Coastal Hazard Risk Indicators

A REPORT TO

ENVIRONMENT BAY OF PLENTY

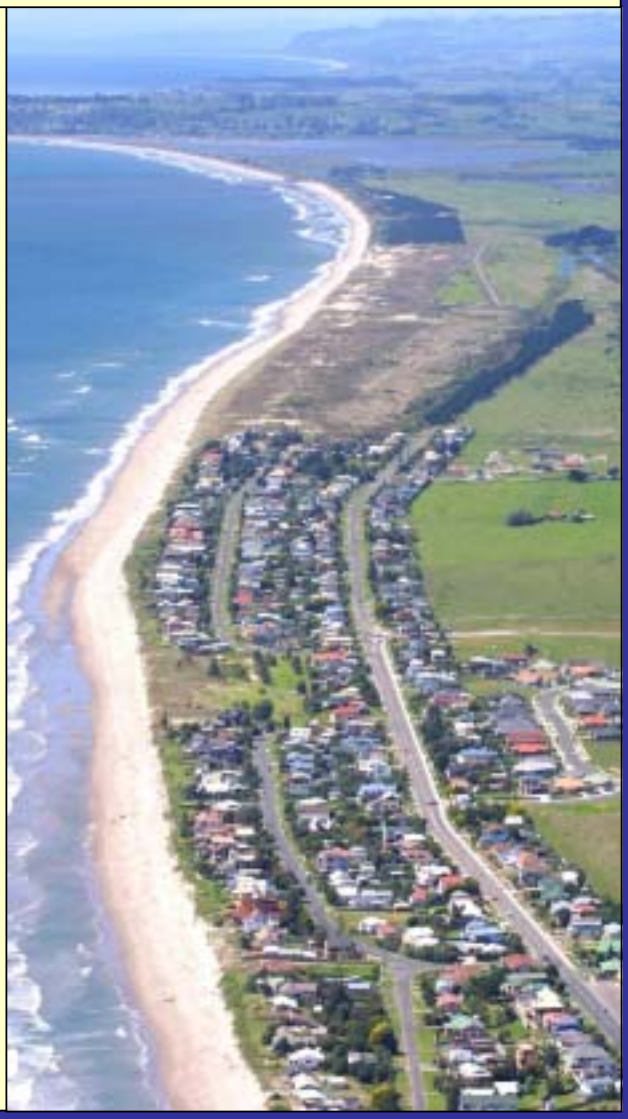
FROM

HILL YOUNG COOPER LTD

IN ASSOCIATION WITH

ECO NOMOS LTD

OCTOBER 2003



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Lastly we acknowledge the knowledge and experience of Jim Dahm who provided some of the input to the report, greatly assisted in providing clarity on appropriate indicators and peer reviewed the report at various stages of its development.

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1 Introduction

1.1 Background

Environment Bay of Plenty *"Regional Coastal Environment Plan" (RCEP)* has the following objective:

> *"No increase in the total physical risk from coastal hazards"*

This objective is the foundation policy for the RCEP in how it deals with coastal hazards.

The wording of this objective was referred to the Environment Court by Western Bay of Plenty District Council, and the new wording added the term "physical". Our understanding was that this was added to ensure that non-physical attributes such as a focus directly on the valuation of properties, or the value of buildings on properties where not considered as part of any determination of physical risk. An important starting point for this project therefore will be to develop a working definition of "total physical risk" and identify the attributes which may influence this risk. This will include the nature of the natural hazards and the receiving environment, which together create particular and different risk profiles.

In evidence for Environment Bay of Plenty to the Environment Court[i] this discussion of risk from coastal hazards occurred:

> "The risks which these known coastal hazards create are intensified by existing and future urban development. Risk is multi-dimensional and includes not only the quantification of the hazard events, but also a "receiving environment" factor. So, for example, coastal erosion in unpopulated, undeveloped coastlines has a much lower risk profile than the same events in a location with urban development. It therefore follows that the greater the level of development in both capital investment and density of people, the greater is the risk profile in that location."

1.2 Purpose of Report

The purpose of this project is to recommend the most appropriate means of monitoring changes in the total physical risk of coastal hazards in the Bay of Plenty Region. In addition we will consider the means by which the effectiveness of the policy can be monitored in accordance with section 35(2) of the Resource Management Act. This will be achieved by:

(a) Agreeing a working definition of total physical risk from coastal hazards;

(b) Describing the potential measures of changes in this risk;

(c) Identifying current monitoring or information gathered by councils which relate to these potential measures of risk;

(d) Identifying other methods which may be readily utilised by councils which relate to these potential measures of risk;

(e) Evaluating the methods as to their effectiveness in measuring changes in risk over time;

(f) Recommending the most appropriate means of measuring total physical risk including implementation issues;

(g) Addressing methods by which effectiveness of the policy in fulfilling the Council's duties in managing coastal hazards under the Resource Management Act can be measured.

The focus of this project is on indicators to monitor the effectiveness of risk management on the landward side of the coastal environment. While it is important to understand and provide information on the nature of the hazards, and the monitoring that EBOP is carrying out on coastal processes, this is not the subject of this project. Rather, it is to better understand subdivision and development processes in areas subject to coastal hazards and how the increased potential for risk associated with increasing development is being managed. The project must identify relevant and useful indicators associated with this development (and other public estate development), which can provide measures of risk and whether it is increasing or decreasing.

1.3 Purpose of the Study

This report focuses on subdivision and development processes occurring in areas subject to coastal hazard risks. The main objectives for this report are to:

- Develop options for monitoring the policy for the purpose of plan effectiveness.
- Develop options for the monitoring of changes in risk for the purpose of state of the environment monitoring.
- Recommend the preferred options.
- Address implementation issues such as costs and responsibilities.

1.4 Structure of Report

The first section provides a brief background to the report, including the purpose of the study.

The second section provides the statutory context in which this work sits. This includes relevant legislation (Resource Management Act) and planning documents (Bay of Plenty Regional Policy Statement, Bay of Plenty Regional Coastal Environment Plan). In addition we describe coastal hazards and areas of concern within the Region.

The third section develops the concept of coastal risk management. It includes a working definition of total physical risk and looks at approaches to risk.

The fourth section relates to the theory of coastal hazard indicators. In addition, methods used by other localities to measure coastal hazard risk are discussed.

The fifth section provides a summary about the ways the district councils in the Bay of Plenty are currently managing coastal hazard risks. This includes information from Opotiki, Tauranga, Western Bay of Plenty and Whakatane District Councils.

The sixth section provides a list of possible indicators that could be used to measure whether or not the objective: “No increase in total physical risk” has been achieved. This section analyses each indicator and recommends the most suitable indicators for the current situation. It also suggests how the effectiveness of the objectives and policies in the Regional Coastal Environment Plan could be assessed.

2 Statutory Context

2.1 Resource Management Act 1991 (RMA)

Under s 30(1) (c) (iv) of the RMA, regional councils have responsibility for the avoidance or mitigation of natural hazards. Under Section 2 of the Act, the definition of natural hazard is:

> "any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment"

Coastal hazards would therefore fall under the definition of a natural hazard.

2.2 Bay of Plenty Regional Policy Statement

The Bay of Plenty Regional Policy Statement contains several objectives and policies related to natural hazards and coastal hazards. These are set out below:

> "s11 Natural Hazards:
>
> 11.3.1.a Objective - The vulnerability to natural hazards of the region's people and communities, and its natural and physical resources, is avoided or mitigated.
>
> 11.3.1(b)(v) Policy - To recognise and protect the integrity of natural ecosystems, which are natural defences to flooding, inundation or erosion, particularly where new subdivision, use and development is proposed.
>
> 11.3.1(b)(x) Policy - To ensure that new subdivision, use and development, and significant infrastructure are located and designed to avoid significant natural hazards, unless there is a particular functional need to locate in an area subject to significant risk. In particular, new development within existing settlements that are at risk from natural hazards, shall not result in increased vulnerability, and should aim to reduce net vulnerability over time.

11.3.1(b) (xi) To avoid or mitigate the vulnerability of existing suburban subdivision, use and development, and significant infrastructure that is at risk from natural hazards.

11.3.1(b)(xv) Policy - To recognise that some natural features may migrate inland as a result of dynamic coastal processes and to take account of this in providing for the preservation of natural character and the protection of ecological values when subdivision, use and development in the coastal environment is being assessed." Page 143 and 144.

"s9 Coastal Environment

9.3.1.a "Objective - Recognition of and provision for:

(i) The preservation of the natural character of the coastal environment;" …

9.3.1.b.iv Policy - "To ensure that where natural character is already substantially compromised by development, all practicable steps are taken to avoid, remedy or mitigate adverse effects on remaining natural character, particularly when further subdivision, use or development is proposed."

9.3.1.b.v Policy - " To consider the restoration or enhancement of natural character and heritage places in areas that have been degraded by past or existing use and development." Pages 123 and 124.

"9.3.3.a Objective - The coastal marine area is generally accessible to members of the public.

9.3.3.b.i Policy - To enhance public usage and enjoyment of the coastal marine area." Page 126.

The Regional Policy Statement (RPS) states features of the environment where risk is a concern. These include people, communities and the region's natural and physical resources (subdivisions and infrastructure). The general approach of the RPS is to avoid locating new developments in areas subject to significant risk. Where new development occurs within the existing settlements already exposed to risk from natural hazards, the policies intend that this development should not result in increased risk. There is also an aim is to reduce net vulnerability over time.

2.3 Bay of Plenty Regional Coastal Environment Plan

The Regional Coastal Environment Plan (RCEP) largely became operative in July 2003. A reference by RK Skinner to the Environment Court relating to the Areas Subject to Coastal Hazards at Papamoa has just been settled and so the plan is now ready to be delivered to the Minister of Conservation for final and complete approval.

All of the relevant principles, objectives and policies of the New Zealand Coastal Policy Statement have been translated in some respect into the RCEP. The RCEP identifies coastal hazards through the mapping of "Areas Sensitive to Coastal Hazards".

The Ferry Hotel (1890s) and nearby township at Ohiwa Spit was lost to the sea by erosion in the 1920s.

The Plan sets out the need to identify areas sensitive to coastal hazards. It then goes on to discuss the need for territorial authorities to address two circumstances, what to do about existing development and what to do about new development. It also discusses the use of protection works and notes that it is very difficult to provide long-term protection to properties from coastal hazards at a reasonable cost and without significant adverse effects on beaches. It also noted in the plan that further subdivision and redevelopment of existing areas increases the total physical risk and leads to the need for, or at least a demand for, protection works.

The Plan has a simply stated objective: "11.2.2 No increase in the total physical risk from coastal hazards."

There are a large number of policies which give effect to this objective, and which help prescribe the areas where monitoring of policy effectiveness and indicators of changes in risk may be targeted.

Policy 11.2.2 is not inconsistent with the relevant objectives and policies of the Regional Policy Statement. However, it does not encompass a principle of the decrease the total physical risk from coastal hazards. This is a slightly different concept to the term "vulnerability" in the Regional Policy Statement. This project has not attempted to examine the difference but has rather assumed that the use of the concept of risk is a refinement on the Regional Policy Statement.

Chapter 11 policies are listed below:

> 11.2.3(a) To take a precautionary approach to the installation of **coastal hazard protection works**.
>
> 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 practicable.
>
> When considering the option of protection works, the option of using soft protection works such as dune care, beach replenishment, and restoration of estuarine vegetation, should be considered.
>
> When a district council identifies coastal hazard areas that include urban areas it should proactively apply this policy in consultation with the local community, Environment Bay of Plenty and other interested parties. The best practicable option selected should be included in the district plan.
>
> 11.2.3(b) To provide an overview of those areas within the open coast which are sensitive to coastal hazards by **identifying areas sensitive to coastal hazards (Areas Subject to Coastal Hazards).**
>
> 11.2.3(c) Where existing urban subdivision use and development falls within an area sensitive to coastal hazards (Areas Subject to Coastal Hazards) shown in the maps to this plan, the relevant district council should commission research to **identify a coastal hazard area**, and include it in the relevant district plan. That research should comply with policy 11.2.3(f). Policy 11.2.3(c) applies to those areas zoned for future urban development as

well as existing urban areas, but does not apply to urban subdivision and land use promoted in a private plan change. Once a coastal hazard area has been identified in a proposed district plan in accordance with policy 11.2.3(f) of this plan, the Areas Subject to Coastal Hazards identified in this plan have no further relevance to the control of subdivision, use and development in those areas.

Active coastal erosion is a major issue in many parts of the Bay of Plenty coastline. This impacts on public access to and along the coast.

11.2.3(d) The following matters should be taken into account when considering new subdivision, use and development within existing urban areas located in coastal hazard areas identified by district councils:

• Policy 3.4.5 of the New Zealand Coastal Policy Statement: "New subdivision, use and development should be so located and designed that the need for hazard protection works is avoided."

• Policy 11.3.1(b)(x) of the Bay of Plenty Regional Policy Statement: "To ensure that new subdivision, use and development, and significant infrastructure are located and designed to avoid significant natural hazards, unless there is a particular functional need to locate in an area subject to significant risk. In particular, new development within existing settlements which are at risk from natural hazards, shall not result in increased vulnerability, and should aim

to reduce net vulnerability over time."

• [Objective 11.2.2 of this plan.]

• The need to avoid compromising implementation of the best practicable option identified in accordance with policy 11.2.3(a) of this plan.

11.2.3(e) Applications of new subdivision, use and development which are proposed to take place within the areas sensitive to coastal hazard (Areas Subject to Coastal Hazards) shown in the maps of this plan should be supported by a **coastal hazards analysis** of that proposed area of subdivision, use and development. The New Zealand Coastal Policy Statement policy 3.4.5 states, "New subdivision, use and development should be so located and designed that the need for hazard protection works is avoided."

Policy 11.2.3(e) applies to both resource consents and private plan changes but does not apply to subdivision use and development in those parts of the Areas Subject to Coastal Hazards in which policies 11.2.3(c) or 11.2.3(d) are to be; or have been applied by the district council."

11.2.3(f) The following standards and criteria should be applied to the identification of coastal hazard areas for the purposes of policies 11.2.3(c) and 11.2.3(e):

• Erosion impacts of sea level rise: The Intergovernmental Panel on Climate Change best estimate, presently the IPCC 1995, IS92a scenario estimates (this is 0.49 metres by the year 2100), should be used.

• Shoreline response to storm erosion and flooding: Scientifically appropriate models should be used, such as those based on, but not restricted to, the Bruun Rule.

• Planning horizon: A 100-year planning horizon should be used.

