FRAYING COASTAL EDGES:

COASTAL HAZARD ADJUSTMENT

AND

SUSTAINABLE MANAGEMENT

A thesis presented in partial fulfilment of the requirements
for the degree of
Master of Philosophy
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at
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ABSTRACT

This thesis investigates the development appropriate natural hazard policy and adjustment in New Zealand, through a topic evaluation of the proposed coastal hazard zone methodology presented in Gibb (1994). The thesis is structured around the four contexts: institutional, physical, socio-economic and cultural, that are considered appropriate in the decision-making process about natural hazard policy and adjustment.

The review of literature about managing natural hazards provides the attributes which aid in the formulation of natural hazard policy and adjustment. This literature is augmented with attributes taken from the growing body of sustainability literature. These attributes are then modelled into a theoretical policy and adjustment model, supplemented by checklist. The model developed reflects the paradigm shift to a contextual mode of thinking. This contextual mode of thinking means that a wider range of contexts needs to be considered when developing policies an adjustments.

The review of hazard management in New Zealand highlights the fact that the requirements of the Resource Management Act 1991 (the Act) forces planners to be contextual in their approach to natural hazards. This thesis intends to provide further guidance on how this contextual approach should be undertaken. The key findings of the thesis indicate that natural hazards planning should be considered in the wider arena of resource management planning, with policies and adjustment undertaken fulfilling a broader range of coastal management objectives the the narrow objective of adjustments to natural hazards. The contextual approach to natural hazards planning means that planners and local authorities need to obtain better information to inform their management role under the sustainable management concept. The thesis has concluded that the current pre-occupation on the need for a consistent national approach could be ineffectual because the institutional, physical, socio-economic and cultural variations around New Zealand's coastline precludes emphasis on developing a single methodology for adjustments to natural hazards.

ACKNOWLEDGMENTS

Well here it is, the completed thesis!!!!!! Finally this long haul is over. I said it would take a year but one year and one month it had to be. Now I am out of here, and on my way out I must say a heartfelt thanks to many people.

First and foremost to my supervisor on this thesis journey, Dr. D. J. Rosier, Department of Planning, Massey University. Without your help, guidance and pestering Jo, I do not think I would have got this thesis off the ground, finished and bound.

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Finally to Brian, my number one inspiration to finish. Through the ups and downs we have made it and now I'll come and live in Wellsford!!!!!!!!

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LIST OF ACRONYMS

AEE	Assessment of Environmental Effects
BA	Building Act 1991
BOP	Bay of Plenty
CEHZ	Coastal Erosion Hazard Zone
CFHZ	Coastal Flooding Hazard Zone
CHZ	Coastal Hazard Zone
CLHZ	Coastal Landslide Hazard Zone
CWHZ	Coastal Wind Erosion Hazard Zone
DOC	Department of Conservation
DP's	District Plans
EIA	Environmental Impact Assessment
LGA	Local Government Act 1974
LIM	Land Information Memorandum
MFE	Ministry for the Environment
MHWS	Mean High Water Springs
NZCPS	New Zealand Coastal Policy Statement
NZPTD	New Zealand Planning Tribunal Digest
NZRMA	New Zealand Resource Management Appeals
PIM	Project Information Memorandum
RMA	Resource Management Act 1991
RP's	Regional Plans
RPS	Regional Policy Statement
TVNZ	Television New Zealand

GLOSSARY

Atua: god, spirit, supernatural being

Hapu: sub tribe

Iwi: tribe

Kai: doer of word (prefix)

Kaitiaki: (vb) to guard, to protect
(noun) guradian, protector

Kaitiakitanga: the act of guardianship

Mahinga mataitai: cultivation of seafood

Mana whenua: authority to speak and act with respect to a particular part of the land

Mana: authority, power, prestige, influence

Manaakitanga: hospitality

Mauri: spiritual lifeforce

Ranagatiratanga: the exercise fo expression of sheifly authority, power

Taonga: property, treasure, artefact, relic

Tapu: restricted, sacred

Tauranga waka: canoe anchorage

Tiaki: to guard, look after

Tikanga: customary practices, cultural correct customs and practices

Toko taunga ika: pole fishing grounds

Urupa: cemetery

Waahi tapu: cemetery, reserved ground

Whakapapa: genealogy

Whanau: family, extended family

Whanaungatanga: familial relationships

CHAPTER ONE

PROBLEM AND METHODS

The seas and their margins are major contributors to the functioning of the planet, both biologically and economically. A total of 73 per cent of the earth's surface is composed of oceans and the coastal environment (IUCN, UNEP, WWF, 1991). It is this coastal environment, the narrow strip lying between the seaward limit of the continental shelves and the inland limits of the coastal plains, that provides much of the biological wealth of the planet (see Figure 1.1 for a graphic representation of the coastal environment). The significance of such an environment relates to it being an important habitat to both humans and other living organisms. The environment has the highest biological productivity on earth and is home to most of the world's human population. Six out of ten people live within 60 kilometres of coastal waters, and two-thirds of the world's cities with populations of 2.5 million or more are near tidal estuaries (IUCN, UNEP, WWF, 1991).

The significance of the coastal environment is also recognised in New Zealand. 'Significance' is widely used in both the Resource Management Act 1991 (referred to in this thesis as the Act) and the New Zealand Coastal Policy Statement (NZCPS) when referring to the coastal environment. The Board of Inquiry report relating to the NZCPS, defines significance as being:

> *Matters of regional or local significance can, collectively over the whole of the country, have a national significance, particularly in relation to preserving the natural character of the coastal environment of New Zealand.*
> (Department of Conservation, 1994b, p18)

The significance of New Zealand's coastal environment is reflected in the various characteristics, values and uses, that exist within this environment.

New Zealand by nature is a maritime nation, with over 10 000 kilometres of variable coastline including dune coasts, sandy beaches, rocky coasts and rocky bluffs. The variability of the coastline results from variable geology, terrestrial landform sediment sources and wave exposure (Ministry for the Environment, 1988). Along with physical diversity, the coastal environment is biologically

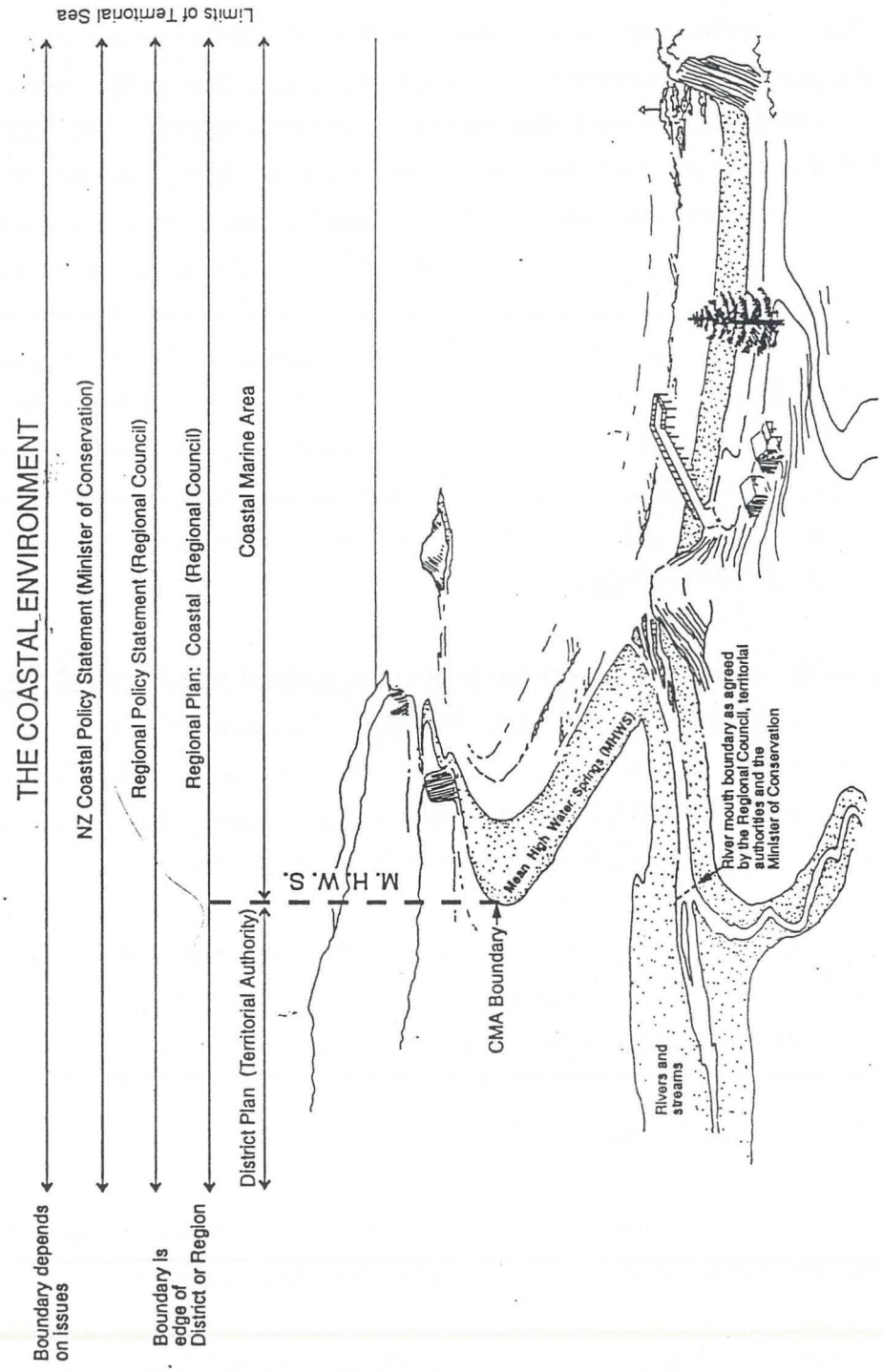


Figure 1.1: Physical and Plan boundaries in the Coastal Environment
Source: Auckland Regional Council (1995)

diverse, with many of the ecosystems present unique only to New Zealand.

Since humans first arrived in New Zealand, the coast has played a prominent part in the everyday life, culture and economy of those who have settled here (Rennie, 1993). The coast is the primary focus for the outdoor recreational pursuits of most New Zealanders, with it being the most popular destination for out-of-town visits (Ministry for the Environment, 1988c). This is enhanced by the fact that no town is no further than 120 kilometres from the coast. The aesthetic and recreational appeal of the coast was great enough by the 1960s to motivate many New Zealanders to purchase sections of land by the sea in order to take full advantage of coastal resources (Gardner, 1988). This development trend continues today.

Not only does the coastal environment play a significant role in the recreational culture of New Zealand, it provides various resources on which many industries are based. Subsequently it is plays an important role in national and local economies. Examples of this include fisheries, mineral resources and recreational resources. These resources have come under increasing pressure, and the recognition of their finite, but dynamic nature, has been slow (Rennie, 1993).

Apart from this conventional view of the coastal environment, Maori, as the indigenous people of New Zealand, have a differing perspective. Maori people once had a very close relationship with the coastal environment, and continue to do so in some New Zealand communities. Many Maori images of ancestry and spiritual origin are associated with the sea, and it is these images that provide a sense of identity for Maori (Walker, 1978).

1.1 Coastal Environment Management Challenges

The coastal environment therefore forms the basis for many human activities. The effects, both beneficial and adverse, of these activities on the natural environment and its elements have resulted in a plethora of planning and management challenges. Lang (1986) identifies many of the planning and managerial challenges that arise from peoples activities and uncertainty in the planning arena. Jolleffe and Patman (1985) specifically identify the challenges that threaten successful and effective coastal environment planning. Their ideas provide the basis for Figure 1.2. These management challenges are classified

into four contexts; institutional, physical, socio-economic and cultural. These contexts are considered important in coastal management and provide the structure of analysis in this thesis.

The first three contexts are traditional contexts that are usually considered in resource management planning and decision-making. Physical context is defined as being the physical coastal environment, including landforms, processes, features, flora and fauna and associated intrinsic values, as defined in section 2 of the Act. Socio-economic context is defined as being the human use context where values and perceptions of humans and investment and development patterns are to be considered. Institutional context is defined as being the political, institutional and managerial constraints that are applicable to coastal environment planning. Cultural context is defined as being the differing cultural arena and value base that indigenous peoples hold and aspire to.

Figure 1.2 illustrates that various challenges affect all contexts, while others are specific to a certain context. An example of a challenge that affect alls contexts is the difficulty in defining the actual 'planning problem'. Problem definition is sometimes hard to achieve in all four contexts, as assumptions, values and priorities are different in each. A challenge in the physical context, for example, may have a different meaning in each of the other contexts. Consensus on what the problem is, would be required in this situation. The institutional context in particular is beset by many specific challenges. Many of the challenges in this context are symptomatic of the management and politics of the institutional agencies involved.

1.1.1 Overall Challenges

Coastal environment planning and management presents four overall challenges to coastal managers and planners. Firstly, what are the actual planning problems - are they a symptom of a problem with its cause upland in the river catchment or are they a cause and symptom confined to the coastal environment? Problems cannot be remedied by only dealing with the symptoms, the cause itself must also be a matter of concern.

The second challenge is what to do about the planning problems? When formulating solutions to these problems there can be uncertainty about what approach to proceed with. There are multiple often competing objectives which

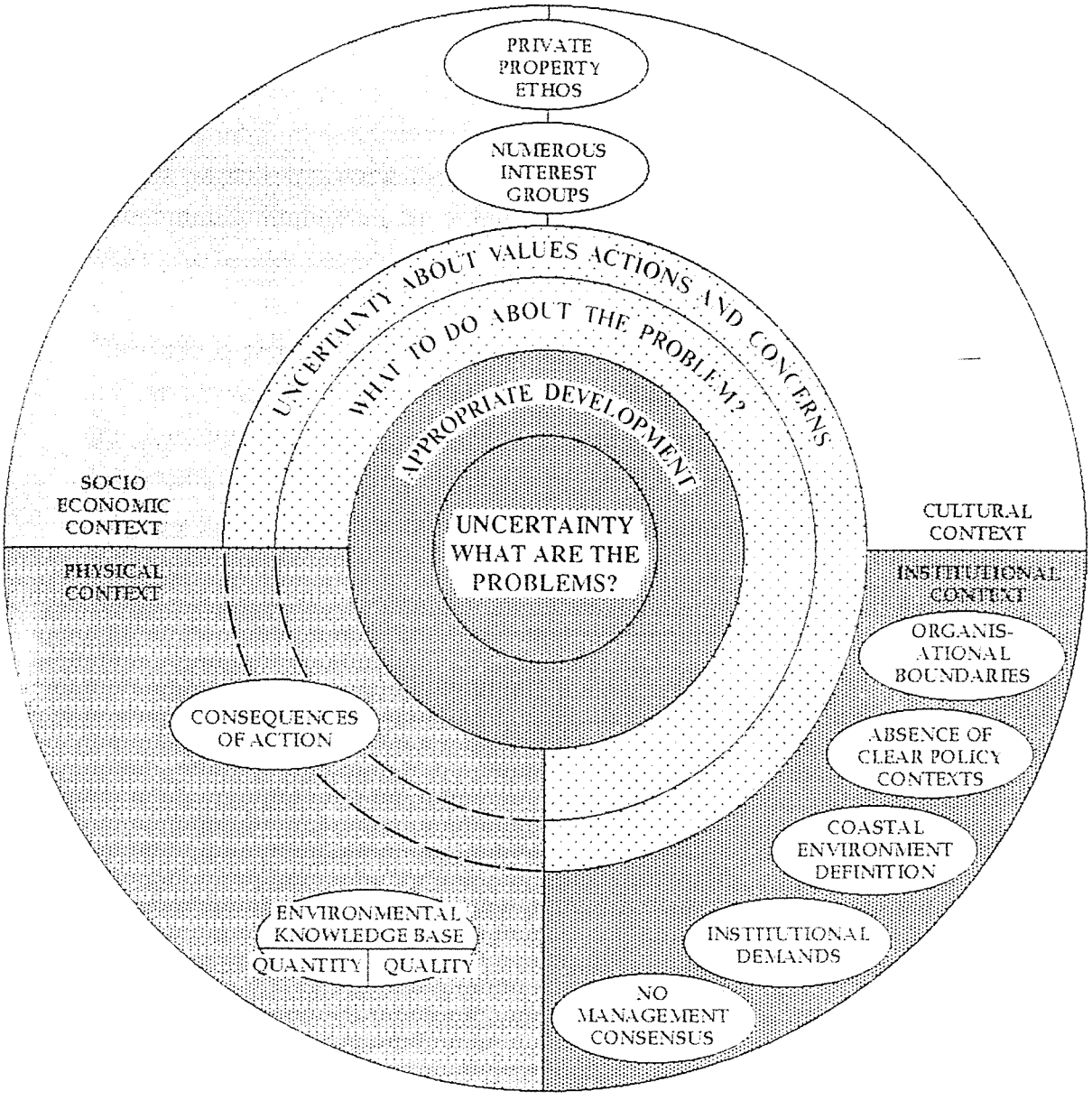


Figure 1.2: Coastal Management Challenges

complicate the matter. This is sometimes accentuated by a lack of clarity about the means available to achieve the desired end and the appropriateness of these means given the institutional, physical, socioeconomic and cultural contexts.

A third challenge can be the lack of definition of what is appropriate development? Appropriate development is often defined by looking at what would be an inappropriate development. Inappropriateness of development is traditionally identified by it being sited on unstable or dynamic parts of the coast (eg. on eroding dunes) or by their visual impact (Rennie, 1993).

The three types of development in the coastal environment are shown in Figure 1.3. As to what is appropriate depends on each case in point, with some types of development being more acceptable than others within the coastal environment. The appropriateness of development also raises questions about amenity values, natural conservation values, intrinsic values and the safety of the coastal user.

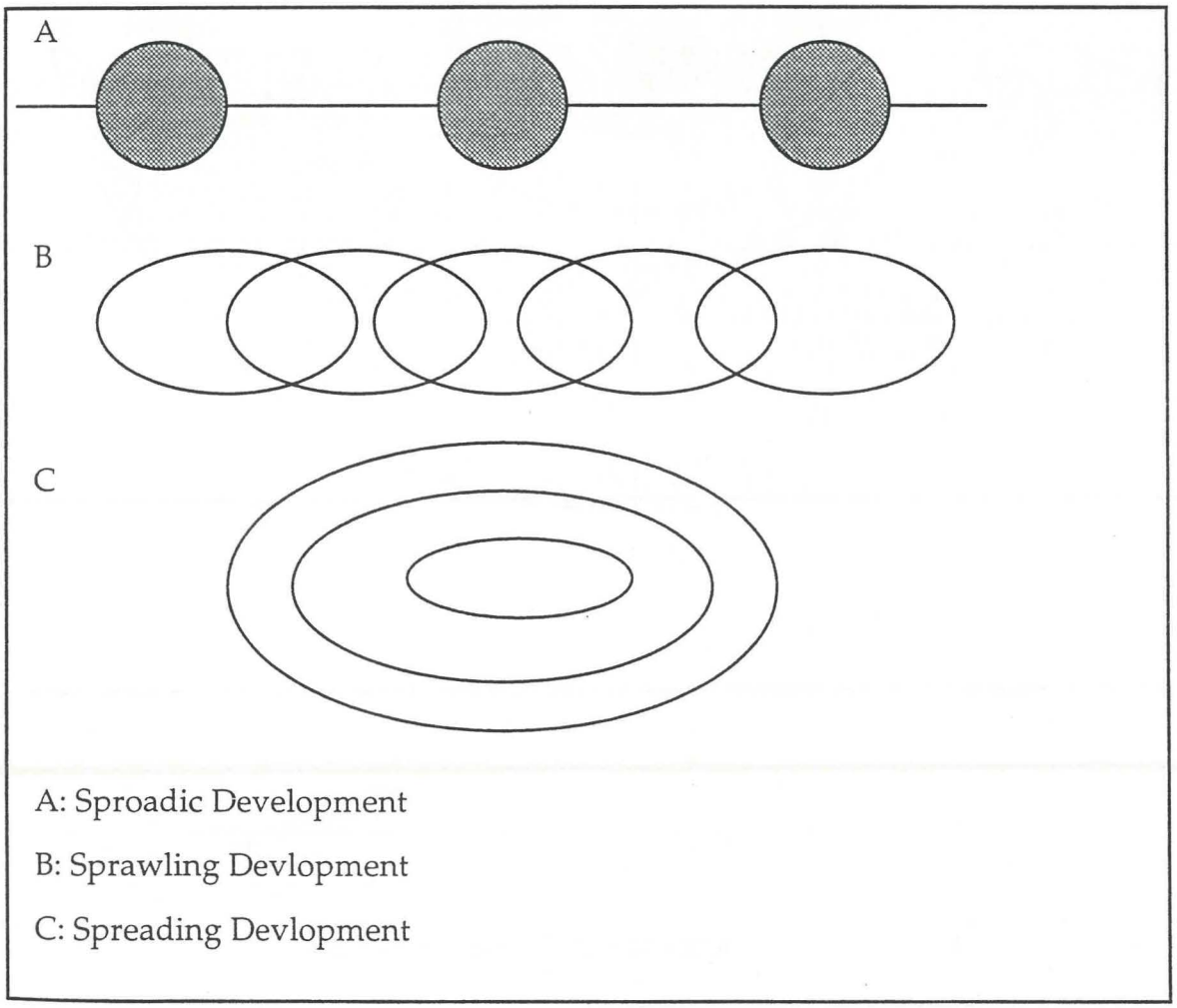


Figure 1.3: Types of Coastal Development (own diagram)

Lastly, there is uncertainty about actions, values and concerns of the many stake-holders in the coastal environment. No one can be certain of the consequences of these in coastal management, even with extensive public consultation. In the public domain, these aspects evolve over time, with the relative importance of issues changing continuously. In some cases poor or under-representation of intrinsic values is an issue, and this is the case for the many of the natural features in the environment.

1.1.2 Institutional Challenges

The institutional context involves five management challenges and it is these challenges that pose the greatest threat to coastal environment management. The first problem is the absence of clear policy contexts in which to plan. Past coastal planning has been ad-hoc, fragmentary and unintegrated, resulting in substandard planning and management in the coastal environment. Many statues provided for piecemeal sectoral governance of coastal environments. Rennie (1993) summarises the past coastal or maritime planning regime extremely well:

> *... the variety of values and demands placed on the resource by the largely ill-informed shareholders, the public, have been substantial. Our management of human interactions with the coastal environment, arguably, has been far more piecemeal than that of the terrestrial equivalent.*
> (Rennie, 1993, 152)

Secondly, there are problems associated within adequately defining the coastal environment. This has been subject of many Planning Tribunal hearings here in New Zealand, and precedence is now taken from these when defining the coastal environment. The below definitions are currently used under the resource management regime as there are no formal definitions given in the Act:

> *The coastal environment is an environment in which the coast is a significant element or part What constitutes the coastal environment will vary from place to place and according to the position from which a placed is viewed. Where there are hills behind the coast, it will generally extend up to the dominant ridge behind the coast.*

Northland Regional Planning Authority v Whangarei County (1977) D A4828, p 4831

The environment is one's surroundings; what one perceives at a particular time and place. Coastal environment means an environment in which the coast is a significant part or element.
Physical Environment Assn v Thames-Coromandel District Council (1982) 8 NZTPA 404, p 408

The Ministry for the Environment has summarised current thinking and released the following definition:

The coast extends outwards to include the Territorial Sea twelve nautical miles wide. Further out still, forming part of the same system, stretch the fishing waters of the 200 nautical mile economic zone. Likewise, to the landward, the coast system [coastal environment] is not cut off at the top of the tidal zone. It includes a natural ecological and visual extension, which grades progressively into terrestrial vegetation types and landforms.
(Ministry for the Environment, 1988c, 8)

Thirdly, organisational boundaries within the coastal environment do not match or conform with ecological boundaries. This problem is linked with the uncertainty about the definition of the coastal environment. In many cases, the organisational or institutional boundaries inadvertently break the environment up into various sections that are administrated by various authorities, which ultimately does not allow for fully integrated management. Competing philosophies and interests are a common problem in coastal management when this institutional division occurs.

Fourthly, there is a lack of management consensus on coastal management decisions. This is related to the above problems, but also can exist in fully integrated planning frameworks. Within a planning organisation, in many cases, there is the problem of uncertainty on how the resources should be used. The competing interests of planners and politicians results in no consensus on what should happen at the local authority management level.

Finally, the institutional demands of the elected council and the public are a major problem in coastal management. In many cases unrealistic demands are

placed on managers and planners in terms of funding, time frames and resources when dealing with the problems in the coastal environment. Thus management and planning objectives are sometimes unable to be successfully implemented, and therefore coastal management objectives are not achieved.

1.1.3 Physical Challenges

There are two main types of physical challenges in coastal planning and management. There is uncertainty about the consequences of action within the coastal environment and the nature of environmental knowledge. The dynamism and unpredictable nature of the physical environment does not allow for certain predictions to be made about the effects of development and activities in this environment. This uncertainty generates the need for planing and management, but it also makes the planning task ever more difficult (Lang, 1986).

Quality and quantity of information in environmental knowledge databases about the coastal environment is uncertain. Quality is uncertain as the data collection may not be correctly performed and the accuracy of the data could be questioned. Data quantity is another issue. Records of coastal data are non existent or scarce as well as, in a lot of cases, incomplete. Making informed judgements from this data would not be scientifically rigorous given the high level of uncertainty present.

1.1.4 Socio-Economic and Cultural Challenges

Managers and planners face different types of problems when dealing with social and cultural issues. The private property ethos prevalent in modern society, is in opposition with the notion that the coastal environment is a common resource available to all. Various interest groups within society need to be taken into consideration when planning activities within the coastal environment. Most groups in society have their own views, values and aspirations about the use of land in the coastal environment. This needs to be dealt with in coastal management so equity is achieved.

1.2 Problem Statement

There has been a gradual realisation by the New Zealand public of the value of our coastline and the importance of taking steps to protect and preserve the coast as far as humanly possible (Healy, 1980). After the resource management

reform and the coastal legislation review, coastal environment planning now is covered by one statute, that is the Act, which is based upon the principle of sustainable management. Figure 1.4 illustrates the place of the Act within the current coastal environment management regime It is expected that fully integrated environmental management systems will result, which is in line with the IUCN, UNEP, WWF, (1991) coastal management guidelines.

It is the intent of this thesis to investigate one significant coastal environment planning issue and determine whether the development of policy and adjustments is adequate to provide integrated management, given the four contexts in the coastal management. The issue that will be investigated is natural hazards within the coastal environment and how to develop policy and adjustments to manage these hazards. Policies and adjustments to natural hazards are defined as being human actions intended to reduce the negative impact of the hazard event (White, 1974). Four areas of theoretical adjustment to natural hazards are available for coastal planning. Table 1.1 shows these four adjustments and the techniques available for implementation.

Table 1.1: Theoretical Range of Adjustments to Coastal Hazards
Source: Sinnathamby (1981)

CLASS OF ADJUSTMENT	TECHNIQUE	
	ENGINEERING	SOCIAL
Adjustments that allow adaptation to the losses		Loss Bearing Insurance Relief and Rehabilitation
Adjustments that Modify Loss Potential	Move endangered structures	Storm warning Evacuation Coastal Zoning Building Restrictions Public purchase of endangered areas
Adjustments that Modify the Hazard	Seawalls, bulkheads, groynes, revetments and breakwaters Beach Nourishment Private protective structures eg. rubble filled drums/car tyres	Dune stabilisation
Adjustments that Affect the Cause	Sand by-passing Removal of obstacles to passage of river silt eg. dams	Prevent beach excavation and harbour dredging

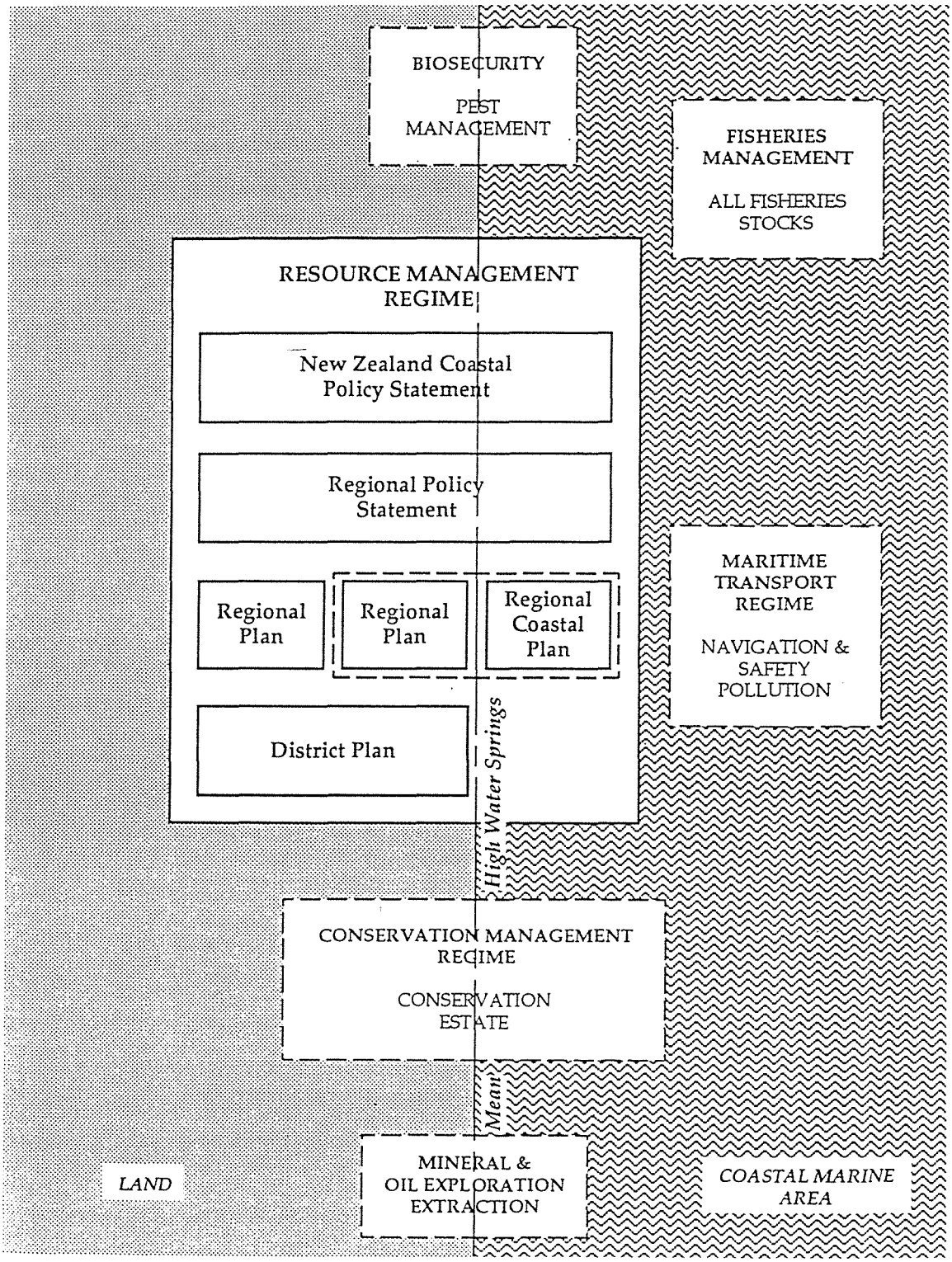


Figure 1.4: Management Regimes Affecting the New Zealand Coastal Environment.
Source: Rosier and Hastie (1994)

Coastal hazards pose one to the greatest planning problems because many of the challenges outlined in Figure 1.2 are present in the issue. The prevalence of the coastal hazard issue has been recognised by coastal researchers and planners over the last few decades.

> *When geologic processes modifying New Zealand's coastlines such as erosion, landslip, flooding and sedimentation threaten life, property and assets, they are termed coastal, or natural hazards. Of these processes coastal erosion is by far the most widespread, most frequently occurring hazard at present.*
> (Gibb, 1983, 15)

Coastal erosion as a significant coastal hazard, has attracted much media attention of late. The evolving Himitangi dune erosion case (TVNZ, 1995b) and the continuing South Wairarapa erosion saga (TVNZ, 1995a) serve to remind us that the issue is alive and well in New Zealand's coastal environment. (Photographs in Appendix One illustrate the coastal erosion issue at Himitangi and Raumati Beach. Newspaper clippings in Appendix Two document the Wairarapa coastal erosion problem.) Coastal hazards are not only restricted to coastal erosion, significant coastal landslides and treacherous coastal storms leading to coastal flooding are common in New Zealand. An example of the coastal flooding problem is at Eastbourne, Wellington, where the coastal road is often closed by police during major storms due to the increased risk of accidents (Lower Hutt City Council, 1994).

