



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

Research Commons

<http://waikato.researchgateway.ac.nz/>

## Research Commons at the University of Waikato

### Copyright Statement:

The digital copy of this thesis is protected by the Copyright Act 1994 (New Zealand).

The thesis may be consulted by you, provided you comply with the provisions of the Act and the following conditions of use:

- Any use you make of these documents or images must be for research or private study purposes only, and you may not make them available to any other person.
- Authors control the copyright of their thesis. You will recognise the author's right to be identified as the author of the thesis, and due acknowledgement will be made to the author where appropriate.
- You will obtain the author's permission before publishing any material from the thesis.

**COMMUNITY BASED COASTAL  
MONITORING:  
DEVELOPING TOOLS FOR SUSTAINABLE  
MANAGEMENT**

A thesis  
submitted in partial fulfilment  
of the requirements for the degree

of

**Masters of Science**  
in Earth and Ocean Sciences  
at The University of Waikato

by

**DARCEL RICKARD**



THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

---

University of Waikato

2008

# Abstract

Burgeoning coastal development, recreational use, and the future affects of climate change are placing increasing strain on regulators to manage risk associated with coastal hazards. Low-lying coastal communities in particular are vulnerable to a range of natural hazards including coastal erosion, storm surge inundation, tsunami and water safety that come with varying levels of risk to life and property. New Zealand's coastal hazard monitoring network is patchy and resources are limited. As a consequence there is considerable potential for coastal communities are going to need to take a more active role in monitoring their environment and building data bases and knowledge that can be used to better manage their coast. This paper describes simple methodologies based on the needs of various community groups and sound science principles that can be used to monitor beaches and the coastal environment. By employing these tools councils, technical experts and community groups will be able to make better-informed decisions for managing activities in the coastal environment.

One of the keys to the successful uptake of a monitoring programme by a community group is its relevance to the group. The programme and the tools provided must fit the interests, needs, capability and resources of the group. This project develops tools for coastal monitoring and targets coastal community groups such as Coast Care, Coastal Hapu, Secondary Schools, and Surf Life Saving Clubs. The monitoring methodologies have been developed in consultation with Tainui ki Whaingaroa hapu, Raglan Area School, and the Waikato Beach Care and Coast Care Bay of Plenty.

Successful methodologies for measuring changes on the coast are also those that are matched to the type of beach, use appropriate equipment, collect structured data, provide data to which analysis can be applied, incorporate local knowledge of the environment, and feed results back to the community and other interested parties such as councils and science organisations. This project provides the target groups with simple monitoring methodologies, field forms/checklists, and appropriate survey and measurement equipment (which have undergone field trials) to carry out coastal monitoring. A web-based facility has been developed to input, check and store data; and provide immediate feedback using graphs and

images. It also provides background information on coastal processes relevant to monitoring programmes. In this manner, a scientifically robust data set is collected and stored within a secure and future proofed archive, providing valuable information to coastal groups for years to come.

Although the primary objective of this research is to develop a means for coastal communities to monitor changes in their environment, there are additional benefits associated with engaging communities in the study of their environment. These benefits include increasing awareness of coastal hazards, capacity building, providing valuable educational resources, and improving the temporal and spatial data coverage of information for the New Zealand coastline.

## Acknowledgments

He kakano tēnei I ruia mai I ngā rakau e tipu ana I runga I te maunga Karioi, e takoto ana I te taha moana o Whaingaroa, e ngunguru ana I te ao i te po, Tihei mauri ora.

Me hoki ako mahara kia rātou ma kua rupeke atu ki tua o te aria. Nā rātou I whakatō I ngā ahuatanga tika ki roto i ahua kia taea e au te whaia I te iti kahurangi. No reirā ka mihi, ka mihi, ka mihi. He tuku mihi tēnei ki tōku Papa, ko koe tōku poutokomanawa, nana I whakahokia te kotiro nei ki te kainga tuturu o ana mātua tupuna, hei whakatipuria I waenganui I ngā ahuatanga Māori. He tika hoki kia tuku aroha ki tōku whaea, mo tona tautoko me aroha. Ki tōku whanau he hono tangata e kore e motu; kā pā he taura waka e motu.

I would like to express my sincere appreciation to Dr Terry Hume for his constant support, guidance and assistance in the preparation of this manuscript. Thank you also to the National Institute of Water and Atmospheric Research (NIWA) for providing me with the resources and funding needed to carry out this research, without your ongoing support this project would not have been possible. Thank you to my supervisor from The University of Waikato Dr Willem de Lange for reviewing my thesis and providing constructive criticism.

Also a special special thank you to my two big sisters for the numerous amount of proof reading they have had to do over the past six years and to all the NIWA staff who allowed me to invade their offices on numerous occasions to chat about my research or just to have a good old moan. Without you my sanity would have been severely compromised. They say the most important thing that you can give someone in your lifetime is your time. So thank you so much to everyone that has afforded me their time.

He kupu whakamutunga ki tōku ipo. He tuku mihi tēnei kia koe, ko koe tōku hoa rangatira, me tōku hoa pumau. Kaore he mutunga mo tōku aroha, e ki a nei ka taea koe te kitea I ngā kokonga o te whare, ēngari he kokonga ngakau e kore e taea te kite.

## Table of Contents

---

Abstract .....	ii
Acknowledgements .....	iv
Table of Contents .....	v
List of Figures .....	ix
List of Tables .....	xi
List of Abbreviations .....	xii
Chapter One - Introduction .....	1
1.1 Introduction .....	1
1.2 Research Objectives and Outcomes .....	2
1.2.1 Aim.....	2
1.2.2 Guiding Objectives .....	2
1.2.3 Outcomes .....	3
1.3 Thesis Structure.....	3
Chapter Two - Literature Review .....	5
2.1 Introduction .....	5
2.2 Community Coastal Monitoring Programmes .....	6
2.2.1 South African CCMP – “Adopt-A-Beach” .....	6
2.2.2 Western Australia – “Coastbase” .....	8
2.2.3 Texas High School Coastal Monitoring Program (THSCMP) ..	10
2.3 Other Environmental Monitoring Programmes.....	12
2.3.1 Wai Care .....	12
2.3.2 SHMAK – Stream Health Monitoring And Assessment Kit ...	13
2.3.3 Additional Literature.....	14
2.4 Lessons and Key Findings Relevant To This Research .....	14
2.5 Summary .....	18
Chapter Three - Thesis Approach .....	19
3.1 Introduction .....	19
3.2 Target Audience .....	20
3.2.1 Coast Care .....	20
3.2.2 Surf Life Saving Clubs.....	23
3.2.3 Coastal Hapu Groups .....	24
3.2.4 Secondary School Science Classes .....	26
3.3 Discussions.....	27
3.3.1 Science Practitioners .....	27
3.3.2 Technical Experts .....	28
3.3.3 Other Key Informants .....	29

3.3.4	Unsolicited discussions.....	30
3.4	Coast Care Survey Questionnaire .....	32
3.4.1	Study Overview.....	32
3.4.2	Methodologies.....	33
3.4.3	Summary of Key Results .....	36
3.5	Conclusion.....	38
Chapter Four - Monitoring Tool Development.....		39
4.1	Introduction .....	39
4.2	Monitoring Approach.....	40
4.2.1	Environmental Observations.....	40
4.2.2	Scientifically Robust Measurements .....	43
4.3	Monitoring Tools.....	44
4.3.1	Selection of Monitoring Parameter and Indicators .....	44
4.3.2	What the Monitoring parameters/Indicators tell us about the Coastal Physical Environment.....	46
4.3.3	Monitoring Methodologies.....	52
4.3.4	Coastal Monitoring Procedure Manual .....	52
4.3.5	Monitoring Forms .....	54
4.3.6	Monitoring Equipment .....	66
4.3.7	Supplementary Information .....	66
4.4	Tool Assesment and Trial .....	66
4.5	Summary and Discussion .....	67
Chapter Five - Web Tools .....		69
5.1	Introduction .....	69
5.2	Background Information .....	70
5.3	Design brief.....	71
5.3.1	Web Tools .....	72
5.3.2	Information Transfer and Dissemination .....	72
5.4	Web Tool Development.....	72
5.4.1	Login .....	72
5.4.2	Data Entry Mechanism.....	72
5.4.3	Data Storage/Archiving.....	75
5.4.4	Data Analysis .....	75
5.5	Information Dissemination and Transfer .....	76
5.5.1	Educational Information.....	76
5.5.2	Downloads and Links.....	77
5.6	Discussion .....	78
5.6.1	Web Tool Trial.....	78
5.6.2	Access to Monitoring Data.....	78
5.7	Summary .....	79