• Long-term trend: This should be derived from cadastral, aerial photography, surveys, or other reliable historic data. The reference shore adopted should be the toe of the fore dune where these landforms occur, or elsewhere should be the seaward limit of vegetation or some other datum as appropriate.

• Short term fluctuation: This should be derived from the most reliable records available at the time for particular stretches of the coast, and should err on the side of caution.

• Dune stability factor: This should be based on the angle of repose (AOR) of the dune sands as defined locally.

• Factor of safety: The coastal hazard area assessment should include an appropriate factor of safety: either built into the above criteria and standards, or added on in the final stage in the calculation.

• Any profiles (cross sections) should be carried out to accepted surveyors' standards and practice. All levels must be in terms of mean sea level to Moturiki datum.

Storm surge in some areas has already resulted in houses being moved back from the coast – Ohope Beach during a storm event

11.2.3(g) For estuaries and harbours, **the minimum ground levels or building platforms** are to be determined by joint research by the relevant district councils and Environment Bay of Plenty. The following standards and factors should respectively be applied and taken into account:

• sea level rise, which is currently 0.49 metres;

• minimum annual exceedance probability of 2% (1% is recommended);

• tide level;

• barometric set up;

• wind set up;

• estuary effects;

• factor of safety (0.5 is recommended).

Notes:

1 The sea level rise should be the official best estimate by the Intergovernmental Panel on Climate Change (currently the IPCC 1995, IS92a scenario estimate of 0.49 metres) over a 100-year planning horizon.

2 A 2% annual exceedance probability (AEP) means that those planning the development must design for a storm surge that has 2% chance of occurring in any one year (or on average, will occur once every 50 years). This is specified as a minimum standard. It is recommended that the 1% AEP standard is adopted for large new subdivisions, or sites where the value of assets at risk is high (or difficult to insure), or where there is infrastructure (e.g. pumping stations, electricity substations) which is important to the well being of the community.

3 It is recommended that the factors listed in bullets 3 to 5 are estimated as joint probabilities, by using an appropriate statistical technique. Environment Bay of Plenty has information that can assist in estimating these factors. An example of joint probability analysis is summarised in D Goring and others, *Extreme Sea Levels on the Mount Maunganui Shoreline* (Moturiki Island), NIWA, 1997. This is available from Environment Bay of Plenty. An alternative and simpler technique is to sum the individual maximums for each factor. However, this will usually give a higher estimate of storm surge height.

4 Estuary effects include the dynamic effect of storm surge in estuaries, wave set up at the estuary mouth which forces water into estuaries and differential wind stress across estuaries. Allowance of 0.33 metres is recommended if specific information is not available.

5 The factor of safety allows for imprecision in estimates of the factors listed in 11.2.3(g), and any other factors not explicitly estimated, e.g. wave run up on to the shores of the estuary.

11.2.3(h) Until the work in 11.2.3(g) is completed for the landward margins of Ohiwa Harbour, the minimum ground level upon which buildings may be constructed should be 2.70 metres above Moturiki Datum plus the latest official IPCC best estimate of sea level rise (which is currently 0.49 metres), based on:

- maximum tide level of 1.00 metres;
- barometric set up of 0.33 metres;
- wind set up of 0.54 metres;
- estuary effects of 0.33 metres;
- factor of safety of 0.5 metres.

11.2.3(i) To ensure that **any earthworks** undertaken for the purposes of complying with policies 11.2.3(g) and 11.2.3(h) will not be subject to erosion, adversely affect the natural character of the coastal environment, or restrict flood drainage.

11.2.3(j) **Lowering of fore dunes is to be avoided**.

11.2.3(k) To take into account the IPCC 1995 IS92a sea level rise scenario when considering the **design and location of structures in the coastal marine area.**

11.2.3(l) **Buildings on the rocky open coast** outside of the identified areas sensitive to coastal hazards should be located so as to avoid the hazard of storm surge and wave run up. A minimum new building platform height of 6 metres above mean high water mark is recommended.

11.2.3(m) Buildings on the rocky open coast outside of the identified areas sensitive to coastal hazards should be located so as to avoid the hazard of cliff or slope instability.

11.2.3(n) To discourage **residential development adjacent to river mouths or** other areas potentially at risk from river mouth meandering.

11.2.3(o) The ability of pohutukawa and other coastal cliff vegetation to maintain **the stability of coastal cliff** is to be protected. Damage to any part of the plant, including the root systems, is to be avoided.

11.2.3(p) To encourage the incorporation of coastal hazard zones into **wider building set backs or reserves established** to provide for recreation, natural character, or waahi tapu. Where appropriate, research to identify coastal hazard areas should be carried out in conjunction with research on the other values of the coast.

11.2.3(q) To encourage and support initiatives designed to involve the community in **Coast Care**.

11.2.3(r) To promote consistency and integration with regard to **future research** on coastal hazards within the Bay of Plenty and neighbouring regions.

3 Bay of Plenty Coastal Hazards

3.1 Characteristics and presence of coastal hazards.

The RCEP describes the coastal natural hazards of the Bay of Plenty Region as tsunami, storm erosion and storm flooding. Storm erosion and flooding have become serious issues within the past few decades due to people's desire to live near the coast.

Coastlines are dynamic and periodically shift between phases of accretion and erosion. Flooding (or storm inundation) is restricted to low lying areas of the region. Erosion and flooding are interrelated because the extent of flooding will be influenced by the amount of erosion.

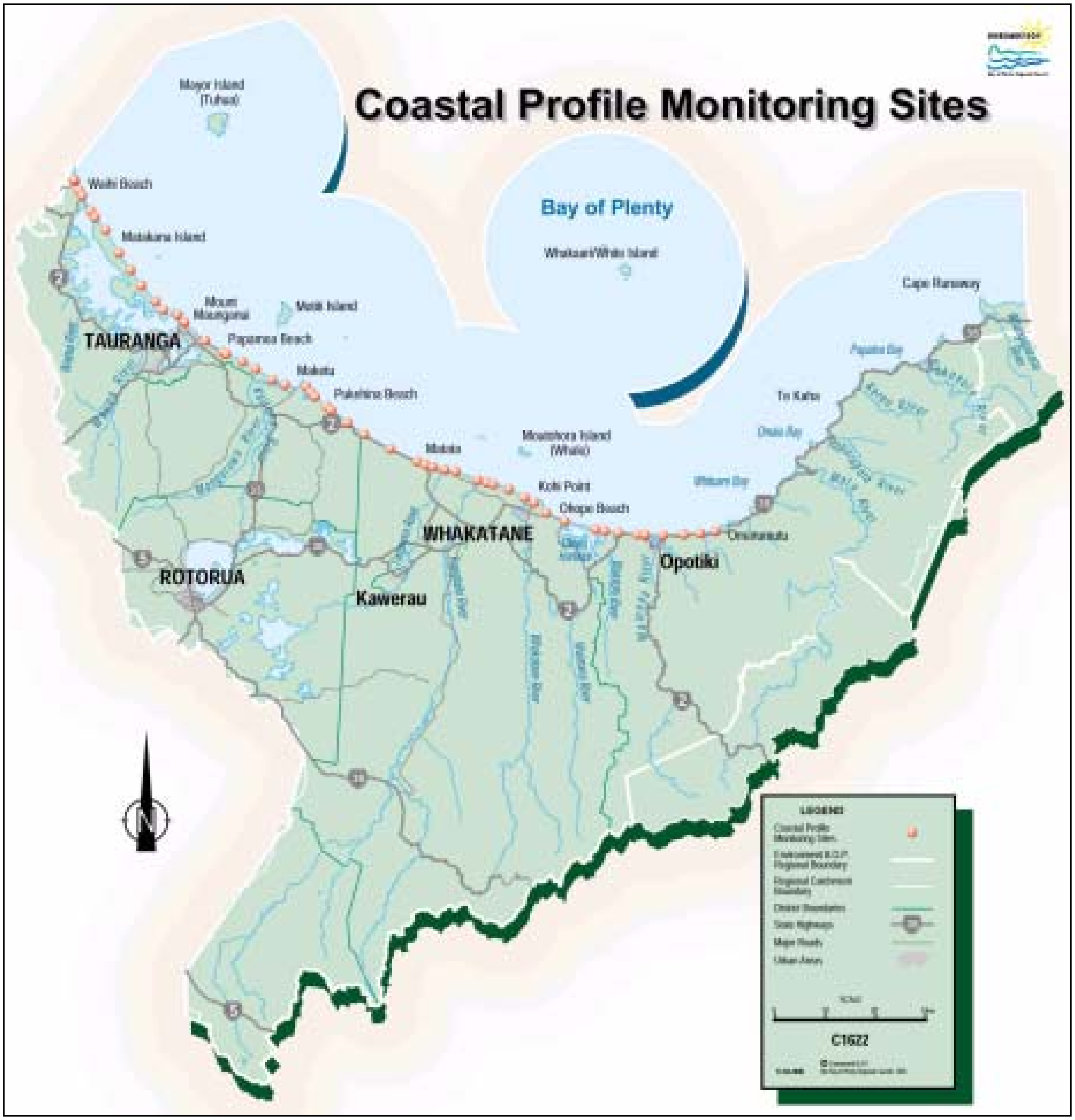
Storm induced flooding (storm surge) is a significant coastal hazard in the region and is caused by temporary local rises in sea level that accompany storms and cause storm wave run-up. A powerful storm surge combined with a high spring tide can cause bad flooding.

The prospect of global climate change, followed by a consequent rise in sea level adds an extra element to the coastal hazard situation. The RCEP advocates the application of the most recent International Panel on Climate Change estimates for sea level rise.

EBOP has included "areas sensitive to coastal hazards" (Areas Subject to Coastal Hazards) in its RCEP. Areas Subject to Coastal Hazards are areas that may be subject to coastal hazards and which should be subject to detailed research. Their purpose is to define areas of open coast where caution should be exercised when considering subdivisions and development. The plan advocates that the relevant district councils commission research to further identify the coastal hazard areas for existing and future urban development areas.

3.2 "Areas of Concern" in the Region

The coastal areas of most concern in the region are summarised below. The nature of risk for each location is described along with a brief explanation on how the district councils are managing the risk in each area of concern.



Coastal Profile Monitoring Sites
Mayor Island (Tuhua)
Bay of Plenty
Whakaari/White Island
Waihi Beach
Matakana Island
Mount Maunganui
Motiti Island
TAURANGA
Papamoa Beach
Maketu
Pukehina Beach
Matata
Moutohora Island (Whale)
Kohi Point
Ohope Beach
WHAKATANE
ROTORUA
Kawerau
Opotiki
Omarumutu
Te Kaha
Cape Runaway
LEGEND
C1622

3.3 Opotiki District Council

Areas at risk of coastal hazards in Opotiki District include Ohiwa Sandspit, and the beach area from Waiotahi to Opape.

Ohiwa Sandspit has a very high Coastal Sensitivity Index (CSI). This area is subject to coastal and wind erosion, as well as overtopping and inundation from storm wave run up.

The stretch of coast from Waiotahi to Opape has CSIs ranging from medium to high. A number of these beaches appear to have a long-term trend of shoreline retreat. The exceptions are Waiaua River to Tirohanga and Waiotahi Spit, which are in dynamic equilibrium, and Waieka River to Waiotahi Beach and Waiotahi Beach to Waiotahi River areas, which have a long-term trend of shoreline advance.

All of the beaches are potentially subject to wind erosion, except for the area from Waiotahi Spit to Ohiwa. Most of the beaches are subject to overtopping except the area from Waiaua River to Hikuwai Beach where dune heights exceed storm wave run up of 4.5m, and the beach from Hikuwai to Waioeka River.

The original Ohiwa Township of the 1890's but was abandoned because of erosion of the sand spit. In the following years the sand spit appeared to stabilise 1950's the land was subdivided again. A period of erosion commenced again about 1965. By mid 1970's several properties were lost to coastal erosion at Ohiwa. Ad hoc seawall protection was tried unsuccessfully. A couple of buildings collapsed into the sea, and remaining buildings were removed from the eroding coastline.

Several Ohiwa dwellings were lost to the sea during the 10 years from 1965 to 1975

3.4 Tauranga District Council

Papamoa Beach is a particular concern to TDC. The CSI for the beach from Omanu to Kaituna River (including Papamoa Beach) is rated as high. These beaches are subject to wave and wind erosion, overtopping and minor inundation. The long-term trend for the Kaituna River to Papamoa section is of shoreline retreat, while the section from Papamoa to Omanu is assessed to be in dynamic equilibrium.

Coastal protection works at the toe of the foredune at Papamoa - 1997

3.5 Western Bay of Plenty District Council

The Western Bay of Plenty District areas considered most at risk from coastal hazards are those open coast areas already developed for urban purposes; the coastal areas from Waihi Beach to Bowentown and Pukehina.

Waihi Beach is subject to storm wave wind erosion; overtopping and inundation from storm wave run up and has been assessed to be experiencing a long-term trend for shoreline retreat. In the past various sea walls have been constructed at Waihi Beach, although these are presently in poor repair and adversely impacting on; natural character, public access along the coast at higher stages of the tide, and generally coastal amenity.

Waihi beach 1973

Pukehina Beach is subject to storm cut, wind erosion, and in places to overtopping and inundation by storm wave run up. There may also be a long-term trend of shoreline retreat. The hazard to existing areas of development is not as serious as Waihi Beach, but probably comparable to Papamoa Beach. Pukehina Beach does not have a sea wall. At Pukehina Beach the erection of new dwellings is deemed as a discretionary activity, and further subdivision is also discretionary, but with restrictions on lot size as the area is unsewered.

Pukehina Beach showing the long narrow spit.

3.6 Whakatane District

Areas at risk of coastal hazards in Whakatane District include Matata and Ohope Beach to Ohiwa Harbour. Ohope Beach is the area of most concern given the erosion risks and developer pressure. There is a general trend for smaller lot sizes which reduces the opportunities to relocate homes, should the need arise. Inundation occurs within the vicinity of the Ohiwa Harbour. Whakatane District Council (WDC) currently requests specific coastal hazard reports for subdivisions.

All of the beaches along the stretch of coast from Matata to Whakatane Entrance are subject to storm cut wave erosion, wind erosion, overtopping and inundation from storm wave run up. The long-term trend for this area is presently assessed as being for shoreline advance, except for the stretch of beach from Matata to Mimihi Road which is in dynamic equilibrium.