A policy and adjustment response as to what local authorities can do about the coastal hazard problem was released in June 1994. The Department of Conservation commissioned a review of coastal hazard zone methodologies (Gibb, 1994). The draft review proposed standards/guidelines for the assessment of coastal hazard zones in New Zealand. The draft document was then circulated by the Department of Conservation for a technical review. The aim of this thesis is to evaluate the standardised coastal hazard zone methodology proposed by Gibb (1994) and determine its applicability in the New Zealand situation.

1.3 Research Objectives

The research objectives of this thesis are to:

1. Explore international natural hazards research to determine a theoretical policy and adjustment development model for natural hazards in the coastal environment.

2. Determine a New Zealand specific policy and adjustment development model for natural hazards in the coastal environment, using the above international model and New Zealand literature.

3. Identify attributes from the two models to be used in a topic evaluation of the proposed coastal hazard zone methodology (Gibb, 1994).

4. Provide recommendations about the applicability of the coastal hazard zone methodology in the New Zealand situation.

1.4 Limits to Study

Natural hazard planning under the Act is not a sole responsibility for one local authority. To cover all levels of planning for natural hazards would be beyond the scope of this thesis. Therefore the focus has been placed on the regional level of government, as the main providers of policy guidance. Given the provisions in the Act, territorial authority plans may not be inconsistent with the policy guidance given by regional councils in regional policy statements, and regional plans. Their guidance consequently plays an important role on how natural hazards are to be managed in any region.

The focus on four regional councils is a reflection of the scope of the thesis. Being a two paper thesis, the whole regional perspective on coastal hazard planning would be too large. Four North Island regional councils have been chosen to illustrate the coastal hazard issues. Other regional council perspectives are present in the submissions to Gibb's methodology, which were obtained from the Department of Conservation.

1.5 Methodology

The methodology was formulated using qualitative methods of data collection and interpretation. The thesis methodology is outlined in Fig 1.5. It is divided into five phases, which sequentially result in the recommendations to regional councils on the applicability of the coastal hazard zone methodology presented by Gibb (1994).

Phase one is the definition of the research problem and determining the research objectives. The research idea for this thesis began with the general topic of planning adjustments to coastal hazards. This research idea was then developed into a topic evaluation of Gibb's (1994) coastal hazard zone methodology to determine its applicability in the New Zealand situation.

Phase two involves the international literature review, based around the four contexts considered appropriate in the analysis of coastal issues - institutional, physical, socio-economic and cultural contexts. The definition of each context was noted and policy and adjustment attributes of the contexts were determined for each author. The policy and adjustment attributes were drawn together into a theoretical development model and checklist, which is augmented with sustainability literature. These policy and adjustment attributes are used as evaluation criteria in the topic evaluation of Gibb's (1994) methodology.

Phase three constitutes the active stage of the research, in which the primary data for the research is reported on. Primary data was obtained through semi-structured interviews at four regional councils: Auckland, Waikato, Taranaki and Wellington. Technical review submissions of the draft Gibb report provided the other main sources of primary data. Other primary data for the New Zealand literature review came from articles, reports and original works pertaining to coastal hazard planning in New Zealand. Secondary sources were used as well, which included commentaries and reviews of New Zealand coastal management research. The analysis of the interviews and submission data was achieved through a content analysis technique, which focussed on the issues brought forward by the submitters and interviewees, as well as the research questions of the thesis.

The topic evaluation of the Gibb's coastal hazard zone methodology is carried out in phase four. The issues identified in the content analysis and the

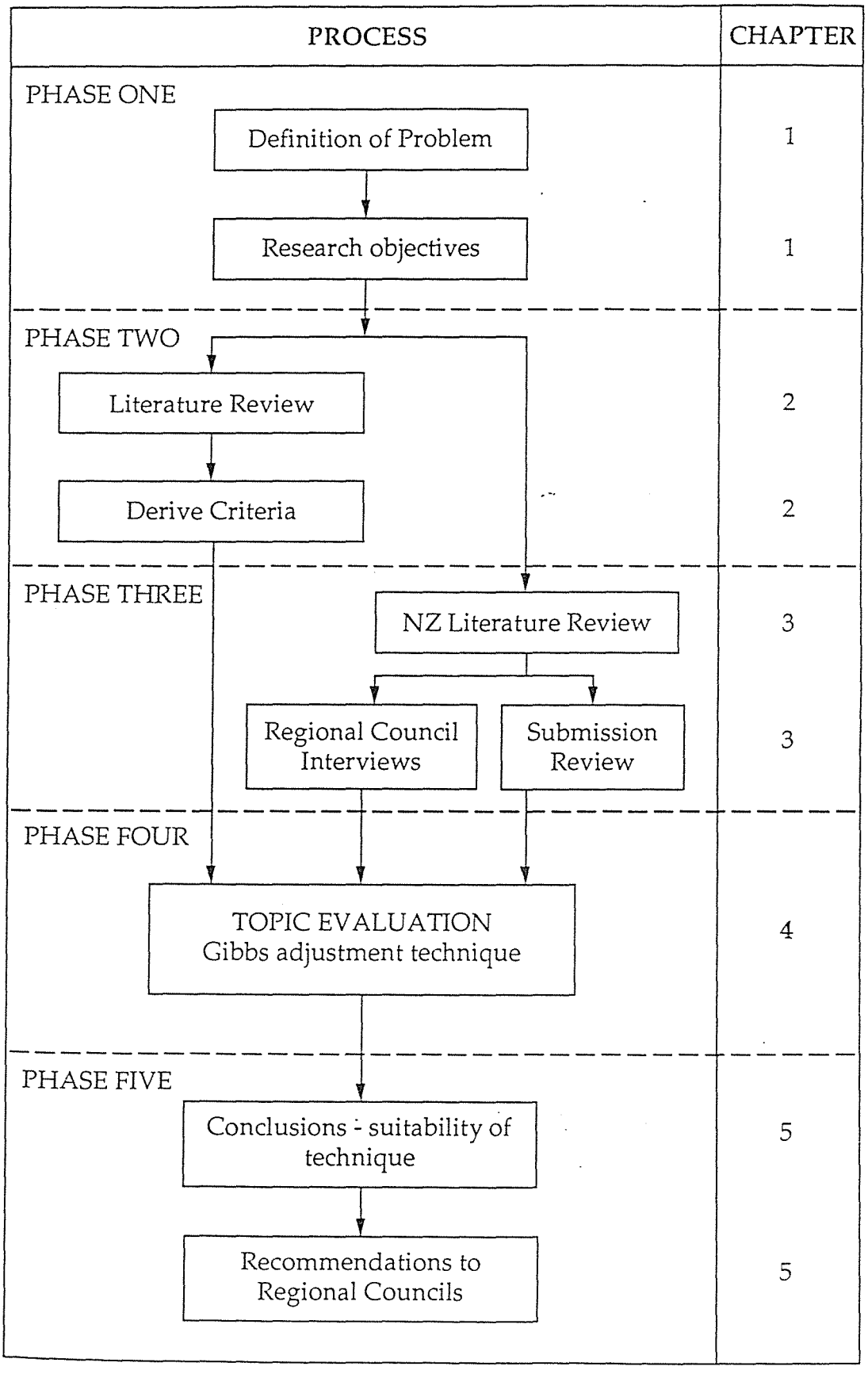


Figure 1.5: Thesis Methodology

attributes from chapter three are used as criteria in the topic evaluation of Gibb (1994). The conclusions drawn are supplemented by quotes from the submitters and interviewees. Further detail for the evaluation was provided by other sources.

Phase five draws conclusions from the four previous phases and synthesises them into a series of final recommendations for regional councils about the applicability of the coastal hazard zone technique.

1.5.1 Regional Council Selection

Semi-structured interviews were organised with four representatives from four regional councils. The four regional councils chosen were: Auckland Regional Council, Environment Waikato, Taranaki Regional Council and Wellington Regional Council. The location of each council is shown in Figure 1.6. Auckland, Waikato, Taranaki and Wellington were chosen for three reasons. Firstly, they all possess physically varied coastal environments, containing both cliffs and beaches. Secondly, the regions all posses urban areas that are at risk to natural hazards in the coastal environment. For example, Fitzroy Beach at New Plymouth is experiencing severe coastal erosion and is damaging private property. Thirdly, all of the councils, excluding Taranaki have major growth potential in the coastal environment, which could be limited by the need to make adjustments for natural hazards. For example, Paraparaumu Beach, in the Wellington Region, is still experiencing substantial development. Population growth in the Wellington Region is highest along the north western coastal strip of Kapiti and this growth is predicted to continue (Wellington Regional Council, 1995).

1.5.2 Semi-Structured Interviews

Semi-structured interviews are informal in nature, where there is a free-flowing exchange of ideas within a structured framework. A number of topics were covered, with precise questions and their order relative to the response of the respondent (Breakwell, 1990). Open ended questions were the norm, thus allowing for new insights to be added by the respondent (Kane, 1983).

This technique has been chosen over the structured interview style for various reasons, some of which were mentioned above. The flexibility of the semi-structured interview was its main advantage. Structured interviews are characterised by a fixed set of questions in a set order, thus not allowing for the

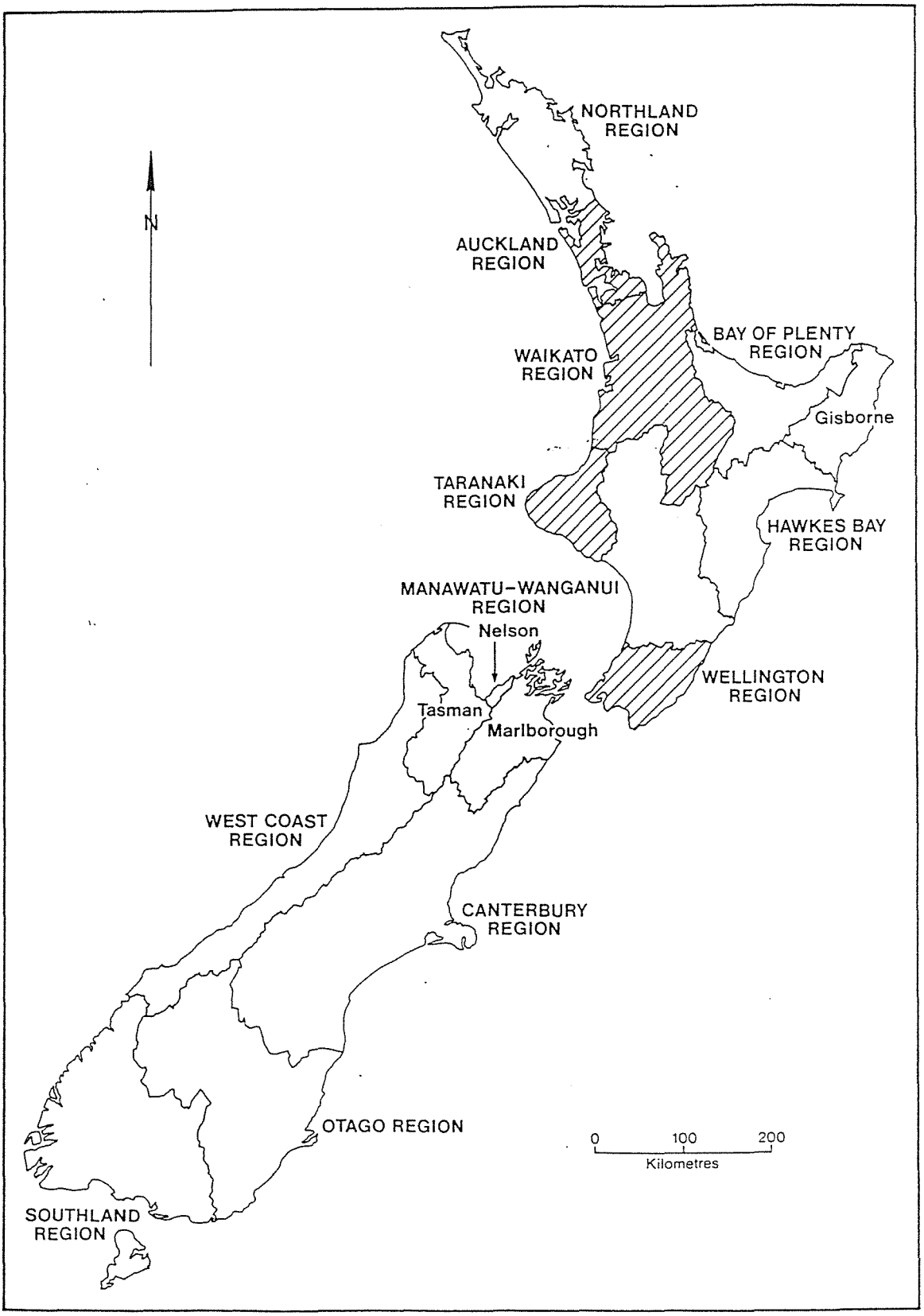


Figure 1.6: Interview Regional Councils Location

respondent to give answers that they think are important. Consequently, a complete area of concern may be missed out because the right questions may not have been asked about it. In the topic evaluation of Gibb (1994) it is important that these concerns are voiced as they can contribute to the evaluation.

The interview process started with contact being made with four representatives at each of the regional councils. Research aims were discussed and expectations of the interviews were expressed. In preparation for the interviews a set of questions were sent to respondents to give them some idea of what questions were going to be asked. This allowed them to view the questions, think about their responses and to consider anything else that may be relevant to the interview and the research topic. A copy of the questions can be found in Appendix Three. Once the interviews were completed, transcripts were compiled of the interviews. Once this process was completed the information was then analysed.

1.5.3 Interview and Submission Data Analysis

The information gathered from the submissions and interviews is qualitative in nature. The analysis of such data is time consuming and difficult, but it should not be perceived as being unquantifiable (Breakwell, 1990). Various people emphasise different themes and comments that need to be understood if responses are to be analysed. Content analysis requires that series of answer categories be defined. The definition of the answer categories was led by the research objectives of the thesis and the common themes present in the responses made. Once the categories were chosen, it was possible to look at each submission and interview for the presence or absence of exemplars of that category.

For the data collected in this thesis, a series of categories were determined according to the four contexts in coastal planning. The submission and interview responses were arranged according to these categories, therefore providing an overall picture of what appeared to be important from the individual respondents point of view. In reporting the results of the content analysis, the categories are discussed with quotations that show the depth and diversity of the opinion expressed by the respondents. By doing so the individuality of each response was maintained. Any other comments made by

respondents were also noted within the contexts, and these are discussed individually in chapter four.

1.5.4 Topic Evaluation

Evaluation within the planning process is necessary and important. Institutionally in New Zealand, planners are bound to undertake evaluations of any objective, policy, rule, or other method undertaken to achieve the purpose of the Act. This is stated in Section 32. Two types of policy evaluation have emerged: process evaluation and impact evaluation (Nachmias, 1979). Process evaluation is undertaken within the planning process and involves the evaluation of alternative polices, plans and methods considered appropriate, to determine whether they achieve the aims and objectives desired. Impact involves evaluation of a programme or policy, after a period, of time to determine its effectiveness.

The topic evaluation undertaken in this thesis is an informal method of process evaluation. The method involves determining topics and simply discussing them in terms of 'pros and cons' and possible implications. The method is simple and this is its main advantage. It is suited to situations where there is little knowledge about the specific implications of development (Meister and Rosier, 1992). The topics chosen for the evaluation are the attributes that have been derived from chapter two. This evaluation technique is often criticised as it is based upon anecdotal knowledge and lacks in rationality and scientific methodology (Hill, 1985).

1.6 Chapter Outline

Each chapter in this thesis builds upon the previous. Problem definition is the crucial element in guiding research. Problem definition is given in chapter one, plus the methodology that is adopted to guide the research task. The practical problem identified in chapter one is set into the international theoretical context in chapter two. Natural hazards and sustainability literature provide the basis for the discussion. The policy and adjustment attributes drawn from this literature are modelled into an ideal alternative policy and adjustment development model.

The model developed in chapter two is altered to reflect the New Zealand context in chapter three. The relevancy of the attributes is reviewed and from this an ideal New Zealand specific policy and adjustment model is proposed.

The model given in chapter three provides the basis of the topic evaluation of Gibb (1994) in chapter four. This chapter serves two purposes. The adequacy of the methodology is determined in the real world situation, and the extent to which New Zealand is achieving the model will be established.

Chapter five draws the conclusions of the previous chapters into a series of recommendations about natural hazard policy and adjustment development in New Zealand. Directions for future research are suggested that will help in the search for appropriate policies and adjustments to natural hazards in the coastal environment.

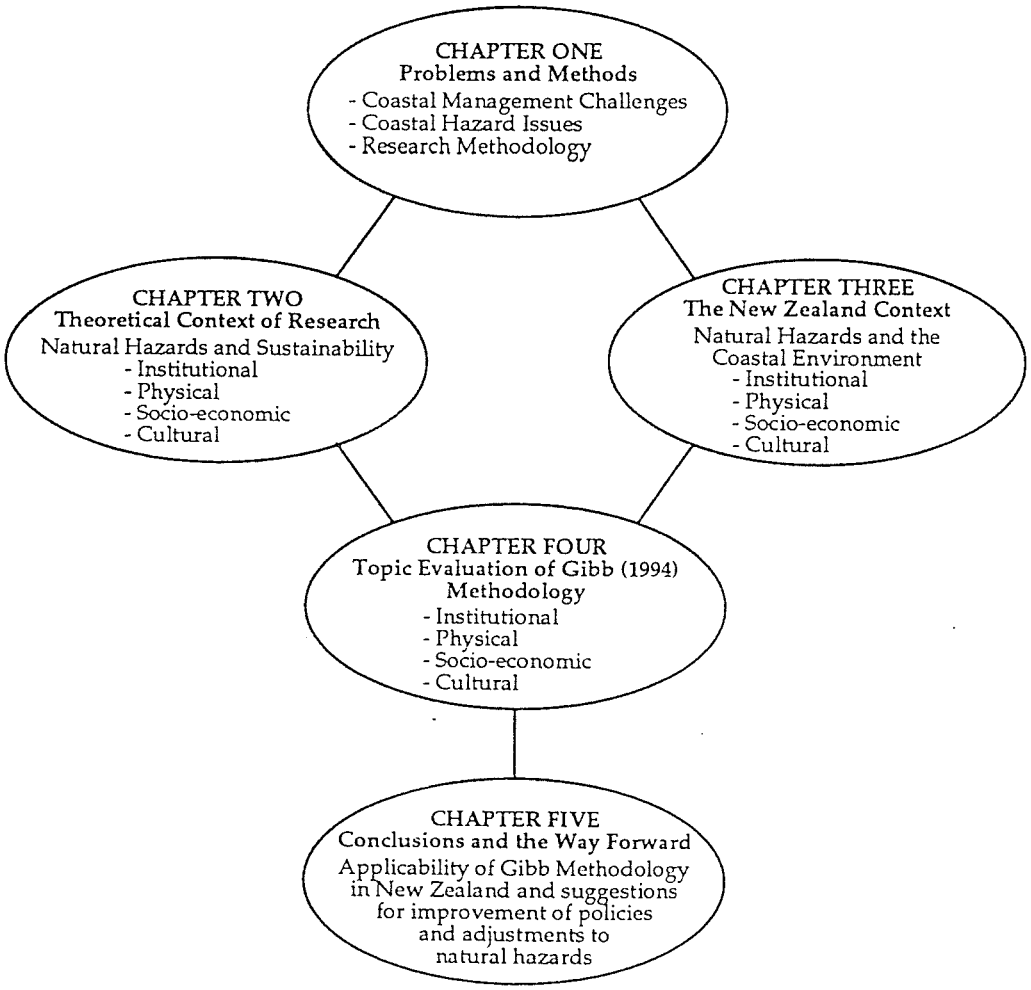


Figure 1.7: Thesis Structure

CHAPTER TWO

THEORETICAL CONTEXT OF RESEARCH

Chapter two presents the theoretical context for this thesis. The aim is to derive a theoretical policy and adjustment development model that integrates natural hazard management with sustainable development objectives and a checklist of policy and adjustment attributes that will help local authorities develop appropriate adjustments to natural hazards. The review of natural hazards literature provides the basis for the model. Planning and sustainability literature is also used in augmenting the institutional, socio-economic and cultural contexts of natural hazard literature. The review literature informs the reader about the research subject, the significance of the subject and what others have described and concluded about the subject (Marshall and Rossman, 1989). By providing the theoretical constructs of the research subject, new connections between theory and real world phenomenon can be discovered. These discoveries, in relation to this thesis, will aid in the development of policy for natural hazard planning and management.

2.1 Historical Review of Natural Hazard Research

Historically, natural hazard research has focused on merely describing the physical causes of natural hazards, with little attention given to the social response to the hazard itself. Hazard management has traditionally emphasised the 'technological fix solution' or engineering responses. For example in the past, sea walls and groynes were often used to control the impacts of coastal erosion (Healy, 1980 and Pilkey, 1991). The theoretical underpinning for this approach stems from the technocratic mode of management, with the application of rational and 'value-free' scientific and managerial techniques by a professional elite (mainly engineers), who regard the natural environment as 'neutral stuff' from which man[sic] could profitably shape his[sic] destiny (O'Riordan, 1981).

In the 1920s and 1930s a change in research trend emerged, following an investigation into the extensive damage and distress to American communities resulting from floods and drought (O'Riordan, 1986). This new research focused on the sociological and psychological response to natural and human-made hazards and the societal adjustments being made. This line of research

was furthered during World War II, where thorough research analysing the human behaviour and social organisation of the communities affected by bombing was undertaken. The principle problems associated with this research was the lack of fundamental understanding about the physical processes that produce natural hazards, and the lack of explanation about why people actually live in hazardous areas (O'Riordan, 1986). Hazard management agencies at this time tended to see their role as being one of hazard control rather than as managers of human interaction with the pysical environment.

2.2 Literature Review Findings

The historical natural hazards research sets the scene for further advances in natural hazards research. Since then, there has been major advances in our approaches to natural hazards research. The review of the natural hazards literature is summarised in Table 2.1. and is concerned with these research advances from the 1970s, as this was the period when two challenging paradigms of natural hazard research emerged. The purpose of the table is to illustrate the progression and evolution of natural hazards research from the 1970s, with the focus of each researcher being highlighted. The layout of the table is based around the four contexts considered important by this thesis in natural hazard planning and management as described in chapter one. The table is set out in the following way: column one contains the author and year, while column two through to column four contain the research findings in each of the four contexts in the following order: institutional, physical, socio-economic and cultural. Within a column, each authors comments about the context is set out in the following manner:

(a)	Author's definition of the context.
(b)	Author's suggestion of policy attributes of the context.
(c)	Author's other comments about the context

If there is no comment within part of a box, the author has not given a definition, suggested attributes or made other comments. If the whole box is left empty, the author has made no mention of that particular context. For

Table 2.1: Review of Natural Hazards Literature 1971 - 1994

AUTHOR	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT
Kates, R.W. 1971				
		Physical context is main cause of natural hazard.	Pre-occupation with 'man' (sic) being ecological dominant. Perception of hazrd. Risk taking propensity. Age. Income. Access to information.	
White, G.F. 1973				
		Acknowledges the absence of an understanding of physical processes	Hazard perception of the community affects the management adjustment taken	
White, G.F. 1974				
			human intiative, choice and percpetion	
		composed of atmoshperic, hydrologic, geomorphic and biotic systems	No natural hazard exists apart from the human adjustment to it.	
Rowntree, R.A. 1974				
			Hazard perception of the community. Prevalence of the private property ethos.	
		Need to preserve the physical processes when managing natural hazards.		

Table 2.1: continued

AUTHOR	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT
O'Keefe, P., K. Westgate, and B. Wisner. 1976				
	Institutional forces accentuate natural hazards		Socio economic context is a major contributing factor in the occurrence of natural hazards	
Burton, I., R.W. Kates and G.F. White. 1978				
		Physical context is main cause of natural hazards.		
	Interaction with the socio economic, cultural and the physical contexts creates resources and hazards	Interaction with the socio economic, cultural and the institutional contexts creates resources and hazards	Interaction with the physical, cultural and the institutional contexts creates resources and hazards	Interaction with the socio economic, physical and the institutional contexts creates resources and hazards
Petak, W.J. and A.A Atkisson. 1982				
	Federal, administrative, legal, economic and political constraints		Community perceptions and attitudes, society norms and economic constraints.	
Hewitt, K. 1983				
	Political influence			
			Socio economic context is a major contributing factor to the occurrence of natural hazards. Why do people live in hazardous areas?	

Table 2.1: continued

AUTHOR	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT
Susman, P., P. O'Keefe and B. Wisner. 1983				
	Institutional context is attributed with processes of underdevelopment and marginalisation		The socio economic context is attributed with the concept of vulnerability and the processes of underdevelopment and marginalisation.	
			Case studies given for the third world to prove argument.	Implicit recognition of the plight of the indigenous peoples in relation to natural hazards and socio economic processes.
Watts, M. 1983				
			Natural hazards are more a reflection of the ability of this context to cope with the unusual harshness of ecological conditions and their effects	
Fischer, D. 1985				
	When considering this context, attention needs to be given to monitoring needs, benefits and costs, compensation and the uncertainty associated with the context.	When considering this context attention needs to be given to shoreline diversity, degree of hazard and uncertainty in context.	When considering this context attention needs to be given to coastal activities, development implications, benefits and costs, public access, compensation, and uncertainty associated with the context.	

Table 2.1: continued

AUTHOR	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT
Ericksen, N.J. 1986				
	Technical feasibility, economic gainfulness, environmental compatiblity, political and economic processes.		Hazard perception, social acceptibility, social processes, past experiences, future images, personality of individual.	
O'Riordan, T. 1986				
	Public faith in the institutional context being able to manage hazards. Efficiency and political influence contribute greatly to the institutional context.		Environmental hazards are circumstance of social existence. The nature of this existence influences the way in which natural hazards are managed.	Recognition that advances in coping strategies requires the application of indigenous knowledge.
Ives, S.M. and O.J. Furuseth. 1988				
		Physical processes diverstiy.	People are aware of the role they play in the dynamics of their surrounding environment.	
	Restates Petak and Atkissons (1982) attributes of this context.		Restates Petak and Atkissons (1982) attributes of this context. Endorsement and approval from this context will increase the likelihood of success of a policy decision.	

Table 2.1: continued

AUTHOR	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT
Mitchell, J.K., N. Devine and K. Jagger. 1989				
		Physical processes	Human activities, exposure, vulnerability, recognition of risk and risk perceptions	
			Cognition of risk and risk perception are amplified or attenuated by socio cultural and psychological processes.	
Godchalk, D.., *et al.* 1989				
	Technical capacity, local political system and local mitigation activity.	Site availability, percentage of development and location within the coastal environment.	Extent of private property ethos, disaster culture, median home value, population size and recent hazard history.	
Ericksen, N.J. 1990				
	Technical factors, polictical factors, economic factors		Behavioural factors, social factors	
National Research Council, 1990				
	Political diversity, public participants in coastal management, methods available and institutional variation.	Physical divesity in coastaline characteristics.	Settlement diversity, private participants in coastal management	

Table 2.1: continued

AUTHOR	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT
Titus, J.G. 1990				
	Economic efficiency, urgency, low cost, equity, politics and economics, consistency and public vs private sector are criteria which need to be met.	Performance under physical uncertainty, unique or critical resources protection are criteria which need to be meet.	Economic efficiency, urgency, low cost, equity, unique or critical resources protection, health and safety, private vs public sector are criteria which need to be meet.	Unique or critical resources protection and health and safety are criteria which need to be met.
Platt, R.H. *et al.* 1992	Defined as the political/legal context of resource management decision makers.	Defined as the physical environment.	Defined as the human or 'built' environment	
	Multiplicity of units and levels of coastal management entities, lack of reliable data, cost sharing, economics versus the environment	Types of processes, shoreline diversity, available sand supply, geographic incidence of storms and other events, effects of coastal engineering, interrelationship between erosion and flooding, long and short term erosion.	Cost sharing, economics versus the environment	
Smith, K. 1992				
	Institutional, economic and political influence, global scale politics and economics and ethical responsibility.		Political and economic influences, influence of landowners and environmental movement.	

Table 2.1: continued

AUTHOR	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT
Wisner, B. and H. Henry. 1993				
			Need to look at the relationship between vulnerability, and social concepts such as class, gender, ethnicity, age and disability.	
Lawerence, P.L. and J.G. Nelson. 1994				
	Variations in institutional arrangements, sustainable development.	Variations in climate, vegetation and geology, coastal ecosystem management - ecological diversity and integrity and essential process preservation.	Variations in land use and human activities, sustainable development.	
	Need holistic approach to resource management, ecological unit planning. Need more policy orientated research. Need more monitoring and assessment of hazard, land use and environmental circumstances		Understand human behaviour, need persistent education and communication with citizens	

example, Kates (1971) does not define any of the contexts in natural hazard planning, although two attributes are provided to describe the physical and socio-economic contexts. No further comments are made.

The review of the literature provides some interesting findings about natural hazards research. The research is characterised by three distinct paradigms, each debating the weaknesses and faults of the previous dominant paradigm. The first two paradigms, the behavioural and structuralist, which dominated trains of thought in the 1970s and 1980s, concentrate on specific areas relating to natural hazards. The behavioural paradigm is based on the premise that natural hazards are the result of the interaction of the physical environment and human activities (the physical environment is the main determinant of natural hazards). The structural paradigm bases itself on the premise that natural hazards are more a consequence of socio-economic and institutional forces than physical forces (O'Keefe, Westgate and Wisner, 1976). These two paradigms are criticised for being specialist and reductionistic. The interpretations of the real world systems are inadequate because important resource management considerations, such as the dynamic nature of physical processes and cultural considerations, are overlooked. In proposing general frameworks for decision-making, researchers concentrate on particular aspects that they feel are important, while not addressing others that have equal importance. For example, researchers adhering to the structural paradigm concentrate on the political and social influences on natural hazards and do not pay much attention to the physical aspects of natural hazards.

The debate between the two dominant paradigms is furthered by a third paradigm being advocated in the late 1980s. This third paradigm, the contextual approach or 'balanced view of disaster' (Smith, 1992) recognises that a combination of influences from all contexts affect natural hazards and the adjustments made to those hazards. Advocates of this paradigm attempt to provide an adequate decision-making model that fits into this wider appreciation of natural hazards. The three paradigms are presented in Table 2.1. The behavioural paradigm and the structural paradigm researchers constitute the beginning of the table. The differences between each are evident by the notes within the context columns, behaviouralists dominate the physical context column with comments being made in the socio-economic context column. On the other hand, structuralists dominate the institutional context column with comments also being made in the socio-economic context column.

The advent of the contextual paradigm can be seen in Table 2.1. The contextualists comment on all contexts and dominate the end of the table.

Much of the early work in natural hazards research may be criticised for being too general, abstract and confusing. Substantive definitions of terms within the paradigms are lacking, which impairs the understanding of the paradigm. For example, the term structural, used to describe the second paradigm discussed, is confusing, as it implies the use of structures in the adjustments to hazards, but this is not the case. From these early paradigms it is difficult to present unambiguous detailed policy and planning guidance for dealing with natural hazards. The models of decision-making proposed by these early paradigms are characterised by too many generalisations and assumptions which do not result in adequate decision-making mainly because of their specialist and reductionistic nature. For example, in the behavioural paradigm the assumption is made that humans are the ecological dominant and natural processes are the main cause of natural hazards. This has resulted in the continuation of the technocratic approach to natural hazards management.