Chapter Six - Science Education.....	80
6.1 Introduction .....	80
6.2 Science Literacy .....	81
6.3 New Zealand Science Curriculum.....	83
6.3.1 Science Learning Strands and Outcomes.....	84
6.3.2 Science Achievement Aims .....	85
6.3.3 Levels of Achievement .....	86
6.3.4 Science Achievement Objectives for this Study .....	87
6.4 National Achievement Standards .....	90
6.4.1 Science Matrix .....	91
6.4.2 Physics Matrix.....	91
6.4.3 Direct Links to Community Coastal Monitoring Tools.....	92
6.5 CREST and Science Fair.....	92
6.5.1 CREST .....	92
6.5.2 Science and Technology Fairs .....	93
6.6 Teaching Science in Context.....	93
6.7 Discussion and Summary .....	94
Chapter Seven - Implementation.....	96
7.1 Introduction .....	96
7.2 Initial Pilot Study and Review .....	96
7.2.1 Needs Profiles of Initial Pilot Study Groups.....	98
7.2.2 Group Involvement and Field Trials .....	103
7.2.2 Evaluation and Review .....	104
7.3 Consultation .....	105
7.3.1 Community Coastal Monitoring Workshop.....	105
7.4 Secondary Piloting and Review Stage .....	106
7.4.1 Secondary Pilot .....	106
7.4.2 Evaluation and Review .....	106
7.5 National Implementation.....	107
7.5.1 The Resource Management Act.....	107
7.5.2 National Implementation at a Regional Level .....	108
7.5.3 Barriers to Successful Implementation .....	109
7.6 Discussion .....	109
7.6.1 Diversify the Tools.....	109
7.6.2 Integration with Pre-existing Environmental Programmes.....	110
7.6.3 Communication.....	111
7.7 Summary .....	111

Chapter Eight - Summary and Conclusions.....	113
8.1 Introduction .....	113
8.2 Research Approach .....	113
8.3 Key Research Findings.....	114
8.3.1 Tools Relevant to Local Needs .....	114
8.3.2 Selecting Scientifically Robust Methods .....	115
8.3.3 The value of Web-based tools.....	116
8.3.4 Trialling Tool and Protocols .....	116
8.3.4 Aligning Tools with the National Curriculum .....	116
8.3.5 Implementation is the Key to Success .....	116
8.3.6 This Research Developed.....	117
8.4 Recommendations for future research and Development of Community Coastal Monitoring tools.....	117
8.4.1 Realisation of the Implementation Strategy .....	117
8.4.2 Web Tools need to be Trialled and Reviewed .....	118
8.4.3 Monitoring Frequency .....	118
8.4.4 Different Beach Types .....	118
8.4.5 Identifying Relevant Supporting Information.....	119
8.4.6 Purpose of the Data .....	119
 Chapter Nine - Refences .....	 121
 <b>Appendix A</b>	
A1 New Zealand Coastal Society Conference presentation	
A2 University of Waikato School of Education presentation	
A3 Natural Hazards Hui	
 <b>Appendix B</b>	
B1 Application for Ethical Approval	
B2 Questionnaire Information Sheet	
B3 Final Survey Questionnaire	
B4 Coast Care Survey Questionnaire Tabulated Results and Graphs	
 <b>Appendix C</b>	
C1 Coastal Monitoring Procedure Manual	
C2 Terms and Definitions Glossary	
 <b>Appendix D</b>	
D1 2007 New Zealand Science Curriculum Achievement Objectives	
D2 National Achievement Standard Matrices	
D3 Mapping CREST onto NZQA Achievement Standards in Science	
D4 Texas High School Coastal Monitoring Curriculum Outline	

## List of Figures

---

### Chapter 2

Figure 2.1: Adapted from Wheeler, 2003 .....	9
Figure 2.2: Method rating system .....	10

### Chapter 3

Figure 3.1: Map of Coast Care groups in the Bay of Plenty Region .....	21
Figure 3.2: Map of Waikato Region's coast .....	22
Figure 3.3: Onemana Coast Care Group planting day, Onemana 2007.....	23
Figure 3.4: Surf Lifesaving crew, Ngarunui Beach, Raglan 2007.....	24
Figure 3.5: Tex Rickard of Whaingaroa ki te Whenua Trust, Harvesting Pingao, Ngarunui Beach, Raglan. ....	25
Figure 3.6: Students conducting a beach survey, Ngarunui Beach, Raglan 2007. ....	26
Figure 3.7: Community Coastal Monitoring stand, Whaingaroa Catchment Information Day, 10 <sup>th</sup> of March 2007, Raglan.....	32

### Chapter 4

Figure 4.1: Tex Rickard and Hautai Greensill erecting dune management fencing, Ngarunui Beach, March 2004. Photo by A. Greensil .....	41
Figure 4.2: Evidence of accretion Ngarunui Beach Raglan, November 2004. ....	42
Figure 4.3: Coastal erosion, Ngarunui Beach Raglan, November 2004 .....	42
Figure 4.4: Conducting a beach profile survey (Emery method).....	53
Figure 4.5: Illustration of dune scarping, Ngarunui Beach, Raglan.....	53
Figure 4.6: Illustration of a shore normal rip current, Ngarunui Beach, Raglan ..	54
Figure 4.7: Pre survey preparation checklist.....	56
Figure 4.8: Equipment checklist .....	57
Figure 4.9: Coast care field data entry form example.....	58
Figure 4.10: Field instructions for Coast Care group.....	59
Figure 4.11: Beach profile field form .....	60
Figure 4.12: Field instructions for marking out and measuring a beach profile... ..	61
Figure 4.13: Supplementary field sheet No.1.....	62
Figure 4.14: Supplementary field sheet No.2.....	63
Figure 4.15: Supplementary field sheet No.3.....	64
Figure 4.16: Supplementary field sheet No.4.....	65

### Chapter 5

Figure 5.1: Snapshots of the data entry form .....	74
Figure 5.2: Snapshots of the data entry form .....	74

## **Chapter 6**

Figure 6.1: Science learning strands .....	84
Figure 6.2: Eight levels of achievement and how they correspond to a students' years at school.....	87

## List of Tables

---

### Chapter 3

Table 3.1: Survey delivery and return rate.....	35
---	----

### Chapter 4

Table 4.1: Coastal Monitoring parameters and indicators .....	45
---	----

### Chapter 6

Table 6.1: Level 6 Science Achievement Objectives and how CCMT contributes to examples of there specific learning outcomes .....	88
---	----

Table 6.2: Level 6 Science Achievement Objectives and how CCMT contributes to examples of there specific learning outcomes .....	82
---	----

### Chapter 7

Table 7.1: Onemana Beach Care Group needs profile.....	98
--	----

Table 7.2: Taylor Road/Papamoa East Coast Care needs profile .....	99
--	----

Table 7.3: Raglan Area School needs profile.....	100
--	-----

Table 7.4: Te Kopua needs profile .....	101
---	-----

Table 7.5: Whangamata Surf life Saving Club needs profile.....	102
--	-----

## **List of Abbreviations**

---

AMCS	Australian Marine Conservation Society
CALM	Conservation and Land Management
CCMP	Community Coastal Monitoring Programme
CCMT	Community Coastal Monitoring Tools
CLEO	Continuous Low-level Environmental Observations project
CREST	Creativity in Science and Technology
CSMEE	Centre for Science, Mathematics, and Engineering Education
DEAT	Department of Environmental Affairs and Tourism
ECAN	Environment Canterbury
GPS	Global Positioning System
NCEA	National Certificate of Educational Achievement
NIWA	National Institute of Water and Atmospheric Research Limited
NSW	New South Wales
RMA	Resource Management Act
SA	South Africa
SHMAK	Stream Health Monitoring and Assessment Kit
SiNZC	Science in New Zealand Curriculum
SLO	Specific Learning Outcome
SLSNZ	Surf Life Saving New Zealand
THSCMP	Texas High School Coastal Monitoring Program
UK	United Kingdom
USA	United States of America
UT	University of Texas
WESSA	Wildlife and Environmental Society of South Africa
WWW	World Wide Web

# 1. Introduction

## 1.1 INTRODUCTION

New Zealand has an extensive coastline, which is ranked seventh globally for its length and some 18,200km (Rouse et al., 2005). Approximately 12,000 km of this is open coast, and a further 6,000 km is estuarine shore within harbours and estuaries. New Zealand's population is located in close proximity to the sea, with approximately ninety percent of the population living within fifty kilometers of the sea (Dahm, 2005). Much of the early development of the New Zealand coastal margin took place between the 1950s and the 1970s, during this time there was less knowledge of coastal processes and natural shoreline change (Environment Waikato, 2002). As a result many coastal communities were built too close to the sea. Development in the coastal margin has only increased in recent years, with beaches now mansions and land much more valuable. Ongoing development in the coastal margins and high property prices are placing strains on councils to allow development in the coastal margin (Blackett and Hume, 2006).

Coastal communities are vulnerable to a range of natural hazards, including coastal erosion and inundation, which come with varying levels of risk to life and property (Stewart et al., 2005). Pilkey and Hume (2001) reported that more than 80% of the world's shorelines are eroding, and New Zealand is no exception to this. A collation of erosion and accretion rates conducted by the author from 535 sites about the New Zealand shoreline shows that there is a mixture of coastal erosion and accretion around New Zealand shores, with erosion hot spots focused around stream and rivers mouths and tidal entrances (Pilkey and Hume, 2001). The study also showed that aside from Gibbs (1978) summary of "Rates of coastal erosion and accretion in New Zealand" published in the late 70s there is no collective overview and a lack of current information for the erosion and accretion rates for the New Zealand coastline.