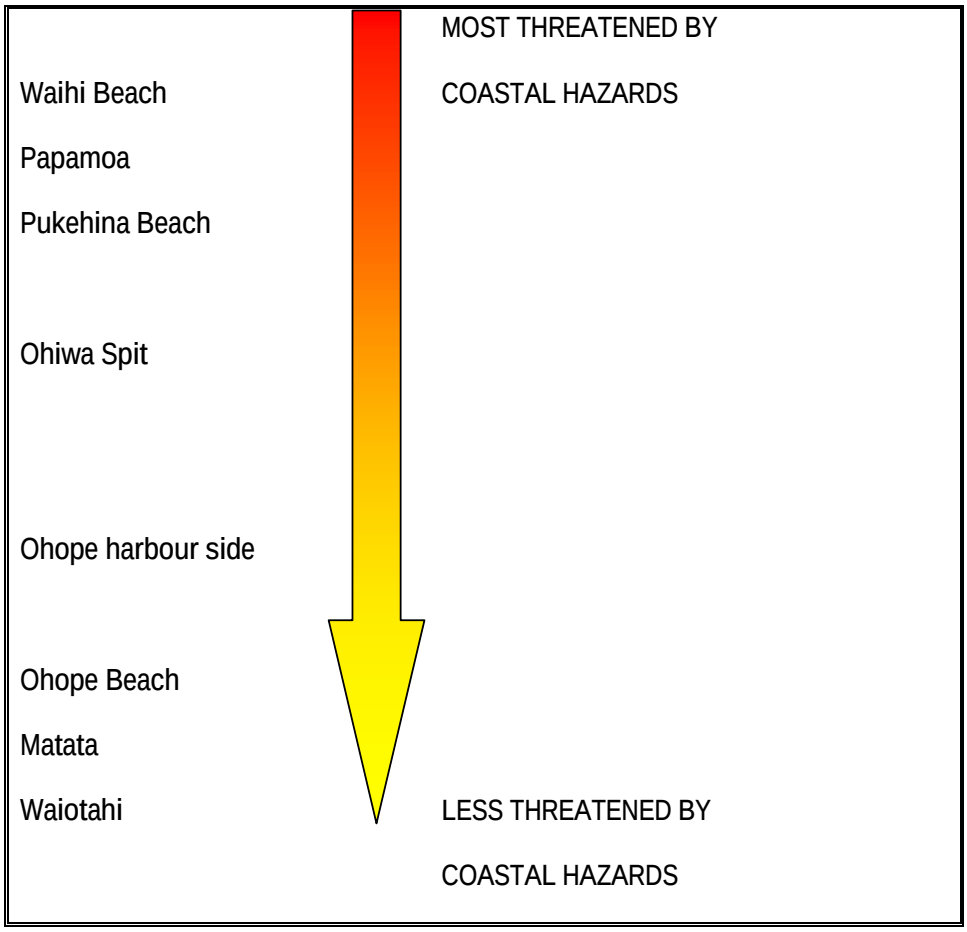
The area from Ohope Beach to Ohiwa Harbour has a high sensitivity to coastal hazards. This area is subject to storm cut wave erosion, wind erosion, overtopping and inundation from storm wave run up. The long-term shoreline trend for this area is assessed to be one of shoreline advance.

The western end of Ohope Beach in the 1996 storm shows the degree of erosion

3.6 Summary of areas of concern

The following areas experience significant risk from coastal hazard in descending order (worst potentially impacted to least badly potentially impacted. The illustration is merely to give a strategic context for the focus of any indicators. It may be that some information is only gathered from the highest potential risk areas. Other areas of the coast are also subject to coastal hazards but are relatively undeveloped, rocky coast, well protected from the hazards or subject to extensive set backs that provide natural buffers to coastal processes.

Figure 1: Areas of concern – where existing development is at physical risk from coastal hazards



Source: Personal discussion with Jim Dahm, Eco Nomos Ltd

4 Risk Management for Coastal Hazards

4.1 What does the objective mean

The objective "no increase in total physical risk from coastal hazards" sets a framework for risk management. It is important to understand what the objective might mean. Some guidance can be taken from the policies in the RCEP. This is discussed later in the report.

4.1.1 What is risk

Risk is made up of two components:

- The likelihood of something happening and
- The magnitude of the consequences if it did.

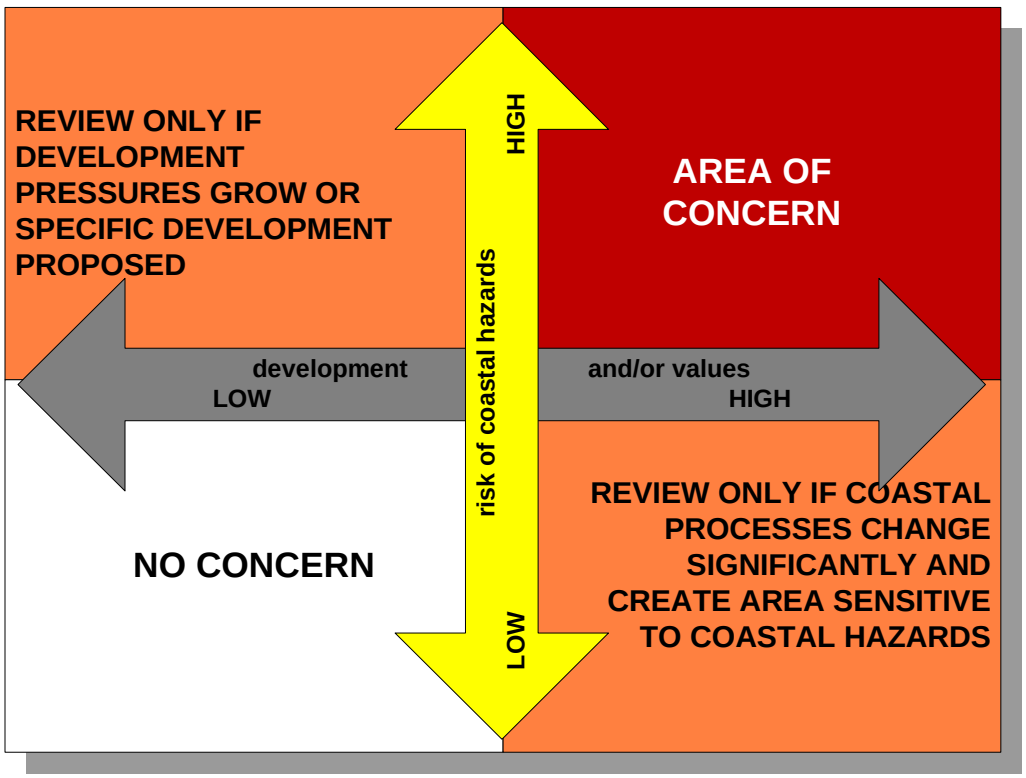
4.1.2 What are the coastal hazards of concern

As already discussed, the coastal hazards of most concern in the Bay of Plenty are storm erosion and storm flooding. These hazards can occur separately but also may occur together and greatly worsen the effects. There is also potential for these natural processes to be exacerbated by changes that may accompany projected climate change, such as an increase in mean sea level. Projected climate change may also increase the frequency and severity of coastal storms. The magnitude of the consequences will be impacted by both the severity of the event and the "risk profile" of the impacted area.

4.1.3 All coastal areas are not equal

Areas of high levels of development or with highly valued vulnerable resources will be of more concern than those with low level of development or values. This is represented in Figure 2, which illustrates the concept of strategic focus for any geographically based indicators.

Figure 2: Strategic focus for geographical indicators of coastal hazards.



4.1.4 A conceptual equation of "total physical risk"

In this project "risk" includes coastal processes (the force acting) and activity on areas impacted (the area acted on). Both coastal processes and the level and management of activity on areas impacted may change in such a way that total physical risk is increased or decreased. This can be represented by the conceptual equation:

$$A + B = TPR$$

Where:

A = the severity of and changes in coastal processes leading to changes in coastal hazards and;

B = changes in the level and management of subdivision and development of private and public land (including roads and open space);

And TPR = changes in total physical risk.

The **focus** of the project however is on the landward side of the coastal environment; the area impacted or acted on by coastal hazards. The indicators therefore will address that part of the equation represented by "B". Environment Bay of Plenty already has monitoring programmes in place to better understand and monitor coastal processes. This part of total physical risk equation does not therefore need to be addressed in this report.

4.1.5 Attributes of the area impacted by coastal hazards

The following attributes or parameters are used in this project in understanding the concept of "physical" rather than "non-specific" risk. The settlement of the reference by Western Bay of Plenty District Council to the RCEP was on the basis that there is a difference between "[non-specific] risk" and "physical risk".

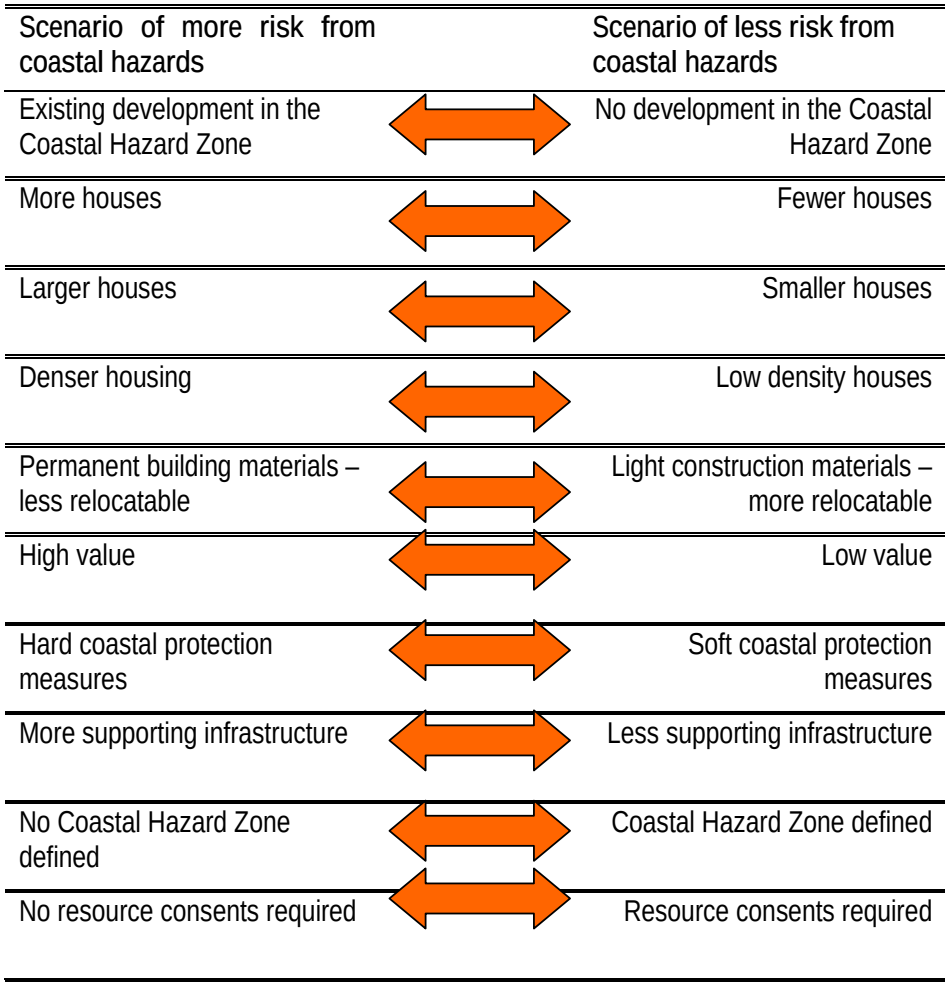
- Land and resources
    - Land use in coastal hazard area
    - Subdivision pattern
    - Subdivision density
    - Roading pattern
    - Physical resources such as infrastructure, vegetation, dunes
- Buildings and other structures
    - The size and location of buildings and other structures
    - Site coverage by buildings
    - The proximity of buildings to the shoreline
    - The height of habitable building floors
    - Relocatability of building
    - Construction materials of buildings
    - Coastal protection works
- People
    - Occupied v unoccupied buildings (as an indicator of permanent v holiday population)
    - Density of development (as an indicator of the number of people in an area)

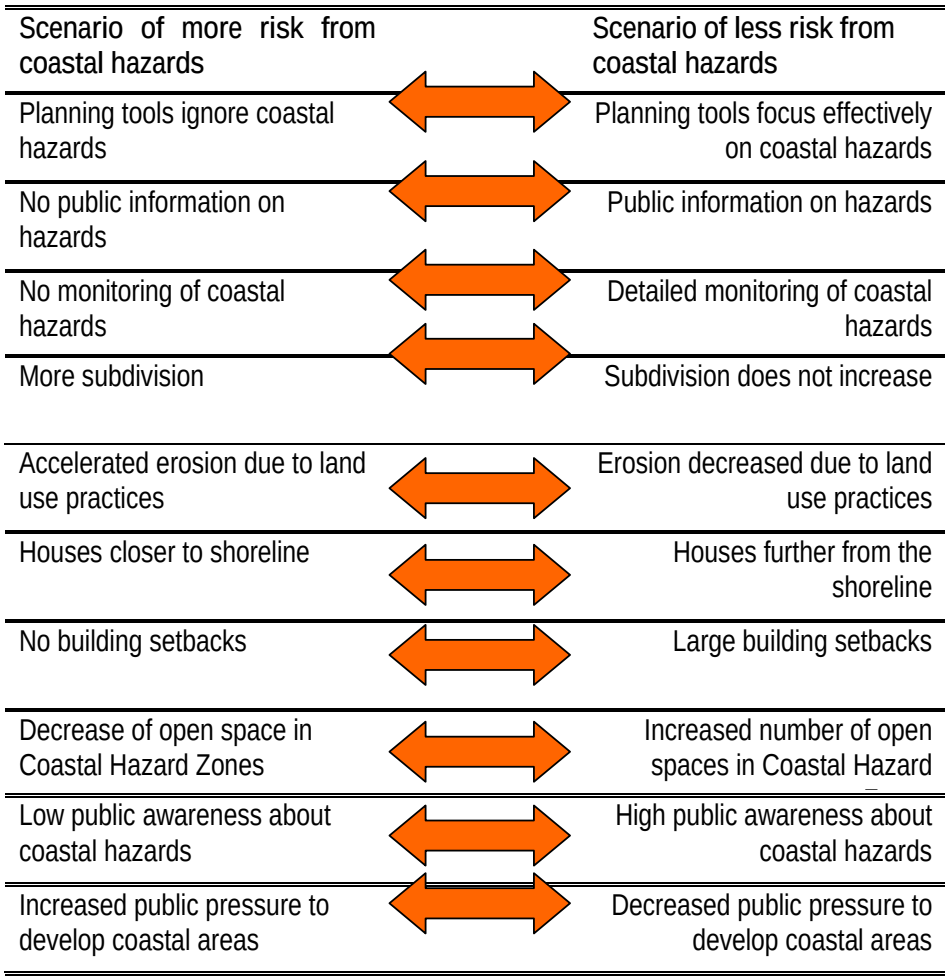
4.1.6 What would an increase in total physical risk "look like"?