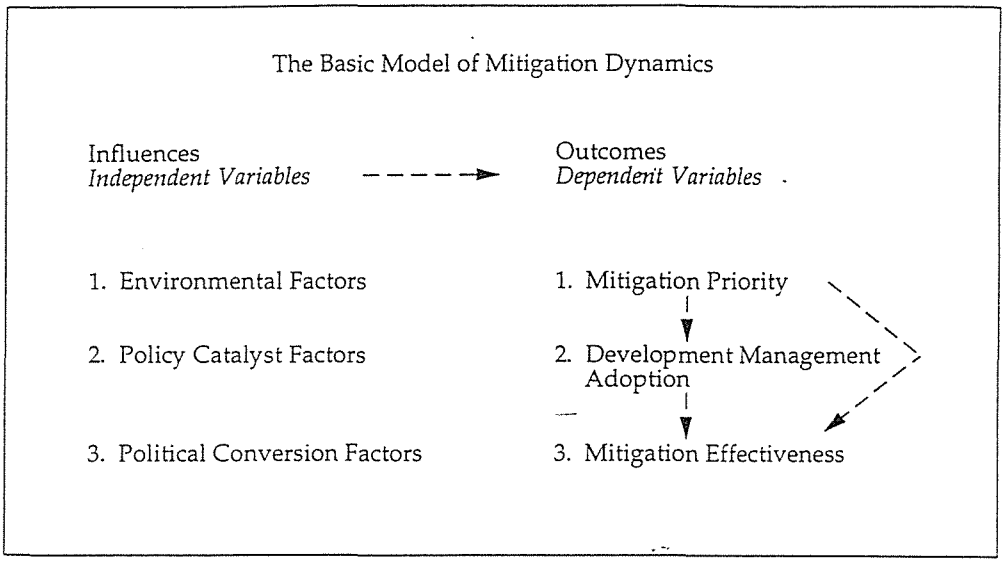
The structuralist paradigm researchers contend that the behavioural paradigm, with its technocratic approach, has failed to reduce the effects of natural hazards (see O'Keefe, Westgate and Wisner, 1976). The structural paradigm hypothesises that natural hazards are more of a consequence of socio-economic than natural factors. The early work in this paradigm is also over-generalised. More attention needs to be given by the structuralists to the finer details of the socio-economic and institutional processes they propose as main causal agents of natural hazards (see Wisner and Luce, 1993).

Researchers concerned with the contextual studies of the late 1980s and 1990s have attempted to overcome the generalisations made in both the behavioural and structuralist paradigms (for example: Fischer, 1985; Ives and Furuseth, 1988 and Mitchell, Devine and Jagger, 1989). By adopting the strengths of the behavioural and structuralist paradigms, and filling in the gaps with their own ideas, contextual models of decision-making attempt to assist in providing better policy and planning guidance. Though these new models (for example, Godschalk *et al.*, 1989 and Platt *et al.*, 1992) may also be criticised for being too general and pedantic in nature. This is because their interpretations of the real world situation may take into consideration a wider range of factors but the relationships portrayed are very simplified.

Godschalk *et al.* (1989) and Platt *et al.* (1992) contextual decision-making models are given in Figure 2.1. Figure 2.1a is Godschalk *et al.* (1989) model of mitigation dynamics, whereby three areas of influence are identified. These three areas of influence are environmental factors, policy catalyst factors and political conversion factors. These areas of influence are composed of the attributes of all four contexts given in Table 2.1. The model identifies these as the independent variables, that influence the dependent variables of mitigation priority, mitigation adoption and mitigation effectiveness. The relationships portrayed in this model are rather simplistic in nature. They are viewed in statistical terms which does not truly reflect the complexity of the relationships within the real world. Platt *et al.* (1992) furthers this model, as shown in Figure 2.1b. They consider three contexts, which can be equated with the institutional, physical and socio-economic contexts given in this thesis. They go on to give attributes of these three contexts which influence the response to natural hazards, which are given in Table 2.1. For example, attributes of the institutional context include lack of reliable data and multiplicity of units and levels of management. These attributes given are adequate, but more is needed to provide a more thorough policy and planning guidance. The model advances Godschalk, *et al.* (1989) by defining the processes that occur between the decision-making contexts. For example, perception of the physical environment and natural hazards by the institutional context will influence the development of natural hazard policy and adjustment.

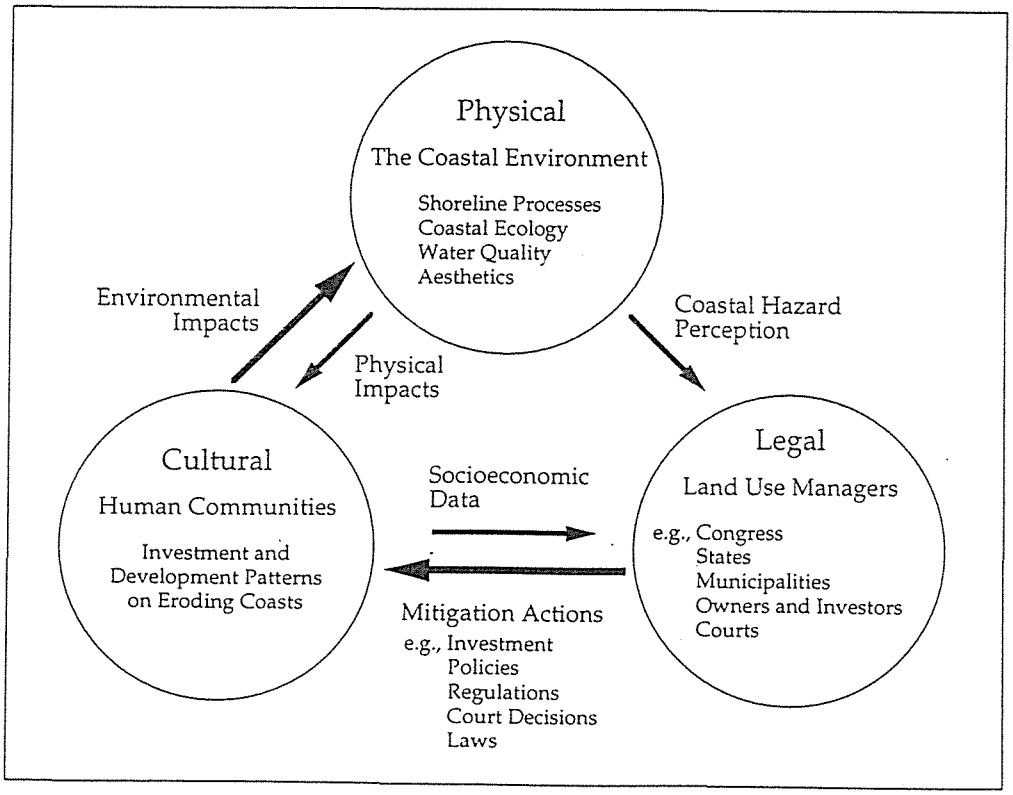
Natural hazards literature to date has paid little, if any, attention to the cultural context. Researchers interested in the cultural context, as defined in chapter one, acknowledge that indigenous and all other forms of knowledge and resource management systems, should be recognised in developing natural hazard policy and adjustments. In natural hazard research this due recognition of the cultural context is missing. O'Riordan (1986) recognises this research gap and states that there is a role for indigenous knowledge in developing coping strategies and adjustments to natural hazards. Laksono (1988) outlines this indigenous knowledge and highlights its potential in developing natural hazard policy and adjustments. This anthropological study compares the responses of the local villagers and government officials to the volcanic threat in Central Java. The government responded to this threat by attempting to resettle the villagers on to another island in Indonesia. The villagers responded by remaining on the volcano and adapting to its hazards, by using local systems of knowledge to monitor and explain the volcanic activity. A complex

A: The Basic Model of Mitigation Dynamics



Source: Godschalk et al, 1989.

B: A Model of Societal Response to Coastal Hazards



Source: Platt et al, 1992.

Figure 2.1: Contextual Models of Decision-making

cosmological explanation is given to describe why the volcano is active. As with many indigenous, folklore systems, the volcano symbolises a god. Villagers believe that activity within the volcano is symbolic of the mountain god interacting with the sea god. The mountains and sea are revered as being the male and female life respectively, and the union of these should be respected. Ritual offerings are made to keep in favour with these gods, so they will be spared during the union (natural hazard event). The cosmological explanation guides the villagers on how to cope with the hazard. The threat from the volcano is perceived as less of a threat than being resettled and having to deal with other unfamiliar hazards, such as famine, social corruption, sickness and overcrowding. These perceptions caused many villagers to refuse relocation and many returned to the original island. The conclusion drawn from this research is that different approaches to dealing with natural hazards have their own validity. This conclusion highlights the fact that indigenous knowledge and customs help indigenous peoples cope with natural hazards in their environment and that these knowledge bases and customs may provide some assistance in developing policy and adjustments for natural hazards.

2.3 Natural Hazard Research Essential Attributes

Important policy attributes emerge from the dominant paradigms within natural hazard research, and they are relevant in the management and planning of natural hazards in a sustainable development regime. The behavioural and structural paradigms contribute greatly to the understanding of the existence of natural hazards. The differences between the two approaches are significant but combined, as attempted by the contextual approach, they contribute enormously to the formulation of appropriate policy for natural hazard planning. The purpose of the following discussion is to highlight these attributes, from the four contexts, that should be continued in present day management and planning for natural hazards.

2.3.1 Behavioural Paradigm Essential Attributes

The behavioural or human-ecological paradigm is based around the application of the ecology of human choice and attempts to deepen the understanding of the decision-making process accounting for particular human activities at particular places and times (White, 1973). This paradigm focuses on two of the contexts given in this thesis, these being the physical and the socio-economic contexts. The main stimulus for this research was the public policy

paradox that modern societies, while increasingly able to manipulate nature, were becoming increasingly susceptible to the ravages of natural hazards.

Research in the behavioural paradigm is based upon the premise that an interaction between social systems and natural systems will create resources - positive resources and negative resources (hazards) (Burton, Kates and White, 1978). A flood is an excellent example of this interaction. While creating a hazard such as damage to a farmstead, it can be creating a resource through the process of fertilisation. The hazard risk arises from the occupancy of the flood area by the human system. This human environment interaction system is represented in Fig 2.2.

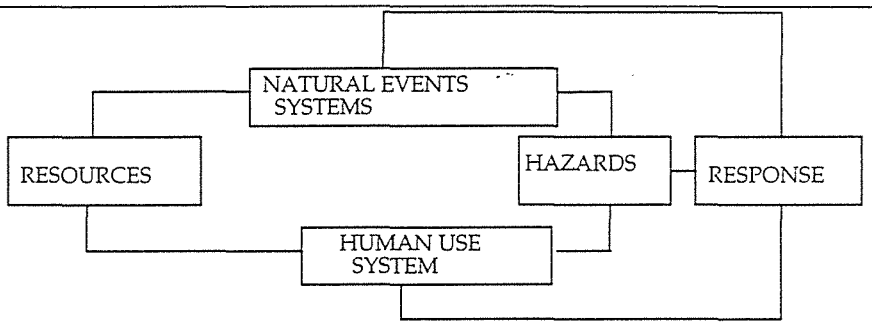


Figure 2.2: Resources and Hazards from Nature and Humans
Source: Burton, Kates and White, 1978.

It is asserted in the behavioural paradigm that natural systems are neither benevolent nor maliciously motivated toward their members - they are neutral, in the sense that they neither prescribe, nor set, powerful constraints on what can be done with them. It is people who transform the environment into resources and hazards, by using natural features for economic, social and aesthetic purposes (Burton, Kates and White, 1978). It is generally accepted in this paradigm, that natural hazards are a result of 'extremes' in geophysical processes (Smith, 1992).

Kates (1971) proposes a general framework of decision-making for natural hazards. In his work, he only considers the physical and socio-economic context as seen in Table 2.1. He does not define those contexts but gives attributes of them which contribute to understanding natural hazards and adjustments. His work focuses on the interaction between the socio-economic context, with man[sic] being the ecological dominant, and the physical context, with natural events being the main cause of natural hazards. The choice of

adjustment is affected by a number of factors, including perception of hazard, personality characteristics, risk taking propensity, age, income and access to information (Kates, 1971, 446). Kates (1971) concedes that many of the real determinants of human behaviour related to natural hazards lie outside the interface of the natural and human systems modelled in the behavioural paradigm.

Adjustments to the hazards resulting from the human/physical environment interaction depend upon the perception of the hazard by the planner and the individuals within society (White ,1973). In White (1974) he furthers this thesis by stating that no natural hazard exists apart from the human adjustment to it: it always involves human initiative and choice. The effects of human adjustments will be dependent upon the particular combination of the physical and social environment that prevail at the time. If an adjustment is to be effective, it is important to continually appraise these physical mechanisms and social accommodations of natural hazards, as well as gaining a greater knowledge of the processes by which people cope with natural hazards. The results of this research provide three lessons for environmental management. The first being that if costly threats to life and property are to minimised from natural hazards, there must be sharing of the skills experience, and research capacity of the family of nations. The second lesson is that modern societies cannot expect to cope effectively with hazards in the environment by relying solely upon technological solutions (White, 1974, 13). The third lesson is that local government programmes can go far astray if they ignore the views of the community.

The role of the socio-economic context in coastal erosion hazard adjustment is investigated by Rowntree (1974). He does not define this context but gives attributes which are important in policy and adjustment development. He states the manner in which a hazard is dealt with depends on the meaning that hazard holds for each resident and, more importantly, for the community as a whole (Rowntree, 1974,). Individual perception was influenced by the experience had with the coastal erosion problem. Consequently, the hazard perception was higher for those directly affected by the hazard problem; those further away from the physical problem, were not so concerned. Many of the perceptions that were held of a symbolic or allegorical nature, dependent upon which ideology the people in the community aspired to (Rowntree, 1974,). For

example, environmental values systems and private property value systems were two prevalent ideologies within the community.

In New Zealand the human-ecological paradigm has been advocated by Ericksen (1986 and 1990). As with the behavouralists already mentioned, the contexts are not defined, though he does provide a range of attributes that assist in development of policies and adjustments to natural hazards. He identifies three main sequential components of the decision-making process leading to the adoption of an adjustment for reducing losses from natural hazards. This decision process is shown in Figure 2.3. The first component is the hazard perception threshold, where people must be sufficiently aware of the problem before they can act. This threshold is affected by the perception of the hazard, past experiences, future images and the personality of the individuals affected by the hazard. The next step is the search for the appropriate adjustment. It has been noted that the full range of theoretical adjustments are never taken into consideration when choosing an adjustment. The choice is dependent upon recent experiences and future expectation of the adjustment chosen. The choice is also dependent upon the adjustments typically available and the one socially sanctioned. The final step is decision criteria, where the most important constraints are technical feasibility, economic gainfulness, social acceptability and environmental compatibility. Ericksen (1986) also notes that a complex intermix of political, economic and social processes exert a powerful influence upon individual action when dealing with natural hazards. Ericksen (1990) furthers this idea by saying that adjustments may depend on a range of behavioural, technical, political, economic and social factors. The ideal adjustment made to reduce the hazards effect must be underpinned by adequate information about both natural and social process (Ericksen, 1990).

Recent work in the human-ecological paradigm by Lawrence and Nelson (1994) advances the earlier work in this paradigm. Their work develops an alternative management model with a focus on understanding hazards in the context of their natural and human components. They do not define these components or contexts. They propose a human-ecological approach reflecting integration of nature and culture, that relates to sustainability, diversity, essential processes and economic well-being. Their approach is based upon a number of key aspects which help in policy and adjustment development. These being:

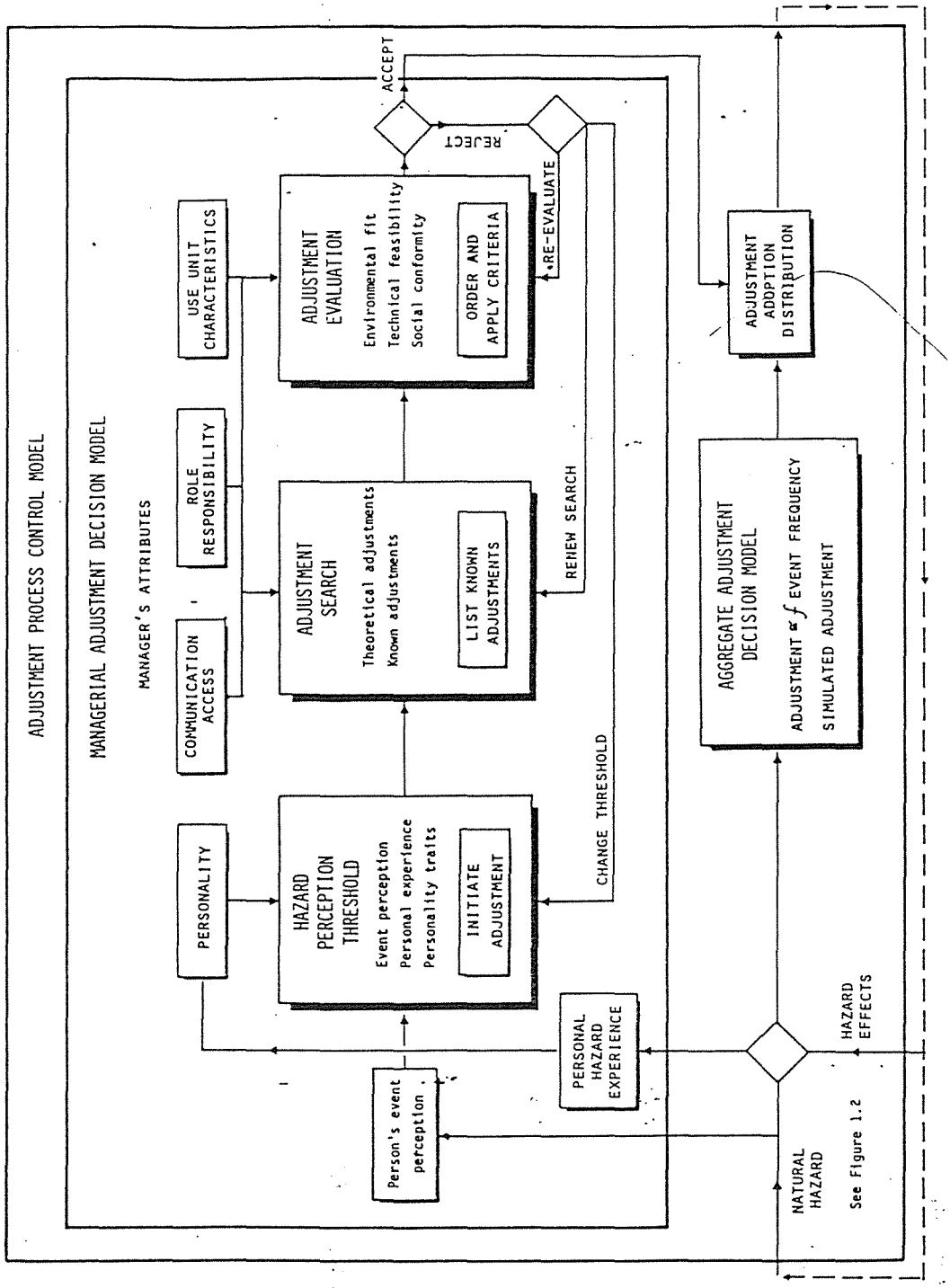


Figure 2.3: The Decision Process of Adjusting to Floods
Source: Ericksen (1986)

1. comprehensive management
2. principles of coastal ecosystem management
3. regional or watershed basis for planning
4. promote development that is sustainable
5. identify linkages between hazards, humans and environmental factors
6. develop understanding of human behaviour
7. interactive - adaptive approach to research

These seven aspects contribute in many ways to policy and adjustment development as seen in Table 2.1. All the contexts are considered, except the cultural context, but the focus of the approach is still that humans are the ecological dominant.

The behavioural paradigm researchers are noted for their lack of definition of contexts. This is probably a result of the generalisations that the paradigm assumes about natural hazard occurrence. Aside from this lack of definition the paradigm does provide some useful concepts for policy and adjustment development. These being: the recognition of the physical context as an essential element in understanding natural hazard existence; the role of public perception in natural hazard adjustment choice and that social and economic processes contribute to natural hazard adjustment adoption and effectiveness.

2.3.2 Structural Paradigm Essential Concepts

Termed the structuralist paradigm, this paradigm emphasises the constraints placed on individual action by broader and more powerful institutional forces (Smith, 1992). The view of this paradigm is that increased vulnerability to hazardous events is due at least as much to the acts of human beings as it is to the acts of God. The human-environment relationship is seen not in terms of a human-environment interactive relationship but largely in a human-human context, where the environment is a independent phenomenon (O'Riordan, 1986). In essence the approach is a radical Marxist interpretation of natural hazards that envisages solutions based on the distribution of wealth rather than the application of science and technology (Smith, 1992). This paradigm concerns itself with the institutional and socio-economic contexts given in this thesis.

The structural paradigm views natural hazards by considering the socio-economic conditions in relation to the physical environment. This relationship turns to the concept of vulnerability, where vulnerability is the degree to which different classes in society are differentially at risk, both in terms of the probability of occurrence of an extreme physical event and the degree to which the community absorbs the effects of extreme physical events and helps different classes to recover (Susman, O'Keefe and Wisner, 1983). Therefore, a natural hazard is defined as the interface between an extreme event and a vulnerable human population. The key difference between this definition and the definition given by the behavioural paradigm is that they believe that hazards are not uniquely dependent upon the physical event.

O'Keefe, Westgate and Wisner (1976) in the seminal work of the structural paradigm suggest that there needs to be a radical re-think on the nature of natural hazards. They state that natural hazards (or disasters), are more a consequence of socio-economic factors than natural factors. The vulnerability of the population is the real cause of natural hazards and disasters, and this vulnerability is induced by socio-economic conditions, which result from the institutional and socio-economic context. This work was very general and does not define socio-economic factors; the context they identify as the main cause of natural hazards. Watt (1983) follows in the same line, in that he proposes that an alternative view to natural hazard research, which recognises that the hazard is mediated by the socio-economic structures of the societies affected, is needed. He says that natural hazards are not simply natural, the crises itself is more a reflection of the ability of the socio-economic system to cope with the unusual harshness of ecological conditions and their effects.

Hewitt (1983b) proposes that the structuralist approach has three important general considerations. One, most natural hazards, or most of the resulting damages, are characteristic rather than accidental features of the places and societies in which they occur. Two, the risks, pressures and uncertainties that bear upon awareness of, and preparedness for, natural fluctuations flow mainly from what is called 'ordinary life' rather then from the rareness and scale of those fluctuations. Three, the natural extremes involved are, in a human-ecological sense, more expected and knowable than many of the contemporary social developments that pervade everyday life. These three considerations imply that a different way of conceiving natural hazards is

required by social scientists when developing natural hazards policies. Hewitt (1983a) makes an important concession concerning the structural approach.

> *In isolation, of course, in the absence of the dominant views [the behavioural approach] our emphasis would also add up to an unbalanced view. It would be wrong to suggest that events associated with flood or earthquake in no way reflect the nature of these geophysical processes.* (Hewitt, 1983a, 25)

From this concession, it can be said that the structural approach does not refute the behavioural paradigm, but extends it to provide a more realistic interpretation of natural hazards in the real world.

Susman, O'Keefe and Wisner (1983) consider the nature of natural hazards in a global framework, which attempts to provide a general theory of modern natural hazard occurrence. Their research evidence in the third world questions the popular belief that natural hazards are an act of God. Their thesis proposes that the processes of under-development and marginalisation are contributing the increased vulnerability of a percentage of the population.[1] These processes of under-development and marginalisation result from the institutional and socio-economic contexts that exist when developing policy for natural hazards. The contexts are not defined and researchers do not go any further than identifying under-development and marginalisation as attributes of these contexts. They contend that policy should be socialist in nature to address these processes but do not go into detail what measures could be adopted to fulfil their socialist objectives.

Recent structuralist research, for example Wisner and Henry (1993), criticises past structural writing for being too general to apply in practical situations. For the structural paradigm to assist in planning and management of natural hazards, characteristics of groups of people, households and individuals that make them vulnerable to disaster need to be precisely defined. Wisner and

[1]Under-development is recognised as a continual process of impoverishment based on a world economy which perpetuates technological dependency and unequal exchange. Marginalisation is identified as the process where there is active under-development of the poorer classes by richer one within a country and as well as between rich countries and poor (Susman, O'Keefe and Wisner, 1983). Under this theory of marginalisation, the implications for natural hazards will be: natural hazards will increase as socio-economic conditions and the physical environment deteriorate; the poorest classes will suffer the most; high technological adjustment and mitigation will reinforce and increase marginalisation; natural hazard planning should be socialist in nature (Susman, O'Keefe and Wisner, 1983).

Henry (1993) do this by exploring the relationship between vulnerability, and social characteristics such as class, gender, ethnicity, age and disability. They conclude that vulnerability analysis will aid better policy and adjustment development by addressing problems such as access to information and technology, and offer clear information on the constraints that planners must face.

The structural paradigm provides useful attributes for policy and adjustment development. Re-thinking the institutional processes and socio-economic processes, which can result in people living in the more hazard prone areas, for example continued development on flood plains, is important.

The structural paradigm has little relevance in the coastal hazard planning context, as vulnerable human populations are not the majority living in such areas although this is not the case in many third world countries. For example, in Bangladesh, where much of the population lives on coastal fringes and offshore islands, which are affected by cyclone-associated flooding and damage. The coastal environment is now the most popular area for residential development, with approximately 50 per cent of the United State population and 80 per cent of the Australian population living within the coastal environment. Coastal populations also exhibit allometric growth, that is they are expanding faster than national populations (Carter, 1988). From these statistics it is evident that coastal residential development is becoming exclusive and that the privileged are the only ones that can afford to live close the beach front, consequently in close proximity to coastal hazards. This raises important questions about the role of private property rights when it comes to providing coastal protection.

2.3.3 Contextual Paradigm Essential Attributes

The contextual approach, as stated before, combines the advantages of the past dominant paradigms and fills in the gaps in an attempt to produce an improved policy and adjustment development model. The paradigm contends that a number of contexts influence policy and adjustment development and adjustments to natural hazards. The early writings of Petak and Atkisson (1982), identify many attributes influencing and constraining public hazard management policy making. In the practice situation, strategies for managing risks associated with hazards may be constrained by legal, socio-political, administrative, economic, and other factors, including the normative

commitments of its citizens and political influences (Petak and Atkisson, 1982). Legal constraints include legislative and regulatory powers, constitutional validity, consultation, and constitutional vulnerability. Socio-political constraints include the willingness of decision makers to adopt certain polices and adjustments, values, perceptions, motivations and public opinion. Administrative constraints include funding capacity and the internal quality of the coastal management agency. Other constraints include value constraints such as ethics and norms of society.

This idea is furthered by Ives and Furuseth (1988), in their article relating specifically to coastal erosion. Here, they restate Petak and Atkissons (1982) policy attributes. Along with Petak and Atkisson, they do not define the contexts which they identify as being present in natural hazard policy and adjustment development. In addition to Petak and Atkissons conclusions, they indicate that the most important factor affecting the range of management options is the nature of the physical process itself (Ives and Furuseth, 1988). They believe that because coastal erosion (as a physical process) is highly variable with a differing character in each location, there will be no standardised solution to the problem. Each physical situation will require a different strategy to cope with the problem and this will be accentuated by the attributes of other contexts. For example, in the socio-economic context, human interaction in the coastal environment is a determinant in natural hazard occurrence.

Mitchell, Devine and Jagger (1989) in their contextual model of a natural hazard identify many contexts that affect hazard management. They indicate that spatial, temporal, organisational, environmental, socio-cultural, economic and political contexts which constitute hazard management and planning, are independent of the actual physical hazard. As with much of the early contextual work, the contexts are not defined, but attributes of them are given. These contexts are also affected by many exogenous factors such as megascale changes in global systems, human population changes and the development of adjustments to the hazard (Mitchell, Devine and Jagger, 1989).

Godschalk *et al.* (1989) in their research of coastal storms, identified three factors that affected the development, priority, adoption and effectiveness of coastal hazard planing policies and adjustments. These being:

1. environmental factors
2. significant policy catalyst factors
3. political conversion factors

They identified three main areas of environmental factors. Firstly, the political and cultural environment, which is affected by the disaster culture of the community and the prevalence of the private property ethos in the community. Secondly, the economic and demographic environment, which is affected by population size, median home value and tourism economic base. Finally, the physical environment, which is affected by the natural processes, the availability of non hazardous sites and present development in the area. They identified that significant policy catalyst factors include recent hazard history and hazard probability for the area. The last factor, that being political conversion, is dependent upon the characteristics of the local political system, and the support of the programme by the community.

In response to the threat of the greenhouse effect and sea level rise, Titus (1990) develops strategies to cope. He proposes that policy makers have to consider a variety of criteria when evaluating potential responses to global warming. The criteria cover all the contexts considered appropriate in this thesis and are given in Table 2.1. He presents many important evaluation criteria and many of the criteria are currently being considered by planners and policy makers. But given the nature of the problems associated with global warming, the role of the criteria within the policy and adjustment evaluation process may have to be altered. Subsequently, some of the criteria assume more importance the ever. For example, the urgency criteria is going to be important in assessing policy and adjustments developed for the effects of global warming. This is because the problem may appear to be imminent and therefore urgent, but given the uncertain nature of global warming effects, these policies and adjustments may not be effective (Titus, 1990).

The National Research Council (1990) identifies four main influences in the formulation of policy on coastal erosion hazards. Firstly, diversity in the physical environment, in settlement morphology and in political systems. Secondly, the values and perceptions of the public and private participants in the coastal environment. In coastal planning and management, there needs to be recognition of the variation in interests and the varied roles of relevant parties (National Research Council, 1990). Thirdly, there is a multitude of

methods available of hazard reduction within the concerned area. And lastly, the institutional variation of federal approaches to coastal management.

Platt *et al.* (1992) indicates that there is three systems that interact when formulating an institutional response to the problem of coastal erosion. These systems being the physical environment, the human or built environment and the political/legal context of resource management decision makers (Platt *et al*, 1992). They define these contexts which are given in Table 2.1. They go on to highlight the attributes of these contexts relevant to policy and adjustment development. Their model has already been described in section 2.1. In addition to their societal response model, Platt *et al.* (1992) also provide ten factors which impair policy making for coastal hazards, particularly coastal hazards. These are also illustrated in Table 2.1.

The contextual paradigm provides a considerable amount of substance to the policy and adjustment development model explored in this thesis. In addition to the useful concepts provided by the behavioural and structural paradigms, the contextual approach considers a wider range of attributes. The main attributes carried forward contribute to all the contexts described throughout this thesis. Many of the attributes are those that have been outlined in the behavioural and structural paradigms regarding the socio-economic and institutional contexts, therefore are not repeated here. The physical context is given more attention and the relevance of the context in policy and adjustment development is highlighted.

In the contextual approach the physical context and its processes and elements present are regarded as having intrinsic worth, as well as utilitarian worth, and are therefore deserving of further protection. The concept of intrinsic value of worth of natural features is explored by Nordstrom (1990). Recent environmental debate has centred around the concept of rights of sentient non-human beings. The holistic view of the interconnectedness of non-living and living things or the argument that rights should be extended to non-living natural features provides a more fruitful way of conserving natural features and ecosystems in developed and undeveloped areas of coastal environment. (Nordstrom, 1990). The idea has continued into the Draft International Covenant on Environment and Development (IUCN Commission on Environment Law and International Council of Environmental Law, 1995). Incorporation of this notion is in Article 2 - respect for all life forms. It states

that nature as a whole warrants respect; every life form is unique and should be safeguarded independent of its value to humanity. This discussion then develops the argument for the consideration of the physical context and its elements as equal with the anthropocentric based contexts.

2.4 Natural Hazard Policy and Adjustment in a Sustainability Regime

The sustainability or sustainable development debate of the last two decades has contributed greatly to resource management and planning practice. A plethora of definitions of sustainability have been generated and debated, which expose a wide range of differing points of world view (Turner, 1993). The most common and popularised definition is the one given in *Our Common Future,* the influential 1987 report produced by the United Nations World Commission on Environment and Development (WCED). WCED define sustainable development as

> *...development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*
> (WCED, 1987, 43)

They go on to further say that

> *In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance current and future potential to meet human needs and aspirations*
> (WCED, 1987, 46)

From this definition three principle attributes can be extracted that contribute to resource management policy and decision-making. These three attributes being: development, needs and future generations. *Development* is a qualitative concept which incorporates notions of improvement and progress, and including cultural and social, as well as economic dimensions (Blowers, 1993). Within this concept of development there needs to be entrenchment of the environmental considerations in economic policy making. The question of human *needs* raises issues of distribution of resources or intra-generational equity. The definition requires a commitment to equity and fair distribution in

terms of local and global space. Consideration of *future generations* incorporates the issue of inter-generational equity, where there is a moral imperative in the idea of stewardship to protect future generations. The duty does not imply the continuation of the status quo situation, it is the incumbent duty of the present generation to hand on a better environment in those areas where it is heavily degraded or socially deprived (Blowers, 1993). The overall idea is that proponents of the concept of sustainable development are asking for a radical re-think about western ideology concerning resource ownership, and a philosophical change is required in peoples' attitudes towards the environment and the role that people and communities play in the dynamics of environmental change (WECD, 1987).