Shoreline change information for New Zealand seems to be disproportionately distributed around the coastline; this is due to the limited amount of resources and funds Regional Councils can afford to this research. Typically, shoreline change

information is only collected by Regional Councils that have a large rating base, leaving many coastal areas without such information.

Also it has been highlighted during this research that there are numerous misunderstandings amongst coastal communities surrounding coastal dynamics and a real lack of accurate scientific education and public awareness on coastal processes and hazards.

Thus the New Zealand coastal situation is that we have coastal communities that are vulnerable to a range of natural hazards, that are unable to make informed choices regarding coastal hazards and the risks associated with them, because of a lack of understanding and knowledge of coastal process, hazards and dynamic shoreline change.

In the future, particularly in light of coastal hazards increasing with climate change, coastal communities are going to need to take a more active role in the management of the coastal environment.

This research contributes to management practices that arise from guardianship approaches through the development of sustainable and robust monitoring tools that will assist in the long-term projection of coastal sustainable management plans.

## **1.2 RESEARCH OBJECTIVES AND OUTCOMES**

### **1.2.1 Aim**

The aim of this research is to develop a means for coastal communities to monitor long-term changes in their coastal environments.

### **1.2.2 Guiding Objectives**

The aim of my research will be achieved through the following specific objectives.

- i) Engage communities in the study of their environment.
- ii) Increase awareness of coastal hazards amongst coastal communities.
- iii) Contribute to a better understanding of how to sustain good management of the coastal resources.
- iv) Enhance science education on dynamic physical processes in coastal areas.
- v) Provide a valuable educational resource for community groups and secondary schools.
- vi) Improve the temporal and spatial data coverage of information for the New Zealand coastline while providing the data links between Communities – Local Governments – National Government.

### **1.2.3 Outcomes**

- i) Simple, inexpensive, but reliable methods; for collecting beach profile data and related beach information that can be used for hazards assessments.
- ii) Collection of scientific educational information on coastal processes.
- iii) Accessible and user-friendly system for entering, storing and analysing beach data and for also producing first order hazard assessments.

## **1.3 THESIS STRUCTURE**

Following on from the introductory Chapter, Chapter Two reviews local and international literature relating to various environmental monitoring initiatives. In particular, this literature review critically examines community based monitoring initiatives, while summarising key factors that lead to the success or failure of these initiatives, thus providing a foundation for this research.

Chapter Three presents the initial approach that was taken in the development of the monitoring tools. It outlines and discusses the target audience for the monitoring tools and identifies the monitoring objectives.. It also details the consultation and discussion process.

Chapter Four discusses the development of the tool kit. It investigated the monitoring tools. It investigates monitoring approaches, parameters and methodologies. It outlines the development of the Coastal Monitoring Procedure

Manual, field forms, cheat sheets, checklists, and supplementary sheets. It also gives details on the preliminary trialling of the tools.

Chapter Five gives details on the proposed development of web-based tools for the data entry, analysis and archiving. of community coastal monitoring data.

Chapter Six investigates science education and how the tools could be utilised in the secondary school science curriculum.

Chapter Seven discusses the proposed implementation strategy that has been developed for the Community Coastal Monitoring Tools.

Chapter Eight concludes this thesis by providing a summary of this research and key findings. It also provides recommendations for future research.

## **2. Literature Review**

### **2.1 INTRODUCTION**

Generally monitoring tools are developed and trialled within the context of monitoring programmes, usually by science practitioners in partnership with one or more community groups. They are implemented, revised and improved through a community based monitoring programme.

Therefore, during the conception of this project a preliminary study was undertaken to investigate the different types of environmental monitoring programmes in New Zealand that were available to communities. This investigation highlighted that there was a number of community based programmes that monitored physical and biological features of estuarine, river, and lake environments, but none that specifically monitored the physical features of the open coast. Hence, this research is a pioneer of its type for New Zealand. However, following a more extensive international investigation of literature, it became apparent that there existing international examples of community based coastal monitoring programmes.

This chapter will discuss and review international examples of community based coastal monitoring programmes. It will also summarise and discuss key aspects from other environmental monitoring programmes, which are relevant to this research, paying particular attention to the key aspects that have led to the successful and not so successful uptake of these programmes by the community. This literature review will also provide a context by which the monitoring tools can be developed, because monitoring tools are generally developed within the context of monitoring programmes, so by reviewing monitoring programmes it provides an opportunity to examine some of the facets that need to be taken into consideration when developing monitoring tools.

## **2.2 COMMUNITY COASTAL MONITORING PROGRAMMES**

### **2.2.1 South African CCMP – “Adopt-A-Beach”**

This Community Coastal Monitoring Programme (CCMP) was initiated by the Coastal Management Office, Department of Environmental Affairs and Tourism (DEAT), South Africa in 2000. The programme originates from the Continuous Low-level Environmental Observations project CLEO, which was established in the late 80s and early 90s. CLEO utilised community volunteers to develop a database which would ultimately enable regulators and researchers “to assess the extent of long- and short-term fluctuations in the coastal zone against which changes caused by episodic events and human activities could be measured”(Illenberger & Associates, 2001). Officially funding ceased for CLEO in 1993 however, recognising the significant educational value of the programme, the Coastal Management Office decided to initiate a CCMP with Illenberger and Associates appointed as coordinators for the (initial) pilot phase (Illenberger & Associates, 2001).

In contrast to its’ predecessor CLEO, this CCMP uses environmental monitoring as an educational tool, to encourage a caring and responsible attitude towards the coast and to raise awareness (Illenberger & Associates, 2001). Importantly the production of data was never seen as the primary objective of the programme, rather an additional benefit (Illenberger & Associates, 2001). The CCMP was first piloted between October 2000 and March 2001, to monitor physical, biological, social and economic elements of beach, estuarine and rocky shore environments (Illenberger & Associates, 2001).

The programme recognized that there are two methods to monitor environmental change, the first being the use of environmental indicators and the second being the use of environmental observation. Environmental indicators provide a framework to scientifically validate environmental change. In contrast environmental observation is typically a qualitative method of evaluating environmental change. Illenberger & Associates (2001) describe an environmental observation as “peripheral elements, not necessarily key deterministic ones, which encourage a holistic understanding of an ecosystem”. Therefore, Illenberger &

Associates (2001) suggest that environmental observations primarily serve as an educational tool rather than as a robust indicator of change. Illenberger & Associates (2001) defined criteria to aid them in the selection of indicators and observations that would be suitable as coastal monitoring parameters. These criteria are listed below in the approximate order of significance as detailed by Illenberger & Associates (2001).

Each indicator/observation should:

- act as a tool for environmental education
- be easy to understand and use
- serve as a robust indicator of change
- be useable in the National Environmental Education Programme
- reflect a fundamental and valuable aspect of the environment
- provide an early warning of potential problems
- have relevance to local policy and management needs
- be cost effective
- where possible, contribute to monitoring of progress towards implementing commitments in national environmental policies, and
- where possible, and appropriate, use existing indicators of proposed or established monitoring programmes

Tables were drawn up in an attempt to rate the indicators and observations based on these criteria. They found that most indicators/observations did not meet all of the selection criteria. However, they noted that the indicators/observations were rated from the perspective of poorly resourced and largely uninformed observers (Illenberger & Associates, 2001). During their field pilot study they found that all indicators and observations were functional, but not necessarily at all sites. As a result they developed a flexible approach to each site by only using parameters relevant to that site (Illenberger & Associates, 2001).

There were two target audiences for this programme secondary schools and local environmental groups, with secondary school being the primary target audience. During phase two of the project the CCMP was renamed Adopt-A-Beach, and is currently being co-ordinated by the Wildlife and Environment Society of South Africa (WESSA) as part of the Coastcare programme.