It is worth considering, for a moment, what an increase in physical risk would "look like". In the diagram below, we have grouped a number of scenarios together. The left hand side shows a scenario where risk may be increasing, while the right hand side shows a scenario where risk may be either stable or decreasing.

The purpose of this discussion is to assist in identifying where indicators may point to an increase, stable or decrease in total physical risk, in such a way that the Council can use the indicator information to confirm risk or change approaches to risk management.

Figure 3: Scenarios that indicate more or less risk within the area subject to coastal hazards.





As can be seen, defining and measuring coastal hazards is a very complex task. In any part of the region, there will be a number of factors working together at once. The extremes are easy to measure. Take, for example, a low risk situation of coastal farmland in accretion mode compared to a high-risk situation where there are heavily developed foredunes on an eroding coastline with a lack of planning controls. These two scenarios are easy to place on the risk spectrum. In most coastal situations, risk scenarios will fall somewhere in between. For example, there may be a situation where there is increased subdivision in the coastal hazard zone, with large homes and increased infrastructure but the dwellings are complying with District Plan rules and the homes are readily relocatable. In order to determine whether risk is increasing or decreasing, it would be necessary to determine the physical risk pressures on the new developments and also the effectiveness of the planning mechanisms that are being followed.

The development of a risk index could be a useful tool to impartially categorise locations along the risk spectrum. The indexes would combine key attributes that help define risk (environmental processes, the built form and planning processes).

4.2 Approaches to Risk

Approaches to risk can be placed into four different categories:

- Risk avoidance
- Physical risk reduction
- Risk transfer
- Risk management

Risk avoidance is often a very desirable condition. This approach assumes that good knowledge can be applied to understand and define the physical risk of coastal hazards (e.g. by identifying the area likely to be subject to erosion and inundation over one hundred years), so that no risk prone activity takes place within the risk zone.

The risk reduction approach has two major components to it. The first relates to actively changing the physical nature of the environment. This can include "hard" approaches such as erection of groynes, sea walls or softer approaches such as the "Coast Care programme" and beach or dune replenishment where an enhanced beach or dune profile reduces the risk to private properties and infrastructure. The second category of risk reduction relates to managing the human assets that exist or are to be built within the Coastal Hazard Zone. This approach includes options such as minimum floor level increases and opting for increased setback of dwellings from the sea.

Risk transfer is an approach that reduces local authority risk and places it with landowners within the community. Insurance is a typical risk transfer approach, where landowners and businesses purchase financial protection, should a risk event take place. Another approach currently used is s36 of the Building Act.

Risk management is an active approach, where local authorities provide a framework to guide and force the community into making sensible resource decisions about Coastal Hazard Zones. This includes the provision of rules in plans that prohibit or limit subdivisions in zones with a high risk. Where subdivisions are permitted, they are subject to controls and may require site-specific resource consents. This approach includes the monitoring of risk compliance as part of the resource consent conditions. It may also include monitoring of the environment (e.g., sea level, position of the toe of the dune,

beach profile) and describes the situation and changes that have occurred over time. This information provides the scientific basis for decision-making.

Table 4 summarises the approaches to risk management for coastal hazards. Within any coastal region, it is possible, and perhaps desirable to have an approach to risk that combines the most suitable approaches from each of the four categories. The specific package chosen would be entirely dependent on the needs of each coastal community, both from an environmental and a human perspective.

Figure 4: Four approaches to risk for the management of coastal hazards and examples of that approach.

Risk Avoidance	Physical Risk Reduction	Risk Transfer	Risk Management
Coastal hazard zone identified and in public ownership or reserved from all development	*Changes to dunes* Coast Care programme Groynes Sea walls Beach/ dune replenishment Access alternatives *Changes to public and private assets* Floor levels Building location	Insurance Earthquake Commission S36 certificate (Building Act 1991)	No subdivision Subdivision controlled Evaluation plans Guidelines for approved construction Resource consent & conditions for building Relocation requirements and plans Alternative locations for houses Monitoring of risk compliance with consent Monitoring of coastal processes - sea level, sand reservoir, toe of dune, beach profile

4.3 Common Coastal Hazard Risk Management Methods in New Zealand

We now discuss some specific risk management methods in greater detail, apart from approaches under the Resource Management Act, which are commonly used in New Zealand to deal with risk to dwellings in areas subject to coastal hazards.

4.3.1 Section 36 of the Building Act

Section 36 of the Building Act relates to building on land that is subject to erosion (e.g., in coastal hazard zones). A territorial authority may grant a building consent to a landowner if it is satisfied that adequate provision has been made to protect the area from erosion or the owner will restore any damage caused by the building work.

The building consent includes a condition of that consent which says that an s36 notice will be lodged with the District Land Registrar stating that the land is subject to erosion. The District Land Registrar makes this entry on the certificate of title. This process alerts both the property owner and any subsequent buyers that this parcel of land is subject to erosion.

The territorial authority, its employees and agents are not under any civil liability to the building owner for a development on a parcel of land which has an s36 notice on its certificate of title and which later suffers damage arising directly or indirectly from erosion (which includes inundation).

This process thereby transfers some of the risk to the landowner, and away from the approving territorial authority.

A major review of the Building Act is before Parliament, which also affects these sections of the Building Act.

4.3.2 Earthquake Commission (EQC)

The EQC[ii] insures against loss or damage to homes, personal possessions, and land by natural disasters including natural landslip, tsunamis, storm and flood damage, up to $100 000.

After a natural disaster has occurred, dwellings may not be damaged but may be under immediate danger from that disaster. People can make claims to EQC for the costs of taking reasonable steps to protect your property or to prevent further damage. Storm and flood damage is covered for damage to land only; however, the Commission does not cover damage caused by erosion. EQC will settle with a cash payment to a landowner they are unable to secure relevant consents from local authorities.

EQC does not pay for the cost of protection works against future natural disasters; this cost must be borne by property owners. EQC can also refuse to pay a claim if there is a Section 36 notice (Building Act 1991) on the Certificate of Title to the land.

4.3.3 Coastal Monitoring

Coastal monitoring is a scientific approach that focuses on collecting information about the physical condition of a number of coastal parameters. These coastal parameters include sea level and wave conditions, beach profiles, coastal hazard events and other features that related to changes in the coastal environment. Analysis and modelling of this data may also take into account current scientific theories and trends that may impact on the coastal environment, such as climate change and rises in sea level.

Coastal monitoring is a crucial tool because it provides information on physical coastal trends and when coupled with land-use information, it provides decision makers with information that highlights areas that are prone to risk.

5 Coastal Hazard Indicators

This section briefly reviews experience from New Zealand and around the world with the use of indicators to monitor the state of coastlines and track the progress of coastal management efforts, particularly in regard to coastal hazards and management. Looking at lessons from previous work and the common approaches utilised that may indicate best practice.

5.1 Ministry for the Environment Best Practice Guidelines

Within New Zealand, MfE is establishing a set of environmental indicators as part of their Environmental Performance Indicators Programme. Available and proposed indicators are listed on their website;[iii] however, they did not include indicators that measured coastal hazards or risks.

MfE[iv] define environmental indicators as:

> "…aspects of the environment which are monitored regularly to detect trends or sudden changes in a specified environmental condition."

MfE[vvi] has provided guidelines on the development of environmental indicators. They suggest that indicators need to be simple and robust, policy relevant, analytically valid, cost effective, easily understood and able to use existing data wherever possible.

An ideal indicator would encompass all of the following attributes; however, in practice this is not usually possible. Data availability (which directly relates to data cost) and data consistency over areas measures appear to be key drivers in indicator selection.

5.1.1 Policy relevant

Indicators must be relevant to the environmental policies that they are attempting to measure. They should measure whether or not key outcomes from the policy and legislation are being met.

The extent to which indicators are able to measure policies will, in part, be attributable to the quality of the policies. Succinct and measurable policies will be easier to monitor compared to policies which are vague, broad or lack recognised techniques to measure the elements that the policy is attempting to address.

5.1.2 Provide information on which decisions can be made

As well as being policy relevant, the indicators must also provide information on which decisions can be made. Indicators should give insight into areas where policy decisions have to be reassessed. Policy makers will have to decide whether or not more resources need to be channelled to achieving a particular policy, or whether the policy requires adjustment to align it to a more practicable approach. Indicators will alert the decision maker that changes are required, although further information may be required to determine which approach should be taken.

5.1.3 Data which can be consistently gathered and consistently interpreted

Indicators should be measurable, represent the system being assessed and be responsive to environmental change. The data collected should be replicable to clearly show any changes that occur through time. Data needs to be scientifically valid and sampling design should be statistically sound, so as to maintain credibility and ensure that any decisions resulting from indicator results are defensible. Consistent standards are required for data collection, analysis and management.

Where possible, the indicators should be able to detect human induced change from natural variations.

5.1.4 Simple and easily understood

Indicators must be simple to monitor, interpret and available from accessible information systems. They also need to clearly display the extent of the issues. Highly technical data, which requires detailed interpretation and explanation, should be avoided.

5.1.5 Be readily collectable without significant additional cost

Ideally, indicators will be chosen from data that is already collected by Councils or available from other agencies in a readily accessible form. Establishing indicator programmes requires data collection on an ongoing basis. Time consuming and high cost monitoring programmes can be subject to cost-cutting exercises when fiscal constraints arise. Indicators are less likely to be cut from programmes if the data is already collected within the system.

Establishing a limited number of indicators will also minimise data costs.

5.1.6 Comparable over the area under study

It is important that indicators that measure different geographical areas are comparable. For example, because the current study has been established by Environment Bay of Plenty to measure their objectives and policies in the RCEP, it will be important that the indicators can be measured across each district within the Region. This will allow comparisons to be made and provides a broad, regional picture.

5.2 General Considerations Relevant to Coastal Indicators

The process of integrated coastal management (ICM) has received a great deal of attention over the last 20-30 years and there is now recognition that the process follows a widely accepted policy or project development cycle – composed of identification of issues, plan preparation, formal adoption and funding, implementation, and evaluation. The initial cycle usually requires 8-15 years to complete and tackles a few urgent issues, with the projects or programmes maturing through the successive completion of management cycles.[vii]

The present project fits with the general conceptual model of ICM noted above. Coastal erosion hazard has been identified as a critical issue for the Bay of Plenty coastline and considerable attention has been given to identifying coastal hazard areas in recent years, including significant Environment Court cases. There is also an ongoing effort to develop and implement appropriate management measures to arrest the escalating risk profile.

Experience with mature coastal programmes suggests that it often takes a sustained effort, measured in decades and spanning several generations of a given programme, to achieve tangible expressions of improvement in coastal resource conditions.[viii] In coastal management programmes 'real change is real hard and takes real time'.[ix]

This is particularly the experience in regard to the management of coastal hazards. There are few, if any, parts of the world in which escalation of the risk profile has been successfully curtailed in popular coastal areas similar to the Bay of Plenty, even in areas extremely vulnerable to coastal hazards. For instance, in Florida, populations continue to escalate in the most vulnerable coastal counties, including nearly 25% of the total state population living within the highest risk hazard area. This occurs despite the extreme vulnerability to coastal hazards and the recent experience of major disasters such as Hurricane Andrew. In this disaster 43 people were killed and damages were in excess of $25US billion. It has been one of the costliest natural disasters in US history.[x]

Therefore, successful implementation of Policy 11.2.2 of the RCEP will require significant attention to the management of use and development in hazard areas. Reliable indicators will be critical to monitoring the ongoing success of this work, including state indicators that can be used to provide good baseline information on the existing risk profile and sensitive indicators that can provide early detection of trends that need to be addressed. As changes in baseline conditions will probably be relatively slow, baseline indicators may only need to be measured every three to five years, although simple trend indicators will be required to supplement these measurements so that ongoing management trends can be closely monitored.

A recent review of the use of indicators in coastal management noted that there is no 'perfect' indicator or set of indicators. Indicators must be tailored to their expected use, theoretically well founded, supported by reliable and valid data, provide meaningful and readily understood information that is useful to their intended audience, be cost effective,

and directly related to specific policy goals.[xi] Existing best practice also uses the smallest relevant set of indicators and, where appropriate, may aggregate sets of indicators into indices.

The recent review also identified that indicators developed for the assessment of management policy and practice have tended to focus on measures of project or policy implementation, rather than outcome evaluations, (i.e. how management is impacting on coastal resources and human use). They concluded that outcome evaluation is critical to ensure management is having beneficial "on the ground" impact[xii]. Once again, this is likely to be especially important in hard issues such as arresting escalation of coastal erosion risk in popular nearshore coastal settlements.

SECRU[xiii] note that the development and use of outcome evaluations face various challenges, including:

- There is no consensus on appropriate indicators to measure specific outcomes. As discussed further below, this is a particular issue for indicators related to coastal hazard management, with these indicators generally at an early stage of development.

- There is an absence of good quality baseline and time-series data on which to base indicators. Lowry et al[xiv] also note that the design of coastal management initiatives rarely involves documenting baseline conditions in sufficient detail to enable rigorous objective assessment of either management performance or the degree to which any change can be attributed to management efforts. Once again, these are critical areas that will need to be given attention in any realistic or meaningful monitoring of Objective 11.2.2. of the RECP.

- The difficulty inherent in modelling many types of cause and effect relationships with simple indicators.

- The number of years required for management impact to become apparent. Once again, this is particularly relevant to coastal erosion hazard, as the risk profile in any particular settlement changes relatively slowly and one or two poor decisions can set precedents or raise expectations that can seriously prejudice hazard management objectives. This particularly necessitates the development of trend indicators that are sensitive to even relatively small changes.

- The time and money required to assess performance. Cost-effective indicators are required, as well as those that are not overly time-consuming to measure.

The review of coastal management indicators by SECRU[xv] also strongly recommended that a partnership approach be adopted to indicator development and relevant data and information collection. This is particularly relevant to the present project as the indicators required for monitoring Objective 11.2.2 of the RCEP will also be relevant to hazard management objectives in many district council plans. Moreover, much of the day-to-day

management responsibility for use and development within coastal hazard areas rests with district councils and these agencies are in the best position to routinely collate the various information required for indicators. A further advantage is the promotion of integration and partnership and the provision of a common "language" and approach for monitoring and evaluation of hazard management.

Most work on the use of indicators for monitoring coastal management also note that desired outcomes need to be identified for each indicator and triggers agreed for management action if desired outcomes are not being achieved.