Even though three important attributes can be extracted from the sustainable development definition, the tendency has been to use the definition as a device for mobilising opinion about environmental problems rather than as an analytical concept for developing specific environmental polices (Blowers, 1993). Designed as a solution to the world's environmental problems, the definition has been rarely accompanied by an explanation on how it is to be accomplished through policy and planning - until now that is. Therivel *et al.* (1992); Blowers (1993); Gwilliam (1993); Hall *et al.* (1993); Sadler (1993): Sitarz (1994); Dovers (1995) and Johnson (1995) all outline sustainable development principles and techniques that will aid in sustainable policy making. Incorporating these principles and techniques into natural hazard management policy making will ensure that environmental results will be sustainable while sufficiently addressing problems associated with the natural hazards.

2.4.1 Sustainability in the Institutional Context

The principles underpinning the concept of sustainable development affect the way in which the institutional context operates. Blowers (1993) envisages a new type of institutional context in which 'environmental planning' is a comprehensive approach with three basic features:

1. It takes account of future uncertainty by using a precautionary approach.
2. It reflects the integrated nature of environmental processes and policies.
3. It takes a strategic view of decision-making.

(Blowers, 1993, 14)

Taking account of future uncertainty by using a precautionary approach
Uncertainty pervades the sustainability debate, in relation to the causes, nature and seriousness of the impacts of environmental degradation (Dovers, 1995). To overcome this uncertainty, institutional structures and policy processes should admit this uncertainty and handle it more efficiently. It is in these instances that the precautionary approach can be adopted. The precautionary approach urges that action should be taken where there are good grounds for judging either that action should be taken promptly at comparatively low cost, which could avoid costly damage later, or that irreversible effects may follow if action is delayed (Blowers, 1993). Dovers (1995) goes on to say that scientific uncertainty should not be an excuse to postpone environmental protection measures, and therefore should adopt the precautionary approach when evaluating the possible impacts of development.

Uncertainty in the institutional context can be alleviated by the collection of better information. Dovers (1995) is concerned with this part of the sustainability problem. He believes that policies and decisions need to be built upon a firm foundation of information. This point is reiterated by Gwilliam (1993), who states that the present knowledge base is stereotyped and inadequate to answer and assess new questions in environmental management. Within the institutional context, more information needs to be acquired and the linkages between the information need to be assessed. Present day technology can be used to introduce more rigour and perspective into the work undertaken on this information. Johnson (1995) also makes this point very clear. An adequate information system is the most important tool when dealing with the complexity of environmental issues and planning.

It reflects the integrated nature of environmental processes and policies.
The complexity of environmental issues and planning requires a multi-disciplinary approach so effective resource management may be undertaken. A multi-disciplinary approach, as given by Johnson (1995) includes the social sciences, management concepts, ethical considerations and the natural sciences. In adopting a multi-disciplinary approach there needs to be the recognition of the integrated nature of environmental processes and policies. The effectiveness of policies in achieving environmental objectives needs to be determined and this can be done if the interconnections between both is recognised. Blowers (1993) gives three kinds of approaches to integration that need to be considered. Trans-media integration is considered where all

processes occurring within an area are interdependent. Trans-sectoral integration is where integration should cross policy boundaries. Therefore, a combination of the two results in horizontal integration within a planning and management agency. The last integration that needs to be considered is trans-boundary integration where all levels of governance are integrated, consequently resulting in vertical integration when achieving environmental objectives.

Taking a strategic view of decision-making.

A strategic approach should be adopted when developing polices to achieve sustainability. To achieve this strategic approach, all levels of government need to be introducing policies in the short term that will ensure the long term sustainability of the earth's resources. Blowers (1993) proposes a system of institutions or levels of government, with each level having sufficient authority to introduce these strategic polices.

When undertaking a strategic approach to policy making, the evaluation of the polices should also be of a strategic nature. Strategic Environmental Assessment (SEA) provides such an evaluation. SEA extends the traditional project-based assessment of environmental impacts to cover the impacts of policy decisions (Therivel, 1992 and Sadler, 1993). The principles of SEA are summarised below:

a. Full consideration of alternative policy options including the 'do nothing' option.
b. Consistency across different policy sectors.
c. Cumulative, indirect or secondary impacts should be considered.
d. Adverse effects are anticipated.
e. All impacts are assessed regardless of magnitude and scale.
f. Publicly available and accountable decision-making framework.
g. Integration of sustainability and the precautionary principle.
h. Proper place for environmental consideration in decision-making.

The impact of such an approach is to now consider the policy making process as an integral part of achieving sustainable development objectives and that in

developing polices and methods to achieve these objectives, the environmental impact of such are considered.

2.4.2 Sustainability in the Physical Context

Sustainability in the physical context requires that there be an increased understanding of the processes that occur within. By increasing the understanding of these processes, the degree of uncertainty that exists will be lessened. Sustainability in the physical context also requires that the context be seen as a whole with interacting components. No longer should the management of such a context be restricted to one component, as this could adversely effect another (Blowers, 1993). Therivel *et al* (1992) points out the need for the adoption of SEA in coastal environment management. Given the unique nature of the coastal environment it is important that the management is linked to ensure that consistency is achieved and conflict is minimised. Therivel believes that this will be achieved by having local, regional and national policy frameworks as the vehicle to deal with all sustainability issues within the coastal environment.

2.4.3 Sustainability in the Socio-Economic Context

Sustainability in the socio-economic context requires that people radically re-think their role in environmental management. Resource use and environmental deterioration are major environmental issues that face the socio-economic context. The value systems of this context determine the way in which the environment is viewed. Personal attitudes and practices need to be changed to live in a sustainable world (IUCN, UNEP and WWF, 1991). Education programmes are required to inform people of ways to change lifestyles, and techniques to deal with conflicts that will arise between present values and attitudes and the changes that are required. Education will build an understanding of the human relations in the natural world. Within the coastal environment it is important to implement such education programmes as it will raise people's awareness of the consequences of their actions in relation to preventing and mitigating natural hazards.

2.4.4 Sustainability in the Cultural Context

The cultural context has gained more recognition from the sustainability debate. There is growing recognition of the sustainable land practices and knowledge of the indigenous peoples of the world. The main mechanism proposed to include this cultural context is through the concept of primary

environmental care (Pye-Smith *et al.*, 1994). Within this concept, communities are seen as agents of local development and environmental care, who understand the peculiar problems and opportunities offered by the natural resource concerned. In terms of natural hazards policy and adjustment development this concept has a potentially viable role, as the local indigenous communities, through their traditional associations and customs, can provide essential resource management guidance. By allowing communities to be involved in environmental management their access to resources and their traditional associations and customs are maintained.

2.5 Sustainable Policy and Adjustment Development Model

From this discussion of the natural hazard and sustainability literature and Table 2.1, it has been possible to amend the model of decision-making given to provide a sustainable policy and adjustment development model. This global theoretical model is given in Figure 2.4. The model is based around the four contexts within this thesis: institutional, physical, socio-economic and cultural. Within each context, the attributes that are given should be considered when developing policy. Within the model, it has been recognised that any policy that is developed will be influenced by the past. Consequently, it was appropriate to superimpose the past on top of the model. Processes have been identified that occur between the contexts. These are important in the consideration and development of policy. They are also relevant in the adoption and effectiveness of the policy developed. The processes identified are:

A. Institutional Influence
B. Physical Processes
C. Human Interaction, Activities and Effects
D. Public Political Influence and Rights

This model is supplemented with a checklist of policy attributes which is given in Table 2.2. The purpose of the checklist is to bring together the attributes identified in the literature review that are relevant to policy and adjustment development in a sustainable development regime.

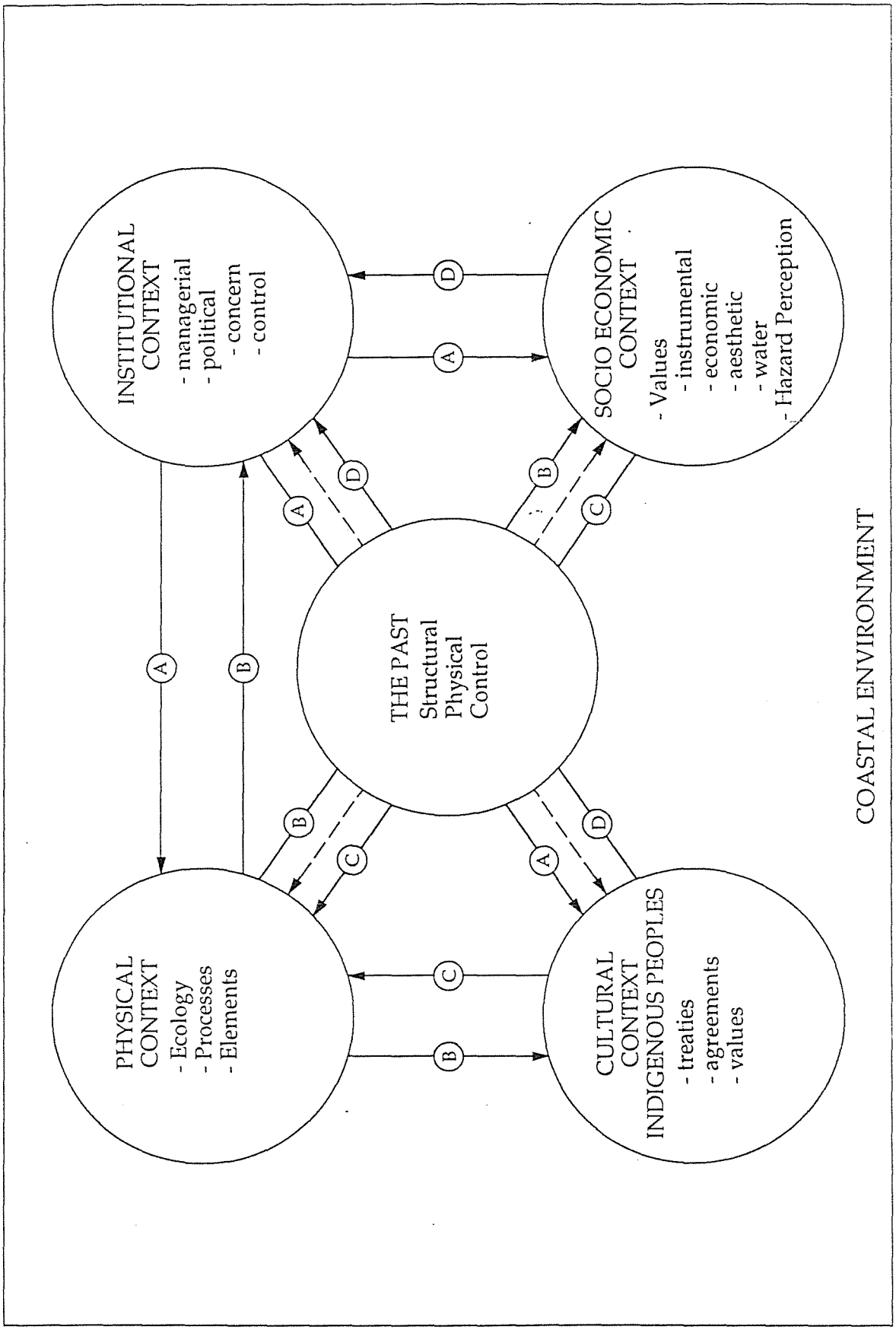


Figure 2.4: Theoretical Policy and Adjustment Development Model

Table 2.2 Policy and Adjustment Development Checklist

Institutional Context	*Physical Context*
Federal constraints Administrative constraints Legal constraints Political constraints Monitoring requirements Benefits and costs Institutional uncertainty Institutional vulnerability Institutional efficiency Technical capacity Other policy or adjustment options Public participation in coastal management Equity Sustainable development Ethical responsibilities Integrated and holistic approach Precautionary principle	Degree of hazard Physical uncertainty Shoreline diversity Coastal Processes diversity Unique or critical resources protection Occurrence of hazard Interactions of hazards Variations in climate and vegetation
Socio-Economic Context	*Cultural Context*
Hazard perception of community and individuals Private property ethos Society norms Health and safety Coastal activities Compensation rights Hazard experiences Development implications Settlement diversity	Unique resources protection Use of indigenous knowledge and practices Access to resources Traditional associations and customs maintained

CHAPTER THREE

THE NEW ZEALAND CONTEXT

The existing New Zealand coastal hazard planning regime is outlined in this chapter. The presentation of the planning regime informs the debate about the actions that planning authorities, at all levels of government, undertake to avoid, remedy or mitigate coastal hazards. The chapter begins with a brief outline of the planning regime that existed before the Resource Management Act (the Act). The chapter then provides a detailed description of the four planning contexts: institutional, physical, socio-economic and cultural in New Zealand. The purpose of this chapter is to highlight the important attributes that need to be addressed within each context when developing natural hazard policy and adjustments, and to incorporate them into the amended policy and adjustment development model from chapter two. A sustainable policy and adjustment development model specific to New Zealand should reflect the main theoretical and practical considerations for management and adjustment to coastal hazards.

3.1 Pre-Resource Management Act 1991 Coastal Hazard Planning

The legacies of past coastal hazard planning play an important role in what options are best suited for future coastal hazard planning. In the past, New Zealand's regime for coastal hazard planning has been characterised by numerous acts that have had jurisdiction over the coastal environment. The major agencies involved were: the Department of Conservation, the Ministry of Transport, the Ministry of Agriculture and Fisheries, the Ministry of Energy, the Ministry of Foreign Affairs, Land Planning Authorities (territorial authorities, including catchment boards), Maritime Planning Authorities and Pollution Control Authorities. The areas of jurisdiction and administrating agency are shown in Figure 3.1. For a detailed description of the various acts of Parliament that applied in the coastal environment, see Ministry for the Environment (1988c), Appendix 1. At best, fragmentation resulted in inefficiencies and confusion over jurisdiction. At worst, effective management was threatened by inter and intra-authority competition (Hansom and Kirk, 1991). This plethora of legislation was inherited not only from 'ad-hoc-ism' but also from a preference for regulating activities rather than the effects

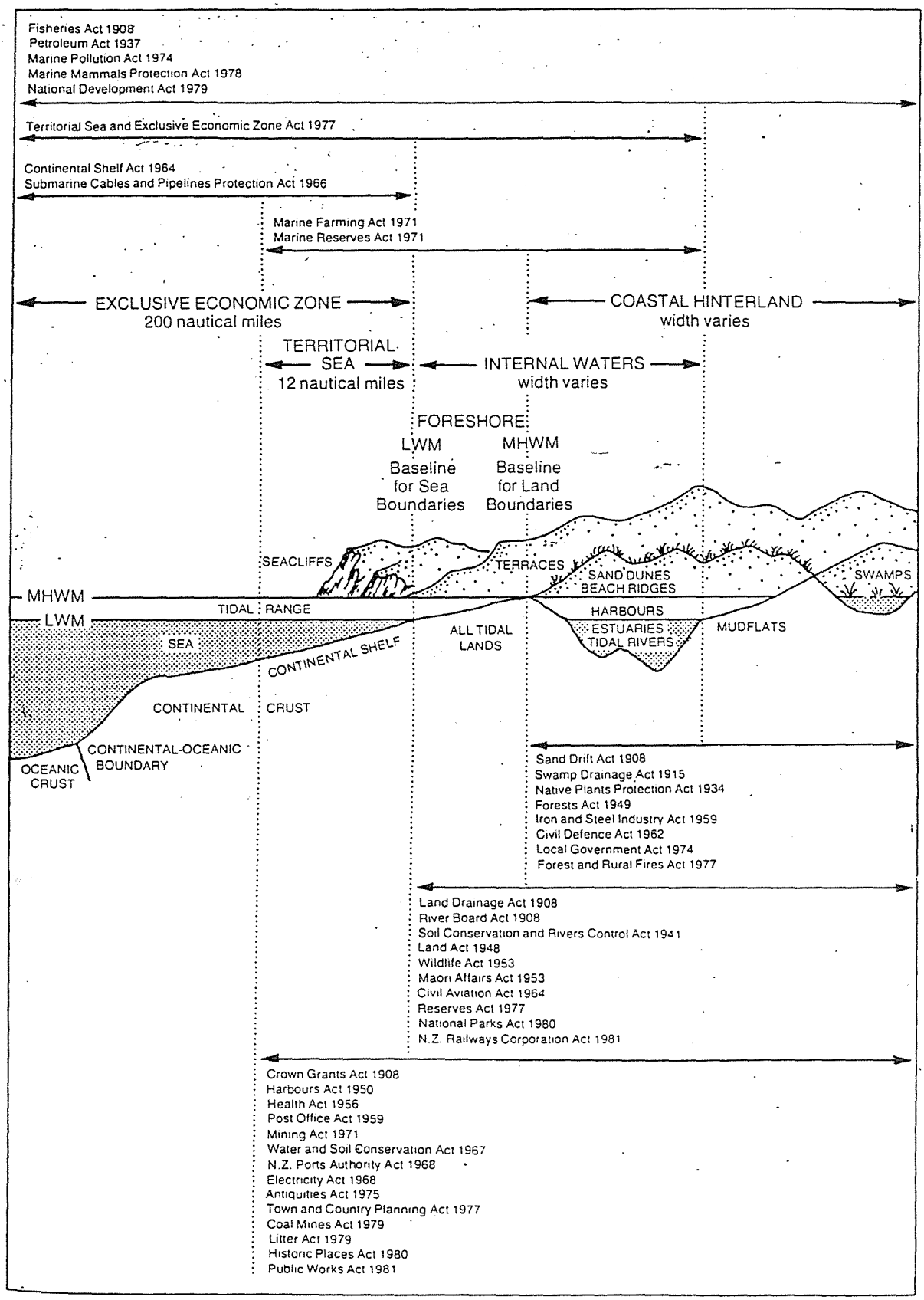


Figure 3.1: The Jurisdiction of Acts of Parliament over Land and Sea Boundaries, Territories and Zones Around the Coastline of New Zealand.
Source: Ministry for the Environment (1998c)

the activities had on the environment (Hansom and Kirk, 1991). Kirk (1987) gives a more detailed description of past coastal management in New Zealand.

A range of provisions for the control of coastal hazards were available, particularly the control of erosion and sedimentation. Catchment boards, under the Water and Soil Conservation Act 1967 and the Soil Conservation and Rivers Control Act 1941, had provisions for the prevention of coastal erosion. Grants and loans were available under Section 30 of the Soil Conservation and Rivers Control Act, for assistance in repairing damage caused by coastal erosion.

The Town and Country Planning Act 1977 provided the main arena for planning for natural hazards in the coastal environment. The Second Schedule stated that the avoidance or reduction of danger, damage or nuisance caused by [natural hazards] was to be dealt with in District Schemes. This reference to natural hazards is furthered in the First Schedule, which requires regional schemes to identify land subject to hazards such as flooding and earth movement, which should be excluded from future urban development. Once the territorial authority had knowledge of such hazards, Section 274 of the Local Government Act 1974 allowed authorities to refuse approval for any plan to subdivide and develop land they felt was unsuitable due to the presence of natural hazards. An associated mitigation provision was given for land already developed that was subject to natural hazards. Territorial authorities had discretionary power, (under the Local Government Act 1974) to issue building permits for the erection of relocatable buildings, the erection of other buildings and the alteration, restoration or re-siting of an existing building (Ministry for the Environment, 1988c). These provisions for building permits did not restrict development in hazardous areas due to the ability to allow relocatable buildings. For the territorial authorities to truly enforce avoidance of development in hazardous areas, the control should be exercised at the subdivision stage where it can be more restrictive.

Coastal hazard adjustment in New Zealand mimics much of what has happened globally in terms of hazard management. Hazard adjustment has usually consisted of measures to protect private property at the beach front, not the actual beach element. Gibb (1981) points out the similarity between this approach and what has happened in Australia:

> *In New Zealand, like in Australia, it has been the common practice to direct expenditure toward works which will only provide protection to residential development rather than contributing toward beach restoration measures.*
> (Gibb, 1981, 47)

Evidence of this approach can be witnessed in many coastal areas throughout New Zealand due to the common presence of coastal protection structures and other engineering works (Kirk, 1987). A present day example of the resulting problems may be seen at Raumati Beach, where the seawall is a continuation of many years of coastal protection works along this stretch of the coastline. Photograph 2 in Appendix One illustrates the continuing series of structural protection at this beach and the visible effects of these protective works on the beach element and adjoining private property. These protection works commenced in the 1950s under the supervision of the then Hutt County Council (Gibb, 1978).

The Ministry for the Environment task force on natural hazards management in the resource management law reform, concluded that the governments intervention, by way of subsidising protective works and providing relief after individual hazard events, has been inefficient and has encouraged development in hazardous areas. It recommended the adoption of a unified or integrated national policy for hazard reduction with provisions at community level, as well as associated alteration of incentives and constraints (Ministry for the Environment, 1988c).

3.2 The Contexts of New Zealand Coastal Hazard Planning

The current New Zealand coastal planning regime reflects considerations in each of the four planning contexts. Attributes from each of these theoretical contexts influences the development of polices and adjustments to natural hazards. The policy development and adjustment model, presented in chapter two, is theoretical in nature. Therefore, it needs to be augmented by the addition of New Zealand specific attributes. The following discussion forms the basis for developing policy and adjustments to natural hazards in New Zealand's coastal environment.

3.2.1 The Institutional Context

The institutional context provides the framework for local government operation and the framework for natural hazard planning and management in New Zealand. Local government operations are principally determined by the Local Government Act (LGA) 1974, including all its amendments, with functions and responsibilities determined in other government legislation. Natural hazard planning and management are dealt with under two acts of parliament: the Resource Management Act 1991 and the Building Act 1991. A brief overview of the LGA sets the local government scene.

3.2.1.1 Local Government Act 1974 and amendments

The LGA establishes, and sets out the operating framework, for local government in New Zealand. Because they are created in statue, the form and functions of local government can, at times, be changed by central government. The purpose and structure of local government is set out in Part IA of the LGA. Local government is separated into regional councils and territorial authorities (district and city councils) and boundaries are set by Sections 37O and 37P. Sections 37S and 37T empower regional councils and territorial authorities to undertake functions, duties and powers conferred to them by the LGA, any other public acts and any local acts that apply to local authorities.

The LGA sets out the accountability provisions for local government operations. These provisions establish the constitutional, structural, electoral and accountability framework that applies to all local authorities. These provisions aim to make local authorities more relevant to the needs of the community, more accountable to citizens and more capable of vigorously and effectively dealing with the issues of the future. Three spheres of accountability are envisaged. Pro-active control through the annual planning process, monitoring of local government by other organisations (Local Government Commission) and reactive action by organisations (Office of the Ombudsman). The annual planning process aims to provide evidence of open and transparent management of the local authority and is a mechanism by which council can prioritise its activities. The annual plan also outlines the financial strategy for the region, city or district. Any activities or structures proposed by a local authority in the coastal environment would need to be costed and prioritised in the annual planning process.

Under the LGA, local authorities are able to make bylaws to achieve their functions and they are guided by the Bylaws Act 1910. Bylaws can be made to assist them in the constitutional management of regional and district regulation and control. In the coastal environment, bylaws may be implemented by local authorities on issues that are not subject to the provisions of the Resource Management Act. For example, controlling vehicles on the beach and the lighting of fires in the coastal environment may be controlled by bylaws in accordance with the provisions of the LGA and associated Acts.

3.2.1.2 Resource Management Act 1991 and amendments

In responding to the global sustainability debate, New Zealand has adopted a new resource management regime to manage New Zealand's natural and physical resources, while achieving integration with economic and social considerations. Principally, the Act is the main mechanism to achieve sustainability and it has an over-riding purpose of sustainable management of natural and physical resources. The other mechanisms aimed at implementing the concept of sustainability, include the Ozone Protection Act 1990, reducing CO_2 emissions by 20 percent of 1990 levels by the year 2000 (New Zealand Government, 1991) and development the Environment 2010 Strategy (New Zealand Government, 1995). Given the functions of local authorities in Sections 30 and 31 of the Act, natural hazards management in the coastal environment is part of this sustainable management regime as outlined within the Act.

Key Principles and Provisions of the Resource Management Act 1991

The purpose and principles influencing natural hazard policy and planning framework are sustainable management, a broad definition of natural hazards as given in Section 2, joint responsibilities between regional councils and territorial authorities, information requirements given in Section 35, the environmental impact assessments required when proposing developments and applying for resource consents and Section 32 evaluations.

Sustainable management provides the purpose for the Act and is defined in Section 5(2):

> *In this Act, "sustainable management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their*

social, economic and cultural well being and for their health and safety while -

(a) Sustaining the potential or natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) Avoiding, remedying and mitigating any adverse effects of activities on the environment.

(Resource Management Act, 1991)

This definition is reinforced by Section 17 of the Act. For example S17(1) states:

Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by or on behalf of that person, whether or not the activity is in accordance with a rule in a plan, a resource consent, [section 10, section 10A, or section 20].

(Resource Management Act, 1991)

It could be argued that adopting such an approach will ensure the effective implementation of the WCED objectives presented in chapter two. Johnson (1995) summarises the philosophical basis behind the adoption of sustainable management as opposed to sustainable development.

New Zealand's ultimate goal is sustainable development, but the RMA [the Act] by itself does not attempt to provide that. Sustainable development, as the government's review group concluded, embraces a very wide range of issues, including social inequities, global redistribution of wealth, and population density problems. The group found this range too complex for a law designed to manage natural resources for a single nation. Consequently, its definition of sustainable management does not address the question of development; it is neither anti- or pro-development. In promoting sustainable management, the government is not as concerned with how the land is used as it is with how various land uses affect the environment and other people. They have shifted from planning for activities to regulating the effects of activities.

(Johnson, 1995, 78)

Therefore, the sustainable management mechanism adopted by the New Zealand government has a more limited focus than the definition of sustainable development in the Brundtland report. The New Zealand definition of sustainable management contains a number of complex elements and the relationships are not evident. The definition continues to be clarified through the Planning Tribunal appeal process and resulting decisions. A number of decisions suggest that Section 5 of the Act is not about achieving a balance between benefits occurring from an activity and its adverse effects. Adverse effects are required to be avoided, remedied or mitigated irrespective of the benefits that may occur (Campbell v Southland D.C W114\94 4NZPTD6). The Planning Tribunal has also concluded that the definition should be seen as a whole. The true interpretation of Section 5 does not allow for it to be separated into separate parts. Section 5 is given further meaning by Sections 6, 7 and 8. The wording of these sections lays down the relative weight of the sections (Proposed New Zealand Coastal Policy Statement Memorandum 3NZPTD109 (1993)). It can be argued that it is difficult to divorce social and economic considerations from physical environment considerations. The Planning Tribunal has provided some precedence for this by stating that while economic well-being is a factor of sustainable management and efficient use and development of natural resources, it is the broad aspects of economics, rather than the narrower consideration of financial viability, that are at issue (NZ Rail v Marlborough DC and Port Marlborough NZ Ltd (HC) 1&2 NZPTD 714, [1994] NZRMA 70).

The natural hazard definition given in Section 2 of the Act is broad and encompassing of any form of natural hazard in any type of environment, including the coastal environment. Not only does the definition take into account the physical phenomena causing the natural hazard, it also considers the human dimension of the hazard. This results from an acknowledgment of the interaction between people and natural events which subsequently results in natural hazards in the resource management law reform process. This definition follows the behavioural or human ecological paradigm of natural hazards. The attention for planners now is to keep people away from hazards as well as keeping hazard events away from people (Bewick, 1990).

The Act now defines the roles and responsibilities for natural hazard management and planning. Hazard mitigation and planning is the responsibility of local authorities, with regional councils having the major

responsibility for natural hazards planning and management. Figure 3.2 outlines the relationships between local authorities and their planning documents as given in the Act. This figure is compiled from the interpretation of the relationships determined in the plan preparation process by various local authorities. The nature of the relationships between the documents varies and this variation is noted in the Figure 3.2. Some of the relationships are strictly policy guidance orientated while some directly feed into the rule making capacity of the local authority. The regional policy statement outlines the overall policy framework and direction for natural hazard planning in the region. The regional coastal plan is a mandatory document, outlining the integrated management of the coastal marine area. This plan has the ability to make rules, which prohibit, regulate or allow activities in the coastal marine area. This rule-making ability is restricted to regional councils. The regional plans that are developed, provide for more detailed guidance and rules. These rules that are developed at the regional level are to be annexed by local authorities and annotations made in the affected local authorities district plan. These planning mechanisms allow a regional council to fulfil its functions and provide avenues for innovative policy and methods for natural hazards to be developed in addition to rules restricting peoples activities. The territorial authorities, through their district plans, implement the natural hazard policy objectives at the local level.

In the four regions chosen in this thesis, a number of methods and approaches are chosen. Some are alternatives to rules whilst others are not. Educational strategies are being developed by the Auckland Regional Council to provide the general public with a greater understanding of risks associated with natural coastal hazards (Auckland Regional Council, 1995). Environment Waikato have opted to avoid the hazard by adopting zoning controls and other non structural measures (Environment Waikato, 1994). For Taranaki, the Regional Council has chosen a more pragmatic approach by stating that coastal protection works are allowed if the positive effects far out weigh the negative effects, thus making the construction of coastal protection a discretionary activity (Taranaki Regional Council, 1995). Wellington Regional Council has also chosen to implement a non-structural approach (Wellington Regional Council, 1994). It is presently supporting the use of a coastal hazard zone on the Wairarapa coast subject to appeal to the Planning Tribunal. The roles and responsibilities of the local authorities in relation to natural hazards is given in Sections 30 and 31 of the Act. Primarily regional councils are responsible for:

Figure 3.2: Relationship between policy statements and plans produced under the Act

> *the **control of the use of land** for the purpose of- ... the avoidance and mitigation of natural hazards. In respect of any **coastal marine area** in the region, the control (in conjunction with the minister of Conservation) of- ... any **actual or potential effects** of the use, development, or protection of land, including the avoidance or mitigation of natural hazards ....*
> (Resource Management Act, 1991, Section 30)

Meanwhile, territorial authorities are concerned with the:

> *the control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the avoidance or mitigation of natural hazards ...*
> (The Resource Management Act, 1991, Section 31)

Section 62(ha) of the Act states that the regional policy statement shall outline who is responsible for natural hazards in that particular region. If these are not identified in the regional policy statement, the regional council will assume primary responsibility of natural hazard management.

These roles have been further clarified by the Court of Appeal decision in the Canterbury Regional Council v Christchurch City Council case (CA99\95, (1995) NZRMA 452). A hierarchy of instruments is provided for in the Act, and there are provisions for overlap of functions between regional councils and territorial authorities. For example, natural hazards and hazardous substances management is covered by both regional councils and territorial authorities. The Court of Appeal clarified that rule making powers of local authorities are restricted to the functions given in Section 30 and 31 of the Act. In relation to rule-making for the avoidance or mitigation of natural hazards, the they went on to say that:

> *It follows that the control of the use of land for the avoidance or mitigation of natural hazards is within the powers of both regional councils and territorial authorities. There will no doubt be occasions where such matters need to be dealt with on a regional basis, and occasions when this is not necessary, or where interim or additional steps need to be taken by the territorial authority. Any controls imposed*

can be tested by appeal to the Planning Tribunal, and inconsistencies are precluded by Section 75 (2).
Canterbury Regional Council v Christchurch City Council CA99\95, (1995) NZRMA 452 p 12

The Auckland Regional Council has adopted an information-provider role in natural hazards planning and management. It sees its role as being a co-ordinator of the management of natural hazards and advocator of methods to the territorial authorities (Auckland Regional Council, 1994). Territorial authorities have the responsibility of enforcing provisions of the regional policy statements and regional plans in their district plans. Environment Waikato have chosen a joint planning approach with territorial authorities, allowing the regional council to establish a consistent and comprehensive natural hazards policy, implemented primarily through rules within the district plans (Environment Waikato, 1994). The roles and responsibilities of both levels of local authorities have been clearly defined in the Taranaki Regional Policy Statement (Taranaki Regional Council, 1994). The Wellington Regional Council has taken primary responsibility for the development of natural hazards policy in the Wellington region, with the consent of the territorial authorities. However, primary responsibility for writing rules to control the use of land in relation to natural hazards (other than in the coastal marine area and on the beds of lakes and rivers) goes to territorial authorities.