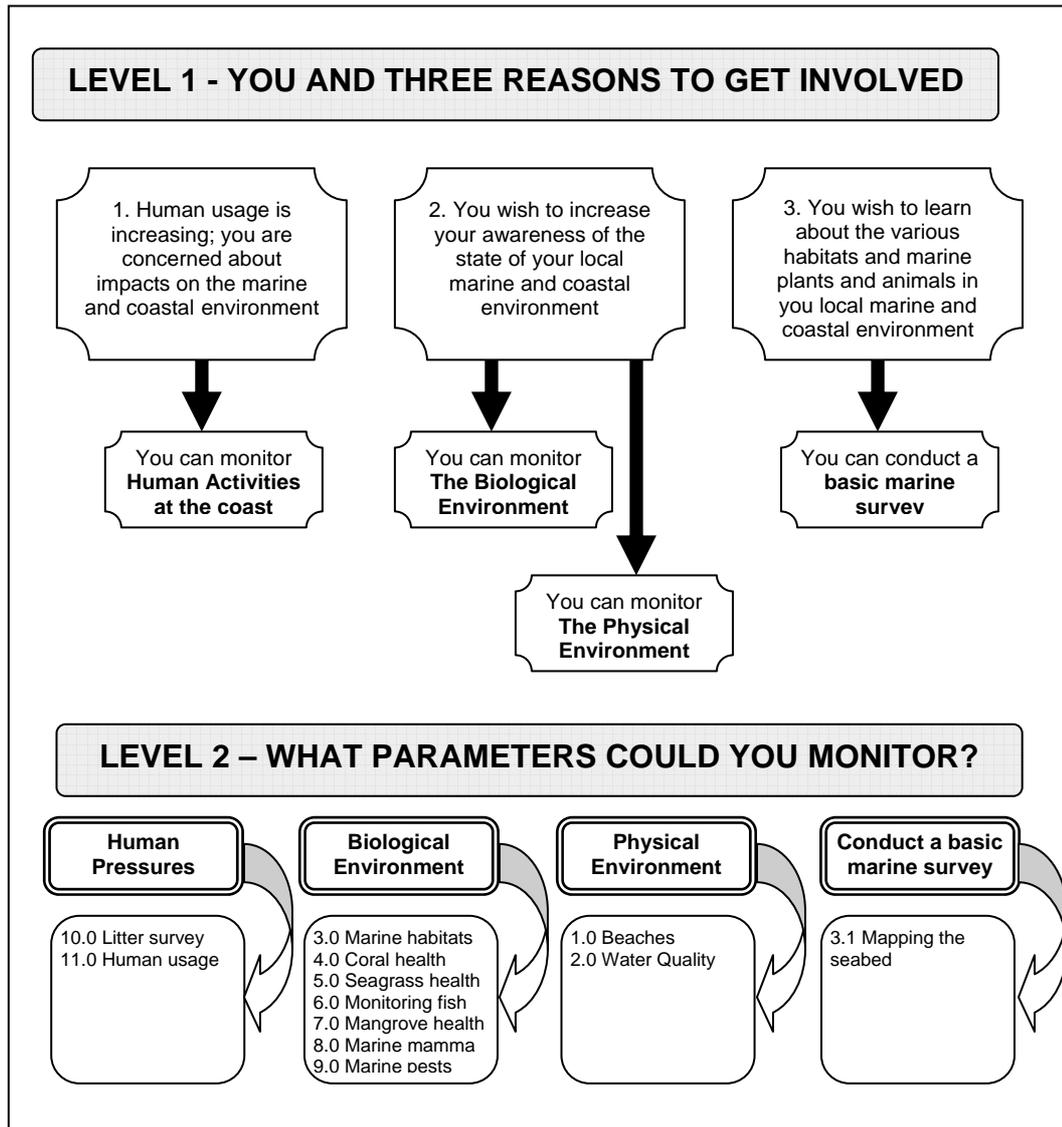
### **2.2.2 Western Australia – “CoastBase”**

This CCMP is a collaborative effort between the Department of Conservation and Land Management (CALM, Marine Conservation Branch), Australian Marine Conservation Society (AMCS), and Natural Heritage Trust’s Coastwest/Coastcare Programme (Wheeler, 2003b). The programme is based in Western Australia and was initiated in Perth in 1998 - 1999.

In contrast to the SA CCMP “Adopt-a-beach” which primarily focuses on education, this programme focuses on the dissemination and sharing of information through the development of partnerships between regulators, scientists, and communities; and fostering community involvement in the management of the marine environment through active participation.

This programme primarily provides community groups with the tools needed to monitor the biological health of the marine environment. However it also provides some tools to monitor physical processes and the human impacts and pressures related to the coastal environment.

The programme has been specifically designed in a manner to suit the different needs, abilities, interests and time schedules of the various participants. It provides groups with eleven separate modules; two for physical process, seven for biological aspects, and two based on social impact. Figure 2.1 is an example of how groups are guided towards a suitable monitoring programme. Groups are first asked to define why they want to conduct monitor, which allows them to identify what modules they will monitor in the coastal environment.



**Figure 2.1: Adapted from Wheeler, 2003**

For each of the eleven modules that relate to physical, biological and social aspects of the coastal environment one, two or three options are provided that might be used to monitor that aspect. For example module one “Beaches” has three monitoring methods available 1) Beach width, 2) Beach structure, and 3) Beach profile. Each of the monitoring methods is given a difficulty rating (Figure 2.2), from one star being simple methods to three stars being more complex methods. By rating the methods groups can determine the appropriate method/s that align with the amount of time and effort they can afford for their monitoring.

★	<ul style="list-style-type: none"> <li>• Simple method</li> <li>• Basic Equipment</li> <li>• Can be completed in less than two hours</li> <li>• Suitable for school groups</li> </ul>
★ ★	<ul style="list-style-type: none"> <li>• Methods are more advanced</li> <li>• Specialist equipment and/or skills needs</li> <li>• Greater than two hours duration</li> </ul>
★ ★ ★	<ul style="list-style-type: none"> <li>• More advanced methods</li> <li>• Accuracy and attention to detail required</li> <li>• Specialist equipment and/or skills needs</li> <li>• Greater than two hours duration</li> </ul>

**Figure 2.2: Method rating system (Adapted from Wheeler, 2003)**

Once groups determine their monitoring approach and strategy it is then important to evaluate whether the information they collect and the frequency with which it is collected, addresses the monitoring objective. If they answer no they are then directed to review their monitoring strategy to insure that their actions address the reason why they wanted to conduct monitoring in the first instance.

Once the data have been collected they are entered into the Marine Community Monitoring Database, which can then be accessed by community groups, scientists, Government departments and management agencies.

It is important to note that this monitoring programme was developed in three stages over a five year period. The programme was developed in this manner to overcome obstacles that arose during the initial pilot phases, which were limiting the programme from being successfully implemented within communities.

### **2.2.3 Texas High School Coastal Monitoring Program (THSCMP)**

The Texas High School Coastal Monitoring Program involves high school students, teachers and scientists working together to gain a better understanding of the beach and dune dynamics along the Gulf of Mexico coastline. This programme is run by the Bureau of Economic Geology, School of Geosciences,

University of Texas (UT) at Austin and was first piloted at Ball High School on Galveston Island in 1997-1998.

Similar to the two previous CCMPs, the key objectives of this project are about engaging people who live along the coast in the study of their environment, education, and the development of partnerships, with data collection a secondary benefit. The THSCMP also highlight that a key aspect of their programme is about teaching science in an interesting context that is relevant to everyday life. Students that participate in the programme obtain an enhanced science education, while providing coastal communities with valuable data on dynamic change and increased awareness of coastal processes (Hepner and Gibeaut, 2005).

However and unlike the previous two programmes, the UT program focuses solely on physical coastal processes and beach dynamics. Scientists from the University of Texas at Austin (UT) provide teachers with all the resources, tools and training needed for students to carry out scientific investigation of beach dynamics (Hepner and Gibeaut, 2005). Student participation in the program generally involves three class field trips during the academic year. During each field trip students apply scientific methodologies to measure beach morphology and make numerous observations to assess beach, wave and weather conditions (Hepner and Gibeaut, 2005).

This CCMP has a web-site (<http://txcoast.beg.utexas.edu/thscmp/>) and uses the World Wide Web as its central hub for data gathering and information dissemination. Each school that is involved with the programme has their own area on the website to enter and archive their field data. An advantage of this web based system is that it provides schools with the ability to exchange observations with other schools, adding to their learning experience. Scientists from the UT are responsible for the management of the monitoring database and make the information available to the public. The web site also provides all the information needed to carry out beach monitoring, as well as curriculum information outlining how the programme can be incorporated into secondary school teaching plans.

A major benefit of the programme is that it aligns with a number of national science education standards, enabling it to be simply incorporated into the high school science curriculum. Specific aspects of the program that align with these standards include gaining skills in data collection, analysis, and evaluation, and also learning how to plan and implement investigation procedures. Also by engaging with scientists from UT, which visit each participating school at least twice during the academic year, student's get an enhances scientific education and an insight into possible careers in science.

A secondary output for this programme is that the data has been published, by scientists from UT (Hepner, T.L. & Gibeaut, J.C. (2004) *Tracking post-storm beach recovery using data collected by Texas High School students*. *Shore & Beach*, 72,5 9).

## **2.3 OTHER ENVIRONMENTAL MONITORING PROGRAMMES**

### **2.3.1 Wai Care**

Wai Care is a regional stream health monitoring programme. It is coordinated and facilitated by the Auckland Regional Council and currently involves six territorial authorities in the Auckland region. Wai Care was established in August 1999 as a community based education programme to promote the protection and enhancement of the regions fresh water resources (Chard et al., 2005). It focuses on water quality and the chemistry of streams as well as the assessment of the stream habitat. Groups are provided with manuals, water quality monitoring kits as well as training and support for their local territorial authority Wai Care coordinator. Wai Care was modelled on a number of international and national monitoring programmes including Waterwatch (Australia), Adopt-a-Stream (Rodrigues) and Stream Sense (Environment Waikato), and the Stream Health Monitoring and Assessment Kit (NIWA). Wai Care is an extremely successful community based monitoring programme, with over 80 community groups including schools currently participating in the programme throughout the region. Wai Care is based around six major objectives; awareness, monitoring, involvement and action, partnerships and communication, advocacy, and quality and support. Groups can come into the programme at any of the objective levels. One group may need to take action to address a waterway or catchment issue, one

group might want to gather meaningful information about the health of their waterway, while another group may want to increase their awareness or gain a holistic understanding of their waterway. This approach allows Wai Care to be a flexible and community driven programme, not a rigid or politically focused programme, and is one of the keys to their success.