Ideally, indicators should also be chosen that are not only sensitive to change in baseline conditions but which enable evaluation of the role that management action played in promoting such change. The recent review of indicators in coastal management conducted by SECRU[xvi] noted that:

> 'the great majority of SoE reports do not attempt to link change in environmental, social or economic variables with management effort...(p18).

Therefore, while the monitoring may indicate that desired outcomes are being achieved, the link with various different management action and the causes of change are often not able to be determined.

5.3 Experience from other locations with coastal indicators

To date, most indicators developed for monitoring the state of the coastal environment have been developed for State of Environment (SoE) reporting, with groups of such indicators generally forming coastal or marine themes within larger SoE reports. These sets of indicators are typically science-based information on environmental conditions and trends, generally following the Pressure-State-Response (PSR) framework developed by the OECD in 1994 or simple measures of management response.[xvii]

This appears to be particularly the case for indicators developed for national and/or international reporting. For instance, at the international level, the European Environmental Agency provides a comprehensive assessment of the European Union (EU) environment, updated on a three yearly basis, including both pressure and state indicators. However, the indicators for coastal erosion are simply measures of the physical environment – the pressure indicator being shoreline recession in metres/year and the state indicator being land loss in square metres/ year.[xviii] The Australian indicators for national SoE reporting, developed in 1998, involve 61 condition (C), pressure (P) and response (R) indicators for the estuaries and sea theme[xix], with indicators grouped into 8 classes. The only measure relevant to coastal hazards (the nature and cost of beach rehabilitation and stabilisation works) occurs in the Integrated Management class. This indicator provides an indication of management response but does not provide any useful indication in trends of the nearshore risk profile. Similarly, the potential indicators developed for Scotland

include the nature and extent of coastal defences as the only indicator relevant to coastal hazards and management is the extent and nature of coastal defences. This is also a common indicator in many other programmes.

The national indicators proposed for New Zealand's marine environment[xx] do not include any indicators of coastal erosion or associated hazard. However, in the submissions on these draft proposals,[xxi] several submitters identified indicators related to coastal hazards they wished to be considered. For instance, four submitters (including the New Zealand Coastal Society, two regional councils and a university) noted the need for indicators monitoring land use in coastal hazard zones. The submitters argued that well accepted and understood techniques were available for the definition of hazard areas and that management of risk in these areas was a significant policy goal in regional and district plans. Other submitters also requested more science-based indicators that directly measured the process of coastal erosion and activities (such as sand extraction) that can cause erosion.

However, at state, regional and local level, indicators are more commonly adopted for coastal hazards and management.

One of the more notable overseas examples is the Florida Assessment of Coastal Trends (FACT) programme, which includes coastal hazards as one of six major trends that are monitored. This reflects the extreme vulnerability of Florida to coastal hazards[xxii]. In this particular case, inundation is a more significant hazard than erosion. The state monitors the number of people "at risk" in coastal counties and also the number of people in the highest risk Category 1 storm surge zones, the areas most likely to be inundated by storm surges. The purpose of this indicator is to help direct limited state and federal resources to either reduce growth or ensure potential losses are mitigated.

However, apart from this case, no other overseas programmes were found that attempt to monitor the level of risk within coastal hazard areas.

The only agency we are aware of in the early stages of developing such indicators is Environment Waikato.

5.3.1 Environment Waikato

In 1996, Environment Waikato developed a simple five-class indicator to assess the level of coastal hazard risk within the various coastal communities in its region[xxiii]. The highest risk categories were those settlements where houses (Category 1) or beach front residential properties (Category 2) were wholly or partially located within the area potential at risk from erosion with existing coastal processes (i.e. excluding the effects of projected climate change). The settlements with the lowest risk profile (Category 5) were those where both the existing beachfront properties and dwellings were landward of the total area likely to be at risk from existing coastal processes and projected global warming.

More recently, the Environment Waikato has completed definition of erosion hazard risk areas for all Coromandel coastal settlements – identifying a Primary Risk Area (at risk from

erosion with existing coastal processes) and a Secondary Risk Area (additional area that may be impacted by erosion in the event of projected sea level rise to 2100). Indicators have now been developed to monitor use and development in these areas. To date, the indicators include the number of houses and lots within both the Primary and the total (Primary + Secondary) risk areas and the capital value of the properties and dwellings in both these areas. The indicators have also been refined to reflect whether the risk to the property is minor (<10% of property in hazard area), moderate (10-30%) or major (>30%)[xxiv].

The baseline measurements are presently (August 2003) being finalised for these indicators (will be completed by end of August 2003) and can be updated relatively easily using GIS as future DCDB and valuation databases come to hand.

In addition, the seaward face of all beachfront dwellings has been fixed on GIS for a baseline year (1995/96) and it is hoped to be able to develop a further indicator specifying the setback of each house from the shoreline, using the 1995/96 shoreline as a baseline. The rationale for this indicator is that the proximity to the shoreline determines the level of risk and therefore provides more precise (and property specific) information on the risk profile. At present, Environment Waikato plans to update this indicator using future aerial photographs. However, as most houses will not have changed, it may be more cost-effective to work with district councils to ensure the relevant information is updated at the time of building consent applications. For instance, an alternative approach could be to collect information on the setback of the existing house and the proposed new dwelling at the time of the resource/building consent process. This would also enable the indicator to be quite sensitive to trends. This is because the setback of the new dwelling could be compared to that of the previous house on the property, indicating whether the risk has been decreased by a location further landward or not. Therefore, this indicator may provide a very simple measure for day to day monitoring of management trends.

Other elements of the physical risk profile, including size of dwellings (either in site coverage or total area) and relocatability are not currently addressed. These measures could however be relatively simple to introduce as a trend measure – if the information (on both the existing and the new or modified dwelling) was collected at the time of resource/building consent.

6 Risk Management within the Bay of Plenty

6.1 Regional coastal environment plan

The contents of the RCEP and the integrated approach to risk management laid out in that plan have been discussed in earlier sections of this report and are not repeated in detail here. In summary the approach:

- Identifies areas subject to coastal hazards in the plan
- Requires district councils to carry out further work to more precisely identify and zone areas of coastal hazards
- Directs that in areas of no development, no further development or subdivision should occur
- Expects that in developed areas a managed approach will be taken to any new development
- Takes a precautionary and generally discouraging approach to managing coastal hazards through hard coastal protection works
- Takes an encouraging approach to soft approaches such as coastal care and public education.

6.2 Existing and planned EBOP coastal monitoring and EBOP reporting

EBOP reviewed their Natural Environmental Regional Monitoring Network (NERMN)[xxv] in 2001. This report identifies that coastal hazard monitoring is carried out through regular surveys of beach profiles at 54 sites throughout the region on an annual basis. In addition, a group of sites is selected each year for quarterly monitoring. The changing shape and volume of the plotted beach profiles indicates the stability of the shoreline at each site. A baseline of ten years of data has been gathered. The NERM report also identified that there are small pilot trials underway to assess new methods for coastal monitoring, but these will require careful evaluation before replacing any existing methods.

The review concluded that Council's monitoring role was wider than what it currently encompassed and identified that further monitoring is required to better understand coastal hazard management. Changes to existing NERMN modules were also recommended. The review recommended the expansion of the coastal profile monitoring, in partnership with

District Councils, where development is taking place. There is no other monitoring for the purpose of understanding coastal hazard, or the effectiveness of regional or district council policies.

The Ministry for the Environment (MfE) national environmental indicators programme does not include any indicators in the areas of managing natural coastal hazards. (This is mentioned in section 5.1).

6.3 Opotiki District Council

Technical work is underway to determine the Coastal Hazard Zone for ODC. It is expected that a plan change will be notified late in 2003. There are thoughts that subdivision may be dealt with in a wider coastal strategy that will determine where development should occur. Increased residential growth is anticipated for the Opotiki District. A recent example of a new development is a 250-lot subdivision at Waitotahi, which has a 70-metre setback.

Currently, where subdivision or development is proposed within the Areas Subject to Coastal Hazards zone, specialised reports are requested from applicants. These reports are checked and building consents are granted under the Building Act.

Coast Care programmes are operating at Ohiwa, Bryans Beach, Waiotahi, Tirohanga, Hawai, Opape and Te Kaha. Project Crimson (which promotes and plants pohutukawa trees) is also active in the District.

6.4 Tauranga District Council

The Tauranga District (TDC) Plan is operative except for one outstanding appeal being RMA1666/98, Skinner. The matters at appeal are being resolved as this report is written. This appeal relates to the Coastal Hazard Erosion Policy Area of Papamoa East. Coastal Hazard Zones have been identified in the TDC District Plan. TDC has a different number of zones within the Coastal Hazard Zone depending on the location. There are three zones at Papamoa and four zones in most other Coastal Hazard Zones in the District. The Environment Court ruled that the safety buffer area was to be deleted along the length of the coastline of issue at Papamoa,[xxvi] hence the resulting three zones at Papamoa.

The zones are termed:

- Extreme Risk Coastal Hazard Erosion Policy Area
- High Risk Coastal Hazard Erosion Policy Area
- Medium Risk Coastal Erosion Policy Area
- Safety Buffer Zone (except for Papamoa Beach)

Coast Care programmes are operating at Mt Maunganui and Papamoa.

Within the Extreme Risk Coastal Hazard Policy Area subdivision and erections or extensions to buildings are Prohibited Activities. In the other three zones subdivision, erection and extension of buildings are deemed Limited Discretionary Activities.

The matters for discretion and conditions for Limited Discretionary Activities in the Management Rules for Natural Hazard Policy Areas section of the TDC District Plan (except for Papamoa East) are quoted below. Matters of discretion, among other things, relate to the potential to relocate or demolish buildings, whether the activity will create further damage, are subject to damage or reduce the net risk of coastal hazards.

"17.2.1 Limited Discretionary Activity

Standards and Terms

17.2.1.2 Within the Extreme-, High- and Medium-Risk Coastal Hazard Erosion Zones and Coastal Protection Area

(a) Matters of Discretion and Conditions

The Council limits the exercise of its discretion to:

(i) Whether the proposal would be consistent with the objectives and policies for Hazard Management - Coastal Hazards

(ii) The extent to which activities, *buildings* and *structures* can be relocated or demolished with minimal *disturbance* to the site or adjacent sites

(iii) The degree to which the proposed activity is likely to:

- Accelerate, worsen or result in further damage to that land, other land, or *structures* or *buildings* caused either directly or indirectly by erosion or inundation
- Be subject to damage from erosion, inundation or wave runup
- Compromise the natural buffering ability of the foredune system
- Reduce the net risk of *coastal hazards*

(iv) The general requirements for development or *subdivision* of land (see Rule *11.3*)

(v) The imposition of *financial contributions* in accordance with *Chapter 26 Financial Contribution Rules*

(vi) The imposition of conditions relating to the proposed *subdivision* or development

(vii) Any other matter for which Council limits its discretion for a limited discretionary activity in the zone in which the activity occurs.

(b) Special Standards and Terms for Limited Discretionary Activities in the Coastal Hazard Erosion Policy Area and Coastal Protection Area:

Activities, *buildings* and *structures* must be able to be relocated or demolished with minimal *disturbance* to the site or adjacent sites

(i) Land-use consent may be granted for a limited duration of not more than the period before the toe of the frontal dune is projected to reach the front *boundary* of the *building* or activity site. Renewal or review of consent may be a non-notified application

(ii) No activity, including *earthworks*, shall reduce the buffering ability of, or alter, the natural dune landform

(iii) On a *subdivision*, any new lot which is affected by the *Coastal Hazard Erosion Policy Area* must have a practicable *building platform* clear of a Coastal Hazard Erosion Zone as defined in *the Plan*

(iv) *Subdivision* consent may be granted without limitation for minor *boundary* adjustments and alterations or vesting of *reserves*

(v) An application for a *building*, *structure*, or site works within the *Coastal Hazard Erosion Policy Area* shall include a report on the suitability of the proposed *building* or *structure* prepared by an independent coastal engineering specialist or include written confirmation that the Council's Coastal Hazard Area Building Guidelines are to be adopted for the proposed *building*, *structure*, or works site, as an acceptable solution.

(c) Reassessment of the Coastal Hazard Erosion Policy Area

An application for consent may require a reassessment of the *Coastal Hazard Erosion Policy Area*. If so, the methodology for assessing coastal risk shall comply with that presented in the Regional Coastal Environment Plan."

6.5 Western Bay of Plenty District Council

WBOPDC commissioned a detailed study on areas from Waihi Beach to Bowentown and Pukehina and the findings are reflected in land identified on the District Planning Maps as being within the "Coastal Protection Area". There are two zones (primary and secondary) within the Coastal Protection Area.

The provisions of the Coastal Protection Areas in the WBOPDC District Plan were appealed to the Environment Court in 1998. A decision on the appeal (RMA 27/2002) was made in February 2002. In summary the Court upheld the science behind the coastal hazards analysis and the notified provisions of the WBOPDC District Plan.WBOPDC have developed an information brochure on developing in a coastal hazard zone. Coast Care programmes are operating at Waihi Beach, Island View, Pios Beach and Pukehina.

Within the primary zone, dwellings, subdivisions and additional dwellings are all discretionary activities. Within the secondary zone, dwellings are limited discretionary and subdivision is discretionary. Within both zones, the activity rules are complicated if sewer reticulation does not exist.

The performance standards from the Natural Hazards section of the WBOPDC District Plan are quoted below. Performance standards, among other things, relate to alternative access, relocatability of new buildings and the location of the building on the site.

"12.3.4 Activity Performance Standards – Restricted Discretionary and Discretionary Activity Criteria

12.3.4.1 Council will have particular regard to:

(a) the proposed avoidance, remedial, or mitigation measures relating to the identified hazard.

For 12.3.1(a) above these measures include:

(i) the provision of an access yard of at least six metres as shown on the planning maps (this is to enable the creation of alternative legal access should the seaward road be removed).

(ii) the extent to which the building is relocatable (design, location of building on site, practical access for relocation).

For 12.3.2(a) above these measures include:

(i) new buildings or significant redevelopment of existing buildings should be situated as far back from the sea as is practicable to provide the greatest distance between the hazard and the building. In determining what is practicable the location of adjacent buildings will be taken into account, and

(ii) additions or alterations to any building should be landward of the existing building

and

(b) the potential environmental effects of or likely to result from the proposal including those relating to any measures referred to in (a) above, and

(c) the effect of proposed buildings or other works on the capacity of ponding areas and on floodwater flow paths, and

(d) the extent to which the proposal addresses any identified natural hazard in a way that enables the existing natural character of the coastal environment and other natural features having recognised ecological, landscape or other significance to the District to be protected, and

(e) verifiable new information which demonstrates that any land within an area identified on the District Planning Maps as potentially subject to natural hazard is not in fact under threat from the hazard concerned."