Obtaining good information about the physical environment is now a vital part of achieving the purpose of the Act. Section 35 states that every local authority has a duty to gather information, monitor and keep records (see Appendix Four for a copy of this section). To effectively fulfil their functions provided in the Act, local authorities need adequate information to make decisions and these decisions must be monitored to determine their ability to achieve the purpose of the Act. Monitoring will provide a national picture of the environment and it also will provide the essential feedback loop between resource management issues, policies, methods and environmental outcomes at all levels of planning (Ward, 1994 and Hutchings, 1995).

Every local authority is required to record natural hazards to the extent that it is considered appropriate for the effective discharge of its functions (S35(4)(i)). Given the uncertain nature of physical processes in the coastal environment, monitoring and research will prove to be very useful in developing policy for

the coastal environment, especially in terms of natural hazards. New knowledge will lead to a better understanding of what is occurring within the coastal environment, consequently providing some degree of certainty about the decisions made.

Many local authorities are finding that their existing monitoring activities do not provide them with the information they need to monitor the relationship between their policies and activities and the state of the environment (Ward, 1994). This state of the environment monitoring is important in making a judgement about the suitability and effectiveness of policy statements and plans in achieving expected environmental outcomes. In relation to natural hazards, state of the environment monitoring will broaden the understanding of the degree of hazard in the region, as well as determining whether present natural hazard objectives are being met. Some of the local authorities are reviewing their monitoring programmes and developing comprehensive regional monitoring strategies to overcome the shortfalls of their present monitoring systems. Coastal monitoring has been identified as an area in which a better monitoring network will be established. For example, Taranaki Regional Council and Wellington Regional Council are presently developing regional monitoring strategies, which aim toward the collection of better and relevant data useful for policy development and evaluation.

Provisions for Environmental Impact Assessment (EIA) are an integrated feature of the sustainable management regime given in the Act. EIA or Assessment of Environmental Effects (AEE) is now incorporated into the statutory planning process through Section 88 and the Fourth Schedule (presented in Appendix Five). This mandatory assessment of environmental effects signals three major shifts in traditional planning practice (Montz and Dixon, 1993). The emphasis is now on the evaluation of environmental effects rather than activities. Planning is focussed on being a means of achieving outcomes, rather than just a process. The shift in planning is towards more integrated and less discipline specific planning practice. The AEE prescribed in the Act is aimed at both policy development and consent application. The implications of AEE at the policy development level are such that the local authority must consider the anticipated environmental effects of that policy. Consequently, in the case of natural hazard policy and adjustment development, this indicates that there needs to be a shift away from the structural methods of avoidance, remedy or mitigation, to non structural

methods. The effects of previous structural protection on beach width has been noted by Wright and Pilkey (1989) and evidence of end-wall effects at Raumati Beach can be seen in photograph 1 in Appendix One.

A duty to consider alternatives, assess benefits and costs and any other form of evaluation tool is provided for in Section 32 of the Act (presented in Appendix Six). The purpose of this section to provide a more rigorous approach to policy analysis and plan preparation (Dixon and Fookes, 1995). Environmental effects of objectives, policies and rules and alternatives to these need to be considered in plan preparation. Evaluation is now an integral part of the sustainable management regime given the Act. Section 32 is being seen as a methodology which imposes an evaluation discipline for policy development (Fookes, 1992).

The New Zealand Coastal Policy Statement 1994

The New Zealand Coastal Policy Statement (NZCPS) is the only mandatory national policy statement. It includes policies to achieve the purpose of the Act in the coastal environment. Prepared by the Department of Conservation (1994a), it guides all policy making, in the coastal environment, at local authority level. Any issue, except those relating the fisheries, that is seen to be of national importance can be dealt with by the NZCPS (see S58 - Content of New Zealand Coastal Policy Statements). Natural hazards in the coastal environment are recognised as being an issue of national significance, and polices are given that will assist local government in the management of natural hazards. The Board of Inquiry report (Department of Conservation, 1994b) refined the section pertaining to natural hazards, resulting in a comprehensive set of national policies, providing guidance to the local authorities in dealing with natural coastal hazards.

Outcome 3.4 (Recognition of Natural Hazards and Provisions for Avoiding or Mitigating their Effects) outlines the national policy direction for managing natural coastal hazards (reproduced in Appendix Seven). The principles which underpin these policies guide the management of natural hazards are summarised below:

a. To exercise the functions given in Section 30 and 31 concerning natural hazards, there needs to be the identification of the hazards with the area of jurisdiction - see policy 3.4.1.

b. When dealing with the possibility of sea level rise, there needs to be the recognition that it is a direct threat to the coastline, and where it may accelerate natural hazards, these areas need to be identified - see policy 3.4.2.
c. Natural protection against natural hazard exists in the coastal environment, for example beaches, sand dunes and wetlands. These protection features need to be recognised and maintained to assist in natural hazard planning. In cases where it is appropriate, the features should enhanced to offer more protection - see policy 3.4.3.
d. The intrinsic nature of natural coastal features and dynamic coastal processes should be recognised. As well as intrinsic values, utilitarian values need to be recognised - see policies 3.4.3 and 3.4.4.
e. When considering adjustments to natural hazards in the coastal environment, best practicable option assessment needs to be undertaken. The idea is to move away from the automatic use of coastal protection works, and look to other forms of hazard adjustment. For example the abandonment or relocation of existing structures within the coastal zone - see policy 3.4.5 and 3.4.6.

3.2.1.3 Building Act 1991

The Building Act 1991 (BA) is the central focus of building control in New Zealand. Territorial authorities are the only building control authority within a district, and it is their role to administer the BA. The BA has three statutory purposes (Section 6(1)(a) and (b):

1. *To provide, together with the Building Code, necessary controls for building work and the use of buildings;*
2. *To ensure that buildings are safe and sanitary and have means of escape from fire; and*
3. *To co-ordinate building controls with other controls relating to building use and with the management of natural and physical resources.*

(Department of Internal Affairs, 1992, 9)

The BA influences natural hazards management through limitations and restrictions on buildings subject to erosion and other land instability. Under Section 36 of the BA, a local authority must refuse to grant a building consent involving construction or major alteration to a building if the land, on which the building work is to take place, is subject to instability or the work itself is likely to accelerate, worsen or result in the instability of that land or any other property (Department of Internal Affairs, 1992). A consent can be granted if the territorial authority is satisfied that adequate provision has been made or will be made to protect the land or work from instability.

The BA has provisions in relation to civil legal liability of the territorial authorities and building work. A 10 year limit is given on the determination of territorial authority liability. A territorial authority can not be held liable in damages for relying on the decisions of the Building Industry Authority or building certifiers (Department of Internal Affairs, 1992).

The BA is primarily concerned with the building process and the associated responsibilities. The BA recognises that building processes should not occur in a vacuum and that it is intricately linked with natural and physical resources management. There is a provision for Project Information Memorandums (PIMs) to be complied that state factors relating to the location of buildings and how the use of those buildings may affect services to them. Associated with this memorandum is Land Information Memorandums (LIMs), which are prepared under the Local Government Official Information and Meetings Act 1987. The purpose of these memoranda is to provide all of the information held by a territorial authority about a particular piece of land to prospective buyers. The effect of such memoranda is to enable those who deal in property and prospective buyers to make decisions on that property. These memorandum are also important in natural hazard planning as they may alert prospective buyers and developers to potential for natural hazards to affect land, structures and people's activities on that particular property.

3.2.2 The Physical Context

The physical context involves three main areas of discussion: the *ecology* of the environment, the *processes* that operate within the environment and the physical *elements* that exist within the environment. Ecology refers to the study of the relationships between living organisms, as well as their relationship with

the environment (Gilpin, 1976). Processes refers to natural operations or series of changes that occurs within the coastal environment (Sykes, 1982). Elements refers to any of the principal constituent parts of the environment including water, atmosphere, soil, vegetation, climate, sound, odour, aesthetics, fish and wildlife (Gilpin, 1976). Table 3.1 provides examples of the various coastline types that are present in New Zealand, and gives examples of the underlying geology, process and elements. The table also provides information about where various types of coastline may be observed. From the table it can be seen that the physical character of the New Zealand coastline is varied along its entire length.

The contemporary New Zealand coastline is very much a result of previous geologic processes. For a detailed explanation of the evolution of New Zealand's coastline, see Healy and Kirk (1992). The framework for New Zealand's coastline was established in the late Quaternary period (2 million years ago to present day), with the finer details occurring during the Holocene Epoch. The Quaternary period was characterised by climatically induced sea level lowering, periods of colder temperatures, increased windiness, frosts, precipitation and accelerated physical weathering and erosion. With these conditions predominating, there was increased sediment supply to the seashore via rivers. The rise in sea level that occurred after the last ice age resulted in valleys becoming infilled to become present day estuaries and harbours. This rise in sea level, which steadied approximately 7000 years before present, was followed by rapid coastal sedimentation. Evidence of this includes the extensive coastal plains formed in the Bay of Plenty, the Manawatu, Canterbury and Northland. The evidence presented indicates that the New Zealand coastline is geologically young (New Zealand Government, 1991) and that 'nothing is constant in this environment except for change' (Healy and Kirk, 1992, 161).

3.2.2.1 Ecology

New Zealand's coastal ecology is bequeathed with many different and unusual native species, both of flora and fauna, that are nationally and internationally significant. Some of the coastal resource inventories identify the particular species and the status of those species. Examples include: Dix, B *et al.* (1990), Fechney, L *et al.* (1990), Henriques, P.R *et al.* (1990) and Wellington Regional Council (1992) (relates only to the coastal marine area). The first three examples of inventories are part of a programme initiated by the Department of

Table 3.1: The Physical Coastal Context of New Zealand

COASTAL TYPE	GEOLOGICAL DEFINITION	CHARACTERISTIC PROCESSES	COASTAL ELEMENTS PRESENT	EXAMPLE
Shore Platforms	Subhorizontal surface eroded into the base of a rocky cliff	wave attack, biological, chemical and mechanical weathering	Rock pools, barnacles, mussels, tubeworms, sea eggs	Auckland's West Coast; Waitemata Harbour; Paihia; Whangaparoa Peninsula; Hawkes Bay; Gisborne; Waitemata Harbour; Whangaparoa Peninsula
Cliffed Coasts	Steep irregular highly reflective wave barriers	Wave attack induced erosion	Pohutukawas. large brown algae, native forests	Marlborough Sounds; Banks Peninsula; Canterbury Bight; Young Nicks Head
Estuaries	A semi enclosed coastal body of water which has a free conexion with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage	Erosion and deposition; sea level changes	Mangroves, mud crabs, sedges, rushes, wading birds, herons, terns, cabbage trees, kingfishers	Waitemata Harbour; Bay of Islands; Port Chalmers; Kaipara Harbour; Tauranga Harbour; Tairua; Whakatane; Port Waikato; Wanganui; Firth of Thames; Marlborough Sounds; Lyttelton Harbour; Akaroa Harbour; Fiordland; South Westland

Table 3.1: continued

COASTAL TYPE	GEOLOGICAL DEFINITION	CHARACTERISTIC PROCESSES	COASTAL ELEMENTS PRESENT	EXAMPLE
Barriers, Spits, and Progradational forms	Sedimentary accumulations which separate enclosed estuaries and lagoons from the open sea	Wave direction; tidal action; erosion and deposition; sea level changes		Ohope Spit; Pauanui; Golden Bay; Matakana Island; Rabbit Island; Mount Maunganui; Mahia Peninsula; Bowentown; Weiti River, Auckland; Lake Ellesmere; Lake Grassmere; Wairau River Mouth; Nelson
Beaches	The strip of land or terrace bordering the sea, sloping gently downwards from the land	wave action, erosion and deposition	Beach Ridges,	Whiritoa; Matakana; East Coast North and South Island
Coastal Dunes	A mound or ridge of sand formed along the sea coast, through wind transportation	Aeolian sand transport, storm wave attack	Dune grasses, gulls	West Coast - North Island; Muriwai; Rangitaiki Plain fringes
Relict Coastal Features	Features formed under different environmental conditions than those prevailing at present, Pleistocene and Pliocene epoch		Coastal terraces, barriers, cliffs (same elements present ad above examples)	Kaipara Harbour; Manukau; Raglan; Kawhia; Wanganui; West Coast, South Island

Sources: Cometti and Morton (1985), Healy and Kirk (1992) and Rosier and Hastie (1992)

Conservation. This programme is aimed toward producing coastal resource inventories that provide important information on the physical, biological, recreational, cultural, historic, archaeological, human modification, uses protection and threats to the coastal environment.

3.2.2.2 Processes

Processes are the principle agents of change in the coastal environment. Due to the location at the dynamic interface between land, water and air, these processes are either sudden, catastrophic changes or slow, gradual changes over geologic time. The physical changes at the coast either result in erosion or accretion of the beach area. 50 percent of New Zealand's coastline is described as eroding, with 25% of it is eroding at a rate of 0.5 metres\year (Gibb, 1984). Hansom and Kirk (1991) states that there is regional variation, with 47 percent of the southern east cape eroding and virtually the entire North Otago\South Canterbury coast is eroding at rates of up to 4 metres\year.

A range of natural controls in the coastal environment result in erosion and accretion (Bird, 1985). Sea level rise, due to global warming, is accredited with widespread contemporary coastal erosion (Pilkey 1991; Hanson and Lindh, 1993). Although in New Zealand accelerated rates of sea level rise due to global warming are yet to be recognised and are therefore not considered to be a major contributing control to erosion (Hansom and Kirk, 1991). Other contributing factors include high rainfall events and storm activity, which accelerate the severity of coastal erosion. For example, increased erosion damage has occurred at Omaha Beach during severe storm events. These storms have ultimately resulted in the destruction of the sea wall built to protect property and structures (Healy, 1980). Climate variation caused by the quasi-biennial El Nino/Southern Oscillation (ENSO) in the Pacific Ocean, causes sea level fluctuations that contribute to the erosion at the coastline. The sea level fluctuations are as significant as the expected fluctuations from global warming induced sea level rise. For example, at Wellington in May 1987, sea levels were depressed by 5cm because of El Nino effects. Whereas in May 1989 13cm of sea level rise was produced by La Nina effects (Hansom and Kirk, 1991).

Other erosion process controls present in the New Zealand coastal environment include sediment supply and the role of tectonic processes. The continued supply of sediment to the coastline is important as this can counteract the

erosional effects of sea level rise. But in situations where sediment supply to the coastal environment is reduced or interrupted, accelerated erosion occurs to maintain the equilibrium beach system. Sediment supply to the New Zealand coastal environment is predominantly from rivers and cliff erosion. Sediment supply from cliffs is continual, but supply from rivers has the potential to be interrupted. Damming and dredging of rivers for gravel are main causes of loss of sediment to the coastal environment. The sediment supply is also affected by the direct removal of sand from the coastline. Direct loss will also result in accelerated erosion of the beach element to maintain the equilibrium system.

Tectonic processes are a dominate process in New Zealand due to the location upon a tectonic plate boundary. Tectonic processes have been attributed with changes in sea level, but in New Zealand these processes do not contribute significantly to sea level change (Hansom and Kirk, 1991). Although there is potential for sea levels to either rise of fall due to tectonic processes. If sea level was to rise, the consequent erosion will pose a significant hazard.

The description of Taranaki's coastline illustrates the different processes that may occur within one region's the coastal environment:

> *The Taranaki coastline lies exposed to the west. As a consequence, 'high energy' wave and wind conditions dominate the coastal environment of Taranaki. There are few areas of sheltered water beyond the major river estuaries (Mokau, Tongaporutu, Waitara and Patea) and the confines of Port Taranaki.*
>
> *Almost the entire Taranaki, coastline is subject to varying rates of erosion as a result of wave and wind action. This has resulted in a predominantly cliffed coastline with the western coast characterised by boulder cliffs and offshore reefs derived from erosion of lahar and other volcanic material. In north and south Taranaki, erosion of the Tertiary marine sediments has formed an almost continuously cliffed 'papa' coastline with sandy beaches.* (Taranaki Regional Council, 1993, 24).

From this example, it can be noted that it is often the erosion process that provides the distinct physical character of any coastline.

3.2.2.3 Elements

Elements are the constituent parts of the coastal environment. Table 3.1 gives examples of these features in the four case study regions. It can be seen that within New Zealand many different elements occur, and in some instances the features are of national or international significance. For example, Lake Wairarapa in the Wellington Region is of national significance, because of its wetland features which meet IUCN criteria for internationally significant wetland classification (Dix *et al.*, 1990).

From this discussion and description of the physical context, it can be seen that New Zealand is endowed with a varied and unique coastal environment. Many of the ecological features are of significant or outstanding conservation value. Another important feature about the coastal environment is that it is characterised by many coastal processes, that are not properly understood by coastal scientists at present. To generalise these processes is difficult, as there is no coherent body of coastal data that has been systematically collected for this purpose. Existing data is the result of individual effort by researchers and isolated regional authorities who perceived a need for it (Hansom and Kirk, 1991). The quality of this data is variable, as past techniques of coastal surveying and data collection have been inconsistent (Dix *et al.*, 1990).

3.2.3 The Socio-Economic Context

The introduction to this thesis documented the significance of the coastal environment in New Zealand's culture. To understand this socio-economic context, the values and uses of the people within this context need to be determined and examined. Through the public consultation undertaken by regional councils in their plan preparation process, these values and uses will need to be determined.

Recognition of people's values about the coastal environment is an integral part of the sustainable management regime. The Act recognises these values in:

1. The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development [Section 6(a)].

2. The maintenance and enhancement of public access to and along the coastal marine areas, lakes, and rivers [Section 6(c)].
3. The maintenance and enhancement of amenity values Section [7(c)].
4. Recognition and protection of the heritage values of sites, buildings, places, or sites or areas [Section 7(e)].
5. Maintenance and enhancement of the quality of the environment [Section 7(f)].

The natural character of the coastal environment embraces ecological, physical, cultural, intrinsic and aesthetic values and the blend provides New Zealand with the distinctive character of the coastal environment (DOC, 1992). The values within the coastal environment arise from the association people have had with it. Meister and Rosier (1992) identify three sets of human values in the coastal environment: consumptive use, non-consumptive use and non-use value. The basis for these values is that the coastal environment is a resource available for human use and appreciation of its natural values.

The use of the coastal environment is a integral part of New Zealand's culture. This point has been recognised in the general principles for the sustainable management of New Zealand's coastal environment in the NZCPS.

> *Some uses and developments which depend upon the use of natural and physical resources in the coastal environment are important to the 'social, economic and cultural well being' of 'people and communities'. Functionally, certain activities can only be located on the coast or in the coastal marine area.*
> (Department of Conservation, 1994a, 2)

Table 3.2 gives examples of the various uses in the coastal environment and their effects. As illustrated by the table, many of the activities in the coastal environment exacerbate the erosion hazard and damage the natural buffer features. Evidence of this can be seen in the photographs in Appendix One. The interaction of the socio-economic and physical context results in the existence of natural hazards. Photographs 2, 3 and 4 shows this interaction at Raumati Beach. Residential development on the foredune may be aesthetically pleasing, but the property is being destroyed by natural processes. This interaction is also shown in photograph 8a and b. This example is taken from

Table 3.2: Socio-Economic Uses and Their Effects

Uses and their characteristics	*Some Externalities/Effects*
• Sewerage effluent discharge	Bacterial contamination of water/shellfish; sedimentation; increased plant growth
• Storm water runoff	Deposition of oil and heavy metals; ground water overload leading to erosion
• Agricultural runoff and effluent disposal	Chemical changes; bacterial contamination; sedimentation; increased plant growth
• Sand Mining	Accelerated erosion of beach feature
• Subdivision of the Foreshore	Public Access precluded; dune morphology altered; cultural site damage
• Construction of buildings and structures	May not fit 'character 'of the coast; obstruction of views 'of' and 'from' the coast; natural character affected if structures are above tree line and dominate the landscape or if vegetation is removed; increased erosion of primary dunes. flooding behind dunes; overshadowing beach area; aesthetic values affected; wave and current patterns may alter; increased opportunity for conflict between uses; cultural site damage
• Construction of structures, ports and marinas	
• Farming of dunes	Physical destruction of dunes
• Drainage of wetlands	Species/habitat loss; breeding grounds lost; species diversity reduced; public good affected
• Exotic plantings	Indigenous species loss
• Reclamation	Sedimentation; shellfish beds affected; wave and current patterns altered
• Deforestation	Increased erosion; cultural site damage; loss of natural buffer
• Grazing of dunes	Erosion of dunes; aesthetic loss; cultural site damage
• Rubbish tips in dunes	Erosion of dunes; leaching of waste liquids into littoral zone
• Vehicles on beach	Damage to vegetation; increased erosion; damage to shellfish; loss of natural buffer
• Commercial Fishing	Loss of species; loss of species diversity
• Recreation	Conflict between uses

Himitangi, where the natural process of river mouth relocation has resulted in the increased mobility of the dune system. The hazard exists as residential housing is being threatened by the naturally moving sand, which is characteristic of dune systems (Carter, 1988).

3.2.4 The Cultural Context

As the indigenous people of New Zealand, Maori have been afforded a more active role in resource management decision making by being recognised as partners in management of natural and physical resources. A number of positive obligations about implementing the Treaty of Waitangi and protecting Maori interests have been introduced into the resource management regime. These include requirements to:

1. Recognise and provide for the relationship of Maori and their culture and traditions with their ancestral lands, sites, *waahi tapu* and other *taonga* [s.6(e)].
2. Have particular regard to *kaitiakitanga* [s7(a)].
3. Take account of the principles of the Treaty of Waitangi [s.8].
4. Consult with *iwi* in the preparation of plans and policies and resource consent decisions [First and Fourth Schedule].

Meeting the requirements of the Act in regard to Maori affects all contexts. In the institutional context, considerable scope has been given for Maori to take an active role in decision making, but for this to be effective a new working relationship between Maori and local authorities needs to be forged. The relationship will have to be based on mutual tolerance, co-operation and commitment (Crengle, 1993). The obligations in the Act reflect the outcomes of the Waitangi Tribunal claims of the 1980s. The principles derived from these reports provide essential guidance on how the Treaty of Waitangi should be dealt with in resource management decisions. The following discussion explains these four obligations in the Act and what the implications are for the development of policy and adjustments to natural hazards.

A requirement to recognise and provide for the relationship of Maori and their culture and traditions with their ancestral lands, sites, waahi tapu and other taonga [s.6(e)].

Maori perspectives on conservation and the environment challenge many of the western ideologies about the natural environment (Roberts *et al.*, 1995). To

obtain an understanding of their culture and traditions, the uninitiated must learn about Maori history, cosmology, customs and language. In undertaking the study of the Maori perspective, it must also be remembered that there is no single Maori perspective on this subject. Maori are composed of discrete groups, each group (*iwi* or tribe) having its own distinctive, although recognisably similar perspective. Each view point needs to be seen and understood in the light of the tribal background of the individual concerned (Roberts *et al.*, 1995).

Maori cosmology seeks to explain the origin of the universe and the beings within, and from this Maori people derive their culture and traditions. Maori cosmology has two distinct aspects, that of *whakapapa* (genealogy) and the personification of natural phenomena (*atua* or god, supernatural). Poetic stories are derived from these personified beings, or *atua*, which allow Maori to construct complex genealogical trees which explain the beginning of time and the creation of life (Roberts *et al.*, 1995). Brief examples of those myths and stories that are relevant are given in Appendix Eight. Following on from these myths, important Maori environmental virtues unfold, including: *tapu*, *mauri*, *whanaungatanga*, *manaakitanga* and *kaitiakitanga*. *Kaitiakitanga* will be discussed further in the next part of this section. The following discussion is generalised and only briefly outlines the environmental virtues that are drawn from the complex cosmological world of Maori. An exhaustive coverage of all the myths given by Maori would be difficult and time consuming. Maori myths are tribally sensitive, in the respect that each tribe has their own version, therefore the discussion will focus on those myths that are familiar and widely accepted in the Maori world.

The virtue of *tapu* involves the idea that the world is not ours, as we are one with the world in which we live (Patterson, 1994). Therefore humans should always respect the inherent worth of all the elements in the environment and the natural environment in which we live. This virtue of *tapu* also brings in the concept of *mauri* as an environmental virtue. The concept of *mauri* implies that all things have a nature or character of their own, which the English interpreted as 'life force'. Subsequently, both inanimate and living things have *mauri* and they are deserving of protection (see Rata and his canoe myth).

The virtue of *whanaungatanga* involves the way in which environmental kin should interact with one another. As a environmental virtue this highlights the

fact that the destruction of the environment is inappropriate as the environment is our kin. The failure to provide protection is also inappropriate. *Whanaungatanga* implies that we should seek to implement ways of enhancing the welfare of the whole environment and all its members, rather than simply abstaining from harming them (Patterson, 1994) (see Tane and his human children myth).

The virtue of *manaakitanga* counters the traditional western thought of 'I' being the centre of the universe. *Manaakitanga* means that when dealing with the environment, there is acceptance that others also have their place in this environment. We should identify with our environmental kin, as part of a larger whole and as children of common ancestors (see Tane and his human children myth).

Maori use the coast in much the same manner other peoples of New Zealand. Therefore they contribute to the socio-economic uses and effects as described in 3.2.3. In addition to these every day uses, many traditional Maori uses are based on natural and physical resources in the coastal environment. For example, the coastal environment provides essential source areas (*mahinga mataitai)* of kiamoana (seafood) and other mataitai (food resources from the sea). Historically, the coastal environment has played an important role in Maori culture. Many *wahi tapu* (sacred or spiritually endowed places or things) sites are present in the coastal environment. For example, *urupa*, coastal battle grounds, *tauranga waka*, *mauri* stones, *toko taunga ika* and landscape features that denote *iwi* and *hapu* boundaries.

Have particular regard to kaitiakitanga

Kaitiaki is the word derived from the verb *tiaki* which means to guard, to protect, to keep, to watch for with the prefix *kai* denoting the doer of action (Roberts *et al.* 1995). Therefore *kaitiaki* is translated as meaning guardian and kaitiakitanga the act of guardianship. *Kaitiaki* are represented by either *tohunga* or animal guardians (see Rata and his canoe myth) and they have an important controlling role in the upholding of Maori laws or tribal *tikanga.* This traditional Maori custom was lost with the adoption of Christianity by many Maori. This, along with other values and customs are being rekindled with the passing of the Treaty of Waitangi Act 1975 and the setting up of the Waitangi Tribunal. The Treaty of Waitangi guaranteed Maori the full exclusive and undisturbed possession of their land and estates, forests, fisheries and other

properties (*taonga*) so long as it is their wish and desire to retain the same in their possession (Article II, Treaty of Waitangi, 1840). The understanding and practice of the concept of *Kaitiakitanga* is dependent upon this treaty right given to Maori as interpreted by the Waitangi Tribunal.

The definition of *kaitiaki* taken from the Resource Management Act 1991 arose from the Waitangi Tribunals Manukau Harbour case, where *kaitiaki* where appointed, both *mana whenua* and non-Maori. The Huakina Development Trust Vs Waikato Valley Authority Court of Appeal Case decision extended this legal recognition of Maori spiritual values. The precedence set by these cases has lead to contemporary interpretations of the concept of *kaitiakitanga* being given, such as the Act and the Board of Inquiry Report into the New Zealand Coastal Policy Statement (DOC, 1994a).

Fundamental concepts arise from these definitions given. It is important to understand that *kaitiakitanga* is based on *whakapapa*-lineage and inherited nurtured responsibility and direction from tribal elders. Thus the *kaitiaki* can not be filled by a group from just anywhere, as the status of *kaitiaki* arises from Maori tribal associations (Roberts *et al.* 1995). Therefore *kaitiaki* can only come from the Tangata Whenua. The relationship between these appointed *kaitiaki* from Tangata Whenua and the natural environment is documented in DOC (1994b). Here the role of the *kaitiaki* is given and *kaitiakitanga* is defined, which is to ensure that the *mauri* of natural and physical resources is protected. Or in the case of depleted *mauri* they should strive to restore it to its original strength. The concept relies heavily on tribal *mana*, where the *mana* of the Tangata Whenua can be upheld or removed by their ability to be successful *kaitiaki*. If *mana* is removed then harm and danger will come to members of the *whanau* and *hapu*. In DOC (1994b), *kaitiakitanga* is defined as being the practice of the *kaitiaki* role.

Another important aspect of *kaitiakitanga* is the relationship it has with *ranagtiratanga*. *Rangatiratanga* is the exercise of chiefly authority, power and mana. *Kaitiakitanga* has been recognised as an inherent part of the exercise of *rangatiratanga* by the Waitangi Tribunal. Therefore, appropriate recognition of *kaitiakitanga* needs appropriate recognition of *rangatiratanga*, which is not so in government law of New Zealand.

Take account of the principles of Treaty of Waitangi

The Treaty of Waitangi Act 1975 requires that principles from the Treaty of Waitangi be derived. Principles are used instead of provisions to overcome the problems of understanding the literal words of the Treaty as signed in 1840. The problems have arose due to the different literary translations of the Treaty. The Maori and English translations have resulted in different understandings of what was implied by the Treaty. The principles still yet to determined, although the Waitangi Tribunal (under the Treaty of Waitangi Act, 1975) and the Court of Appeal (under the State Owned Enterprises Act, 1986) have defined a number of principles. Moreover the principles of the Treaty are continually evolving and there is presently no definite set as many of the issues are still yet to be resolved.

Presently, four essential principles, drawn from the Treaty, relate to resource management decisions. These being:

1. *The Essential Bargain*

This principle has been defined as the right of the crown to make laws was exchanged for the obligation to protect Maori interests. The Crown has devolved some of the law making or regulatory capacity, in relation to natural and physical resources, to local authorities. Through local authority policy statements and plans, this regulation will be enforced for the use and access to natural and physical resources.

2. *Tribal Self-Regulation*

This principle has been defined as the crown has an obligation to legally recognise tribal *rangatiratanga. Rangatiratanga* denotes an institutional authority to control the range of user-rights in terms resources, including conditions of access, use and conservation management. This principle implies that Maori authority must be considered when making resource management decisions. This can be facilitated in the institutional context by the development of Maori Standing Committees and other structures in local government. Kerins (1992) provides insight into one such standing committee in Hawkes Bay, concluding that in this case the committee was no more than an advisory board limiting its rights to fully exercise *rangatiratanga.*

3. *The Treaty Relationship*

Four constituent interpretations are given for this principle. The Treaty implies a partnership to be exercised with the utmost good faith; the Treaty is an agreement that can be adapted to new circumstances; the courtesy of early consultation is a partnership responsibility under the Treaty; the needs of both Maori and the wider community must be met, which will require compromises on both sides.

4. *Active Protection*

Three constituent interpretations are given for this principle: Maori interests should be actively protected by the Crown; the Crown right of pre-emption imposed reciprocal duties to ensure that the Tangata Whenua retained sufficient for their cultural needs; the Crown can not evade its Treaty obligations by conferring an inconsistent jurisdiction on others.

These four principles have important ramifications for the development of natural hazard policy and adjustments. When developing these, Maori have to be treated as partners in resource management decisions. Tangata Whenua are not to be treated as just another interest group, and the principles of the Treaty reflect this.

Consult with iwi in the preparation of plans and policies

The Resource Management Act contemplates that consultation will occur in two instances in natural and physical resource planning. Firstly, in the preparation of policy statements and plans and secondly, in the resource consent decision making process. A duty to consult arise from the principles of the Treaty of Waitangi discussed above. Case law about consultation with *iwi* has set precedents on how consultation should be undertaken. These precedents include:

a. Consultation with *iwi* must take place in the initial stages of decision making process - Haddon v Auckland Regional Council [1994] NZRMA 49
b. Consent authorities are not subject to the obligations of the Crown under the Treaty. Rather the consent authority is to take these [Treaty] principles into account when reaching its decision - Halton v Auckland City Council [1994] NZRMA 289

c. Meeting the obligations of Section 8 and the Treaty of Waitangi is a consent authority responsibility not a duty of the applicant - Whakarewarewa Village Charitable Trust v Rotorua District Council [1994] NZRMA 412
d. The extent of consultation should be proportionate to the extent of likely effects of the proposal in question - Paul v Whakatane District Council [1995] A12/95
e. For consultation to be meaningful, it requires more than sending out information to various *iwi* about the application - Aqua King Limited v Marlborough District Council [1995] W16/95
f. Consent Authorities do not have the authority to decide whether the Crown is in breach of its obligations under the Treaty in any respect, let alone to decide what redress might be appropriate. This redress issue is to be dealt with in Waitangi Tribunal. - Banks v Waikato Regional Council [1995] A31/95

The Parliamentary Commissioner for the Environment has set out guidelines for consultation with *iwi* after an investigation into past local government consultative procedures. Essential elements of consultation include sufficient information, sufficient time and genuine consideration.

