk assessment and from the levels of risk that would result from the recommended actions for protection works.
- There are some practical difficulties associated with the current controls. In particular, the “relocatable” housing policies along some parts of the coastline may not be fully effective, given the uncertainties that have arisen in the application of this requirement – for example, in defining and determining the meaning of “relocatable”.

Conclusion

The retention of the existing controls would have many of the advantages and benefits that would not be attained by the removal of controls. However, while the retention of the existing controls would have some benefits, particularly in terms of familiarity and the likely costs of introducing new controls, these would be outweighed by the disadvantages and costs relative to the recommended controls in that –

- It would be inappropriate and unreasonable to retain the existing controls, given the state of current knowledge and the effect of controls on properties.

- The existing controls are not as effective or targeted as the recommended controls.
- It would not be consistent with an integrated management approach towards managing the coastal environment, and may result in the need to implement a less cost-effective management strategy: for example, through more costly protection measures.

3. Regulatory Approach – Replace with New Controls

Having regard to the above conclusions, the introduction of new planning controls in accordance with the recommended management strategy would be the most effective and appropriate method. The principal advantages and disadvantages of this option are as follows:

Advantages/Benefits

- This would ensure a consistency of methodology, approach and rationale in the application of controls, which would be reasonable to all property-owners;
- The management of development would be in accordance with the currently known levels of risk determined by this study;
- This option would ensure that the planning controls directly relate to the levels of risk associated with the recommended protection works and other recommended actions – i.e., part of the proposed integrated management strategy, meeting the requirements of the Resource Management Act; and
- This option would ensure that the planning controls have had the input of current property-owners and the wider community.
- In the interests of promoting uniformity of management practice on the New Zealand coastline, terminology developed by Environment Waikato has been used to describe the construction setback provisions.

Disadvantages/Costs

- Costs of implementation, monitoring and enforcement (for resource consent applicants and Council) – however, while these costs are relatively comparable to the retention of current controls, the recommended controls would be more defensible and potentially less costly;
- Total avoidance of exacerbation of risks cannot be achieved due to the uncertainties involved with coastal erosion; and
- A level of discretionary assessment would still be required in determining resource consent applications.

Conclusion

While the introduction of the recommended controls would have some disadvantages/costs, many of these are either comparable or less than the costs entailed with retention of the existing controls. In total, the benefits and advantages would outweigh such costs, in that –

- The level of controls would be in accordance with the most current information and the estimated levels of risks;
- The controls would recognise the current and recommended circumstances along each section of coastline, including the levels of current and future risks;
- The controls would not prevent the further development and enjoyment of properties along the coastline, while avoiding the need for extended protection works, and thus the adverse effects and costs to be borne by the community and local property-owners; and
- It would be consistent with an integrated management approach in managing the coastal environment for future generations.

7.4 Issues, Objectives and Policies

1. Current Provisions

Currently the relevant objectives and policies relating to the management of coastal hazards under the operative Kapiti Coast District Plan are separated into two sections of Chapter 5, “Objectives and Policies”: C.9 Coastal Environment, and C.15, Natural Hazards.

Coastal Environment

The objectives and policies on the Coastal Environment are primarily focused on the protection of natural coastal values (ecology, natural character and amenity values), public access to the coast and the relationship of tangata whenua with the coast. Under these matters, there are a number of policies that directly relate to coastal hazard management, namely:

C.9.1 Objective 1 - Protection of Natural Coastal Values

...Policy 2 – Discourage the development of buildings and other significant assets in areas which may be prone to coastal erosion or the effects of sea level rise, unless the structures:

- *Have a significant community benefit and need to be located in the coastal environment; and*

- *Do not adversely effect the natural character of the coastal environment; and*
- *Are relocatable.*

Policy 3 – *In respect of residential buildings, control the location of buildings within areas subject to coastal erosion.*

Policy 4 – *Discourage coastal protection works on the Coastal Marine Area interface where they are not already present and encourage management options such as managed retreat and coastal renourishment rather than hard engineering works when protection works are sought....*

There are also a number of relevant policies under Objective 2, which seeks “to facilitate public access to and along the coast”:

C.9.1 Objective 2 – Public Access

...Policy 1 – *Require the creation of Esplanade Reserves along the entire coastline of the district....*

Policy 3 – *Protect the foredunes and the adjacent Coastal Marine Area from disturbance and damage by vehicles and from the adverse effects created by public access points.*

In regard to Policy 1, one of the purposes of esplanade reserves is to mitigate the risks of natural hazards, including erosion. In terms of Policy 3, disturbance of dunes from vehicles and by access in general is another potential source of erosion when protective vegetation is destroyed and the dunes become subject to wind erosion.