At Waihi Beach proposed Plan Change 23 (still in the submission and hearing stage) proposes that further subdivision in the primary risk area should be prohibited. The erection of new dwellings and additions to houses are deemed a discretionary activity in the primary zone. In the secondary zone it is a restricted discretionary activity. It is anticipated that a similar plan change may be expected at Pukehina Beach in the near future.

6.6 Whakatane District Council

Coast Care programmes are operating at Matata/Pikowai/Otarmarakau, Coastlands, West End and Ohope.

Whakatane District Council (WDC) has completed technical work to define the Coastal Hazard Zone; however, no time frame has been set down for a plan change. Technical work[xxvii] for WDC on Coastal Hazard Zone analysis has made provision for three subzones within the Coastal Hazard Zone:

- Current Erosion Risk Zone: a zone that includes all land presently at risk from erosion due to storm erosion, short-term fluctuations and due instability with sufficient safety factors
- 2060 Erosion Risk Zone: a zone that includes the current erosion risk zone and additional areas predicted to be subject to shoreline movements from sea level rise to the year 2060
- 2100 Erosion Risk Zone: a zone includes that includes the current erosion risk zone and those areas that are predicted to be affected by shoreline movements due to sea level rise to the year 2100.

Although Coastal Hazard Zones have not been added to the Proposed Whakatane District Plan, section 4.4.1.1 had provided that activities located within the Areas Subject to Coastal Hazards had a discretionary activity status.

The Council has since withdrawn this rule for its urban zones, leaving the management of the risks associated with locating houses in the Area Subject to Coastal Hazards to the limited controls available under the Building Act.

Section 3.11 of the Proposed Plan lists assessment criteria for Discretionary and Non-Complying activities. Under section 3.1.10 (Natural Hazards) assessment criteria include inundation issues, whether or not the activity will worsen the hazard and physical attributes of the site. For coastal hazards, Council shall have regard to erosion impacts of sea level rise, shoreline response to storm erosion and flooding, planning horizon, long-term trends, short term fluctuations, dune stability factors and factors of safety.

7 Indicators

7.1 Identification of indicators

This section describes a selection of indicators that can be used to measure coastal erosion hazards within the Bay of Plenty Region. These indicators are primarily focussed on the land/human impact side of the coastal hazard equation. The indicators are then prioritised to reflect those which we consider to be most useful in terms of monitoring plan effectiveness and inclusion in the Environment Bay of Plenty State of the Environment Report which is due to be redone later this year.

For the purposes of this report, it has been assumed that the policies, rules and methods in the Regional Coastal Plan which are then adopted into the District Plans to deal with coastal hazards, will be effective. Therefore, the ultimate aim of indicators that are selected from this project is to measure whether or not these policies are being achieved. Whether or not the policy is effective in actually reducing the total physical risk of the region is out of the scope of our brief, and something that would be determined by the Council during policy **effectiveness** monitoring.

We have developed indicators by reviewing the **policies** in the Regional Coastal Plan itself – and asking the question – how could we measure whether this policy is being achieved or not with respect to total physical risk. In addition we have used the scenario description in Figure 2 earlier in this report as a basis for developing possible indicators. Lastly we have developed indicators based on a "whole picture" approach to the overarching objective of "no increase in total physical risk".

7.2 Number of "hard" coastal protection works established in each district

Policy 11.2.3(a) of the RCEP relates to taking a precautionary approach to the installation of coastal protection works. Hard protection works include sea walls and informal protection measures such as placing car bodies, rocks and concrete at the foot of dunes. Policy 11.2.3(d) refers to taking into account Policy 3.4.5 of the NZ Coastal Policy Statement (new subdivisions and development should be located and designed so that the need for hazard protection works is avoided) when planning subdivisions in Coastal Hazard Zones.

This indicator would be related to the open coast, rather than estuaries and harbours where sea wall protection is often for purposes other than protecting land from erosion (e.g. "tidying" the coastal edge or retaining land).

No further hard coastal protection works would imply that other methods (hopefully more preferable methods) are being used to manage risk in the region. An increase in the number of hard coastal protection works would suggest that a precautionary approach to coastal protection works is not being taken.

Information on the establishment of new formal coastal protection works would depend on where the coastal protection works were placed in the environment. EBOP Environment Bay of Plenty would hold records for consents granted in the CMA; however, those sites above the CMA would be under District Council jurisdiction.

Currently there are approximately 500-600 seawalls in the region that were constructed pre RMA. Because the RCEP is now operative, these structures will require resource consents. Therefore, measuring the number of resource consents granted in the future, is likely to give an uninformative picture, as many of the consents, at least in the short-term, will be for existing structures.

7.3 Number of "soft" coastal protection works established in each district

Policy 11.2.3(a) of the RCEP relates to taking a precautionary approach to the installation of coastal protection works. Soft protection works include dune care, beach replenishment and the restoration of estuarine vegetation. The wording for this policy implies that soft protection works are preferable to hard protection works.

An increase in the amount of soft coastal protection works could indicate that alternatives to hard coastal protection works were being established.

Information on the number of soft coastal protection works established at any one time is available from the Coast Care Co-ordinator (Greg Jenks) Environment Bay of Plenty. The main soft coastal erosion works is planting of native species. Once the native plants have established, replanting is usually not necessary. An indicator could measure the proportion of area planted compared to the total area that required planting at the start of the Coast Care programme. This indicator would require the identification of total areas that required planting.

7.4 The presence/absence of a Coast Care programmes in the Areas Subject to Coastal Hazards

Policy 11.2.3(q) of the RCEP encourages initiatives designed to involve the community in Coast Care. Measuring the numbers of Coast Care programmes in the Areas Subject to Coastal Hazards will show whether or not the number of Coast Care initiatives has changed, but it will not determine whether or not these initiatives are effective or describe the size of the programmes.

Information on the number of Coast Care programmes is available from the Coast Care Co-ordinator (Greg Jenks) at Environment Bay of Plenty. There are currently 16 Coast Care groups and there is a potential for another four to six groups to be established in the region. Environment Bay of Plenty maintains a mailing list for all established programmes, which provides details of participants of each Coast Care group.

Alternatively, an indicator could be developed that measured the change in the number of participants in Coast Care per District. This would show if the individual programmes over the districts are changing over time.

Given that there is only a potential for another four to six groups to be established, this indicator may give little useful information on which decision-making could be based. Should the Coast Care programmes decline, then this indicator may pick this up. However, if the mailing list were not maintained, the number of participants on lists could be misleading. In addition there are many people who participate in Coast Care programmes but are not on mailing lists. Nonetheless, it would be useful to report the presence of such programmes in a "state of the environment" type report as a baseline situation – as by comparison with other regions Environment Bay of Plenty may be able to indicate that a good level of attention is being given to these "soft" approaches in comparison with other jurisdictions.

7.5 The presence/absence of Areas Subject to Coastal Hazards

Policy 11.2.3(b) of the RCEP aims to identify Areas Subject to Coastal Hazards. Because Areas Subject to Coastal Hazards have already been identified by Environment Bay of Plenty in the RECP this indicator does not add any further helpful information to assist with decision making. As with the presence or absence of Coastal Care programmes this would be helpfully reported in a "state of the environment" report as a baseline achievement.

7.6 The presence/absence of a Coastal Hazard Zone in the district plan

Policy 11.2.3(c) of the RCEP states that where existing urban subdivision or development falls within an Areas Subject to Coastal Hazards, the district council should commission research to identify a coastal hazard area and include it in the district plan. The presence of a Coastal Hazard Zone in the district plan indicates that this research has been undertaken and the results have been incorporated into the planning tools at the District Council level.

This information is readily available in the district plans for each local authority. As already discussed some Councils are well advanced (achieved) in this area, and others have considerable statutory processes to be transacted. The presence of the Coastal Hazard Zone in the district plan is a very important statutory tool, which then enables a whole range of other tools and techniques to be utilised. Again it is probably most appropriately reported in a baseline document as "achieved" or other status.

A comparison between Councils of the level of planning control for a set of parameters would also be helpful as baseline information. For example the level of planning control on subdivision, minimum lot sizes, houses, minor household units and the like.

The presence of a Coastal Hazard Zone will also be an important component of some of the other indicators that aim to quantify whether or not there are changes in total physical risk within these zones.

7.7 Number of houses in the Coastal Hazard Zone

The number of houses in a Coastal Hazard Zone, plotted over time, will give an indication of building activity within this zone. A decrease in the number of houses would suggest that risk had decreased. This indicator will help to measure Policy 11.2.3(d) of the RCEP. Policy 11.2.3(d) refers to the New Zealand Coastal Policy Statement (new subdivisions and development should be located and designed to avoid the need for hazard protection works) and the Environment Bay of Plenty RPS (new subdivision, use, development, significant infrastructure is located and designed to avoid significant natural hazards and new development within existing settlements at risk from natural hazards shall not result in increased vulnerability and aims to reduce net vulnerability over time).

Houses within the Coastal Hazard Zone could be obtained via aerial photographs. Environment Bay of Plenty has a Regional Digital Aerial Mosaic (RDAM), which contains aerial photographs (1:10000) within their GIS system. Higher resolution photographs are available for some areas (1:7500). These photographs are updated; however, historically this has occurred at set intervals. Environment Bay of Plenty currently does not have District Plan Coastal Hazard Zones within the GIS system. This information can be loaded for WBOPDC and TDC and for other Councils as it becomes available. Counting dwellings at certain periods would then be a relatively simple exercise. The indicator is probably best suited as a baseline indicator and used in conjunction with other indicators to provide information on which risk issues can be addressed.

The concept is also simple to describe and the information is easy to collect. This indicator does not provide information about type of the dwelling (e.g., short-term holiday home, permanent home), its financial value or size.

Depending on availability of photographs, it will be possible to gather this information for previous years to gain a historical context and set historical baselines, if desired. Coastal Hazard Zone boundaries could be superimposed on historic aerial photographs and the number of houses counted within each zone.

7.8 Percentage of houses in Coastal Hazard Zone subject to planning controls

All Councils with a Coastal Hazard Zone on their planning maps also have accompanying planning rules that limit the development within a Coastal Hazard Zone. It would be expected that any new dwelling or alterations to existing housing within the Coastal Hazard

Zone would be subject to resource consents. Therefore, over time, the percentage of houses in the Coastal Hazard Zone subject to resource consent would be expected to increase, suggesting a decrease in risk.

Risk may not necessarily decline, even if this indicator shows an increase in the percentage of houses that are subject to a set of planning controls in the Coastal Hazard Zone. Take, for example, a situation where new houses are not replacements for existing houses, but rather are adding to the total number of houses. It could be argued that risk is increasing, if overall housing numbers are increasing in the Coastal Hazard Zone. The risk profile would be dependent on the effectiveness of the resource consents and the conditions attached to them.

Information relating to resource consents for houses is available from District Councils.

This indicator would not be useful for Whakatane and Opotiki District Council, where Coastal Hazard Zones are still to be formally implemented. However, as these Councils implement plan changes to limit and guide development within Areas Subject to Coastal Hazards, the Districts will become more comparable over time.

There are also issues relating to comparability of planning controls between Councils. Unless the planning controls are similar, and interpreted in a similar manner, comparing the data across District Councils may be less useful.

7.9 Number of residential lots in the Coastal Hazard Zone

An increase in the number of residential lots within the Coastal Hazard Zone is a leading indicator, in that new subdivisions suggest that further development is anticipated. Cadastral information is available from the Environment Bay of Plenty GIS system, which is updated several times a year. This data is also readily available from LINZ or cadastral databases such as Terraview. The location of the Coastal Hazard Zone would need to be mapped onto the Environment Bay of Plenty GIS system.

This indicator may need to be adjusted to capture any pre-existing cross- lease arrangements (prior to 1991 when the RMA was introduced and they were not always captured as if they were a subdivision).

This indicator may also measure a decrease in risk if property amalgamations are to occur (e.g., the formation of a reserve from previously subdivided areas).

7.10 The percentage increase in total floor area in the Coastal Hazard Zone

An increase in the total floor area in the Coastal Hazard Zone will determine if the quantity of physical structure is increasing. With recent trends for increased dwelling size, this indicator would estimate the amount of risk to physical structures without including the financial value of house in the equation. It would also help to measure Policy 11.2.3(d) of

the RCEP which refers to the New Zealand Coastal Policy Statement (new subdivisions and development should be located and designed to avoid the need for hazard protection works) and the EBOP RPS (new subdivision, use, development, significant infrastructure is located and designed to avoid significant natural hazards and new development within existing settlements at risk from natural hazards shall not result in increased vulnerability and aims to reduce net vulnerability over time).

Building floor areas are available from EBOP from their valuation data obtained via Quotable Value NZ Limited. QVNZ adds building floor areas to their database when they inspect new dwellings. Building floor areas will be adjusted for those existing dwellings for only those properties that require a building consent. The data from building consents is updated approximately bi-monthly; however, data can take longer if homeowners need to be present to allow valuers assess the improvements.

The advantage of this indicator is that it measures increase in risk in already established areas where total physical risk can still increase through dwelling renovations, even if no new dwellings are erected. This indicator could also be further broken down to measure the changes in floor areas over time within new coastal subdivisions. It could be argued that this indicator is a surrogate for measuring the value of property; however floor area may also be an indicator of parameters such as more permanent population, more people in households and houses that are more difficult to relocate. As an indirect indicator it would be less preferable than more specific indicators of increases or decreases in risk.

7.11 Proportion of applications that have a complete coastal hazards analysis for new subdivision, use and development for properties falling within the Areas Subject to Coastal Hazards.

Policy 11.2.3(e) of the RCEP aims that applications to councils for new subdivisions or development in the Areas Subject to Coastal Hazards should be supported by a hazards analysis. A complete coastal hazards analysis would be defined by the criteria set out in policy 11.2.3(f) of the RCEP.

Coastal hazard analysis is only required where the coastal hazard zone has not been put in place, and so will become less relevant over time.

This information would be available from district councils.

This indicator would measure policy 11.2.3(e); however, it is unlikely to measure a change in the total physical risk. Like a number of other potential indicators it would be useful to establish as a baseline “achieved” for those councils who have not yet introduced Coastal Hazard Zones.