For natural hazards management, this duty to consult means that in developing policies and adjustments, there needs to be discussion with Tangata Whenua about their expectations of what should occur and whether any special or sacred areas will be affected by these resource management decisions.

3.3 Sustainable Policy and Adjustment Development in New Zealand

A New Zealand model of policy and adjustment is presented in Figure 3.3. This model amends Figure 2.4 by inserting New Zealand specific attributes. For example, in the institutional context, the legislation covering the management of natural hazards in New Zealand is given. The physical coastal context of New Zealand is summarised and the cultural context of New Zealand is defined. The checklist given in Table 3.3 supplements this model by providing detailed policy attributes of each context that contributes to effective

difference between this model and the one presented in chapter two is the consideration of sustainable management. In New Zealand sustainable management is a lesser concept than that of sustainable development, where by it only relates to natural and physical resources. Sustainable development, on the other hand, relates not only to natural and physical resources planning but social and economic development of a nation.

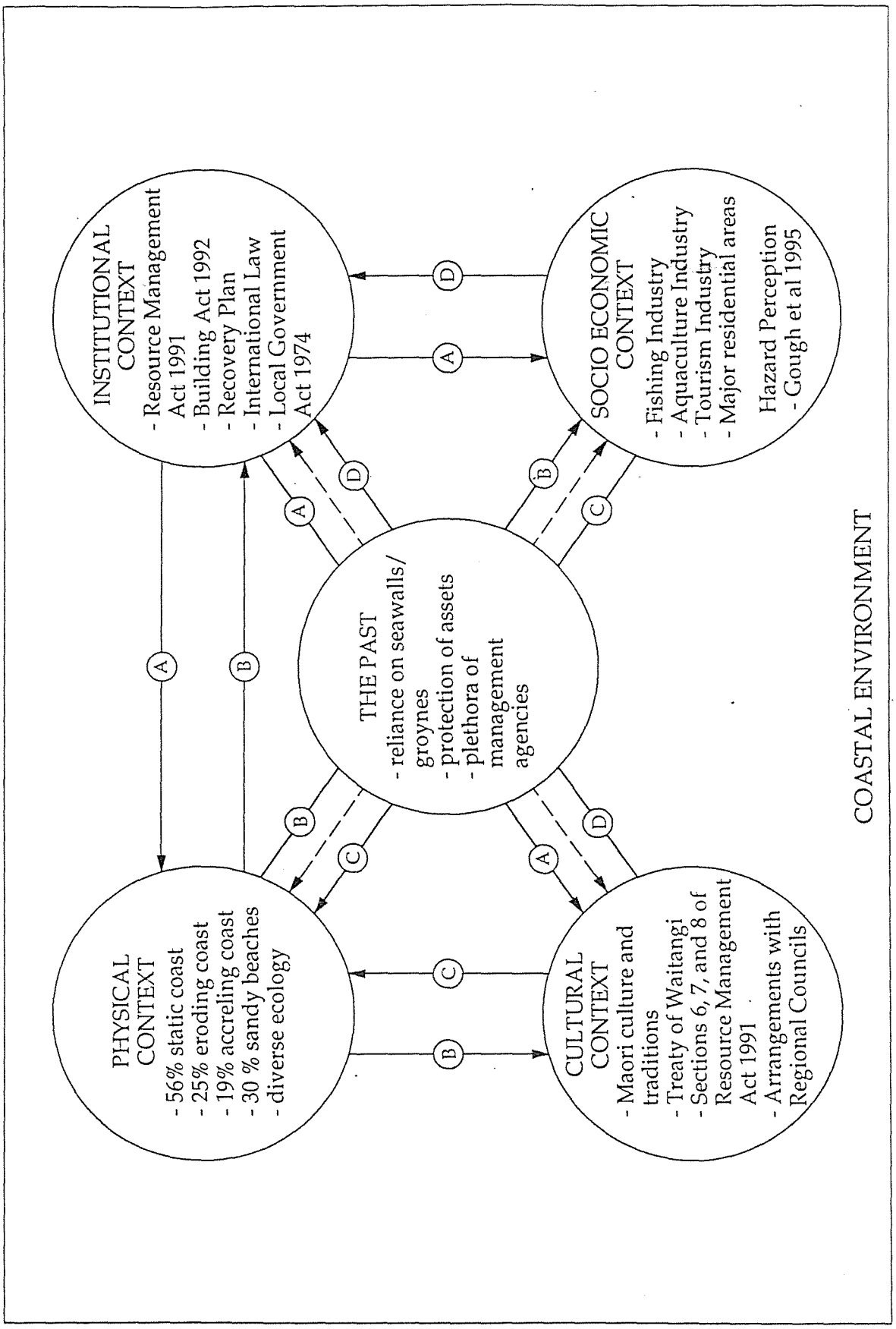


Figure 3.3 New Zealand Specific Policy and Adjustment Development Model

Table 3.3 New Zealand Specific Natural Hazard Policy and Adjustment Checklist

Institutional Context	*Physical Context*
National constraints: LGA, the Act and the BA Administrative constraints: technical capacity Legal constraints Political constraints: regional councillors and territorial authority councillors Monitoring requirements: Section 35 of the Act Benefits and costs: institutional vulnerability: Section 32 of the Act Institutional uncertainty Institutional efficiency Alternative policy or adjustment options: Section 32 of the Act Public participation in coastal management: First Schedule of the Act Equity Sustainable management: ethical responsibilities Integrated and holistic approach Precautionary principle	Degree of hazard Physical uncertainty Shoreline diversity Coastal processes diversity Unique or critical resources protection Occurrence of hazard Interactions of hazards Variations in climate and vegetation Part II considerations of the Act
Socio Economic Context	*Cultural Context*
Hazard perception of community and individuals Private property ethos Society norms Health and safety Coastal activities Compensation rights Hazard experiences Development implications Settlement diversity Part II considerations of the Act	Unique resources protection: Part II considerations of the Act Use of indigenous knowledge Acknowledgment of: *kaitiakitanga; manaakitanga; rangatiratanga; tikanga* and *whanaungatanga*

CHAPTER FOUR

TOPIC EVALUATION OF GIBB METHODOLOGY

The purpose of chapter four is to undertake a topic evaluation of Gibb (1994) coastal hazard zone methodology, which will be based upon the data collected within this thesis. Technical and other submissions made in regard to Gibbs document were obtained from the Department of Conservation as well as interviews that were conducted with four practicing planners (see Appendix Three). The research process and the issues relating to the collection of the data are discussed fully in chapter one. The analysed data is presented in Tables 4.2, 4.3 and 4.4.

The technical review process initiated by the Department of Conservation was in two stages. Leading coastal researchers, coastal planners and managers where asked to take part in stage one of this review. Their responses can be found in Table 4.2. After this stage, it was felt that the review group should be extended to incorporate more local authorities (see Table 4.3 - when referencing the comments made in these submissions, the submitters surname has been used. Appendix Nine contains a list of the technical review submitters and their affiliations with local authorities or research organisations so these references can be easily found). Table 4.4 conveys the responses given in the interviews performed with the four case study regional councils. It was requested that when reporting this information, confidentiality needed to be maintained. To do so, the regional councils have been allocated a number, and this is used to reference their comments. All the responses are categorised according to the four planning contexts: institutional, physical, socio economic and cultural described in chapter one. If a submitter has not commented on a particular context, a gap is left to indicate that no comment was made. Other comments made by the submitters and interviewees are summarised in the general comment column of the tables compiled.

The analytical framework for this chapter is set out in Figure 4.1. This framework outlines the relationship between Gibb's (1994) methodology and the statutory coastal planning framework presented in the Act. Gibb's (1994) report is a non-statutory document produced to provide informal guidance and assistance to local authorities when planning for natural hazards in the coastal environment. This information is expected to feed into the preparation of

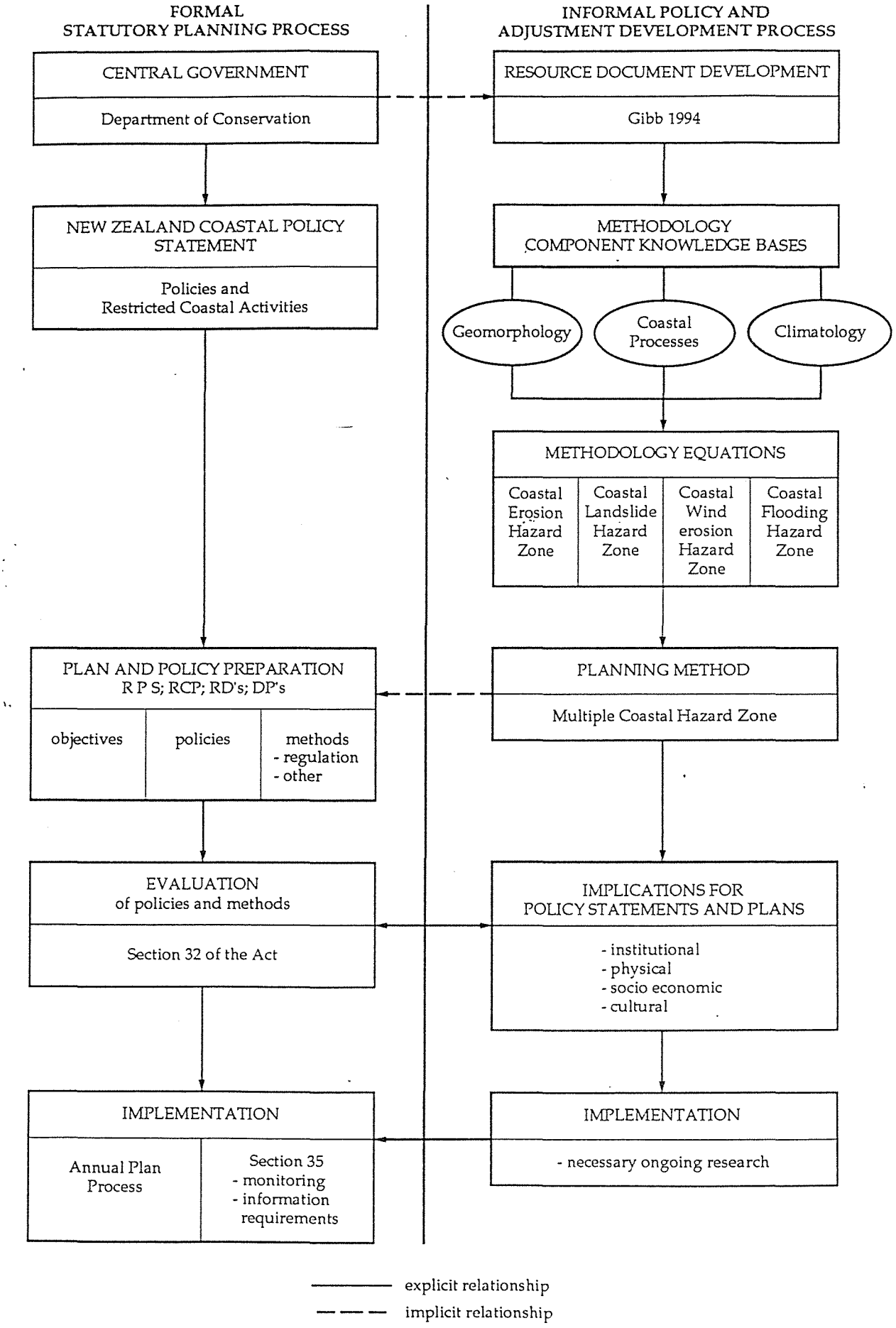


Figure 4.1: Analytical Framework for Topic Evaluation of Gibb (1994)

policy statements and plans at the local authority level. The implications of the methodology will directly affect the formal evaluation required under the Act (see S32). These implications will also highlight the areas in natural hazard planning that require further, on-going, research. The conclusions drawn from evaluating Gibb's methodology, within this framework, will illustrate whether natural hazard planning in New Zealand considers the 'big picture' represented in Figure 3. 3.

Several coastal hazard zone methodologies have been developed in New Zealand. Healy (1980) proposed the use of semi-quantitative methods, which consider geomorphological factors, nearshore processes, potential hazardous events and human effects on the beach element. The development setback, or coastal hazard zone, considered all these factors and determined a width that would be appropriate to protect development from the effects of continual coastal erosion. Gibb (1981, 1983, 1987) and Gibb and Auburn (1986) outline the early workings of a standardised quantitative coastal hazard zone methodology. In this work, they applied it to various locations around New Zealand that experience severe erosion hazard problems (Waiapu Country, Pauanui Beach and Hokitika). These equations were adapted from equations from the Beach Protection Authority, Queensland, Australia. The New Zealand equations incorporate a specified planning period, rates of erosion experienced in the area plus a safety factor. Each equation has been modified to suit particular beach conditions that prevail at each setting. The Gibb and Auburn (1986) equation introduces a factor that represents the rate of erosion resulting from accelerated global sea level rise. This is an important development as the methodology now deals with the expected effects of sea level rise. This sea level rise factor was estimated using the Bruun Rule, which hypotheses that:

> *...for given sea level rise there is a shoreward translation of the equilibrium profile, during which the material eroded from the beach is redeposited offshore to allow the original profile to become restabilised.*
> (Healy, 1991, 15)

The Bruun Rule has been criticised for its simplicity and two dimensional nature. The major limitation of the technique is the definition of boundary conditions in the nearshore zone (Carter, 1988 and Bruun, 1989). The distinction needs to be made between the nearshore and the offshore zones to fulfil the

data requirements of the rule (see figure 4.2 for the theoretical boundaries of the nearshore and offshore zones).

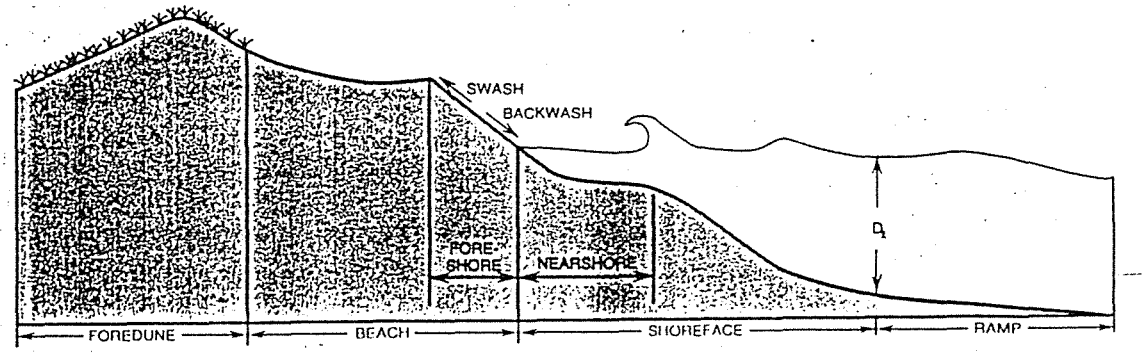


Figure 4.2: Theoretical boundary conditions of the Nearshore Zone

Bruun (1989) actually acknowledges that the rule is limited as it is difficult to quantify erosion due to sea level rise. This form of erosion is also difficult to distinguish from other causes of erosion. Healy (1991) concludes that the Bruun Rule does provide a quantitative method for prediction of shoreline erosion which can guide coastal planners in determinating coastal hazard zones. Dubois (1992) suggests a re-evaluation of the Bruun Rule and its supporting evidence, commenting that the Bruun Rule is applicable to the beach and nearshore zones, but evidence exsists that does not support the application of the rule to other zones identified in the shore system (see Figure 4.1).

Further development of the coastal hazard zone equations by Northland Regional Council (1988), Healy (1994) and Kay *et al* (1994) have resulted in a convergence of opinion toward similar methodologies. The methodologies all require common databases, including long term trends of shoreline retreat or accretion, sea level induced erosion, dune stability and a planning horizon. These equations provide some background concepts in the development of Gibb (1994).

4.1 Gibb's Methodology

Dr. J. Gibb was commissioned by the Department of Conservation to undertake a review of coastal hazard zone methodologies, and propose a set of

standards\guidelines for coastal hazard zone determination in New Zealand. The product of this review is a draft report titled *Standards and Information Requirements for Assessing Coastal Hazard Zones for New Zealand* (Gibb, 1994). In commissioning Dr. Gibb to undertake this review, the Department of Conservation intended to provide information and guidance to local governments to assist them in fulfilling their functions under the Act and the NZCPS in relation to the management of coastal hazards. It was to be treated as a technical series report, containing the views and analysis of Dr. Gibb. In its final form, the report is considered as a resource document but not representative of departmental policy or position about coastal hazard planning in New Zealand. The principle objective in developing this methodology was to determine a nationally consistent method to deal with natural hazards in the coastal environment.

After a review of all the past work undertaken, Gibb proposed four standardised formula for individual coastal hazard zone determination. Table 4.1 provides a summary of the Gibbs proposed standard equations; full explanations of the variables are given in Appendix Ten. The four identified hazard equations were for:

coastal erosion (CEHZ)
coastal landslides (CLHZ)
coastal wind erosion (CWHZ)
coastal flooding (CFHZ)

The final equation in the report is an addition of all four hazard zones into a multiple hazard zone. The recommendation is to subdivide this multiple zone into extreme, high and moderate risk zones. The extreme risk zone encompasses the area adversely affected by actual hazards of high probability of occurrence, while the high and moderate risk zones include areas adversely effected by potential hazards with moderate to low probability of occurrence.

In his report, Gibb outlines the broad information requirements in order to fulfil the proposed methodology. Information is required, to a greater or lesser degree, about the many variables needed to identify coastal hazards and the degree of potential risk to elements or people's assets. A list of these requirements is Appendix Eleven. Gibb recommends that the minimum survey record for the methodology should not be less than 50 years and would ideally

be of 100 years or more. Predominantly, the information required refers to the physical context concerning the types of physical environment, erosion rates for

Table 4.1 Gibb(1994) Standardised Coastal Hazard Zone Formula

CEHZ = [(X + R)T + S + D]F + L (m) For developed, relatively modified stretches of retreating or dynamic equilibrium coast, it is recommend that Factor L be deleted from the equation, as there is little, if any, chance of a representative landform being preserved in the future on retreating shorelines on such coasts (Gibb, 1994, 31).
CLHZ = [(R x T) + S]F (m)
minimum CWHZ = width of foredune complex (m) **maximum CWHZ** = with of both the foredune complex and the secondary dune complexes according to their sensitivity to wind erosion (m)
CFHZ (empirical approach) = $(h_T + h_{\Delta p} + h_W + h_b + h_z + h_a)F$ (m)
CHZ = CEHZ + CLHZ + CWHZ + CFHZ (m)

the area, erosion risk and the natural features present within the physical environment. The only references to socio-economic and cultural contexts are the identification of elements of risk, for example, to property and cultural sites. The institutional context is only dealt with from the aspect of the planning horizon used in the calculation. Gibb (1994) states that the planning horizon should fully encompass the expected occupation life of buildings on properties, public services and amenities and the specified intended life of buildings (see section 39 of the BA).

4.2 Implications for the Preparation of Policy Statements and Plans

Gibb's (1994) methodology has strengths and weaknesses when it is applied in the preparation of policy statements and plans under the provisions of the Act. These become evident when evaluating the methodology against the policy development model and checklist given in chapter three. The following discussion describes these strengths and weaknesses as identified by one: the submitters; two: the interviewees and three: other sources. The final part of the

Table 4.2: Submissions to Gibb (1994) - Stage One

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Benn, J.	Many small regional and district councils would not be able to implement the method, lack of human, scientific and financial resources	Is the method applicable to sand gravel beaches? Unnecessarily wide CHZ			
Benson, A.P.	Need a measure of consensus on a standardised approach How is data going to be collected? The method is silent on the management of coastal hazards		Definition of CHZ focuses on physical component of hazard, does not acknowledge the effect of human use of the coastal environment		'a number of shortcomings in the report' To narrow scope, what about other methods
Black, R.D. and D. McBryde	Nationally accepted methodology is required	The method is quasi two dimensional in nature and this needs attention, can give misleading results. A third dimension is required. 'The past can predict the future' this comment needs attention as often not the case Needs further quantification of physical processes			'good summation of the existing methodologies'
Brookes, H.		Double counting when determining final CHZ			

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Crozier, M.J.	Need to know more about the degree of hazard than what is given in the formula (section 32 requirement) There should be requirements for regularly reviewing claculated zones and acting on new information	Conservative estimate of the area that might be subject to a specified hazard over a given period Weak aspects include - reliance on changeable IPCC predictions and reliance on the Brunn rule Double counting in CHZ formula			'Really only the first step for proper hazard management' 'May provide sufficient information for hazard management'
Gunn, I.	Safety factor in practice is proving to be difficult and resulting in extensive litigation				
Hastie,W.	National consistency is desirable Need agreement between key players Further refinement of coastal hazard definition What is the purpose of risk zonation - planning sense	Safety factor not encompassing of all possibilities that could occur, eg. other effects of climate change other than sea level rise Does not make sense to add all the individual zones together			'is an inexact science' 'best guess of what might happen in the future' Narrowness of literature reviewed
Healy, T.	Need a consistent planning horizon No real need for multiple sets of zone within the CHZ, confuses the issue No benefit in distinguishing four separate hazard zones	Should not apply the Brunn Rule to predict future potential erosion More than one safety factor should be used in the final CHZ formula The result of the formula is indicative rather than absolute			'application of Gibb CHZ methodology may well circumvent [coastal conservation] and allow development'

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Kirk, R.M.	Zones not really an appropriate method for dealing with hazards as an aspect of coastal management				'Hazard Lines' not 'hazard zones'
Marra, J.J.		Can combine Equation (15) and (20) into a single relationship Essential to recognise the limitations for determining factor R from aerial photographs Factor T is important, need to consider what value is used as to gain political support Brunn Rule limitations need to be considered - questionable accuracy when determining factor X Factor F possibly should be applied to individual terms			'Sound basis for assessing the extent of CHZ'

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Neale, D.	What sort of controls should be placed within the CHZ? Planning period should be 100 years	Too focussed on the use of an empirical formulae Need to understand more about how coastal systems function, they cannot be understood by a standard formulae Past does not necessarily reflect the future Empirical formulae does not take into account local environment changes Factor L is poorly defined Brunn Rule limitations are not acknowledged CHZ formula is not logical, effects of different hazards are not additive but interactive Safety factors are important			'focussed on the empirical CHZ method'
Ramsey, D.	More information needs to be included on the monitoring required to maintain the zone, time for updating should be included	Should have separate safety factors for each variable			'excellent review of coastal hazard assessment'
Reid, Steve		Consistency between variable definitions Equations not particularly useful - need explanations			

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Rennie, Hamish		Lack of emphasis/comment referring to ecosystems Differences between elements and assets Definition between tectonic and other physical processes Needs definition of nearshore and offshore - contentious in some places Requires consistency between definitions of variables Agrees with factor L - would allow complex features to be added in if appropriate Needs more than 2 or 3 comparison points when determining factor R Need solid data for factor D Potential for double counting in final CHZ equation	Differences between assets and elements Need to provide reference for property devaluation		'Concerned at the narrowness of the literature reviewed' Need to compare with other models Grammer is too technical

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Shephard, M,		CEHZ does not seem to take account of morphology of foredunes, advocates dune calculations as attempted by Healy, 1993. Past physical history could be irrelevant if there is a change to more intensive land use			'well researched document, and a useful reference'

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Swales A. and K. Smith.	There needs to be more detail about what constitutes an appropriate monitoring research strategy National standards should be established via a working party of specialists Standards at a regional level may be more appropriate Minimum planning horizon should conform with the 50 years expected building life given in the Building Act 1991	Areas of uncertainty about climate change and sea level rise are not addressed in the report Implications of the Southern Oscillation are not addressed, what are the effects of these on the wave climate and beach profiles . Need to be aware of the inherent errors in using historical data Should not the potential effects of sea level cooling be considered in the assessment Beaches can behave contrary to the Brunn Rule, therefore treat with caution Factor L is to rigid in approach to deal with preserving natural character, may not incorporate the features fully CLHZ is not required as this hazard is already dealt with under other planning controls and processes			'Report does not appear to advance the methodology of coastal hazard assessment much beyond whaat has been practiced for the last decade or so.

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Todd, D.	National approach needs to be developed (with care) and a consensus of opinions What to do with the hazard zone when established - effectiveness of the zone over time - planning sense Data requirements are often not available in the councils, will require 'financial and resource support'	Other effects of climate change are not considered, eg. changes in wave climate and direction Double counting involved in the final CHZ equation Irrational use of 'seaward' sides of features when measuring hazard zone widths - see detailed explanation Inundation hazards not considered adequately No mention of errors involved in determination of several of the factors No recognition of the Brunn Rule limitations In NZ, 50 years of survey data is the maximum that can be used with any confidence			'Not a comprehensive review of assessment methodologies'
van Voorthuysen, R.	Need national consistency when developing standards				"very comprehensive' 'need a much simplified version'

Table 4.3 Submissions to Gibb (1994) - Stage Two

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Auckland Regional Council	Need to look at various other options, broaden out the CHZ technique Need to get the most appropriate technique of the situation				
Canterbury Regional Council	Require acceptance of standard procedures				
DOC Waikato	Strictly a regional council responsibility				
DOC West Coast	Coastal Hazard Zone needs to be defined				
Environment BOP	Need a consistent national approach Who pays for the assessment? What levels of precision are required? How should the information be displayed to the public?	What factors should be taken into account?			
Hawkes Bay Regional Council	Robust and nationally applicable technique				Completeness of report
University of Canterbury	Document should be policy and guidance based, not and overly simplistic, scientifically deficient model or formulae. Balance inherent in the Act, this mix needs to be remembered when undertaking proactive coastal management	Report should acknowledge that NZ has a varied coastline therefore should not be restricted to a limited range of coastal landforms	Need to acknowledge the various uses within the coastal environment	Need to acknowledge the various cultural uses within the coastal environment	'There is no legislative obligation for hazard zoning'

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Victoria University		Should identify what is at risk	Should identify what is at risk then undertake an assessment	Should identify what is at risk then undertake an assessment	Risk, vulnerability and importance combined with degree of hazard will result in appropriate management strategies
Wellington Regional Council	Need to understand the limitations of the methodology The hazard zone itself is of limited value, the risk reduction methods are the key Problems with recognition at the district level		Need to understand the potential effect on coastal property owners	Need to understand the potential effect on coastal property owners	'Document should include both a standard methodology for determining hazard zones ***and*** a set of recommendations relating to the use of this information to mitigate the hazards, for both developed and undeveloped coasts'

Table 4.4 Interview Responses to Gibb (1994)

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Council 1	Difficulty in acceptance at territorial authority level Hard to develop policies within the zone, especially a divided hazard zone as proposed Regional level of politics has accepted the technique Hazard Zone will aid territorial authorities in preparing LIM's and PIM's Can only use what data is available to give a reasonable forecast of zone width	Many types of hazard exist in the coastal environment Some physical factors have little influence on hazard zone width Not good at dealing with shifting river mouth hazard What effect does dune steepening have on hazard zone width? Other forms of coastal protection affect zone calculation Other effects of climate change need to be addressed	Resident opposition to coastal hazard zones Need public acceptance What is the potential effect on coastal property values?	Potential for hazards to affect urupa sites and other cultural areas	
Council 4	Should consider other forms of coastal protection First priority is to identify the hazards and the areas affected within the region Data requirements beyond some councils ability Hazard planning and management should be taken by a case by case basis as each situation is unique	Credibility of the zone is affected by the uncertainty of the physical variables Equation does not take into account natural fluctuations in erosion rates Equation does not take account of changing circumstances, for example, diversity in coastline characteristics Does it afford protection to ecotones and associated ecology?	Public are very concerned about the occurrence of natural hazards in the coastal environment Need to understand more the human interaction at the coast and the effects Hazard zones create hysteria and paranoia - does not aid in planning and management Hazards only exist where people and infrastructure exist		Concept is too simplistic and easy, does not take into account all the variables that operate in the coastal environment

SUBMITTER	INSTITUTIONAL CONTEXT	PHYSICAL CONTEXT	SOCIO ECONOMIC CONTEXT	CULTURAL CONTEXT	GENERAL COMMENT
Council 2	Data requirements for methodology are beyond many councils resources and ability Past data is inadequate and there is not a comprehensive monitoring strategy in the region as yet	Dynamism of coast affects the coastal zone width	Pragmatic public and they accept the problems and what to do about them What are the implications on peoples economic rights Need to deal with the social costs of the problem	Some conflict over other forms of coastal protection interfering with cultural uses	
Council 3	Data within the region is adequate and on a par with other regions Difficulty with getting it accepted at territorial authority level Be able to justify it in the Planning Tribunal from a multiple coastal management view point not just natural hazards Standardised approach won't succeed due to institutional variation between and within local government Need a more pragmatic, integrated and intuitive approach to coastal management Favourability of non-structural adjustments to natural hazards Problems with historical data is location of MHWS	Differences between short term and long term recession rates are not easily differentiated Standardised approach won't succeed due to physical variation of coastline Method tries to incorporate landscape and ecological values into zone calculations	Need to be able to represent other socio economic objectives in coastal management Politically easier to develop zones on undeveloped coasts	Local Tangata Whenua want more consultation on coastal matters	

discussion critiques these responses and identifies other strengths and weaknesses of the methodology. The discussion will be structured around the four contexts considered appropriate in this thesis: institutional, physical, socio-economic and cultural.

4.2.1 Submissions about Gibb's Methodology

Central themes emerge from the submissions made to the Gibb report (for a synopsis of the submissions made see Tables 4.2 and 4.3). The predominant themes reflect the limitations of the methodology, while, at the same time, some acknowledge the opportunities presented by the methodology. The themes relate principally to the institutional and physical contexts. General comments have also been made about the methodology presented. Many local authorities, who responded to the review, have indicated that they feel the methodology is complete and will provide good guidance in planning for natural hazards in the coastal environment, although some have noted that it is not comprehensive enough. Most researchers and academics who have reviewed the methodology feel that it is to narrowly focussed on an empirical formula and does not acknowledge that the less empirical formulas, such as naturally determined buffer zones, maybe more relevant and applicable.

4.2.1 1 Institutional Context

In the institutional context, principle themes apparent in the submissions relate to: the need for national consistency, data requirements and information, monitoring of hazard zones, coastal management objectives achievement, and consistent planning horizon.

National Consistency

As seen in Tables 4.2 and 4.3, local authorities and other coastal management agencies have responded to Gibb's methodology by agreeing with the Department of Conservation that a nationally consistency approach to coastal hazard management is desirable. Presently, coastal planners are uncertain and confused as to what methodology should be used as a number of methodologies and formula have been suggested. The Department of Conservation has attempted to start the process of developing consistency in approach by commissioning Dr Gibb to undertake and produce his report. The continuation of the process will require a consensus to be reached between the Department of Conservation, local authorities and key coastal researchers about the aspects of each possible methodology, that results in a unified approach to coastal hazard planning and adjustment (Hastie, Todd). Some

submitters have commented that the report is complete therefore is no need to continue the development process of the methodology (van Voorthruysen, Black and McBryde).

Data Requirements and Information

Another major concern voiced by the submitters is that the methodology demands complex data and resources to obtain an adequate and useful result. The data requirements given in the methodology are very comprehensive and relate predominantly to the physical context. Some of the variables are easy to obtain as many of them are geomorphic or geologic descriptions of the coastal environment, for example geology including lithology, structure, tectonics and coastal landforms. However, many others require more specific expertise to obtain the data. For example, elevations of primary coastal features, long term trends of shoreline advance, retreat or dynamic equilibrium and potential rate of shore retreat from relative sea level rise, require derivation of expert knowledge. The problems of deriving of erosion from sea level rise is exacerbated by the limitations of the Bruun Rule outlined in the introduction to this chapter.