Under Objective 3, “to recognise and provide for the relationship of tangata whenua with the coastal environment”, are the following policies of relevance:

Policy 1 – *Provide for tangata whenua input into the decision-making process, regarding proposals affecting policies and the coastal resources of importance to tangata whenua....*

Policy 3 – *Recognise and provide for Kaitiakitanga by tangata whenua in the management of the coastal environment.*

Natural Hazards

Section C.15 of the District Plan addresses the issues arising from natural hazards, including coastal hazards, which are divided into four types:

- Long-term erosion of the shoreline;
- Short-term erosion of the shoreline [through storm events];

- Erosion from river mouth migration; and
- Wind erosion of dunes.

Notably, hazards arising from tsunamis and inundation are not identified.

There is one objective set out in relation to natural hazards management in the district: Objective 1.0 - “To manage activities and development within natural hazard prone areas so as to avoid or mitigate the adverse effects of natural hazards.”

There are nine concomitant policies, of which the most relevant to coastal erosion are:

Policy 1 – Permit subdivision and development where the effects of natural hazards can be avoided, remedied or mitigated

Policy 2 – Ensure services are designed to resist natural hazard events.

Policy 3 – Ensure appropriate uses, zones and performance standards are developed for areas known to be liable to flooding, coastal erosion and ground rupture from faults....

Policy 5 – Promote community awareness of natural hazards to encourage avoidance of adverse effects of natural hazards....

Policy 7 – Avoid and/or mitigate the potential adverse effects of flooding and erosion from major rivers and the sea on:

- Human life, health and safety,
- Private or community property,
- Flood mitigation works, and other natural and physical resources

when planning for and making decisions on new subdivision, use and development within river corridors and adjacent to the sea.

Policy 8 – Recognise the ability of natural features (such as sand dunes) to buffer development from natural hazards through performance standards including minimum setbacks for new and relocatable buildings.

2. Recommended Changes

Provide updated summary of issues related to coastal hazards in Section C.15, based on findings of this Study

The description of the issue under Section C.15 of the District Plan under the subtitle of “Coastal Hazard[s]” should be replaced with a summary of the key findings from this study.

Transfer Policies 2, 3 and 4 under Objective 1, Section C.9 (Protection of Natural Coastal Values) to Section C.15 (Natural Hazards Management)

It would be preferable to contain all policies of direct relevant to coastal hazard management within one section of the Plan, with the use of cross-referencing from other sections as required, or, where there is a need for an integrated policy approach, the provision of a clear linkage.

Thus, notwithstanding any changes that may be made to the policies and their wording, it is recommended that Policies 2, 3 and 4 referred to in Section C.9, under Objective 1, “**Protection of Natural Coastal Values**”, be transferred to the Natural Hazards policies of the Plan under Section C.15.

Add further explanation to policies under Section C.9.1 Objective 2, Public Access

The policies under Public Access do not need to be transferred, but an explanation is needed as to the relevance of esplanade reserves and protection of damage to foredunes for natural hazards mitigation.

Amend or add to policies under Section C.15 to reflect the general courses of action proposed under the Coastal Erosion Management Strategy

Many of the policies under Natural Hazards section relate to all natural hazards, and not solely coastal hazards: given their generic scope, therefore, it may not be necessary to amend these policies significantly. However, wherever necessary, it is recommended all policies in this section be either amended as required or rationalised to ensure they cover the following courses of action in accordance with the CEMS:

- 1 *Recognise and protect the ability of natural processes and features (such as sand dunes) to buffer development from natural hazards.*
- 2 *Coastal protection works that have significant adverse effects on the natural character, visual and amenity values, public access and recreation and the relationship of tangata whenua with the coastal environment should be discouraged, unless there is a*

high risk of significant cumulative property damage and/or such works already exist.