7.12 Proportion of minimum ground levels or building platforms determined for estuaries and harbours in the district

Policy 11.2.3(g) aims that the district councils and Regional Council jointly determine minimum ground levels or building platforms at estuaries and harbours. An indicator around this policy would simply indicate the baseline – "achieved" or not and the locations where the floor level standard had been achieved. Another level of indicator would be around whether the minimum floor levels actually protect the buildings from flood and other damage. This could be instituted on an infrequent basis, and following major storm events.

7.13 Number of foredunes lowered in the district in Areas Subject to Coastal Hazards

Policy 11.2.3(j) states that lowering of fore dunes is to be avoided. Lowering of dunes would increase the total physical risk.

It would be hoped that resource consents did not provide for the lowering of dunes in the coastal environment. However, if consents did allow this practice, consent conditions could be checked at District Councils, for each consent granted in an Areas Subject to Coastal Hazards or Coastal Hazard Zone. Informal dune lowering would be more difficult to determine and would be best measured via a survey that determined how many cubic metres of sand were removed over a period of time. It would be difficult to attribute sand loss to purely human causes. For example, erosion could cause sand loss from dunes. In addition, for landowners to legally lower dunes, they would require riparian rights. There are very few areas in the Region where landowners have riparian rights.

It is unlikely that this indicator would provide useful information that is not obtained through other means.

7.14 Number of houses in zones at risk from river mouth meandering

Policy 11.2.3(n) aims to discourage residential development adjacent to areas that are potentially at risk from river mouth meandering. An increase of houses within this zone will show that risk has increased; conversely a decrease within this zone would suggest that risk had decreased.

The concept is simple to describe but zones at risk from river mouth meandering have not been identified in the RCEP and is not considered a major issue across the Region. Housing development is assessed on a case-by-case basis and tends to relate to small streams. In addition where there are existing houses the issue can often be addressed by works such as training the mouth of the stream.

7.15 Number of resource consents approved relating to the removal of coastal cliff vegetation

This indicator relates to policy 11.2.3(o) in the RCEP, which aims to protect pohutukawa and other coastal cliff vegetation from damage due to its ability to maintain the stability of coastal cliffs.

Resource consents could be checked to determine if there had been any approvals given to prune or remove coastal vegetation (providing rules are in place in District Plans to protect this vegetation). Resource consent conditions would not provide information on vegetation that was destroyed without Council approval. Vegetation can also be destroyed by pests and diseases and climatic conditions. Surveys would be required to obtain accurate information about status of vegetation, which would be time consuming. Even if vegetation surveys were undertaken, it would not be possible to attribute all changes in vegetation to human causes.

7.16 Distance of building setbacks on new properties within the Coastal Hazard Zone

A primary indicator of risk form coastal hazards is the distance of all buildings from the shoreline. As new buildings are built in the ASCH or Coastal Hazard Zone, then those new buildings should be set further back from the sea wherever possible. This is one of the simplest methods of managing total physical risk from coastal hazards. EBOP would need to set up a baseline (from the most recent aerial photographs) of the toe of the dune – or where this cannot be easily read from the aerials, from the line of vegetation. An accuracy level of plus or minus 2 metres would be suitable for this indicator.

A baseline (of say 2003) would identify the number of houses directly adjacent to the coast (rather than second line or further back), and the distance to the shoreline. For each area (say Waihi Beach) an average distance to the shoreline should be calculated. The indicator that total physical risk is decreasing or not increasing will be that over time that average distance to the shoreline should remain static or increase.

7.17 Relocatability of new dwellings within the Coastal Hazard Zone

As new buildings are constructed they are now required to be "more relocatable" as part of resource consent or building consent conditions. There are degrees of relocatability, and this could be measured on some kind of rating standard index. The parameters that could be measured include:

- The extent to which the house is designed and built to be relocatable (including on a modular basis)
- The ease with which the building (including parts of the building) could be relocated within the site and from the site
- The presence of an approved relocation plan.

The rating index could rate each new building on the relocatable index as High Medium or Low using criteria developed for the indicator.

7.18 The percentage increase in value of residential dwellings in the Coastal Hazard Zone

An increase in the property value of a dwelling can be attributed, among other things, to the following factors:

- Capital improvements made to the property
- Increase in the desirability of a particular location
- Effects of inflation on the property market.

Valuation data for properties is available from Environment Bay of Plenty via Quotable Value NZ. This data is updated for all homes every three years, therefore, any indicator relating to value of homes would also need to be collected on a three monthly cycle. Valuation data may be indirectly indicative of other important indicators such as the increasing floor area; greater density or site coverage in coastal hazard zones and in this way is a "gross" indicator of increase in risk. However, property value is also dependent on a number of factors (including a general high demand for coastal properties) and therefore an increase in property value does not necessarily denote an increase in risk. Other indicators will be more specifically related to an increase in total physical risk and for this reason; it is recommended that this indicator not be investigated further.

In addition, Objective 11.2.2 "No increase in the total physical risk from coastal hazards" implies that the value of buildings on properties is not considered as part of any determination of physical risk.

7.19 The value of building additions made to residential houses in the Coastal Hazard Zone per year

This indicator would give an idea of the size of additions that are being carried out on already existing properties within the Coastal Hazard Zones. This information is available from building consent data. When people make additions that require buildings consents, they provide an estimate of the cost.

One disadvantage of using this indicator is that people tend to underestimate the cost, in an attempt to keep building consent fees low.

7.20 Proportion of Coastal Hazard Zone which is held as a reserve

Policy 11.2.3(p) aims to encourage the incorporation of Coastal Hazard Zones into wider building set backs or reserves for recreation, natural character or waahi tapu. If a greater proportion of land in the Coastal Hazard Zone is held as a reserve, total physical risk should decrease, because physical structures on reserves are generally limited.

Information for this indicator is available from the Department of Conservation, local and regional authorities.

If the proportion of reserves increases in the Coastal Hazard Zone, this may suggest that the total physical risk is declining. This would be the case where dwellings are removed from properties and the vacant land is used as a reserve. However, in green-field developments the increase in the proportion of reserves in the Coastal Hazard Zone could indicate that risk has increased. If the number of reserves increase and the number of houses also increases, there are still more dwellings in the Coastal Hazard Zone, compared to the rural landscape that was present prior to the new developments.

In addition, the position of Mean High Water Spring (MHWS) can move. Where coastal erosion is occurring, MHWS will move further inland. This can remove a portion of a reserve in an area.

7.21 Resource consents granted in the Coastal Hazard Zone

If the granting of new resource consents relates to property improvements and new development, then showing the number of resource consents granted in the Coastal Hazard Zone can give an indications that total physical risk is increasing. This indicator could be further fine-tuned to categorise the types of resource consents granted. An appropriate focus would be on resource consents for new houses, additions to houses and new subdivisions. A further focus will be conditions on which such consents are granted.

The disadvantage with this indicator is that differences in plan rules for Coastal Hazard Zone between District Councils will mean that similar proposals could be treated in a different manner. For example, one Council may require resource consent for a home in a Coastal Hazard Zone whereas another Council does not require resource consent for the same kind of proposal and may not even have Coastal Hazard Zones defined. This indicator would be most useful where district plan rules are similar for all Coastal Hazard Zone in each Council and are interpreted in a similar manner across all district councils.

7.22 The number and value of properties in coastal hazard erosion risk areas compared with non-risk areas[xxviii]

The number and value of properties in coastal hazard erosion risk areas compared with non-risk areas has been used as an indicator by Tauranga District Council to measure coastal hazards. In practical terms, the indicator compares the average monetary value of houses within each zone.

This indicator is unlikely to be suitable to monitor Objective 11.2.2 "No increase in the total physical risk from coastal hazards". The value would need to be adjusted for inflation, over time. Comparison with non-risk areas appears to add little information to this indicator.

7.23 Indicators that refer to public opinion on coastal hazards

Indicators that measure public perceptions on coastal hazards are more likely to measure the effects of public education programmes or media publicity of a significant hazard event, compared to the actual hazard status of any given area at a particular time. High levels of perception may still not alter behaviours sufficiently to alter the risk profile in areas subject to coastal hazards.

7.24 Summary of indicators

The above section of the report has identified twenty-three indicators to assist in measuring the performance of the RCEP objective "no increase in total physical risk". These are set out in the following table. An A3 pull out table is also appended at the end of this report.

Figure 5: Summary of indicators and attributes

Possible indicator	Attributes	General assessment
Number of hard coastal protection works on the open coast	New hard coastal protection works may reduce the total physical risk in the short term, but also encourage further building and increase in longer-term risk.	Not a straightforward indicator of increases or decreases in total physical risk. Not recommended for further consideration. *Information is not available in a useful format and would need to be collected by analysis of maps and on-ground survey.*
Number of soft coastal protection works on the open coast. A subset of this indicator is the presence of Coastal Care programmes.	Soft coastal protection works such as dune care, beach replenishment and restoration of coastal vegetation may be preferable from an amenity perspective.	These types of works will mitigate rather than reduce total physical risk and so is not a good focus for indicators. The physical benefit of such programmes should show up in beach profiles or the sand reservoir and these physical attributes are not the focus of this project. *Some information on coastal care programmes and planting carried out is available.*

The identification of Areas Subject to Coastal Hazards.	This is a policy in the RCEP and has been achieved through research and analysis.	Of itself this indicator does not denote whether total physical risk is increasing or decreasing – but is an important precondition to many of the risk management responses identified in the RCEP and district plans. *This information is recorded already in the RCEP.*
The presence of a Coastal Hazard Zone in the district plan.	This is a policy in the RCEP and allows a variety of planning responses once identified through research and put through the statutory process to be recorded in the district plan.	This is an important foundation indicator as it is through the CHZ and accompanying rules in the district plan that more targeted and effective risk management can be achieved through resource consent requirements. *This information is readily available.*
Number of houses in the Coastal Hazard Zone	This indicator simply counts the number of houses within the CHZ at certain dates. Where CHZ have not been identified, a surrogate could be the use of the ASCH line on the maps.	This is a simple indicator that could be counted historically as well on an ongoing basis. This indicator is likely to be a useful high-level indicator on the scale of the general issue, and how that changes over time. *This information can be assembled through the use of historical aerial photographs and the RDAM system in association with EBOP GIS system. Some work would be needed on the existing data sets.*

Percentage of houses in the Coastal Hazard Zone subject to planning controls (resource consent).	If the percentage of houses subject to resource consent (and conditions such as relocatability) increases over time this may indicate a decrease in total physical risk.	This indicator really records whether Councils have CHZ present on their planning maps, and the level of control. More direct indicators will be more useful. *This information would need to be compiled from first identifying the total number of houses, and then establishing from district council records the total number of resource consents. This could be done as planning controls are recent, and EBOP has in theory been sent all resource consent applications.*
Number of residential lots in the CHZ	This is a simple count of the number of lots at certain dates. Where the CHZ has not been identified a surrogate could be the use of the ASCH line on the maps.	As with the number of houses this will be a useful baseline indicator. *This information can be readily compiled from the GIS system.*
Increase in total floor area.	This indicator would measure additions to floor area of residential buildings in the CHZ or ASCH.	It may be difficult to ascertain whether new buildings are replacing existing floor area or are truly additional. *This information could be compiled from the building floor area data from Quotable Value NZ Ltd, held by EBOP, but the integrity of the data may be difficult to assess.*

Hazard analysis for new development in ASCH	This is a transitional method to identify and address risk in the period before CHZ are identified in district plans.	As an interim tool there is little point in establishing this as a long-term indicator of risk.
Minimum floor levels	Floor levels assist mitigate and reduce total physical risk by placing the floor of habitable rooms above 2% AEP flooding.	These levels have been set for all areas at risk of coastal hazards and as such there will be no change in this indicator over time.
Number of foredunes lowered.	Lowering of foredunes would increase total physical risk, but should be a very rare event.	It is unlikely that this indicator would provide information not obtainable from other means.
Number of houses in zones at risk from river mouth meandering.	While there is a policy in the coastal hazard risk part of the RCEP on this matter it is not considered a major issue in the region.	This will not provide a useful indicator.
Number of resource consents approved relating to the removal of coastal cliff vegetation.		This is of a similar nature as river mouth meandering.
Distance of new building setbacks from shoreline	The distance of the building setback from the shoreline is a direct and physical measure of the closeness to the risk of coastal erosion.	This is a direct and useful indicator of increase or decrease in total physical risk. We should be measuring a gradual retreat from the shoreline over time. *This information can be compiled using the RDAM information held by EBOP, ground checked in places.*

Relocatability of new dwellings in the CHZ	This indicator would assume some kind of rating or index of the relocatability of new houses within the CHZ or ASCH. It would require some work to develop the indicator and may be subjective, but the relocation of houses is a core risk management technique being used in the region.	This indicator has considerable potential but would need considerable further work to develop an objective assessment method.
Percentage increase in value of dwellings. A subset is the increase in the value of additions and alterations.	This indicator would be based on a three yearly revaluation of properties in the CHZ or ASCH. It could be an indirect indicator or increases in the use of more expensive materials or larger floor areas.	Many factors can impact on the increase in valuations, and there are more direct indicators available. *The information could be compiled from Quotable NZ Ltd data in association with GIS data.*
Area of the CHZ held as reserve.	This indicator would record the total area, or proportion of the CHZ or ASCH held as public reserve on the basis that such land would generally not be built on (or only to a very limited extent).	This is a useful baseline indicator. In association with building setback indicator over time it will provide information on gradual retreat from the CHZ, particularly in greenfield areas. *This information should be held on the GIS and cadastral database held by EBOP.*
Resource consents granted in the CHZ	This indicator is focused directly on measuring the number and conditions applied to resource consent for building and subdivision within the CHZ.	This indicator will be very useful where such zones exist but not for Whakatane or Opotiki until CHZ are placed in their district plans. *This information will be held in the files of EBOP and the district councils but would require further analysis of the information of those files.*

Public opinion	This indicator would measure the level of awareness of coastal hazards.	High awareness of coastal hazards does not of itself alter total physical risk. More direct indicators are preferable. *NIWA & GNS have carried out baseline research into the awareness of coastal hazards. This could be repeated in a similar form at appropriate time periods (by survey).*

7.25 Discussion of suitable contenders

As can be seen from the above lengthy discussion and analysis there are many potential indicators available to measure changes in the total physical risk from coastal hazards. Many of these indicators are not very helpful or significant and should not be pursued.

Those recommended for further consideration and refinement centre around:

- The number of houses and residential lots in defined coastal hazard areas;
- Those new houses and residential lots subject to resource consents (and the efficacy of those controls);
- The setback of houses from the shoreline in relation to the most significant hazard – eroding soft coastlines;
- The area of coastal hazard zone held as reserve.

In addition we think it may be helpful to identify and refine the indicators to the primary and secondary risk areas where they exist (WBOPDC and TDC).