Associated with the limitations of data collection, are the issues concerned with unrealistic data expectations in the application of Gibbs' methodology. For example, coastal surveying and data collection has not been a priority issue in New Zealand. Consequently, historical data sets are incomplete and unreliable to use for various reasons. Different interpretations of mean high water springs (MHWS), as a survey point, poses difficulty as possible inconsistancies in previous surveys of the coastal environment could affect the results obtained. Aerial photographs as a source of data also have inherent problems. Photographic series are incomplete and series' of some regions do not go back beyond the 1950s. Secondly, in sets of aerial photographs, a consistent reference point may not be present. For example, a farm building or a tree maybe identified as a reference point in part of the series, but this may not feature in other photographs in the series, making the determination of changed shoreline position difficult. The difficulty in determining historical shoreline changes are documented by Crowell *et al.* (1991) and Anders and Byrnes (1991). The recommended data set of 50 to 100 years given by Gibb (1994) is not at all realistic given that these data problems exist. Todd points out that in New Zealand, only 50 years of survey data could be used with confidence.

Many of the local authorities, who have responded to the submission process, indicate that fulfilling the data requirements of the methodology would be difficult (if not impossible) as they lack the necessary human, scientific and financial resources (Benn, Todd). Present databases within local authorities are scarce and inadequate, as data collection in the coastal environment has not been a high priority issue. In many instances, series of aerial photographs are non-existent, and there are no other forms of historical data which could be used to determine rates of long term shoreline recession. These rates of long term shoreline recession are important as they are a major contributing factor in the formulas determining the multiple coastal hazard zone. The historical data limitations have also been recognised in earlier evaluations of the coastal hazard zone technique. In addition, Healy (1980) outlines the difficulties in obtaining data, due to the fact that extensive aerial surveying and comprehensive beach monitoring systems do not exist in New Zealand.

Monitoring of Coastal Hazard Zones

When setting out recommended formulae for coastal hazard zones, it is also important to indicate what requirements are needed to monitor and review the resulting coastal hazard zone. Many of the submitters have observed the absence of monitoring and review provisions in Gibb's methodology (Swales and Smith). Due to the physical dynamics in the coastal environment, it is important that local authorities reassess any designated zone that is responsive to changing conditions in the physical environment. Important questions concern the time needed to update the calculation of the zones and the frequency of monitoring needed to provide information for regular updates of zone calculations (Ramsey, Crozier). Given the unavailability of present day data, it is important to obtain information that ultimately improves the database underpinning the calculations for the multiple hazard zone. Since monitoring is a requirement in Section 35 of the Act and local authority resources are limited, it is clear that national guidelines would facilitate basic monitoring and that research is required into maintaining coastal hazard zones in vulnerable areas. Environment BOP raised an important issue of who pays for all of the monitoring and data collection given that their zone straddles, in a lot of cases, regional council jurisdiction and territorial authority jurisdiction. This issue also relates to the lack of human, scientific, and financial resources mentioned earlier.

Coastal Management Objectives Achievement

The adequacy of Gibb's coastal hazard zone methodology for achieving multiple coastal management objectives is also questioned (Kirk). The focus of the report is a single technique to reduce the risk to assets and elements from natural hazards in the coastal environment. In the Resource Management Act regime, this management objective is subservient to other ecological, social, economic and cultural considerations, especially given the focus of the definition of sustainable management. A balance is implied when looking at the sustainable management definition. Ecological considerations can not be divorced from the other social, economic and cultural issues. The methodology could possibly be used further in addressing other coastal management objectives, but this detail is missing from the methodology presented.

In order for a local authority to include provisions and rules about coastal hazard zone in its plans, it would need to justify these as being the most appropriate method for achieving the purpose of the Act in relation to its functions in the coastal environment (see S32). This may not be possible if the chosen methodology is addressed to only one coastal management objective. Given that various values and uses need to be addressed in coastal management, it would be vital that any method chosen could fulfil a number of objectives in the coastal environment. Therefore, a multiple-objective based planning and management approach may be more suitable. It is this multiple-objective approach that is implied in the sustainable management definition of the Act.

Another concern is raised about the idea of dividing the coastal hazard zone into three separate risk zones (Hastie). Given the dynamic nature of the coastal environment, it would be difficult from a planning perceptive to develop and maintain polices in an environment that is constantly changing. It is also argued that no extra benefit will be gained from identifying these three separate risk zones and if this is not done it could cause unnecessary confusion (Healy).

The report is also noted for its silence on the nature of planning methods that would be beneficial in implementing the technique and the three separate risk zones that are identified (Neale). Given that the purpose of the report is to provide local authorities with guidance on dealing with natural hazards in the coastal environment, this guidance is limited only to the determination of the

coastal hazard zone. No indication is given on the types of risk reduction measures that may be utilised to fulfil the purpose and objectives of imposing the coastal hazard zone such as education programmes, service provision and regulation. The coastal hazard zone is only as good as the planning methods that used within it (Hastie).

Better definition of the coastal hazard zone is required to enable effective implementation in natural hazard policy (Neale). It needs to be clearer as to what the is purpose of the zone, and the three divisions within it. This issue is related to the lack of institutional guidance given to planners for the implementation of the result of the methodology.

Consistent Planning Horizon

The choice of planning horizon is important in applying Gibbs' methodology. The horizon should allow for a reasonable projection of the long term trend of shoreline retreat, the cumulative effects of sea level rise, the expected occupation life of buildings and essential services on properties. The Building Act 1991 provides guidance by prescribing that the minimum specified intended building life be 50 years. This will be useful when appointing a planning horizon. Warrick *et al.* (1993) suggests a planning horizon of 100 years which coincides with the predictions of both the international bodies investigating the effects of climate change and the expected durability of buildings within the coastal environment. They also suggest that the planning horizon be flexible enough to enable variations for different types of development in the coastal environment. For example, low intensity development such as recreation may require a smaller planning horizon.

4.2.1.2 Physical Context

The themes apparent in the physical context are: methodology definitions, Factor L, double counting in hazard formula, past predicting the future, Bruun Rule limitations, safety factors and other effects of climate change.

Methodology Definitions

For the methodology to be adequately understood by those who need to implement it in the preparation of policy statements and plans, there needs to be clearer definitions of the terms used within the methodology. Cases in point include the definition of the nearshore and offshore zone (Rennie). Zones within the surf zone of the beach system are presently being debated as to what

point in space they occupy. When calculating expected erosion from sea level rise, definitions are important influences on the nature of the data collected and the issues discussed. The risk of coastal hazards arising from sea level rise has increased the importance of hazards planning in coastal management. In developing policies and adjustments, it is essential that there is a high degree of certainty as to what the definitions mean when they are used in that particular methodology.

Factor L

It is generally agreed that the inclusion of factor L is a significant step toward fulfilment of NZCPS provisions, and that it does have the ability to incorporate complex features when appropriate (Rennie). Factor L in the equation represents the width of coastal features that will provide a buffer, at the end of the planning period, against the effects of natural hazards. However, some criticism has arisen from the lack of definition of the L factor. Clearer guidelines are being requested by Neale about the dimensions of the feature that should be used within the equation. The current definition, which is given as the horizontal distance of representatives natural features, appears to be too rigid to use as an approach to protect the natural character of the coastal environment elements. Practitioners and researchers fear that the factor will not incorporate the landform features fully when used in the CEHZ equation. Subsequently, inclusion of the current landform factor may not truly represent the natural landform features in question (Swales and Smith).

Double Counting in Hazard Formula

Here submitters question the logic behind the multiple coastal hazard zone. The basic calculation is difficult to understand. The principle is to add together all the individual hazard zones to obtain a coastal hazard zone width, that is the multiple hazard zone = CEHZ + CLHZ + CWHZ + CFHZ. This equation allows for two alternative interpretations. The first interpretation is that all the zones will be added to give a grand total width. For example:

CEHZ = 30 m
CLHZ = 30 m
CWHZ = 70 m
CFHZ = 100 m
therefore Multiple hazard zone = 230 m

The major criticism of this interpretation is that double counting of some factors will occur in the equation, thus leading to an unnecessarily wide coastal hazard zone (Hastie, Crozier, Brookes, Benn). The addition of the individual hazard zones implies that the effects of the hazards are additive whereas they are interactive. For example, there is a clear relationship between the coastal erosion and coastal flooding hazard zones (Neale). The second interpretation is the multiple hazard is the extent of the largest individual hazard zone determined. Using the above example, the multiple hazard zone would be 100 metres. Hastie argues that this interpretation of a single hazard zone which extends inland to the maximum extent of any of the component hazard would be appropriate. Adopting the wider zone is not wrong given the precautionary approach to management decisions. But in having such a wide zone, it will be important to be able to justify the width to politicians within local government as well as the public.

Past predicting the Future

In geological terms the past does not always necessarily determine the future (Healy, 1987). This point has been reiterated by many of the submitters and they caution the use of this simple relationship (Shephard, Neale). The physical context of the coast is evolutionary in nature - a continual process of change. This evolutionary nature is exacerbated by land use in the coastal environment. Gibb's methodology assumes that the change will be constant in the coastal environment, and the change is able to be predicted from past trends. This could be untrue given that different forces and actions are occurring in the physical context during present geological time. Presently, the physical environment is enduring deplorable pressures and impacts from human activities at a scale and intensity never generated or experienced before (Bollard, 1995). Healy and Kirk (1992) validate this point with their following comment.

> *nothing is constant in this environment except for change*
> *(my emphasis)*

This statement is applicable to all contexts in resource management as evolutionary changes in processes are constantly occurring.

Bruun Rule Limitations

As stated in the description of Gibb (1994), the Bruun Rule predictions are limited to sandy beaches and this point has been acknowledged by the South Island submitters who comment that sandy beaches only make up 30% of the coastline in New Zealand. The applicability of this technique to predict sea level induced erosion on other beach types, for example, gravel and cliff beaches (Todd, Benn) is questionable. Evidence after tectonically induced sea level rise in the Bay of Plenty and after the Edgecombe Earthquake of 1987, indicates that beaches may behave contrary to the Bruun Rule, therefore should be treated with caution (Swales and Smith).

Physical Uncertainty and Safety Factors

Given that we have little knowledge about the nature of coastal processes which operate within the land-water interface, the Department of Conservation (1994a) recommends a precautionary approach to management decisions. Gibb's methodology attempts to deal with the physical uncertainty by including a safety factor into the equations. However it is felt that this safety factor does not adequately cover uncertainties in the physical context as it does not reflect the errors in the data collected (Todd). In order to deal more sufficiently with uncertainty, safety factors should be applied to individual variables used within each of the equations. For example, safety factors should be applied to factors R, X and D. Submitters believe that safety factors need be applied to overcome the uncertainty associated with each (Marra, Ramsey, Healy). Safety factors would address the uncertainty that arises in trying to predict how climate change affects the coastal environment. This uncertainty has not yet been considered thoroughly in each equation.

Other Effects of Climate Change

Other effects of climate change have not been considered by the methodology. Sea level rise and associated accelerated coastal erosion is recognised as a major resource management problem, but other, expected effects, are not. These include increased storminess and the increased occurrence of tropical cyclones in New Zealand, which are particularly important in policy development for natural hazards. Addressing the effects of sea level change should include consideration of both the potential for sea level rise and lowering in the methodology (Swales and Smith).

Global warming induced climate change should not be the only climate change factor to be considered. Biennial southern oscillations also cause change in the local climate, and the effects of these have been discussed in chapter three. No consideration of these issues are suggested in the methodology, when assessing the effects of climate change (Hastie, Swales and Smith, Todd).

4.2.1.3 Socio Economic Context

The themes apparent in the institutional context are: differences between assets and elements, effect on coastal property owners and property value, human interaction in the coastal environment and identification of what is at risk.

Differences between assets and elements

The use of element in Gibb (1994) to describe what is at risk in the environment has been criticised (Rennie). It has been pointed out that the definition of element follows an asset orientated definition rather than defining it in terms of the ecological and geomorphic sense. Consequently ecological and geomorphic elements have not been considered as entities which have intrinsic value, rather they are considered as having utilitarian value. The implications of this is that the focus of the methodology is limited in its objectives. This criticism relates directly to the coastal management objectives achievement limitation already recognised.

Effect on coastal property owners and property value

In justifying the use of coastal hazard zones, Gibb states (without reference to other expertise) that there is evidence which shows coastal hazards have devalued properties by up to 30 per cent. The question asked by the submitters, 'is what is the effect of imposing a coastal hazard zone on the coastal properties value?' (Hastie). On developed coastlines, the potential for property devaluation is high due to potential threats inferred by imposing a coastal hazard zone. The imposition of a multiple hazard zone would imply to prospective buyers the property will be subjected to a number of hazards in the near future and is perhaps not worth the trouble of buying.

Human interaction in the coastal environment

Human activities in the physical coastal environment is a significant part of New Zealand culture, whether it be residential or recreational. Whatever the activity, most have the potential to result in some form of exacerbation of natural hazards. For example, photograph 3 at Raumati Beach and photograph

8 a and b at Himitangi Beach (see Appendix One) show residential development in the coastal environment and the resulting hazards. In terms of residential activities, the home and associated infrastructure may become threatened assets. In terms of the recreational activities, many of the actions undertaken accelerate natural processes such as erosion. For example, trail bike riding in coastal dunes can lead to accelerated coastal erosion, which can then lead to increased coastal flooding as the protective element has been damaged (Healy, 1978). The methodology is criticised for not acknowledging this human interaction and its effects on the occurrence of natural hazards (Benson, Kirk).

Identification of what is at risk

The methodology has been criticised for addressing the problem before the problem has been properly identified. To successfully develop a management framework for natural hazards in the coastal environment, it is important to identify what assets, values or elements are actually at risk from natural hazards in the coastal environment (Crozier). From this recognition of what is at risk, the development of natural hazard policy and adjustments should follow. It is important to recognise that Gibbs methodology is not the only avenue for local authorities to impose objectives, policies and rules to facilitate hazard protection. Other methods are available. For example, the local authority may chose to facilitate the use of land care groups to fulfil a number of coastal management objectives. The choice made will depend upon the seriousness and the potential of risk and damage to assets and people. An assessment of the risk will help determine the appropriate method that should be chosen. In some instances the continuation of structural defence is the only option, given the severity of the problem and the surrounding environment.

4.2.1.4 Cultural Context

The theme apparent in the cultural context is the effect of the methodology on coastal iwi, traditions and values. This theme, in this context, is based upon singular comments made by a handful of submitters. Generally comment from submitters about this context was not present.

Effect on Coastal iwi, traditions and values

Maori and their activities fulfil both this context and the socio-economic context, although general Maori activities fall into the domain of the socio-economic context. For example, if they live in the coastal environment and they subsequently enjoy everyday recreational activities. Cultural aspects come

through in the consideration of the cultural context. Maori have special affiliations with the coastal environment and they apply environmental virtues (as identified in chapter three) in their use of the coastal environment.

Gibb (1994) is noted for his lack of acknowledgment and respect for the cultural context. The definition of elements given in the methodology could afford protection to the cultural sites but this may not be adequate for all Maori needs. The coastal environment is a significant area for the siting of *urupa* (burial grounds) and other sacred areas. These are not usually publicly well known areas, as the virtue of tapu commonly applies. Maori have retained the locality of these sites from local authorities to protect them from desecration and damage. In some cases the exact location is not known by Tangata Whenua, although they do know the general area in which it is located. The methodology requires that at risk elements be quantified to enable protection and this could offend cultural tradition. Although it is important that these areas are known, they need not be fully quantified in order to retain the sacred nature of the site. Wellington Regional Council, University of Canterbury and Victoria University have noted that the methodology fails to recognise Maori values and traditions which is required to satisfy the cultural requirements of the Act.

4.2.2 Interview Responses to Gibb's Methodology

The interview responses extend the comments made in the submission process. Many of the concerns voiced have already been commented on in the previous discussion. Although they do add some useful additional comments to the topics already discussed, as well as new concerns which need to be noted. The general feeling is that the methodology will be hard to implement due to its limitations. It should be noted that three of the four regional councils are supporting the coastal hazard zone concept in their natural hazard planning. The additional concerns will also be discussed in the four context of this thesis: institutional, physical, socio economic and cultural.

4.2.2.1 Institutional Context

In the institutional context, a number of additional comments were made by the interviewees. These comments relate to: national consistency, coastal management objectives achievement, acceptability at territorial authority level and preparation of LIMs and PIMs.

National Consistency

Councils 3 and 4 noted limits to developing a consistent approach to natural hazard policy and adjustment development. Each hazard situation is unique and therefore requires individual responses that fit their particular situation. The methodology is criticised for its simplistic nature which does not account for these unique situations. Another limitation to the development of a consistent national methodology is the presence of institutional variation through out the country. Variation occurs in the capacity and commitment of the councils in fulfilling the methodology. This variation is noted mostly in the availability of resources to obtain the information needed for the methodology. Council 2 notes that the data requirements for the methodology are beyond many local authorities resources and ability.

Coastal Management Objectives Achievement

In addition to the comments made about coastal management objectives achieved, an important consideration was noted by council 3. Any decision made by a council is subject to appeal to the Planning Tribunal. This council noted that the methodology would not be easily defendable at the Tribunal if it werer aimed only toward one coastal management objective. The methodology would be more useful if it was directed at achieving a multiple number of coastal management objectives. A less quantitative methodology would be able to achieve this, as more values and considerations could be incorporated.

Acceptability at Territorial Authority Level

Councils 1 and 3 have noted that in supporting the methodology and using it as policy guidance, they are finding it difficult to have it accepted by territorial authorities. Council 1 is presently debating the coastal hazard zone width as their point of view differs from that of the territorial authority. The success of the zone that is determined by methodology is dependent upon the planning methods that are enforced for that zone. As territorial authorities have the responsibility for the control of the use of land, it is important that they accept the zoning and develop appropriate methods to achieve the zone's purpose.

Preparation of LIMs and PIMs

Land information memorandums (LIMs) and project information memorandums (PIMs) are an essential part of the building process in New Zealand. Council 1 has noted that the designation of a coastal hazard zone will

help territorial authorities provide adequate information about the possibility of natural hazards to prospective property buyers and developers.

4.2.2.2 Physical Context

The policy and adjustment checklist given in chapter three considers many issues in the physical context. The main issue of concern noted by the interviewees is the lack of recognition of the diverse range of natural hazards coastal processes and coastline types present in New Zealand. Others issues such as interaction between hazards and the protection of critical resources do not appear to warrant much attention.

The diverse range natural hazards and coastlines in New Zealand has been noted by the interviewees. They all identified that some hazards are not adequately dealt with by the methodology, especially the shifting river mouth hazard (Council 1). There is also a lack of recognition of diverse coastline types and this is criticised as sandy beaches are not the predominant coastline type. Council 4 mentioned estuaries and the associated ecotones as another form of coastline that is not adequately addressed by the methodology. This thesis has documented this diversity of ecology, processes and elements present in New Zealands coastal environment (see table 3.1). Although Gibb (1994) addresses sandy beaches as a type of coastline on which the methodology would be useful, the report lacks guidance needed to manage coastal hazards present at other coastline types (Kirk). For example, estuarine coastlines, gravel beaches and resistant rocky coastlines are generally ignored. The limitations of the methodology in relation to gravel beaches have already been outlined in chapter three. This is an important factor as other coastline types will require different variables to be considered in the coastal hazard zone equations. For example, erosion from sea level rise on a gravel beach and resistant rocky coastlines will require different approaches of determination.

4.2.2.3 Socio-Economic Context

In the socio-economic context, additional comments are made about public acceptance, social costs of natural hazard problem and human interaction in the coastal environment.

Public Acceptance

When further developing coastal hazard zones on already developed coastlines, it is important to gain public acceptance. This point is noted by all

the interviewees. Council 4 states that the imposition of a zone on a developed coast creates hysteria and paranoia among coastal residents, and therefore creates public opposition to the zone development. The need for public acceptance is illustrated by the incorporation of a 30m foreshore yard in the Proposed North Shore District Plan. In effect this foreshore yard is representative of what Gibbs methodology proposes as a method to avoid natural hazards. Hull (1995) explains the situation that resulted from the release of this document.

> *It all hit the fan at the end of October 1994. The North Shore City Council unveiled [the] Proposed District Plan containing the now notorious section on the 30 metre "foreshore yard". Affected householders were outraged, and the media rubbed its hands in glee as a barrage of letters poured into the newspapers and public demonstrations took place.*
> (Hull, 1995, 7)

On undeveloped coasts it is politically easier to create hazard zones, but in many cases the natural hazard issue is not perceived as an important problem as elements or assets are not at any risk, therefore no need for protection measures to be undertaken.

Human Interactions

Human interaction in the coastal environment is not recognised by the methodology. Humans and their activities in the coastal environment are known accelerators of natural hazards and this is not considered by Gibb (Council 4). Because of human interaction in the coastal environment, there is a social cost involved when developing policies and adjustments. Questions will be raised about what the effect of the imposition of the zone will be on peoples property values and economic rights in relation to development of their land (Council 1 and 2).

4.2.2.4 Cultural Context

The main theme present in the cultural context is that Maori wish to be involved more actively in the development of coastal hazard polices and adjustments as areas of cultural significance may be affected by these protection methods if adopted.

4.2.3 General comments about the Methodology

The submitters and interviewees provide an excellent evaluation database, and there are few issues on which they can be criticised. The following will discuss these issues as well as discuss the areas that were not addressed by the submitters and interviewees. The discussion will follow in the order of the contexts that is present in previous discussions.

The submitters and interviewees can be criticised for not considering all contexts in their review of the methodology. As seen from Table 4.2, 4.3 and 4.4 most of the comments made relate to the physical and institutional context. Very little mention is made of the socio economic and cultural contexts. This is on a par with international natural hazard literature as seen in chapter two. The sustainable management regime presented in chapter three is contextual in approach, therefore this review would not constitute a full evaluation of the technique. The lack of appreciation of certain contexts and attributes given in chapter three present areas that require more research into the effects and implications of the methodology. For example, the effect of the coastal hazard zone and its planning methods on coastal property values within the calculated zone. The interviewees commented more on the socio economic and cultural context, but these were a result from the pointed questions asked in the interview process. General discussion about the methodology did not raise these contexts and the resulting issues.

The submitters and council comments are useful in measuring our understanding about the limitations of the methodology, especially recognising the constraint in using the Bruun Rule as a method to estimate shoreline erosion due to sea level rise. The submitters and interviewees also raise the awareness of the uncertainty associated with the determination of the physical variables needed to complete the methodology. However, very little in the way of alternative courses of action are suggested by the submitters and councils. They did not provide actions or guidance that could alleviate these limitations of the methodology and make it more applicable and useful. Without their input as to what a better methodology could include, it is difficult to imagine how further assistance could be given by national departments to local authorities in planning for natural hazards in the coastal environment.

The methodology developed by Gibb is based dominantly around the application of scientific physical knowledge to a anthropocentric problem,

namely natural hazards in the coastal environment. The report is concerned with the protection of elements at risk in the coastal environment. Gibb (1994) defines elements at risk as being the population, properties, economic activities, including public services, etc. This definition of elements could be extended to afford protection to cultural sites of significance to Tangata Whenua. The focus on the protection of the elements [assets] limits the methodology in the fulfilment of all the aspects in the four contexts as noted by Rennie. He highlights throughout the report that the term ecology is inadequately portrayed and needs to be refined to give a clearer definition and understanding.

Intrinsic values of elements in the physical context are not addressed by the formulas given in the methodology. Factor L (landform factor) may attempt to provide intrinsic value protection, but the justification for the inclusion of this factor given by Gibb is based around the ability of these features to provide protection of the assets from the effects of natural hazards, thus fulfilling policy 3.4.2 and 3.4.3 of the NZCPS. Council 3 considers this limitation of the methodology, and suggests that the landform factor will not adequately fulfil the provisions of the Act requiring intrinsic value protection, due the to methodology being directed toward one coastal management objective.

The zones formed by the methodology represent potential administrative boundaries which will, be in turn, formulated around the boundaries prescribed in the Act. Within these boundaries or zones, planning methods will be used to achieve the natural hazard avoidance objectives. These administrative boundaries unfortunately do not conform with natural ecological boundaries (Council 4). Natural zonation pattens are a characteristic feature of coastal environments (Carter, 1988), with each zone significant in determining the form and functioning of associated ecosystems. If administrative boundaries do not coincide with these natural ecological boundaries, the form and functioning of ecosystems could be irreversibly damaged.

4.3 Conclusions

The evaluation of Gibb (1994) has highlighted main areas of concern regarding its implementation and its effectiveness in achieving coastal hazard management objectives. The evaluation has also identified areas which need

further investigation, and these will be addressed in chapter five. The following discussion comments on the main concerns identified in each context in the evaluation process.

Particular concern about the instituional context has been raised in regard to being: technical capacity and monitoring requirements of local authorities, institutional vulnerability, an integrated and holistic approach to management and alternative hazard policy and adjustment options. Substantial resources are required to complete the methodology which is beyond the technical capacity of many of the coastal management sections of the regional councils. The data requirements from the physical context also make the methodology hard to implement at the local authority level. In a lot of cases this is unrealistic, given that local government funding is limited. Therefore, whatever information and data is available will have to suffice. Institutional vulnerability means the use of the methodology for just one coastal hazard management objective will not be enough justification for the inclusion for use. The local authority should use the concept of a coastal hazard zone, in its wider sense, as a method for achieving other coastal management objectives in conjunction with natural hazards management. The evalution has raised the need to consider other possible methods to alleviate the coastal hazard problems present in New Zealand.

Concerns are raised about the uncertainty that is associated with the coastal hazard calculation due to high degree of uncertainty in the physical context. This may lead to the failure of the methodology in the public arena. To over come this, a less quantitative concept could be used to incorporate other coastal management objectives, thus gaining public credibility. Another area of concern is the lack of appreciation of diverse coastline features present in the physical context, which limits the methodologies applicability around New Zealand.

The socio economic implications of the methodology are presently unknown. Although some concerns have been noted in the evaluation. Public opposition to the zones was noted by submitters, even though the zone is intended to protect the public from the natural hazards. For some property owners, the issue is that the methodology represents a non-structural solution that does not stop their properties falling into the sea, therefore not achieving their personal hazard management goals. Other property owners see it as a threat, as it

implies certainty that natural hazards will occur in this zone, thus damaging their property. Consequently the application of zone as a method of natural hazard adjustment requires public endorsement and acceptance.

The implications of the methodology on the cultural context are also not obvious. The evaluation has highlighted that Tangata Whenua wish to actively participate in the coastal hazard policy and adjustment development process. The methodology offers potential for sacred and significant sites to be protected. though this can only be achieved if Tangata Whenua are actively consulted and involved in natural hazard policy and adjustment development.

CHAPTER FIVE

CONCLUSIONS AND THE WAY FORWARD

Chapter five draws together the findings of chapters three and four, providing suggestions for the improvement of policies and adjustments to natural hazards in the coastal environment. Directions and recommendations for further research into the development of policy and adjustments are also presented.

5.1 Principle Thesis Findings

The principle aim of this thesis was to develop a theoretical model to analyse policy and adjustment for natural hazards by improving the preparation of these policies and adjustments. This model is then tested in the evaluation of Gibb's draft coastal hazard zone methodology. From both an international and New Zealand perspective, it is evident that some attributes contributing to the theoretical model have been more thoroughly researched than others. For example, much of the earlier natural hazard research focuses on how the individual behaved toward a natural hazard, whereas later research incorporates many other attributes from other contexts, such as sustainability, critical resources protection and the physical diversity of the areas being affected. For instance, the physical context is currently given increased recognition as a crucial factor in the development of policy and adjustments to natural hazards. This recognition arises from the further understanding of the effects of physical processes on the implementation of previous policies and natural hazard adjustments. Previous policies and adjustments tended to rely on structural solutions, which have, in a lot of cases, failed due to the fact the coastal erosion process has continued, in spite of sea walls and groynes being constructed for protection of people and property. Natural hazards researchers now advocate a contextual (institutional, physical, socio-economic and cultural) approach or balanced view of natural hazards, where all contexts are considered when developing policy and adjustment to natural hazards.

The concept of sustainable management was adopted by the New Zealand government in 1991 in order to guide the management of natural and physical resources. This, in turn, has forced planners and mangers to be contextual when developing polices and adjustments to natural hazards. The legislation's focus on environmental effects also provides planners with the potential to

develop new planning methods for adjustments to natural hazards. The policy and adjustment model developed in this thesis for the New Zealand situation reflects this additional new contextual approach. The approach advocates the full integration of all contexts which requires the effects of policies and adjustments on these contexts to be considered in the preparation of policy and natural hazard adjustment.

The reality of the sustainable management concept is that it is difficult to implement in practice. Implementation of this concept requires a number of changes to occur within the frameworks of natural and physical resources planning in the institutional context, as well as the socio-economic context, in which planners operate. Planning frameworks are changing, although the transition phase, from old to new, is taking longer that expected (see chapter three).

The results of the evaluation of Gibb's (1994) methodology and submissions to the Department of Conservation in relation to the methodology highlight this need for a contextual approach when developing policies and adjustments. A multi-disciplinary approach, incorporating a number of key researchers and practising planners is required to truly achieve integrated development. This has been attempted by the Department of Conservation in initiating the technical review, but this approach has been unsuccessful as a consensus among submitters was not reached. The technical review is also deficient in the respect that no alternative solutions to the limitations identified in Gibb's methodology were presented.

In addition, the evaluation of Gibb's (1994) methodology highlights the issues associated with a desire for national consistency in regional approaches to natural hazard adjustment. The coastal hazard problem may be common to all regions, but differing circumstances in each region make each hazard situation unique. Physical, institutional and socio-economic variation within the regions makes it difficult to propose a consistent approach for the country as a whole. Consequently, it can be concluded a national methodology is ineffectual in achieving the Department of Conservation's original aim, although it has provided insight into the management problems associated with coastal hazards. It also provides the rationale for local authorities to consider other options when developing their coastal management plans and polices for their particular regions and districts.

The first generation of regional coastal plans have recently been completed under the new resource management regime. Under Section 79 of the Act, these plans are to be reviewed no later than 10 years after becoming operative. District plan reviews are also covered by this provision. The issues raised in this thesis will be useful in evaluating the effectiveness of regional coastal plans and district plans. If implemented, the results of the evaluation can be used as an assessment criteria when determining whether environmental outcomes in relation to natural hazard adjustment are achieved.

The conclusions of this thesis will also aid in the fulfilment of Policy 7.1.2 of the NZCPS (DOC, 1994a), whereby the attributes that are considered relevant in coastal hazard planning can assist in developing a national state of the coastal environment monitoring programme. The attributes which are identified should help to identify the areas which need to be monitored, resulting in an integrated, contextual, monitoring strategy.

5.2 Limitations of Research and Research Methodology

A broader evaluation should include other parts of the institutional context, as well as the socio-economic and cultural context. Expanding the evaluation group to include territorial authorities and central government would identify other institutional perspectives. Incorporating the general public and Tangata Whenua allows them to determine their own perspective and complete a fully contextual evaluation. The overall implication of expanding the evaluation base will be to increase available information about the implications of the methodology, especially in the socio-economic and cultural context.

The topic evaluation of Gibb (1994) undertaken in this thesis is qualitative in nature and the methodology is not compared with other coastal hazard adjustment methodologies. The resource management regime provided in the Act anticipates that adverse effects of natural hazards can be avoided, remedied or mitigated. Thus the potential exists to consider methodologies other than that developed by Gibb. Those methodologies may focus on remedies or mitigation of coastal hazards rather than limiting the options to the avoidance of the hazard. For example, the establishment of beach care groups to remedy natural hazard damage and the relocation of buildings and

infrastructure away from the hazardous area would be an appropriate approach in some communities.

The evaluation of Gibb's methodology could also be approached from a different angle in which a formal quantitative evaluation is used to compare Gibb (1994) with other forms of coastal hazard adjustment. For example, a cost benefit orientated evaluation could be undertaken, as implementation of a multiple coastal hazard zone is not cost-free to the general public, nor to the local authority implementing it. Although quantification of some benefits and costs may be difficult in a formal evaluation, as many involve assessment of public goods and values. For example, quantification the benefits of protecting peoples safety and the costs of such action to the community as a whole may prove to be difficult in practice.

5.3 Suggestion for the Improvement of the Preparation of Policy Statements and Plans

A number of suggestions can be made that will help in the preparation of policy statements and plan provisions for natural hazards. These suggestions arise from assessing the linkages between the contexts that contribute to natural hazard planning, and the specific attributes that have been identified in each of the contexts.

Linkage Improvements

Understanding linkages between contexts is a vital key in developing better policies and adjustments to natural hazards. Identification of linkages will enable a better understanding of what the possible effects and implications of particular polices and adjustments on each of the contexts will be.