- 3 Manage subdivision and land development within that area subject to significant coastal erosion hazards according to the level of risk from fluctuations in natural beach processes under existing sea level and climatic conditions, given the latest information and knowledge.*
- 4 Subdivision and the construction of structures for occupancy (i.e., for habitation or commercial uses) should be prevented from being constructed within land subject to significant risk from fluctuations in natural beach processes under existing sea level and climatic conditions.*
- 5 Structures for occupancy (i.e., for habitation or commercial uses) should only be constructed within land subject to moderate risk from sea level rise and climate change over the next 100 years provided they meet appropriate conditions to satisfactorily mitigate the risks.*
- 6 Promote community awareness about and initiatives for the avoidance or mitigation of adverse effects of natural hazards.*
- 7 Encourage management options such as managed retreat, coastal renourishment and planting in preference to hard engineering works, provided they are effective.*
- 8 The effects of coastal protection works on public access and visual values should be satisfactorily avoided or mitigated.*
- 9 Continued investigation and assessment into coastal processes and the consequent effects on natural hazards, particularly in areas of coast where there are uncertain relationships between processes and activities, and/or where there are significant potential risks.*
- 10 Ensure that there is adequate preparation for the adverse effects of hazard emergencies.*

Under Section C.15, add to the list of Methods the key methods employed in the implementation of the proposed Coastal Erosion Management Strategy

The list of methods used in regard to the management of natural hazards under Section C.15 should be expanded to include those used to implement the proposed Coastal Erosion Management Strategy, including the use of a management strategy itself. Other methods to add include:

- Support for voluntary community initiatives such as Beach Care Groups;
- Emergency Response Plans; and
- Guidelines for private coastal erosion mitigation (for example, planting, protection works, and other methods).

7.5 District Plan Rules

1 Current Rules

The operative District Plan contains a number of rules managing the subdivision, development and use of land along the coastline.

The four main areas in which activities are managed by Rules in the District Plan:

- Subdivision – Subdivision in the coastal environment is controlled through minimum lots sizes, rather than specific controls for the coastal environment. Under s.106 of the Resource Management Act, consent to a subdivision proposal can also be declined if the land is subject to erosion and cannot be satisfactorily avoided, remedied or mitigated [However, under the Amendment Bill currently before Parliament, this section may be changed].
- Esplanade Reserve Requirements – Rule H.1 provides for an Esplanade Reserve Requirement of 50m for the rural zones and 20m for the other zones, measured from the line of MHWS for lots created as a result of subdivision, which are less than 4ha in size.
- Development Standards – Various provisions applying to the location of structures in the various zones and locations as follows:
 - Coastal Building Line Restriction/Siting of Buildings/Coastal Yard Requirement – a minimum yard setback that differs throughout the zones and coastline. The rural zone (provisions D.2.1.5 and D.2.2.1 yards (iii)) controls any form of building within 100m of the seaward title boundary. The residential zone (provision D.1.2.1 (iii)) provides a variety of standards, being controls in Waikanae and Te Horo Beach (7.5m from the seaward title boundary), Peka Peka (70m from the seaward boundary of the existing Esplanade Reserve) and Paraparaumu, Raumati and Paekakariki (20m as shown on the maps contained within the District Plan).
 - Relocatable Building Area – an area in which only relocatable buildings are allowed (provision D.2.2.1 yards (iv)). The width varies between 20-50m. The District Plan defines a Relocatable Building as “any building, generally of timber framing, but excludes any structures that have cast in situ concrete walls,

concrete block walls, brick and stone walls (including brick veneer). Provided that such structures will be permitted if certified by a qualified structural engineer to be of a specific design which would enable at least the greater part of the building to be relocated if required”.

- Earthworks - Earthworks shall not be undertaken within 20m of a water body, including wetlands and coastal water, without requiring resource consent as discretionary activity. The District Plan does not stipulate where the line is to be taken from (the RMA 1991 defines coastal water as “water within the outer limits of the territorial sea”). The restriction also controls the volume of disturbance to land, being 100m³ for the rural zone, and 50m³ for all others (barring the River Corridor zone) with a change in existing ground level by 1m measured vertically.