The Wai Care programme also uses a web interface for data entry and analysis. Each group that participates in the programme has their own secure area on the Wai Care website to enter and archive their field data. Wai Care recently upgraded their web page to address some of the short falls that were identified in the Chard et al. (2005) “Wai Care Review: Summary of findings and action plan”. Chard et al. (2005) records a number of specific comments made by group members regarding the website concerning web site access, data input, navigation and the dissemination of information.

### **2.3.2 SHMAK – Stream Health Monitoring and Assessment Kit**

The National Institute of Water and Atmospheric Research Limited of New Zealand developed a Stream Health Monitoring and Assessment Kit (SHMAK). This kit assist with the collection of data which can be grouped into three main categories: biological, stream habitat, and land-use and farm management. The kit was launched in 2001 in the South Island and was implemented during a series of workshops with Papatipu Runaka o Kai Tahu.

In 2006 Adams and Penny conducted a review of the use of the SHMAK. This review was of particular interest to this study because it highlighted a number of issues relating to the somewhat unsuccessful uptake of the kit, as well as offered some recommendations on how to improve the kit. These findings and recommendations will be discussed in section 2.4 of this chapter.

### **2.3.3 Additional Literature**

Although the following literature has not been reviewed in detail in this chapter, it does contain useful information that helped guide this research.

Turning the tide - An Estuaries toolkit for New Zealand communities. Taieri Trust. (Robertson and Peters, 2006)

Kaimoana Survey Guidelines for Hapu and Iwi. Otaraua Hapu, N.Z Ministry for the Environment. (Otaraua Hapu et al., 2003)

Life's a Beach - A Coastal Education Resource Kit. Environment Bay of Plenty. (Environment Bay of Plenty, 2006)

Stream Sense - A secondary school teaching resource for monitoring the health of stream and rivers in New Zealand. (Environment Waikato)

Iwi Estuarine Tool Kit - Tools for managing aquatic systems. National Institute of Water and Atmospheric Research Limited. (Swales, 2006)

Volunteer Estuary Monitoring - A Methods Manual. U.S. Environmental Protection Agency (EPA), Office of Wetlands, Oceans and Watersheds to The Ocean Conservancy. (Register and Ohrel, 2006)

## **2.4 LESSONS AND KEY FINDINGS RELEVANT TO THIS RESEARCH**

The following lessons emerge from the review.

### **Purpose for monitoring**

Most monitoring tools are developed with two key goals in mind; education and the dissemination and sharing of information/data, with data collection as a secondary goal. By providing communities with a valuable educational resource and engaging them in the study of their coastal environment it; increases their awareness of coastal hazards, contributes to a better understanding of how to sustain good management of the coastal resources, enhances their overall knowledge of dynamic physical processes in coastal areas, encourages a caring and responsible attitude towards the coast and provides data links between Communities – Local Governments – National Government.

**Target audience**

The general target audiences for community based monitoring programmes are secondary school students and various environmental interest groups. Monitoring tools are generally pitched at a secondary school level. This level is regarded as an appropriate level for monitoring tools because it is accessible and understandable by the majority of adult interest groups.

**Monitoring framework**

Groups must outline what's important to them, why they want to conduct monitoring and what information they want to find out from conducting monitoring. Defining these things first is extremely important when developing a monitoring programme because it determines the approach you will take. The reasoning for conducting monitoring will differ between groups depending on the issues they are facing; one programme is not going to be suitable for everyone. Once the group has established its monitoring objectives, methodologies can be devised to satisfy each objective, thus developing a tailored monitoring strategy. Once the monitoring framework has been set out, it's important to review the monitoring strategy to insure that it realizes the need for monitoring.

**Flexibility**

Because different groups have different requirements, time constraints, and intentions, monitoring tools need to be flexible so that they can be adapted and customised to cater towards the needs of each individual group. Enthusiasm for monitoring will quickly wane if groups believe that they are just monitor for the sake of monitoring, which is why it's extremely important to make sure that the tools realize their needs. Also because New Zealand has a dynamic coastal environment that is very diverse in terms of sediment supply, geology, and wave climate not all parameters are going to be relevant or necessary at every site. The most important aspect is that tools are flexible so that they are relevant to each groups needs and to the site. It's a good idea to have a number of methodologies for a single parameter, some that require little time and minimal technical skills and others that require more time and specialised technical skills. Simple methods generally serving an education role by provide a holistic view of the environment,

while sophisticated methodologies are robust, reproducible and standardised allowing other researchers the opportunity to verify results by attempting to reproduce them.

### **Monitoring indicators**

The literature review also highlighted that monitoring tools do not solely have to be a range of scientifically robust measurements. A number of key assumptions can be made regarding the state of an environment by simply observing it. Key environmental observations may not necessarily scientifically validate environmental change; however they do serve an education purpose by encouraging a holistic understanding of the coastal environment. Environmental observations also provide a good mechanism to initially engage communities in monitoring because they are simple, cost effective and require little time.

### **Meaningful data**

It is important that groups feel empowered by monitoring and believe that they can effect change through monitoring. Data collected through community based monitoring needs to be of a high quality and robust so it can be utilised to facilitate improvement and for resource management processes. The key to collecting meaningful data lies within the monitoring tools and methodologies, methodologies need to be robust and tools need to be developed in a manner that aligns with Regional Council monitoring protocols. Adequate data interpretation is also important in making data meaningful.

### **Electronic database**

Monitoring for community groups does not end in the field. Once groups have collected information in the field, how do they analyse and store the field data. The majority of the programmes reviewed in this chapter offered participants the ability to store data in a real-world internet database. Affording groups this facility was noted several times as a positive aspect of the various programmes. Monitoring groups that were not afforded this facility found that the lack of an electronic database proved to be an obstacle to meaningful monitoring. An internet database facility also provides a permanent repository for data, which

allows participating groups, science practitioners, and regulators to readily access monitoring information with ease.

### **World- wide- web**

The World Wide Web (WWW) is a popular method for information transfer and dissemination. It has a number of functions in addition to information transfer and dissemination. In particular it provides a central hub for groups to exchange dialogue, a mechanism for data entry, analysis and storage, instant feedback to participating groups, and links to other relevant web sites. Wheeler (2003) noted that there were difficulties in maintaining community enthusiasm in monitoring without feedback. The WWW provides a mechanism to overcome this problem and the great thing about the WWW is that it can be accessed by a range of end users. All community based environmental initiatives that I reviewed have a web site or web page.

### **Links to school curriculum**

One of the key target audiences for community based monitoring initiatives is secondary schools. As a key target audience it is important that monitoring tools align with their needs. Teachers are required to teach within the framework of the schools curriculum while aligning with national education standards. Hence to, meet a schools needs from a monitoring programme it is extremely important to ensure that a monitoring programme aligns with the school curriculum and national education standards. Teachers and schools will be more likely to participate in monitoring if it can be simply incorporated into the high school science curriculum. The Texas coastal monitoring programme attributes some of its success to being relevant to the school curriculum.

### **Pilot phases**

Community feedback prior to the official launch of the Western Australia CCMP manual was considered instrumental to the success of their manual and the programme (Wheeler, 2003a). Monitoring programmes need to be developed in stages to overcome obstacles that might arise. Even though monitoring methodologies, data sheets and accompanying information are generally

developed in consultation with the end users or with them in mind it is fundamental for the success of the tools that members of the community test them. Pilot phases or field trials allow for communities groups to provide feedback on features that might limit successful uptake and implementation.

## **2.5 SUMMARY**

A review of both international and national community based monitoring initiatives has been presented in this chapter. The issues discussed in this chapter provide a context for the development of monitoring tools by highlighting various facets of community based monitoring initiatives that have lead to their success or failure. For monitoring tools to be successful they must not be developed in isolation they must be developed with the end user in mind and also with a range of other factors in mind. This chapter clearly highlighted these factors and considerations by outlining and summarising the key findings from the literature that are relevant to this research.

### **3. Thesis Approach**

#### **3.1 INTRODUCTION**

The primary aim of this research is to develop a means for coastal communities to monitor long-term changes in their coastal environment. Following a review of literature and initial discussions with science practitioners it was devised that the best way to achieve this would be through the development of Community Based Coastal Tools (CCMT). This chapter describes the preliminary approach that was taken in the development of these CCMT.

Research showed that one of the keys to the successful uptake of any community based monitoring initiative is it's relevance to the end users. Monitoring initiatives need to be designed in a manner that caters towards the needs and desires of the end user groups. Thus the first step that needed to be taken in the development of the CCMT was to define the "target audience" or the end user groups (see section 3.2).