- There is a need to increase understanding about the effectiveness of policies in achieving natural hazard management objectives, thus determining the links between the institutional context and the other three contexts. This will only eventuate through a thorough monitoring system that addresses all the effects of the natural hazard policies and adjustments.

- To over come uncertainty in the physical context, a precautionary approach is needed when developing policies and adjustments. In adopting this precautious approach, it will be important to understand the possible

implications on the other contexts. For example, being too cautious may result in paranoia among those in the socio-economic context who are affected by the policies and adjustments.

- A greater understanding of secondary and cumulative effects is needed. This means the less obvious linkages between contexts need to be investigated so strategic, long-term, decisions can be made about natural hazard policy and adjustments for the coastal environment.

- Planning for natural hazards should include consideration of future generations when assessing which effects of natural hazards are to be avoided, remedied or mitigated. Adverse consequences of the past are now being realised within the four contexts, particularly the effects of past coastal hazard polices and adjustments. There is a need to link these past results into the development of new policies and adjustments.

Attribute Improvements

Due to the sustainable management concept and the provisions given in the Act, many of the theoretical attributes of good practice are being considered throughout New Zealand, although some improvement in the policy and adjustment development process is still needed:

- More consideration and evaluation of alternative methods available for the reduction of risk associated with natural hazards is required. In considering alternative methods of hazard policy and adjustment, the wider aspects of coastal management should be incorporated. The credibility and validity of the policy or adjustment chosen will then be more easily defended in the public arena and before the Planning Tribunal.

- A holistic, integrated approach to policy and adjustment development needs to be advocated at all levels of natural and physical resources planning. This approach should be facilitated at the local government level, with additional guidance being offered from outsiders with experience and expertise in various fields relevant to the policy area.

- Realisation of the physical diversity of the coastline will aid in appropriate policies and adjustments being developed. As mentioned previously, each situation is unique, therefore requires a unique management response. In

doing so, a more effective policy and adjustment will result that achieves the desired natural hazard management objectives.

- Determining the degree of hazard within the region would be a step forward for policy and adjustment development, although before any management action is undertaken, it is vital that the degree and nature of the hazard are established. In doing so, the policy and adjustment chosen will subsequently reflect the particular situation.

- Developing natural hazard policy and adjustment requires input from the socio-economic context, as people's personal and development rights could be affected. These implications obviously need to be considered during the policy and adjustment development process (see chapter four).

- The role of Maori in resource management decisions need to be nurtured and that their views and aspirations are fully considered. They should be given the opportunity to actively contribute to the policy and adjustment development process.

Implications of implementing these suggestions

By implementing these suggestions, a contextually considered policy and adjustment should result. In the institutional context, it will mean that there needs to be more focus on obtaining quality information. It will also mean that this context will have to become less sectoral, highlighting the need for agencies to begin working together as multi-disciplinary teams.

In terms of the physical context, adequate consideration will need to be given to the constituent elements and processes for their own intrinsic, as well as utilitarian, value. Obtaining further information about the physical context will result in a greater understanding of the processes within. Consequently, the decisions made will better reflect the dynamics of the physical context, and will be less likely to result in adverse or inappropriate effects.

By allowing more active involvement of the socio-economic context in policy and decision making, the decisions made will be better informed and more responsive to the publics needs. This will mean the institutional context will need to be more receptive to involving the public in the policy and decision making process. Consequently, the socio-economic context will have to

mobilise itself in a co-ordinated manner if their views are to be considered appropriately.

This also applies to the cultural context; by involving Maori in decision-making, their needs and aspirations will need be met. As a result, the decision made will be more appropriate, as well as representative, of community's values in regard to the coastal environment. For this process to take place, there needs to be active facilitation of appropriate mechanisms that allow Maori to become more involved in the policy decision making processes.

5.4 Directions For Future Research

There will need to be a considerable amount of research undertaken in a number of areas to improve the methodology and natural hazards planning generally:

- Development of innovative planning methods will see the success of the adoption of natural hazard adjustment methodologies such as Gibb's (1994). Whether it be the multiple coastal hazard zone determined by his methodology or a similar concept, like the buffer zone or development setback concept, the planning methods implemented will be the key in successful natural hazard planning in the coastal zone. This research should be undertaken by the institutional context, with additional help being given from academic research.

- There is a need to develop integrated regional monitoring strategies that will provide essential feedback loops to asses the links between natural hazards policies and environmental outcomes. These monitoring strategies will also allow regional councils to assess the degree of hazard within their regions, enabling them to fulfil policy 3.4.1 of the New Zealand Coastal Policy Statement.

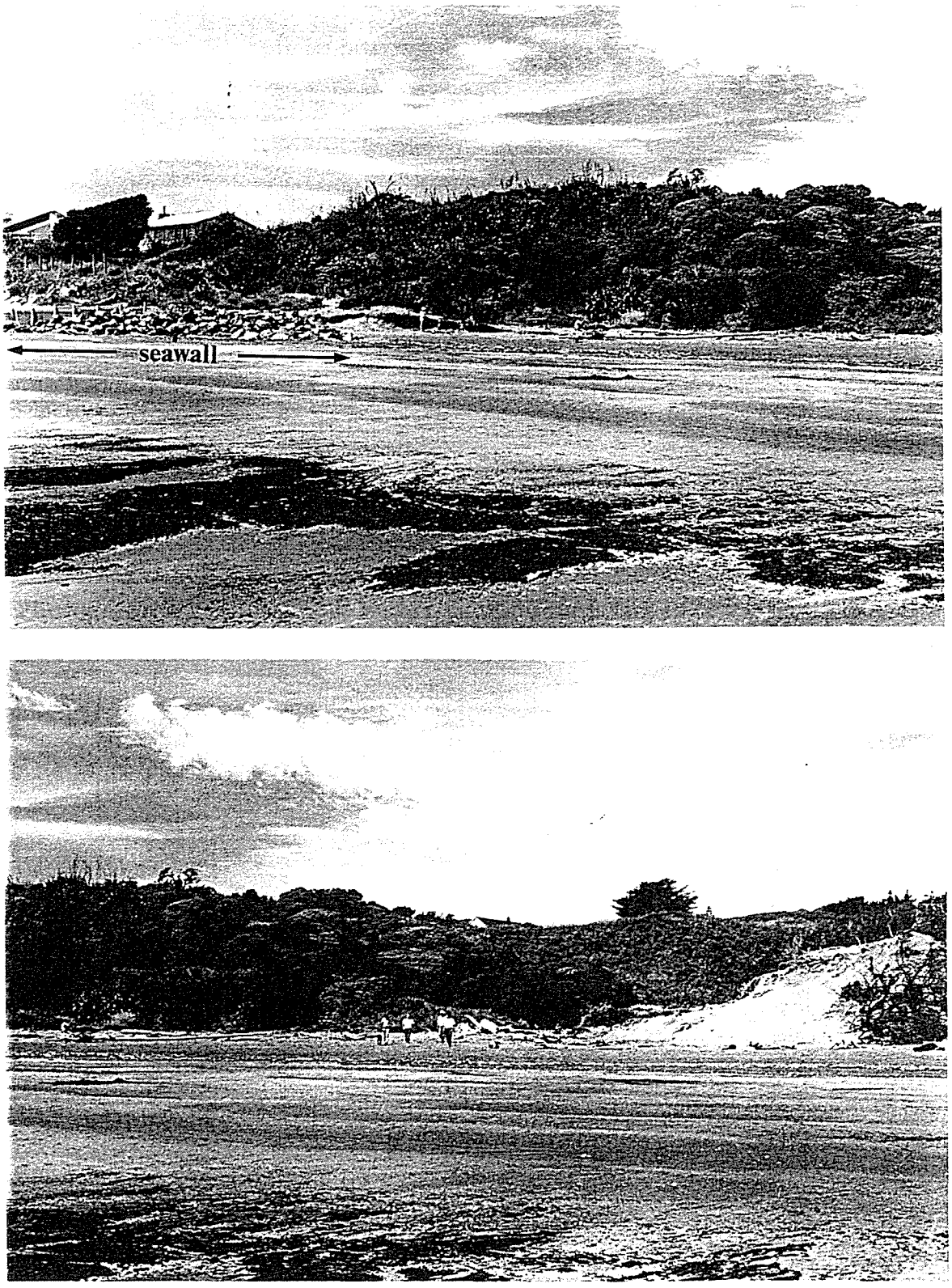
- Physical research is needed to aid local authorities in assessing the risk of natural hazards resulting from sea level rise - currently little is known about how diverse types of coastline react to it. By undertaking this research, the coastal hazard zone methodology could be applied to other types of coastlines.

- The socio-economic context is the area in need of the most research. The choice of natural hazard policy and adjustment will be dependent upon public acceptance. More investigation is required to determine the potential effect on property values and compensation values for property owners, who are affected by the coastal hazard zone, will also need to be determined.

- The presence of sites significant to Maori, which could be at risk from natural hazards, need to be identified. Because this information may be culturally sensitive, appropriate means for relevant information to be disseminated will need to be arranged between local Tangata Whenua and the authority involved.

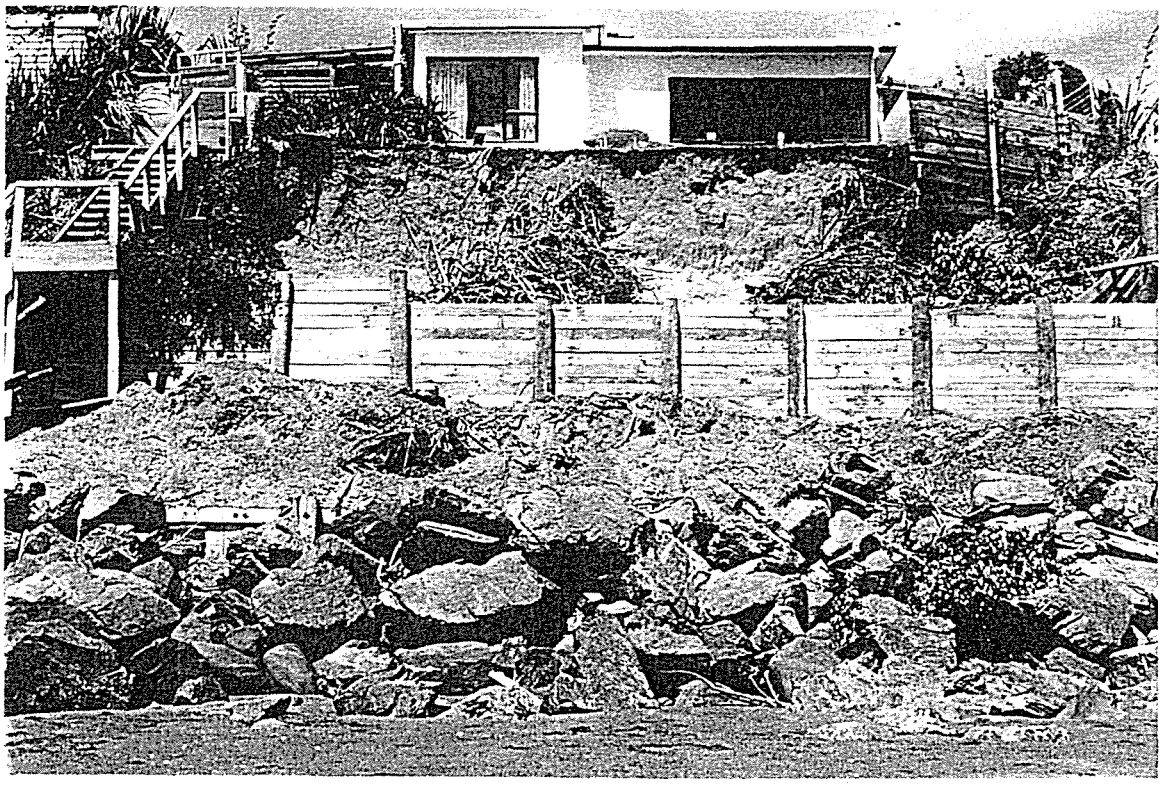
This thesis should enable those involved in planning for natural hazards to understand theoretical considerations, Gibb's methodology and the subsequent debate about its applicability to natural hazard planning in New Zealand. Additionally, good planning practice will improve if the recommendations presented in this thesis are applied.

APPENDIX ONE: Photographs of Raumati Beach and Himitangi Beach
Photographs taken 3 December 1995 and 18 November 1995 respectively

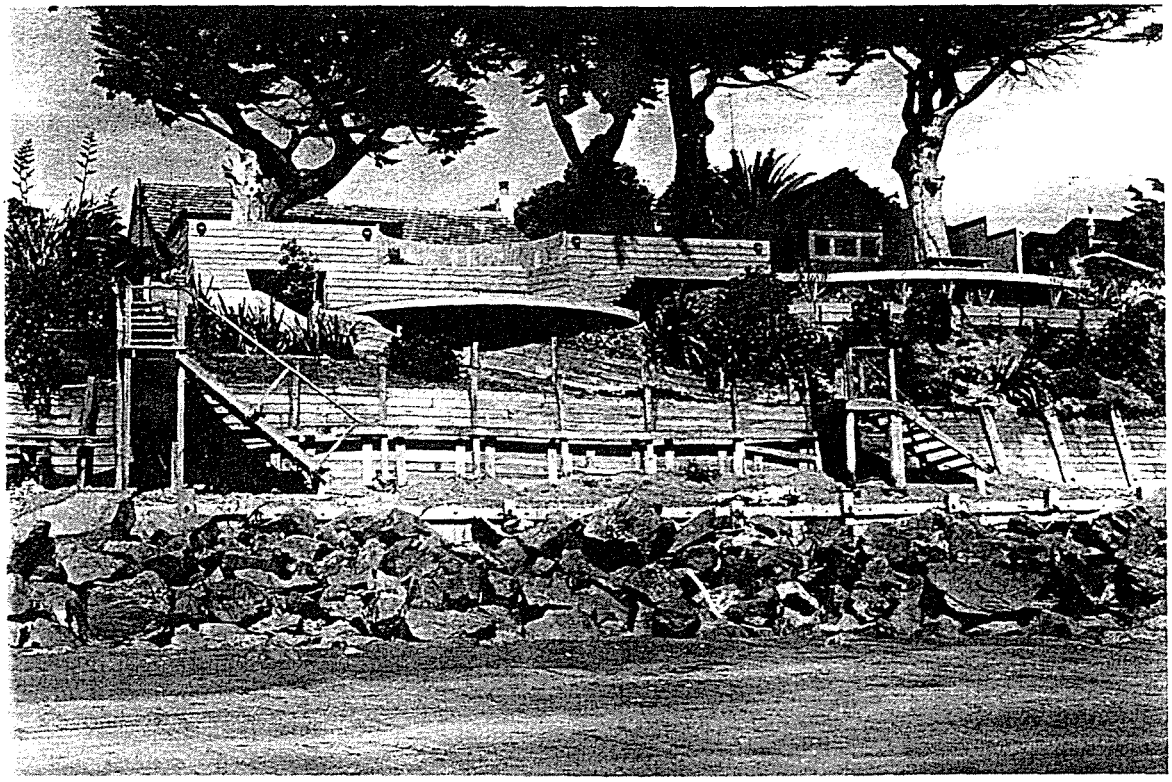


Photograph 1: Raumati Beach. Endwall Erosion effects. Wall built to protect residential area. In turn creates adverse effects on QEII Park Coastal Walkway.

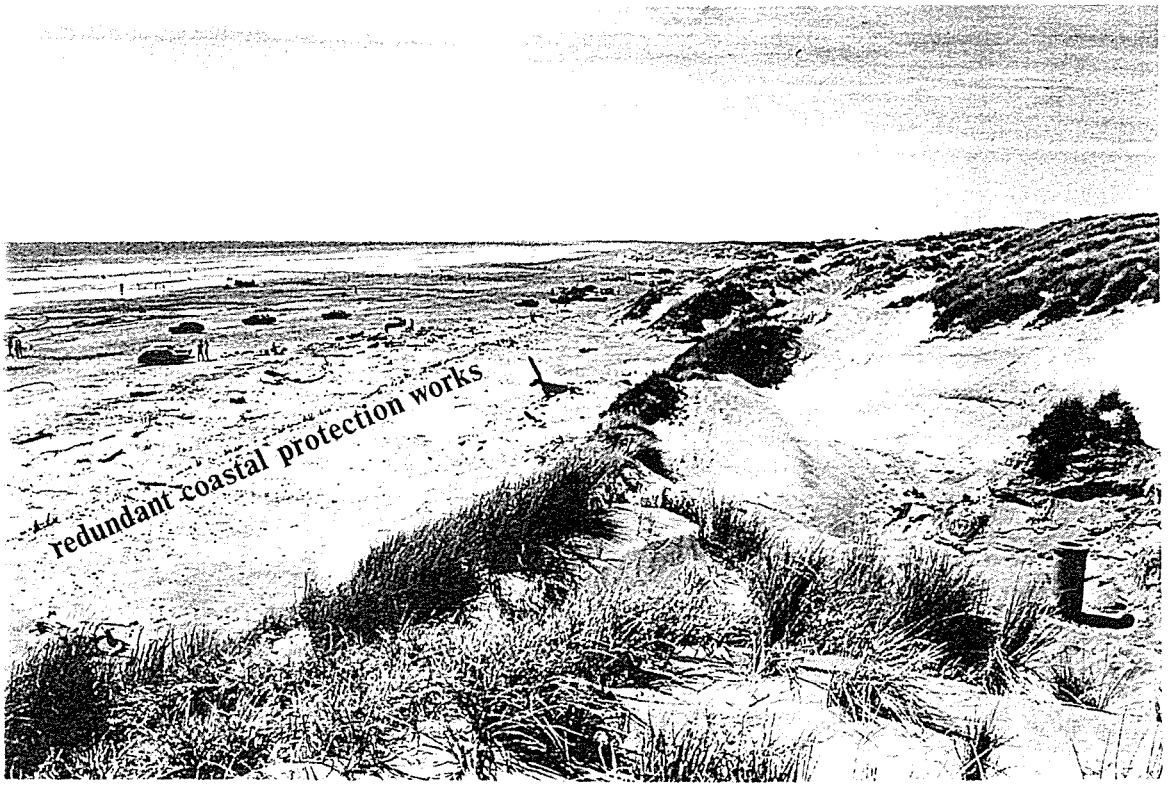
Photograph 2: Raumati Beach. Continuing Series of redundant structural protection. Note continuing erosion of the frontal dune.



Photograph 3: Raumati Beach. Redundant structural protection and the extent of damage caused by continuing erosion.



Photograph 4: Raumati Beach. Redundant structural protection. One final private attempt to create protection which is also aesthetically pleasing.



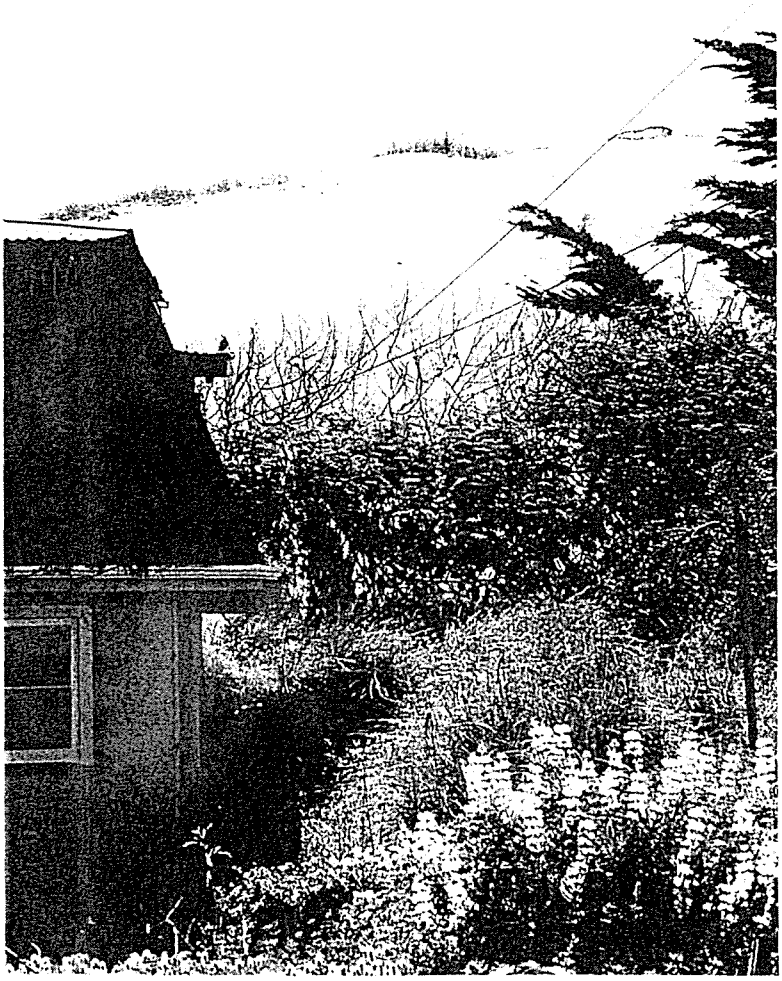
Photograph 5: Himitangi Beach. 3 issues illustrated:

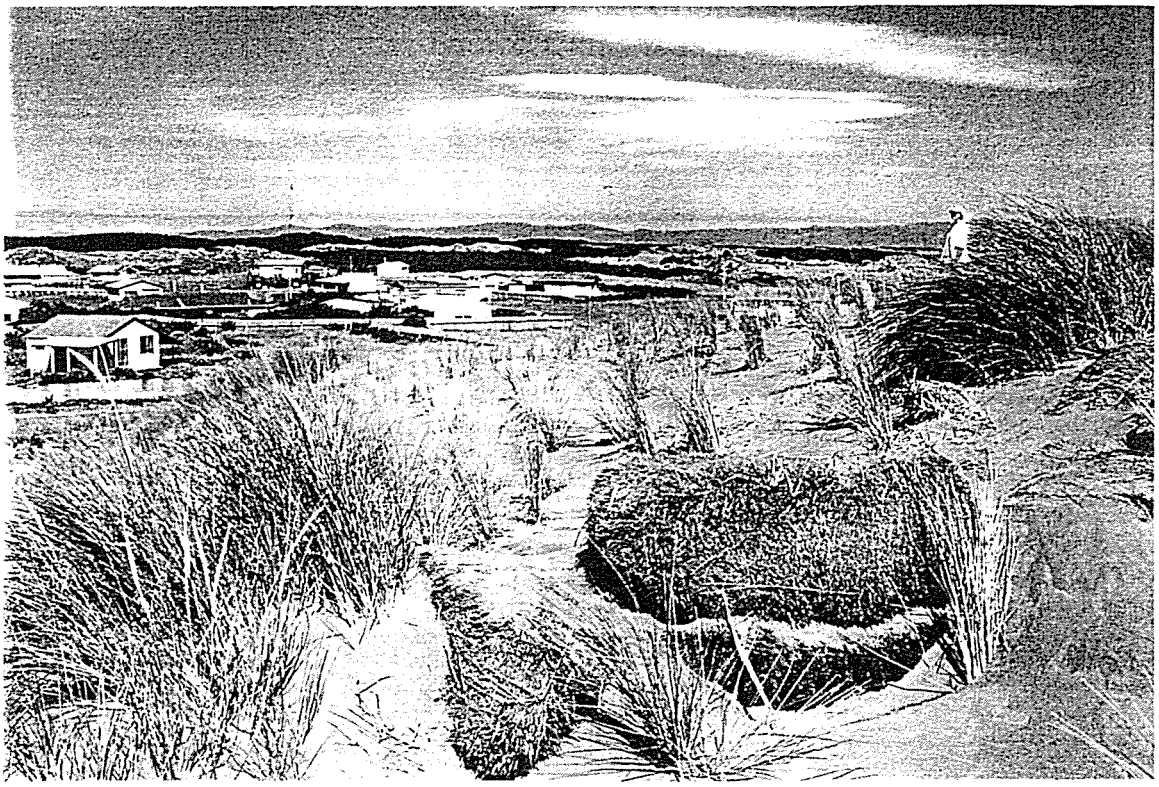
1. human interaction with the coastal environment
2. redundant coastal protection works
3. continued erosion of dune system

Photograph 6: Himitangi Beach. Natural erosion cut of dune system exacerbated by stream undercutting at base. Stream mouth was diverted by the Manawatu Wanganui Regional Council to alleviate erosion problem.

Photograph 7: Himitangi Beach. Detail of dune undercut by stream. The problem is also exacerbated by human interaction. Note the people playing in the dune system.

Photograph 8a and b
Himitangi Beach. The residential development on the inland side of the dune is experiencing sand inundation.





Photograph 9: Himitangi Beach. Naturally migrating dune stabilised through dune planting. The photograph shows the closeness of development to an active dune system.

Photograph 10: Himitangi Beach. Attempts by the Manawatu District Council to stabilise and protect active dune system.

THE ravages of coastal erosion are clearly seen in these pictures. Left, the floor has fallen out of this bach at Te Kopi Bay but it is expected to collapse completely during the next storm. Centre, the coastal road at Whatarangi Cliffs is down to one lane as the ground crumbles on the sea side and the hillside continues a gradual downward slide. And right,Te Kopi Bay, the once picturesque settlement between the sea and the coastal road is being eaten away by erosion.

Palliser Bay

2-95

Lone link to Ngawi slipping away

PART of the only road and popular tourist route to the South Wairarapa fishing village of Ngawi is sitting on a large earth slip moving towards the sea.

Stories: YVONNE CRAIG
Pictures: JO HEAD

South Wairarapa District Council works and services manager Ravi Mangar said today the whole hill, from the bridge at the Pinnacles to the coastal settlement of Te Kopi, has moved 330mm towards the sea and dropped down by 250mm over the past 20 months.

Cracks in the tarseal at the hill stretch right across the road from the shore side. The council has put up caution signs for motorists and cordoned part of the road off, making it one lane.

Mr Mangar said the road is still safe, with council staff checking the condition of it "almost daily".

He said the most movement is at Johnsons Hill, north of Te Kopi, and usually happens with wet weather.

The man responsible for Transit New Zealand funding for the district council to fix the road, Transit programme manager Ken Gilberd, was to look at the site today with Mr Mangar.

Some concerned residents from the coastal area were also going to meet at the site this afternoon.

Just how the road will be saved or if the slip can be stabilised is unclear at this stage, with investigations continuing.

"It's urgent, but urgency that requires other investigation and formalities."

Mr Mangar said because it's not just the hillside, but also the area at Te Kopi which is moving, it is "very hard to fix", and perhaps not just a question of shifting the road.

A Maori burial site on land at Te Kopi means the council can not move the road there back, he said.

But further south along the road where the sea is scouring out the cliff face below the Whatarangi Cliffs Road, the planned shift of the road back from the sea could be three months away from completion.

Mr Mangar admitted he does not know if the road will last until then. It all depends on what the weather and sea will do there before then.

Consultants' plans for the shift should be ready next week, with tenders being called in the next few weeks, Mr Mangar said.

In the meantime the road has been reduced to one lane and warning signs for motorists erected.

Mr Mangar said last year it was estimated the total cost of fixing the road at the cliffs, the slip and erosion near Te Kopi would be $1 million.

But the driver of the school bus which twice daily carries children over the entire stretch of coastal road worries about the safety of the children on his bus and sightseers using the road.

George Sanderson said yesterday: "I have had a bloody gutsful of being told the road is not dangerous.

"If something doesn't happen tomorrow — all hell is going to break loose if I don't get some answers."

Mr Sanderson said the cracks in the road by the cliffs have only happened in the last two months.

Te Kopi resident Norman Murray is also concerned about the safety of the children on the school bus.

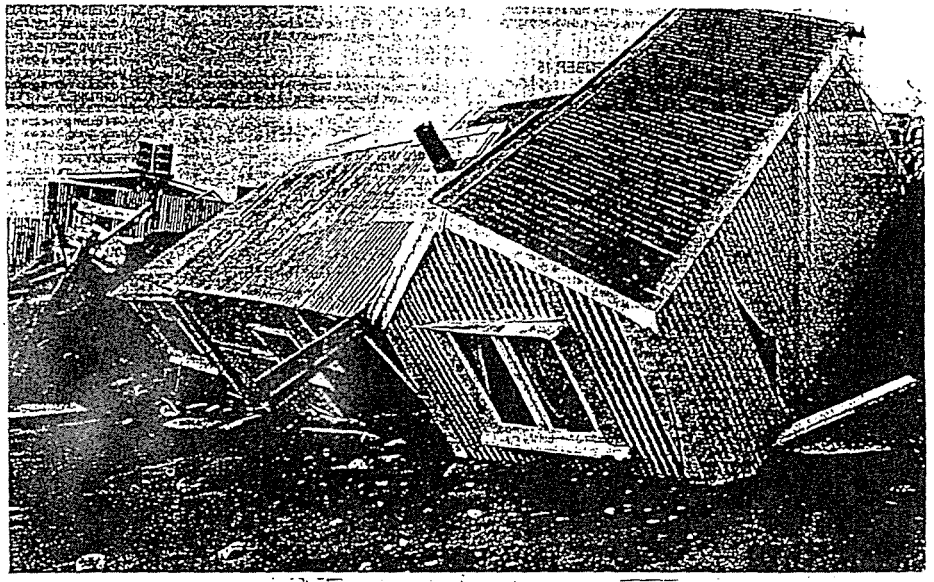
He said: "I do not want a Cave Creek happening up there with school kids."

Mr Murray has monitored the state of the road at Johnson's Hill since August. A lot of the cracks in the road there have happened just in the last few days, he said.

On September 8 cracks were ¼ of the way across the road, but by yesterday stretched right across the road, he said.

Mr Murray calls tarseal which was put over cracks in the road about five weeks ago nothing more than "a bandage".

He said if water gets inside those cracks it will "take the lot out".



THE owners of this bach which slipped into the sea at Te Kopi in the early hours of Saturday morning are overwhelmed by the kindness of neighbours who saved their belongings.

Lesley Barnes and Tony Tomlin were telephoned at their home in the Hutt Valley, by neighbours on Friday afternoon to say their bach was dangling precariously over the sea.

They were visiting Palmerston North but arrived on Saturday evening to find the building had finally toppled over into the sea.

Ms Barnes said today when they first saw the bach they expected their belongings from inside it would have long since floated out to sea.

But neighbours risked "life and limb" to salvage what they could from the doomed bach while it was on a 45 degree angle. Even the cast iron stove and fridge-freezer were saved, she said.

She and Mr Tomlin had owned the bach for 2½ years, spending nearly every weekend there.

Mr Tomlin said the bach was insured, but they have yet to confirm whether the insurance company will pay out for it toppling into the sea.

He said the erosion of land the bach stood on had been very rapid in the past few weeks.

Despite their loss, the couple are keen to buy another bach in the area, depending on what happens to the road.

"We love that area. It's an amazing part of New Zealand," Mr Tomlin said.

Permanent Te Kopi resident Norman Murray said yesterday the bach was the sixth to be claimed by the sea in the past three years.

In June the one immediately to the south of that owned by Mr Tomlin and Ms Barnes fell into the sea.

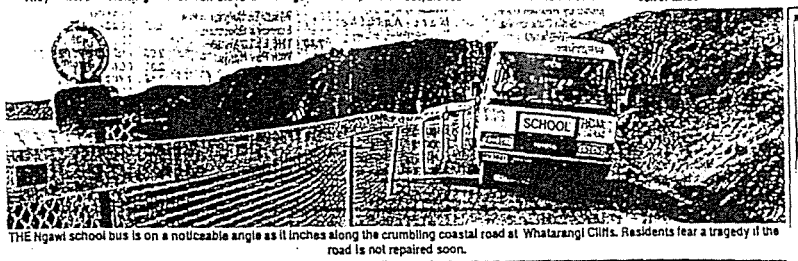
Mr Murray said southerly and southwesterly swells are the most damaging to the land at Te Kopi. The waves cut across the hillside at an angle, eating it away.

A second bach fell victim to the rough seas on Friday night. Although not totally washed away the floor of the bach owned by Greytown man Dave Taylor has been washed away, and the bach left balancing on a mere portion of land.

Mr Murray said Mr Tomlin and Ms Barnes were in the process of strengthening their property by putting in tyres and railway sleepers, but the work was not finished in time.

Other neighbours have built up protective walls of groynes and tyres, through which the sea can filter.

"We are not trying to stop the water, just trying to take the force of the wave out," Mr Murray said.



THE Ngawi school bus is on a noticeable angle as it inches along the crumbling coastal road at Whatarangi Cliffs. Residents fear a tragedy if the road is not repaired soon.