2 Recommended Changes

As outlined in the previous section, the main changes to the rules would be the introduction of a new *Coastal Hazard Management Area* (CHMA) along the entire length of the Kapiti coastline, of a variable width, depending on the assessed risks within each section of coast. The CHMA would comprise a *Primary Development Setback* (PDS) – that area subject to high risk from erosion caused by fluctuations in natural beach processes under existing sea level and climatic conditions - and a *Secondary Development Setback* (SDS) – other land subject to moderate risk from erosion caused by fluctuations in natural beach processes under existing sea level and climatic conditions. The widths of the PDS and SDS vary along the coastline, according to the level of risk, mitigated as appropriate by protection works and/or other actions.

Subdivision – No further subdivision for land within areas of significant risk from erosion under current sea level and climatic conditions.

Introduce a prohibition on the subdivision of land within the proposed Primary Development Setback (recommendation 6.3). Within the Secondary Development Setback, subdivision would be a discretionary activity, with assessment criteria relating the intensity of subdivision (and subsequent development) to the level of risk.

Building Setbacks – Introduce Primary and Secondary Development Setback requirements

Make the necessary amendments to the rules to replace the existing setback requirements and introduce the concept of Primary and Secondary Development Setbacks within a specified hazard zone.

Within the Primary Development Setback (PDS), no new construction for habitation or commercial use would be permitted. Certain exceptions would be provided, such as for structures in connection with landscaping

or outdoor living areas such as pools, decks, and patios subject to minimum setback and height restrictions. It is suggested here, but subject to further consideration, that such structures be permitted providing the height does not exceed 1.5 m, and it is not situated within 10 m of the seaward boundary, in a PDS area. Replacement of existing buildings can be permitted where the effects of the replacement structure(s) are the same or similar in character, intensity, and scale to those which existed before the District Plan became operative (RMA s.10). An exception should also be allowed when a property owner wishes to move an existing structure, presently situated within the PDS, further back on the site, even if it will remain either wholly or partly within either setback area.

The remaining area would provide for a Secondary Development Setback (SDS) where construction activities would be permitted subject to certain restrictions, yet to be defined, but including provision of a qualified structural engineer's certificate to the effect that, in the event that it is threatened by coastal erosion, the building can be removed (appropriate access must therefore be available); or that it is robust enough to ensure that it is capable of withstanding the effects of such events without collapsing. An emergency response plan might also be a requirement of resource consent applications.

Where there is a formed roadway of strategic importance, in front of properties along the coast, or where a “full strength” seawall is provided, there is no need for a Secondary Development Setback.

Earthworks rules

The existing District Plan provisions relating to earthworks are considered acceptable and no changes are recommended.

Esplanade Requirements

The existing District Plan provisions relating to esplanade reserves are considered acceptable and no changes are recommended.

Consent requirements for private protection works, such as secondary seawalls and retaining walls.

Introduce provisions to provide for secondary retaining walls constructed behind seawalls as a controlled activity subject to compliance with design and construction standards.

Review relationship between coastal hazard management provisions with other coastal management provisions to ensure the integrated management of the coastal environment.

It is important that the management of the protection, development and use of the coastal environment be undertaken within an integrated framework. For example, while setback controls are recommended for

erosion hazard management purposes, there may be other reasons for setback requirements along the coast (notably for the protection of the natural character of the coastal environment), which may exceed those required for erosion risk management purposes. It is therefore recommended that the Council ensure that the rules that govern the management of subdivision and land use within each CHMA along the coastline are clearly defined.

Any additions to the rules and standards should be cross-referenced to the relevant objectives and policies of the District Plan.

8 Recommended Strategy

This section summarises the key elements of the proposed Coastal Erosion Hazards Management Strategy arising from the findings of the risk assessment, management options analysis and consultation process. This summary outlines the recommendations of the project team to provide an overall strategic framework for long-term management of the District's coastal hazards. This strategy has been developed for approval by Council for use in consultation with the community and key stakeholders. It has not been formally adopted as Council policy and is subject to revision pending outcomes from the consultation process.

8.1 A Strategy for Action

The Kapiti Coast District Council is committed, where possible, to conserving, restoring and enhancing the district's coastline and beaches. Coastal erosion and beach loss, however, are not issues that can be adequately addressed at only the land-sea interface. Effective solutions require a comprehensive approach that considers watersheds that ultimately flow to the ocean, flood control systems, wetlands, beaches and nearshore ocean processes. Coastal management in the Kapiti district, and indeed throughout New Zealand, must move beyond dealing with coastal management issues (often in crisis situations) on a case-by-case basis to an approach that proactively focuses on larger scale regional issues at both the coastline and within associated watersheds.