Secondly while the literature review provides a key summary of some critical themes that became apparent in research previously conducted on community monitoring initiatives, it's merely a platform upon which to base new research. Therefore in an attempt to further expand on the themes previously presented it seemed critical to engage in discussion with individuals who have a firsthand knowledge of these themes. So the second step in the development of the CCMT was to engage in discussions with key Regional Council staff, science practitioners, technical experts, science educators and end users who are involved with community based monitoring initiatives (see section 3.3).

Lastly to best meet the needs of the end users it is essential to first conduct some social science research pertaining to them. Specifically, a survey questionnaire was conducted to; investigate the value of the coast to communities, establish risk perception and knowledge of coastal erosion and to determine knowledge of coastal management schemes and willingness to be involved with coastal monitoring (see section 3.4).

## **3.2 TARGET AUDIENCE**

The first step in the development of the CCMT was to define the target audience or the end user of the tools. The target audience was defined by identifying pre-existing community groups that have a vested interest in the management of the coastal environment and may therefore benefit from conducting coastal monitoring. This approach was taken because there are key benefits to targeting pre-existing groups. The literature suggests that uptake of tools can be limited if the monitoring tools are developed as an isolated initiative. Targeting pre-existing groups enables you to utilize pre-existing capacity and enthusiasm, and it can also be considered as bad practice to establish new initiatives in competition to pre-existing community driven initiatives.

Numerous community groups have a vested interest in coastal management and could find coastal monitoring beneficial to their activities. These groups include tourism groups, recreational beach user groups, ratepayers association, environmental groups and even individual coastal property owners. However four key target audiences were chosen: 1) Coast Care, 2) Surf life saving, 3) Coastal hapu groups and 4) Secondary school science classes.

### **3.2.1 Coast Care**

Coast Care is a community-based approach to dune management, and involves the local community, Iwi, District Council and Regional Council working together to protect and restore the coastal environment.

Community based approaches to dune management were widely introduced throughout New South Wales in the 1980s (Dahm, 2005) and in 1994 following a visit by staff from Environment Bay of Plenty and Tauranga District Council to NSW to investigate the “Dune Care” programme, Coast Care was formally established in New Zealand (Jenks, 2004).

Coast Care in New Zealand is not a national initiative. Coast Care sits at the Regional, Unitary, and District Councils level with Coast Care groups centred on a philosophy of inclusive community participation supported by facilitation and

resourcing from Regional, Unitary and District Council (Dahm, 2005). Not all Regional and Unitary Councils in New Zealand opt to facilitate a Coast Care programme. Environment Bay of Plenty and Environment Waikato are two Regional Councils that do facilitate Coast Care programmes that are extremely successful.

### Environment Bay of Plenty “Coast Care”

The open coastline of the Bay of Plenty region spans some 259 kilometres, with the majority of the open coast being sandy. In the Bay of Plenty region, practices such as active dune grazing by livestock and dune bulldozing in the 1950 – 60s for development, left the foredune noticeably degraded and unable to function naturally. In response to this Coast Care in the Bay of Plenty was established at Mt Maunganui and Papamoa in 1994 to manage the sand dunes. Since 1994 the programme has steadily grown and currently Environment Bay of Plenty Coast Care has 24 active Coast Care groups spread throughout the Bay of Plenty (see Figure 3.1).

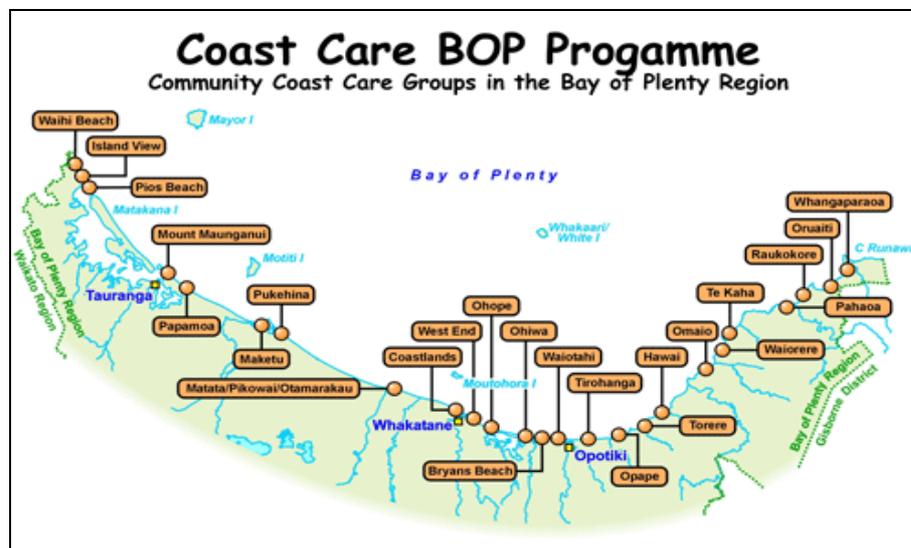


Figure 3.1: Map of Coast Care groups in the Bay of Plenty Region (Bay of Plenty, 2007)

### Environment Waikato “Beach Care”

The Waikato Region’s coastline has approximately 1,150 km of open coast, with the coastline divided into two distinctly different areas - the East Coast (Coromandel Peninsula and the Firth of Thames) and the West Coast (Port Waikato to Mokau, see Figure 3.2).

On the East coast of the region the Coromandel Peninsula coastal areas have been extensively developed in the last 50 years, with much of the development situated too close to the sea (Environment Waikato, 2002). Like the Bay of Plenty the foredune is noticeably degraded and unable to function naturally. On the West Coast the situation is somewhat different. Development is limited to small townships, however beaches on the West Coast such as Raglan, are exposed to complex hydrodynamic processes including high wave energy and large storm surges, often resulting in severe erosion events.



**Figure 3.2: Map of Waikato Region’s coast (Environment Waikato, 2006)**

Like the NSW “Dune Care” programme, Environment Waikato took a community-based approach to dune management by initiating Beach Care in 1993, with the first group established at Whiritoa Beach. Environment Waikato Beach Care currently has 16 active Beach Care groups (11 on the east coast and 5 on the west coast).

### Coast Care Group objectives

The main objectives of Coast Care groups are dune restoration, building a buffer beach, and encouraging a caring attitude towards the coastal environment through education. Their key activities involve restoring native sand binding species on the foredune, fencing dune management areas, managing pedestrian and vehicle access to the beach, re-establishing native shrubs in the backdune area, and erecting educational bulletins.



**Figure 3.3: Onemana Coast Care Group planting day, Onemana 2007.**

### 3.2.2 Surf Lifesaving Clubs

Surf Lifesaving Clubs have been patrolling New Zealand beaches for close to a century now, providing a service to New Zealand communities and beach goers.

Currently there are 71 Clubs nation wide and 13,000 members in total. Clubs are grouped into nine Districts (Northern, Bay of Plenty, Taranaki, Gisborne, Hawkes Bay, Western Districts, Wellington, Canterbury, Otago) and these Districts are part of the National Association Surf Life Saving New Zealand (SLSNZ).

Surf Life Saving New Zealand provides beach patrols on 80 of New Zealand's busiest beaches each summer, with weekend patrols conducted from Labour weekend to Easter each summer, and weekday patrols conducted during the height of the summer holiday period, at the most popular beaches. During the patrol period trained Surf Lifeguards conduct a beach safety assessment each day and set out the red and yellow flags to show beach users the safest place to swim. Surf

Life Saving works with the public to prevent people getting into trouble. They employ a proactive approach to lifesaving through providing a range of education programmes.

Surf life saving club's in New Zealand routinely collect a range of water and beach safety parameters each day during the patrol period as part of the patrol captains daily report form. However, there are additional parameters that can be monitored that will assist them with the hazards assessment at their beach. Additionally the use of scientifically robust monitoring methodologies will add to the validity of their current monitoring.

### **Surf Lifesaving Club objectives**

The main objectives of a Surf Lifesaving Club are to; prevent death by drowning of those swimming and undertaking activities at New Zealand beaches and to promote general beach, surf and fishing safety.



**Figure 3.4: Surf Lifesaving crew, Ngarunui Beach, Raglan 2007.**

### **3.2.3 Coastal Hapu Groups**

Māori communities have their own special spiritual and cultural concerns in relation to the protection of coastal resources. Māori believe that it is their fundamental responsibility to care for, nurture and protect all things within their space, world, and within the area in which they live. This is known as Kaitiakitanga or guardianship and is fundamental in the protection of taonga (resources) for future generations, it is based around the understanding and

responsibility that tangata whenua show when caring for and protecting the taonga and the resources that they govern.

Māori view the coastal environment as the interface between Tangaroa and Tane, the sea and the land whose resources continue to provide sustenance and identity to coastal Māori. They also believe that their ancestors left behind comprehensive customs and practices to manage and protect these resources and to guide their descendants so that they could fully participate in all that the world has to offer.

Māori regard the coastal environment as a sacred space, a place of prayer, a place where they may purify themselves in spirit, mind and body, a place of leisure and play, and a place of learning. Furthermore it is considered as ‘their fridge’ providing kaimoana (seafood) as nourishment for the coastal community. Sand dunes also contain many important cultural sites for Māori including, Midens, Papakainga (settlement) remains, Urupa (burial grounds), and as a source of rare weaving materials such as Pingao. It is for these reasons that the coastal environment needs to be treated with great care and respect.