Some of the indicators will need to be progressively "rolled out" as Whakatane and Opotiki Districts have yet to introduce CHZ to their district plans.

The indicators fall into two broad categories; those that provide baseline information, and those that provide information on whether or not there is an increase or decrease from this baseline.

The relatively small number of resource consents for buildings in coastal hazard zones in any one year means that it may be difficult to gain meaningful changes in baseline information in the short term. Therefore there may be a role for trend indicators. Examples of this are comparing the setback of new houses compared to the houses they replaced (where applicable), or relocatability – are they getting more or less relocatable than the houses they replaced (where applicable).

8 Policy effectiveness monitoring

8.1 Monitoring described

Monitoring can be defined as the purposeful and repeated data collection, analysis, interpretation, reporting and recommendations for action (including future monitoring).[xxix]

Under s.35 of the RMA local authorities have a statutory duty to undertake monitoring of their policy statement, plan suitability and effectiveness. S.35 was amended by the Resource Management Amendment Act 2003.

Section 35(2) was amended by omitting paragraph (b)

"(b) The suitability and effectiveness of any policy statement or plan for its region or district; and"

And replacing it with:

"(b) the efficiency and effectiveness of policies, rules, or other methods in its policy statement or its plan; and."

Subsection (2A) was inserted after subsection (2):

"(2A) Every local authority must, at intervals of not more than 5 years, compile and make available to the public a review of the results of its monitoring under subsection (2)(b)."

Section 35(5) was also amended by repealing paragraph (g) and substituting further paragraphs relating to the storing of information relating to resource consent applications.

The RMA is now more specific about what is required to be monitored. The effectiveness and efficiency must be monitored for policies, rules or other methods in its policy statements or plans (does this mean that a council can choose to monitor either the policies, rules and other methods or its policy statements, or must it monitor both the policy statements and the plans??) Subsection 2A specifies that data must be made available every 5 years for a public review.

Policy Effectiveness Monitoring determines whether or not the Council has the correct policy to achieve the outcomes that it requires. It is a systematic process concerning[xxx]:

- Solving some of the issues raised in plans;
- Environmental outcomes;
- The plan preparation process;
- Implementation of the plan and whether or not the plan achieved its aims;
- Whether or not the plan has covered the most important things.

8.2 How can Policy Effectiveness Monitoring be approached for Coastal Hazards?

Monitoring key indicators provides information with which to review policies and the delivery of implementation programmes. When results are collated, it should be apparent where policies are not being achieved. Where indicators show that policy outcomes are not being met, further assessment will be required. Further assessment could include the following questions:

- Are the outcomes of the policy achievable?
- If the policy outcomes are achievable, what are the other obstacles that are impeding the process? Can these obstacles be removed, or should the policy be re-crafted to take them into account? Are the obstacles due to internal Council processes or obstacles that are beyond Council control?
- Are enforcement options available, and if so, have they been taken? Is there a need for a different enforcement regime?

To determine if the policies have been effective in achieving s Environment Bay of Plenty's objective "No increase in Total Physical Risk", Environment Bay of Plenty will have to determine whether or not risk has increased. In a perfect policy environment, changes in a risk profile will be shown by the indicators. However, due to the complex nature of the system being measured, changes in risk may not always be apparent. In addition, the currently postulated indicators will relate directly to Council policies, and these policies may not capture or address the true extent of the coastal hazard risk.

It will therefore be important to determine if the policies that are used to decrease risk are appropriate. Take, for example, the indicator *Percentage of houses in Coastal Hazard Zone subject to planning controls*. Over the next ten years, all new buildings in the Coastal Hazard Zone may be built with planning controls that relate to the Coastal Hazard Zone and coastal hazards. Therefore, the indicator

will show that risk has not increased. However, whether or not the true state of risk has increased or not will be highly dependent on the effectiveness of these planning controls. Ineffective planning controls for new dwellings in the Coastal Hazard Zone would lead to an increase in risk. It is therefore essential to review the effectiveness of the policies and attempt to quantify the true extent of risk. A number of methods could be chosen to achieve this:

1. Commission an assessment from an impartial coastal hazard expert.

2. Conduct local perception studies.

3. Measure the amount of coastal community lobbying for coastal protection works.

4. Investigate and measure the quantity of informal protection work done.

5. Count the occurrence of hazard events that place property and life at risk.

8.3 Assessment from a coastal hazard expert

It would be possible to commission a risk assessment by an impartial coastal hazard expert. The assessment would review baseline data, scientific indicators (e.g., movement of dunes, storm events), new development and alterations to existing development that had occurred since the inception of the current policies. The assessment would include a determination as to whether or not the total physical risk in the area has decreased, increased or remained static and would suggest causal relationships which had led to the risk outcome.

8.4 Local perception studies

Council policies aim to shift the coastal hazard risk from the public realm into the private realm. This is achieved by making private landowners accountable for their own risk, should they choose to build dwellings within the Coastal Hazard Zone. One way to determine if this approach has been successful is to conduct local perception studies to measure these landowners' opinions on potential coastal hazards. Questions asked in the perception studies could include:

- What are your expectations of your local Council should your property be at risk from coastal erosions (possible responses could include: relocate dwelling, council to provide protection works, provide informal protection works)?

- What compensation, if any, would you expect should coastal erosion/inundation damage your property or dwelling?

- If your house is at risk from coastal erosion what measures would you expect your Council to initiate (e.g., soft coastal protection measures, hard coastal protection measures, nothing)?

- What are your responsibilities for your property in the event of encroaching coastal hazards?

- What actions would you take, should your dwelling be under threat from coastal hazards?

Overall, the aim of the perception study is to determine whether or not homeowners within the Coastal Hazard Zone have taken responsibility for coastal hazards given they have chosen to build within it. If there is an overriding perception that the coastal hazard management remains a Council responsibility, then the policies need to be revisited.

8.5 Community lobbying for hard coastal protection works

In areas where coastal erosion continues and dwellings become increasingly at risk from coastal hazards, the community may lobby the Council for hard coastal protection works such as sea walls; groynes are other hard coastal protection measures. This would indicate that coastal hazard risk has not decreased.

8.6 Informal coastal protection works

Should communities feel frustrated by the lack of Council initiatives to protect their private property from the inroads of the sea, they may take the situation into their own hands and form their own protection works without consent (e.g., placement of rusting car bodies, concrete or rocks at the base of dunes). This would indicate that risk has increased.

8.7 Hazard events

Storm events, continued coastal erosion and tsunamis will, in time, be the ultimate test as to whether or not the current policies have been effective at reducing risk within the Coastal Hazard Zone. If damage to life or property occurs (due to coastal hazards) in areas outside the Coastal Hazard Zone, it will be clear that the Coastal Hazard Zone and the risk management approaches will need to be redefined. If damage occurs to dwellings from coastal hazards built under the current policy regime, then it will be clear that the policies were not sufficient to reduce the risk of coastal hazards they had originally set out to achieve.

Although coastal erosion that causes damage to life or property is the only concrete way to determine if the policies have been ineffective, it is not an approach that we recommend! Ideally other monitoring programmes in place should alert policy and decision makers about the potential risks, long before any such event takes place, enabling a change in policy direction, should the need arise.

9 Recommendations on preferred indicators and policy effectiveness monitoring

9.1 The recommended framework

The recommended framework for monitoring the change in total physical risk from coastal hazards can be described at three levels.

9.1.1 Foundation indicators

The first level is the foundation: are the building blocks for risk management in place. These indicators are generally "yes/no" and descriptive type indicators but are an important if obvious part of the entire picture. They include:

- Whether coastal hazard zones have been identified and included on district planning maps
- Whether there are district rules to support those hazard zones which are aimed at decreasing risks of coastal hazards (in some areas this will include "no-subdivision rules" and large building setbacks/ coastal reserves)
- Whether there are administrative or district plan policies to ensure that any building within the coastal hazard zones is subject to controls to mitigate risk such as relocation and relocation plans

9.1.2 Baseline indicators

The second level of indicators includes those that provide a basis for understanding change over time. Some of these indicators require baseline information first. This information should be plotted onto the Environment Bay of Plenty GIS system, where this has not already occurred and includes:

- The ASCH line where the CHZ has not been introduced into the relevant district plans
- The CHZ divided into a primary and secondary area where the ASCH line has been superseded.

Baseline indicators to be developed are:

- The average building set back for houses in the primary risk area from the toe of the dune
- The number of houses in the ASCH, CHZ (primary) or CHZ (secondary) as at the most recent aerial photography date.
- The number of residential lots in the ASCH, CHZ (primary) or CHZ (secondary) from the DCDB at a date close to the aerial photography date.
- The physical area (from the DCDB) of the ASCH, CHZ (primary) and CHZ (secondary) held as public reserve.

9.1.3 Trend indicators

It is our view that the Council should concentrate its assessment of the increase in total physical risk on the resource consent approvals,[xxxi] or where there is no resource consent, building consent approvals. This will include new houses, additions to houses and new subdivisions creating additional lots. The information should be collected and analysed from information already sent to Environment Bay of Plenty from the district councils and should be compiled into a database which records the following information:

- Suitable reference and geographical information.
- Description of the activity.
- Number of additional lots (if any) and area of lots.
- Number of additional dwelling units (or if replacement).
- Physical area vested as reserve on subdivision.
- Floor area and number of floors (including comparative figures for any preceding dwelling).
- Materials.
- Relocatability index (low, medium, high) (including comparative assessment for any existing dwelling).
- Relocation plan.
- Setback from toe of dune for buildings in the primary risk area including the comparative distance of any prior building.

The recommended indicators are:

- Average change (increase being desirable) of the setback distance of newly consented houses compared to overall average and average of buildings they are replacing.
- Additional number of dwellings.
- Additional number of lots.
- Percentage of additional dwellings subject to resource consent conditions on relocatability, building setback and coastal erosion monitoring.
- Additional physical area adjacent to the coast vested as reserve.

9.2 Timing

Table 4 below outlines a suggested schedule for the establishment of the coastal hazards indicator programme. Within the first year, once a set of indicators has been chosen, Environment Bay of Plenty would compile a "status report" on the foundation indicators. It would then collect data referring to its baseline information and indicators. Year two would see the implementation of the analysis of the trend indicators. This would include tabulating information from gathered consents, and initiating any other data collection programmes that would be necessary. It would also be useful to compile and reconstruct consent based information back to 1996 when the RCEP was notified – or a similar relevant date (such as the date the RCEP objective was effectively made operative).

Year two would see the production of the first coastal hazards indicator report. Monitoring would continue on an annual basis. At the start of year four, after two years worth of indicator data is available, it would be appropriate to review the choice of indicators and note any that had been problematic. If necessary, the indicators could be changed, or new indicators added, to better meet the needs of the monitoring programme. At around year 5-6 it would be appropriate to monitor the effectiveness of the implementation and monitoring of resource consents and Environment Bay of Plenty policies for coastal hazards.

Figure 6: Timing of the establishment of the indicator programme

Timing	**Action**
Year 1	Decide which set of indicators will be used Collection of foundation information, base line information and baseline indicators.
Year 2	Implement the collection of ongoing indicator data. Collect historical data. Produce first coastal hazards risks monitoring report.
Year 3 onwards	Continued data collection
Year 4	Review the appropriateness of selected indicators
Year 5-6	Monitor effectiveness of resource consents and EBOP objectives and policies Review appropriateness of selected indicators

Endnotes:

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[i] Bay of Plenty Regional Council v Western Bay of Plenty District Council, A141/02

[ii] http://www.eqc.govt.nz/ 26 August 2003

[iii] Environmental Performance Indicators Programme, Ministry for the Environment website, http://www.environment.govt.nz/indicators/

[iv] Ministry for the Environment 1996. The Monitoring Guide: A practitioner's guide to Section 35 of the Resource Management Act 1991.

[v] Ministry for the Environment 1996. National Environmental Indicators: Building a Framework for a Core Set.

[vi] Ministry for the Environment, 1997. Environmental Performance Indicators: Proposals for air, fresh water and land).

[vii] Olsen, S.B., Lowry, K. and Tobey, J.A. 1999. A Manual for Assessing Progress in Coastal Management. Coastal Resources Centre Report #2211, University of Rhode Island, Narragansett, Rhode Island, USA.

[viii] SECRU, 2001: Indicators to Monitor the Progress of Integrated Coastal Zone Management: A Review of Worldwide Practice. Scottish Executive Central Research Unit.

[ix] USAID, 1998. Effectiveness of State Coastal Management Programs In providing Public Access to the Shore: A National Overview 1998". USAID, Washington.

[x] FDCA, 2000: FACT (Florida Assessment of Coastal Trends) 2000. Florida Department of Community Affairs, Florida, USA.

[xi] SECRU 2001.

[xii] SECRU 2001.

[xiii] SECRU 2001.

[xiv] Lowry, K., Olsen, S.B. and Tobey, J.A. 1999. Donor Evaluation of ICM Initiatives: What can be Learned From Them? Ocean and Coastal Management Vol 42: 767-89.

[xv] SECRU 2001.

[xvi] SECRU 2001.

[xvii] SECRU 2001.

[xviii] SECRU 2001.

[xix] www.environment.gov.au/soe/envindicators/index.html

[xx] MfE, 1998. Environmental Performance Indicators: Summary of proposed Indicators for the Marine Environment. Ministry of the Environment.

[xxi] MfE, 1998. Summary of Submissions. Environmental Performance Indicators: Proposals for the Marine Environment. Report prepared for the Ministry of the Environment by Sally McNeill.

[xxii] FDCA, 2000.

[xxiii] Dahm, J. 1999: Coastal Erosion Hazard in the Waikato Region. Environment Waikato Technical Series 1999/06. Environment Waikato, Hamilton, New Zealand.

[xxiv] Bronwen Gibberd, Coastal Scientist, Environment Waikato, pers. comm., August, 2003

[xxv] Environment Bay of Plenty, 2001. NERMN Review, Environmental Report 2001/07.

[xxvi] Skinner v Tauranga District Council, A163/02

[xxvii] Tonkin & Taylor Ltd, 2002. Whakatane District Council Coastal Hazard Analysis. Prepared for Whakatane District Council and Bay of Plenty Regional Council.

[xxviii] Tauranga District Council 2000. State of the Environment Tauranga 2000

[xxix] Ministry for the Environment 1996.

[xxx] Quality Planning: the environmental planning resource site: Monitoring Plan Effectiveness. http://www.qualityplanning.org.nz/ 20 August 2003.

[xxxi] EBOP already has protocols in place with the territorial authorities to send through all resource consent applications in ASCH or coastal hazard zones. This should be extended to also include all resource consents once granted.