Responsibility for addressing coastal erosion, and beach loss in particular, in New Zealand, is divided between regional councils and territorial local authorities. Other interested parties range from private property owners and businesses to public interest groups and academia. Cooperation among these parties will be necessary to implement an effective coastal erosion planning and response action plan.

Council has the ability to shape the way new development is sited along the Kapiti coast and to avoid mistakes of the past. Using the strategies identified in this document Council can begin the long-term process of protecting natural sources of sediment to the coast, and maximising natural character as well as amenity values.



The Council must be proactive and work with all interested parties to address coastal erosion and beach loss, including appropriate efforts to maintain natural coastal processes.

In these respects, five general principles are recommended for adoption.

1 Hazard Avoidance for New or Modified Development

Development on coastal lands subject to erosion can threaten public safety, public and private property, habitats and recreational opportunities, and should be avoided whenever possible. Direction is already provided in the New Zealand Coastal Policy Statement 1994, in which several clauses refer to the need to preserve natural character and avoid inappropriate subdivision. In particular, Policy 3.4.5, for example, states: “new subdivision, use and development should be located and designed so the need for hazard protection works is avoided”, a policy reflected in similar policies within the Wellington Regional Coastal Plan. The principle of hazard avoidance seeks to prevent the exacerbation of risks where there is either currently a low risk (for example, rural areas) or where there is already a moderate to high risk.

2 Maintain Natural Sources of Sediment along the Coast

Projects constructed within the coastal hinterland can have significant impacts on the coast by blocking the flow of sediment to the coastline. Developments planned, constructed, or approved by Council within coastal watersheds should meet the following conditions:

- Whenever feasible, and consistent with water quality and habitat protection requirements, the development, together with adjacent developments allowed under local or regional land use regulations, should not reduce the quality or quantity of the natural supply of sediment to the coastline.
- The development should be consistent with any existing district plan within the watershed in which the development is planned.

3 Beach Renourishment

In cases where existing coastal development is threatened by erosion, the first step is to evaluate projects that minimise or eliminate the erosion threat. A common soft protection method is beach nourishment, which is the primary method for restoring and enhancing the recreational capacity of narrowed beaches. Apart from the suitability of beach nourishment as a practical solution at a particular site (for example, erosion rates may be too high), the availability of suitable source material may well be a determining factor in establishing the economic viability beach renourishment projects should conform to the following guidelines:



- Nourishment will not have a significant adverse effect on other areas or developments along the coast, cultural resources, or living marine resources or their habitats.
- The nourishment program is complemented, if necessary, by other non-structural methods to lengthen the life of a renourished beach.
- Measures are included to maximise the effectiveness of the operation within the coastline area (littoral cell) being restored or nourished.
- Sand should be deposited directly on to a beach or in the nearshore in an appropriate manner for effective beach nourishment, and in a manner that protects significant natural resources and public access.

4 Relocation of Assets/Development at Risk

Public or private development located in areas of high coastal hazard can be vulnerable to severe damage or destruction during events where coastal storms coincide with high water level events. Relocating development away from an eroding beach or bluff (sometimes called managed retreat) may be the most appropriate way to preserve the development and ensure public safety and should be considered as a possible option.

5 Hard (Structural) Protection Works

Construction of seawalls, revetments, breakwaters, groynes, or other artificial structural devices for coastal erosion control should be limited to cases where no other non-structural alternative is effective or feasible to reduce erosion hazards to the assets at risk. Each of the following conditions should be met:

- The project is necessary to protect an existing development, or enhance or protect a public beach in danger from erosion where renourishment, on its own, is not practical.
- A report by a recognised coastal specialist demonstrates that an existing development, or a public beach, is at risk from coastal erosion and conclusive evidence is presented in the report to the effect that the proposed protection device is designed and can be constructed and maintained to withstand the specified design criteria that reflect the range of conditions that exist at the project site, and will successfully mitigate the effects of coastal erosion while minimising the significant effects of the project on other sections of the shoreline.