### **Coastal Hapu Group objectives**

The key objective of Coastal Hapu Groups is to insure the sustainable management of coastal resources through maintaining their guardianship responsibilities.



**Figure 3.5: Tex Rickard of Whaingaroa ki te Whenua Trust, Harvesting Pingao, Ngarunui Beach, Raglan.**

### 3.2.4 Secondary School Science Classes

In New Zealand an individual's science education usually begins at the age of five when they begin primary school. Science education is a required school subject in New Zealand up to year 10 (14-15 years of age), with students in years 11 -13 (15-18 years of age) optionally able to specialise in one or more science disciplines.

It's important that an individual gains a rich and satisfying science education while at school, which can then be enhanced throughout their life. High School science courses with content that is interesting and shown to be relevant to our livelihood are crucial in engaging students in science education.

The coastal environment provides an ideal context in which to teach science especially for schools in coastal communities. Conducting hands-on scientific investigations at the coast enhanced science education while increasing their awareness and understanding of coastal hazards and the dynamic physical processes that take place in the coast environment.

#### Secondary School Science Classes objectives

The key objectives of Secondary Science Classes is to enhance science literacy, provide students with hands on inquiry-based learning experiences, and to provide an enhanced learning experience by teaching in context.



**Figure 3.6: Students conducting a beach survey, Ngarunui Beach, Raglan 2007.**

### 3.3 DISCUSSIONS

Consultation for this research was extensive; eight open unstructured discussions were conducted with key science practitioners, technical experts, and a range of other key informants; and a number of unsolicited discussions also occurred following formal presentations by the author on this research.

Consultation grew to inform a large part of this research. It provided first-hand insight into community based monitoring initiatives, coastal management and coastal monitoring tools.

Details of these discussions and comments on how they informed this research are outlined below in table format for ease of reading.

#### 3.3.1 Science Practitioners

Name and position	James Corbett - Environmental Scientist Chrissy Henley - Regional Wai Care Coordinator
Organisations	Manakau City Council Auckland Regional Council
Date	21 <sup>st</sup> August 2007
Location	Auckland City Council, Auckland
<p><b>How they informed this research.</b></p> <ul style="list-style-type: none"> <li>• Dynamics of running a programme</li> <li>• Difficulties faced with programme development</li> <li>• Co-ordinator key role in successful group</li> <li>• Capacity building, integration with pre-existing groups, build on good synergy, overlay monitoring with other groups,</li> <li>• Communication, showing value in collecting data</li> <li>• Web site development</li> </ul>	

Name and position	Greg Jenks – Regional Coast care coordinator
Organisations	Environment Bay of Plenty
Date	6 <sup>th</sup> September 2007
Location	Environment Bay of Plenty, Mt Maunganui
<p><b>How they informed this research.</b></p> <ul style="list-style-type: none"> <li>• Key principals of successful groups</li> <li>• Need for monitoring</li> <li>• Demographic of Coast Care groups</li> <li>• Insight into community based environmental initiative</li> <li>• Dynamics of running a programme</li> </ul>	

### 3.3.2 Technical Experts

Name and position	Jim Dahm – Regional Coast care coordinator, Waikato region
Organisations	Economos
Date	26 <sup>th</sup> September 2007
Location	Onemana
<p><b>How they informed this research.</b></p> <ul style="list-style-type: none"> <li>• Key principals of successful groups</li> <li>• Need for monitoring</li> <li>• Demographic of Beach Care groups</li> <li>• Insight into community based environmental initiative</li> <li>• Dynamics of running a programme</li> </ul>	

Name and position	Doug Ramsay –National Hazards Centre Leader
Organisations	NIWA
Date	21 <sup>st</sup> March 2007
Location	NIWA, Hamilton
<p><b>How they informed this research.</b></p> <ul style="list-style-type: none"> <li>• The process of developing tools.</li> <li>• Identifying end user, their needs and objectives</li> <li>• Methodologies to met their needs</li> <li>• Customised beach monitoring</li> <li>• Interpretation, Answers, Presentation</li> </ul>	

Name and position	Harley Spence– Regional Coast care coordinator Waikato region
Organisations	Coastline Consultants Ltd
Date	6 <sup>th</sup> September 2007
Location	Phone conference
<p><b>How they informed this research.</b></p> <ul style="list-style-type: none"> <li>• Key principals of successful groups</li> <li>• Need for monitoring</li> <li>• Demographic of Beach Care groups</li> <li>• Insight into community based environmental initiative</li> <li>• Dynamics of running a programme</li> </ul>	

Name and position	Andrew Short - Director of the Coastal Studies Unit, School of Geosciences. National coordinator of the Australian Beach Safety and Management Program
Organisations	University of Sydney, Australia
Date	1 <sup>st</sup> November 2006
Location	NIWA, Hamilton
<p><b>How they informed this research.</b></p> <ul style="list-style-type: none"> <li>• Nature vs Condition of the beach system</li> <li>• To what extent has the beach been modified and to what extent is the beach still being modified.</li> </ul>	

### 3.3.3 Other Key Informants

Name and position	Nathan Hight - Lifesaving Development Manger Brett Sullivan - Lifesaving Manger
Organisations	Surf Life Saving New Zealand
Date	16 <sup>th</sup> November 2007
Location	NIWA, Hamilton
<p><b>How they informed this research.</b></p> <ul style="list-style-type: none"> <li>• Inner workings of SLSNZ</li> <li>• Current beach monitoring</li> <li>• Key objectives</li> </ul>	

Name and position	Anne Hume - Senior Lecturer Science Education Maths / Science and Technology Department School of Education
Organisations	University of Waikato
Date	16 <sup>th</sup> November 2006
Location	University of Waikato
<b>How they informed this research.</b>	
<ul style="list-style-type: none"> <li>• New Zealand Science Curriculum</li> <li>• Teaching Science in Context</li> <li>• NCEA requirement</li> <li>• Science education</li> </ul>	

### 3.3.4 Unsolicited Discussions

In addition to meetings being held with a number of key informants the author also gave numerous formal presentations on the research discussed in this thesis. These including oral presentations at the New Zealand Coastal Society Conference, the University of Waikato School of Education, a Natural Hazards Hui, and a Environmental Information Day. These presentations turned out to be extremely beneficial to this research because they resulted in unsolicited feedback, which again helped to inform this research.

#### **New Zealand Coastal Society Conference**

A formal oral presentation was given at the Annual New Zealand Coastal Society Conference at the Sebel Trinity Conference Centre in Tauranga on the 21<sup>st</sup> November 2007.

The New Zealand Coastal Society Conference represents a wide range of coastal science, engineering and planning disciplines, with attendees from a number of organisations including the engineering industry, local, regional and central government, research institutes and universities. The conference ran for four days and was attended by approximately 200 people.

The author presented a fifteen minute power point presentation on CCMT (See Appendix A1 for presentation) to a packed conference room. Following the presentation the author was approached by numerous science practitioners, regulator, and technical experts who further broadened and enlighten this research with there own experiences and knowledge.

### **University of Waikato School of Education**

On the 5<sup>th</sup> of October 2007 a presentation was given to graduating science teacher from the University of Waikato School of Education. It gave me an opportunity to engage with science educators and present the CCMT.

### **Natural Hazards Hui**

This hui was held at the Kokiri Centre in Raglan on 11<sup>th</sup> May 2007. The hui was attended by members of the local hapu group and NIWA scientist. It allowed the author the opportunity to listen to an oral presentation presented by the local tangata whenua regarding the issues and concerns they face with regards to coastal erosion and hazard at Te Kopua. It also provided the author with an opportunity to present the CCMT.

### **Whaingaroa (Raglan) Catchment Information Day**

The Whaingaroa Catchment Information Day was held at the Te Kopua Domain in Raglan on the 10<sup>th</sup> of March 2007 as part of National Seaweek.

Seaweek is an event run by the New Zealand Association for Environmental Education (NZAEE) and is about raising environmental awareness and encouraging all New Zealanders to take an active role in the protection of their coastal environment.

It was important that the Community Coastal Monitoring Tools had a presence at the Whaingaroa Catchment Information Day because Seaweek is not only a time for New Zealanders to celebrate their coastal environment; it's also a time to get involved in activities that promote the health of our coastal environment.



**Figure 3.7: Community Coastal Monitoring stand, Whaingaroa Catchment Information Day, 10<sup>th</sup> of March 2007, Raglan.**

### **3.4 COAST CARE SURVEY QUESTIONNAIRE**

In order to tailor the monitoring tools to Coast Care it is essential to first conduct some social science research of these groups to establish their needs and ability to undertake certain measurements. Thus a quantitative study of Coast Care member's awareness and knowledge of coastal hazards and management and their values associated with the coastal environment was conducted. The study was based around one survey questionnaire, which was conducted between June-August 2007. This section discusses the survey methodology and presents the results.