- Evidence is presented that the proposed structure will not cause erosion of adjacent properties, thus potentially leading to further hardening of the coastline.
- The project is consistent with the requirements of the district plan or the regional coastal plan.
- The project will not have a significant adverse effect on other areas or developments along the coast, cultural resources, or living marine resources or their habitats.
- There will be no net reduction in public access to, and use and enjoyment of, the natural coastal environment, and construction of a protection works will preserve, enhance or provide access to related public recreational lands or facilities.
- Measures are included to ensure that the protection works can and will be maintained to fulfill its intended purpose and to specify the removal of the works if it fails to function as designed, is not maintained, or is no longer necessary.
- When appropriate, other non-structural measures are included that will complement the use of the hard protection device, such as beach nourishment.

8.2 Purpose of the Strategy

The purpose of the Coastal Erosion Hazards Management Strategy should be:

The sustainable management of coastal erosion hazard risks throughout the district should be promoted by focusing on –

- ✓ Avoiding and reducing risk by:
 - Identifying hazard risk areas and setting priorities for action, in conjunction with property-owners, residents, iwi and key stakeholders; and
 - Managing subdivision, development and use within the identified hazard risk areas to avoid worsening the risks; and
 - Protecting and enhancing, where practicable and appropriate, the buffering ability of natural coastal systems.



- ✓ Encouraging and assisting coastal property-owners and communities to avoid or reduce the risks from coastal hazards where this is practicable and appropriate.
- ✓ Avoiding, as far as possible, the use of “hard structures” in mitigating erosion risk unless there is no reasonable practicable alternative, having regard to the level of investment and infrastructure at risk.
- ✓ Facilitating a co-ordinated approach to managing coastal hazard risks between property-owners, communities, iwi and key stakeholders.
- ✓ To establish and implement an ongoing cost-effective monitoring programme to ensure that:
 - Changes in coastal dynamics, processes and characteristics are adequately monitored;
 - Hazard risks are regularly reviewed, in accordance with the level of risk; and
 - The effectiveness of the Strategy can be assessed.

8.3 Implementation

The Coastal Erosion Hazards Management Strategy shall be implemented through a strategic plan to co-ordinate the various actions required to effectively achieve the purpose of the Strategy. The Plan shall comprise the following elements:

1 Element 1 – Implementation Plan

An action plan is required to establish a programme for implementing the Strategy, including tasks, resources, responsibilities, and timeframes. This will need to be negotiated and agreed upon by the relevant parties, and may be subject to change over time as circumstances warrant.

2 Element 2 – District Plan Changes

Changes to the District Plan will be required to ensure that:

- The District Plan is updated to reflect the findings of the risk assessment and analysis of the issues;
- The District Plan objectives and policies in relation to coastal hazards reflect the purpose of and actions required to implement the Strategy; and



- The rules are revised in accordance with the Strategy.

3 Element 3 – Regional Liaison

Liaise with the Wellington Regional Council to:

- Reach agreement about the priorities, requirements and process for design and building of protection works within the Coastal Marine Area;
- Establish guidelines for the design, construction and maintenance of coastal protection works; and
- Ensure regular dialogue over matters of mutual concern in regard to the management of the District's coastal environment.
- Co-ordinate management of coastal erosion within Queen Elizabeth Park.
- Agree on matters of common concern with respect to river mouth control including, in particular, Waimeha Stream, Otaki River and Waikanae River.

4 Element 4 –Works Programme

A programme for upgrading and maintaining the existing coastal protection works in accordance with the recommendations of this study should be prepared, including:

- Timeframes;
- Costs and funding;
- Design planning;
- Consultation intentions; and
- Maintenance requirements.

5 Element 5 – Community Involvement

Work with property-owners, residents, local groups, iwi and key stakeholders to promote awareness of coastal erosion risks, methods for avoiding or reducing risks (for example, guidelines for design, building and maintaining private protection works), and to assist in local initiatives such as beach care groups.



6 Element 6 – Emergency Responsiveness

Emergency response plans should be developed for addressing major coastal hazard events, including erosion, inundation and tsunami. All coastal property-owners and /or residents should be involved in the development of the plans and be aware of the plans.

With respect to tsunami, the preliminary study of tsunami risk on the Kapiti coast carried out for this project has identified three key areas where further work is required in order to improve understanding of the risk and increase community awareness. These are:

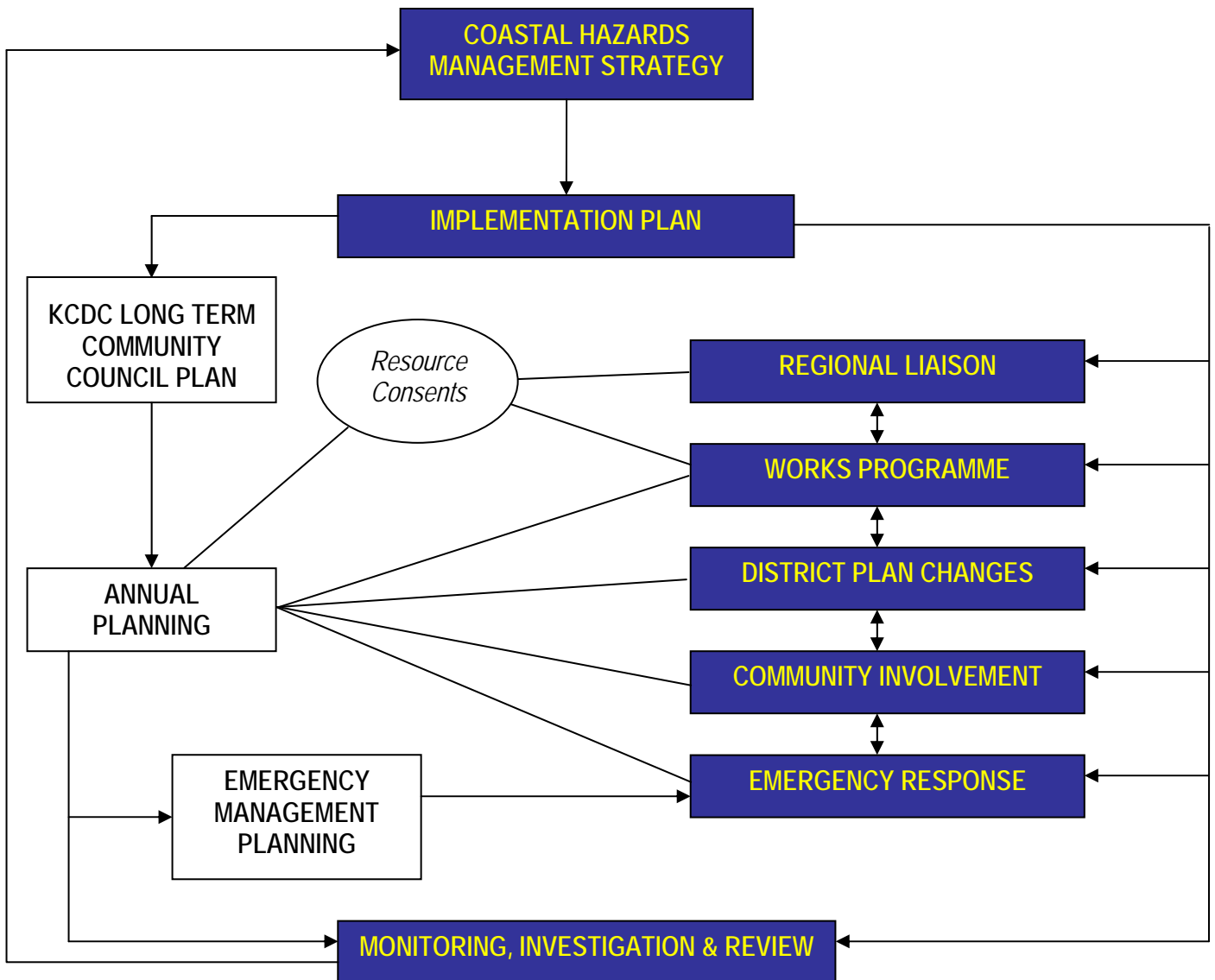
- further palaeotsunami studies at key sites;
- provision of detailed coastal topography; and
- preparation of a detailed inundation map of the district.

7 Element 7 – Investigations, Monitoring & Review

A programme for ensuring that the appropriate level of further investigation monitoring and review is carried out should be established and adequately costed and resourced. The programme should include:

- Identification of the need for further investigation, and how this would be achieved (for example, pilot programmes to test the effectiveness of alternative methods);
- How the Strategy would be monitored; and
- Targets for the review of the strategy, particularly in areas of significant risk.

FRAMEWORK FOR THE COASTAL HAZARDS MANAGEMENT STRATEGY



8.4 Summary of Recommended Actions

The following is a summary of the recommendations for each individual Coastal Hazard Management Area, and across the district as a whole.

CHMA	District Plan	Works and Operations	Other
CHMA-1 Paekakariki	Regulatory Replace the no-build and relocatable building zones with a 60m wide Coastal Hazard Management Area restricting subdivision and new construction.	Seawall Maintain the existing seawall along The Parade and replace as required. Extend the sea wall 300m to the north end of The Parade.	Monitor Beach profiles. Emergency Response Specific Plan with works to occur if and when required.
CHMA-2 QE Park	Regulatory Establish a 100m wide Coastal Management Area in consultation with WRC.		Monitor Beach profiles and the effect of the Raumati seawall on the Park.
CHMA-3 Raumati South	Regulatory Replace the no-build and relocatable building zones with a 60m wide Coastal Hazard Management Area restricting subdivision and new construction. Building and subdivision restrictions would be reconsidered following upgrade of seawall to full strength.	Seawall Maintain the existing seawall and examine feasibility of progressively raising height to RL 4m. Consider potential sources for funding. This will involve adding rockwork to increase the height of the seawall height by approximately 2 metres, and developing landscaping plans in conjunction with the community.	Existing remedial works Maintain existing works programme until upgrade is completed. Monitor Beach profiles. Emergency Response Develop a response plan specific to Raumati South. Education On the erosion issues and emergency response plan.

CHMA-4 Raumati North

Regulatory

Replace the no-build and relocatable building zones with a 50m Coastal Hazard Management Area restricting subdivision and new construction.

Monitoring

Continue monitoring of beach profiles.

Beach Care and Dune Conservation

Planting implementation and maintenance programme to facilitate dune growth. Path formation. Remove unsightly works. Private initiatives.

Education

Of erosion issues and emergency response plan.

CHMA-5 Paraparaumu

Regulatory

Replace the no-build and relocatable building zones with a 50m Coastal Hazard Management Area restricting subdivision and new construction.

Beach Renourishment

Subject to assessment.

Monitoring

Continue monitoring of beach profiles and cutting by WRC on Waikanae river mouth.

Beach Care

Incorporating dune conservation and education.

CHMA-6 Waikanae to Peka Peka

Regulatory

Replace the no-build area with a 50m Coastal Hazard Management Area in the residential area of Waikanae.

Where the existing 7.5 m building restriction is landward of the proposed PDS, this restriction will remain in place.

Retain the existing 70m zone restriction at Peka Peka.

Retain the existing 100m rural zone restriction.

Monitoring

Continue monitoring of beach profiles.

Beach Care

Incorporating dune rebuilding.

CHMA-7 Peka Peka to Otaki

Regulatory

Replace the no-build area with a 50m Coastal Hazard Management Area in the residential area of Te Horo.

Retain the existing 100m

Monitoring

Extend beach profile monitoring programme.

Beach Care

Incorporating dune re-building/stabilisation.



	<p>rural zone restriction.</p> <p>Where the existing 7.5 m building restriction is landward of the proposed PDS, this restriction will remain in place.</p> <p>At Otaki, the current 3m rear yard requirement will be maintained where this is landward of the PDS</p>
<p>District Wide</p>	<p>Regulatory</p> <p>Ensure the integration of coastal erosion management requirements with other controls for the coastal environment.</p> <p>Monitoring</p> <p>Develop a monitoring programme at a district-wide level to assess coastal erosion at an integrated level to obtain an overall picture of the erosion and accretion processes within the District.</p> <p>Emergency Response</p> <p>In addition to specific monitoring programmes for individual management areas, an overall strategy is important outlining the emergency response and strategy, and resources available. Further study of the tsunami risk is indicated.</p> <p>Guidelines</p> <p>To facilitate and promote Beach Care as a method for those beaches where fore-dunes require on-going care and conservation, and the community have indicated their support for such a programme.</p>