#### **3.4.1 Study Overview**

The study aims were to: investigate the value of the coast to communities, establish risk perception and knowledge of coastal erosion and to determine knowledge of coastal management schemes and willingness to be involved with coastal monitoring.

### **3.4.2 Methodologies**

#### **Qualitative vs. Quantitative**

Qualitative research methods have their advantages in that the researcher is actively involved in the collection and analysis of data. However, as a result qualitative research is often very time consuming, and problems frequently arise concerning objectivity and detachment (Sarantakos, 1998).

In contrast quantitative research methods are often seen as being rather sterile, in that the researcher is often detached from the participants of the study (Sarantakos, 1998). However one of the main advantages of quantitative research is that it yields structured data that can be quantified making it ideal for this research.

#### **Choice of quantitative research method**

The principal survey method used for this study was a postal self-administered questionnaire. De Vaus (2002) describes the advantages and disadvantages of self-administered questionnaire surveys. An important advantage of self-administered questionnaires for a study of this scope is that it provided a cost effective way of gathering data from a large, geographically dispersed population. Questionnaires also produce standardised data, allowing for simplistic analysis. Disadvantages noted by de Vaus, 2002 include: their slowness, that there is no interviewer present to clarify any confusion and typically postal questionnaires also achieve poorer response rates in comparison to telephone or personal interview.

An application for ethical approval to conduct this research was lodged and approved by the University of Waikato Ethics Committee (See Appendix B1).

#### **Questionnaire design**

Careful thought must be given when designing a questionnaire; questions need to be precise and unambiguous; the layout of the questionnaire itself needs to be tidy, easy to read, and clear and consistent; and, the participants need to be clearly informed as to what the questionnaire is for, how to complete it and how to return it.

In January to June 2003 a large scale national survey of coastal residents and visitors was conducted to determine perception and preparedness for coastal hazards and in 2007 two surveys were conducted in the Coromandel coastal communities of Tairua and Waihi Beach to investigate current and future coastal management issues in the area. Collectively these questionnaires contained over one hundred questions some of which directly related to the study objectives (see section 3.4.1). So rather than reinvent the wheel this questionnaire drew on a range of established pre-existing questions. Also by using established pre-existing questions, comparisons can be made between the surveys.

The draft questionnaire was subjected to an extensive peer review process. Copies of the draft questionnaire were circulated to key staff members at NIWA, Environment Waikato, Environment Bay of Plenty, GNS Science and the University of Waikato for their comments, which were then incorporated into the final copy. The final questionnaires contained 23 questions relating to values, awareness, knowledge, and management of the coastal environment. A copy of the final questionnaire is reproduced in Appendix B3.

Accompanying the survey questionnaire was a carefully written cover letter which outlined a request for respondent's co-operation; guaranteed confidentially, the purpose of the survey, and also the researcher contact details (see Appendix B2).

### **Sampling strategy**

The sample population was identified from Coast Care groups in the Environment Bay of Plenty and Environment Waikato Regions. Contact was made with the Coast Care coordinators from the two above regions and they gave consent to use the various Coast Care groups in their regions to recruit survey participants.

There are 16 Beach Care groups in the Waikato region (12 on the East Coast and 3 on the West Coast) and 24 Coast Care groups in the Bay of Plenty region. At first it was proposed that the survey sample would be selected from the Coast Care member mailing list, however this proved to be too difficult. Instead it was decided that the survey sample would be selected at random from four care groups two from each region.

### Survey delivery and return rate

Administering the survey was more difficult than initially thought. Initially it was proposed that the survey would be mailed to participants using the Coast Care member mailing list, however this proved to be too difficult.

Instead the questionnaire was hand distributed between June and August 2008 to the four sample groups at various Coast Care meetings and working-bees in their areas. Participants were provided with a questionnaire, an information sheet outlining the purpose of the research project and a pre-stamped and addressed envelope. In total 80 surveys were meant to be distributed to the four groups, however only 50 surveys were distributed.

Participants were required to complete one questionnaire each. This involved answering 23 questions relating to values, awareness, knowledge, and management of the coastal environment. The survey questionnaire took between 10-15 minutes to complete and participants were given two weeks to complete and return the questionnaire to the researcher in the stamped addressed envelope provided.

Table 2.1: Survey delivery and return rate

Location	Date delivered	Number distributed	Number returned	Return rate
Mount Manganui	September 2007	10	4	40%
Onemana	Late September 2007	20	12	60%
Raglan	August 2007	20	14	70%
Other	Late September 2007	Nil	0	0%

The typical return rate for a voluntary postal survey is around 30%.

However, because this survey was hand delivered the return rates were higher than usual ( 40% Onemana, 60% Mt Manganui, 70% Whaingaroa).

**Data analysis**

On receipt of the completed questionnaires, each survey question was coded and the data entered into the statistical package SPSS version 13.

Coding is an important aspect of processing the data because often survey data starts off in text format and needs to be transformed into a format suitable for quantitative analysis: numbers (Denscombe, 1998). Analysis included calculation of response percentages for individual questions. Descriptive statistics are presented in a tabulated data report in appendix B4 of this thesis.

**3.4.3 Summary of Key Results**

A summary of result for the survey questionnaire are presented below in bullet point format for ease of reading.

**Use of the beach and what respondents value about the coast**

- The greatest proportion of survey respondents (70%) said that the natural beauty of the coastal environment attracted them to live next the beach.
- Half of the respondents use the beach several times a week, with the majority of respondent using the beach for walking and swimming.

**Understanding and risk perception of coastal erosion**

- When respondent were asked what they thought was the main causes of coastal erosion, they were mostly likely to say that it was because of storms, followed closely by waves, wind and then humans.
- The majority of respondent thought that coastal erosion was likely to affect their community within the next year and 30 % thought that it would affect them personally within the next year. This suggests that the survey population clearly believe coastal erosion to be a treat to them and their community.

### **Information about coastal erosion**

- Respondents have asked a range of people and organisations for information. However when seeking information on coastal erosion respondents generally ask the Local and Regional Councils followed closely by Research Organisations.
- When asked if they intended to seek information on coastal erosion in the next month no respondent said “Definitely” the majority opted for “possibly”.
- Respondent were interested in finding out more about a range of topic relating to the coastal environment. They were primarily interested in coastal hazards.
- When seeking information about coastal processes most respondent would prefer it to be delivered in pamphlet format.

### **Coastal management**

- The main beach management schemes the respondents identified as being used in their area was dune planting and zoning of beach areas.
- All respondents have been involved in Coast Care activities and think that it is necessary to monitor the performance of a beach/dune management scheme.
- When asked is there had been any monitoring of the beach/dune management scheme in their area. The majority said yes with the main type of monitoring being a vegetation survey, which is primarily carried out by a Coast care coordinator.
- 68% percent of respondent said that they would be interested in undertaking some monitoring of their beach/dune management scheme, with the majority preferring to do it as part of a group.

### **3.5 DISCUSSION AND CONCLUSION**

This chapter described the preliminary approach that was taken in the development of the CCMT. It defined the “target audience” or the end user groups for CCMT; it also outlined the consultation and discussion process and survey questionnaire that informed this research.

## **4. Monitoring Tool Development**

### **4.1 INTRODUCTION**

There are a wide variety of methodologies for measuring changes along the shoreline. Choosing appropriate methodologies is critical to designing a successful monitoring programme.

Monitoring is more than just measuring things. It is about using methodologies that are matched to the type of beach, using appropriate equipment, collecting appropriate data to which analysis can be applied, incorporating local knowledge of the environment, and making the results of the monitoring and feedback readily available to interested parties.

It is difficult for the public to select appropriate and meaningful monitoring methodologies without scientific advice. Monitoring methods need to be matched to beach type which is a function of sediment type and the energy of the wave and wind environment. This has a direct bearing on the frequency and sampling and the choice of useful parameters or metrics to measure. The monitoring equipment must be suitable for the task and, just as important, be able to be easily used by those doing the monitoring. There are various methods for analysing data, and it is important that relevant time-series and statistical analysis procedures be determined and tested before the data collection begins in order that appropriate data is collected for the task.

This chapter will define the approach that has been taken in the development of tools for monitoring coastal physical changes that are hazard related. It will discuss the selection of appropriate coastal monitoring parameters, as well as the development of monitoring methodologies. Essentially this chapter provides the background to the Coastal Monitoring Procedures Manual and accompanying forms and equipment that have been developed as part of this thesis.

## **4.2 MONITORING APPROACH**

As discussed in Chapter 2, monitoring tools need to meet the requirements of a range of users, which all have different requirements and objectives. It was established that most coastal monitoring objectives could be grouped into three governing monitoring themes, with some objectives lying within one, two or all of the themes depending on the users needs. The three themes are coastal stability; beach and water safety; and human impacts. Monitoring objectives may include other themes such as water quality and biological health. However, the aim of this research is to develop a means for coastal communities to monitor long-term changes in their physical coastal environments, through the development of a simple and inexpensive, but reliable method, for collecting beach profile data and a method for collecting beach information that can then be used for hazard assessments. Thus this research doesn't consider monitoring marine biology or water quality.

The literature review highlighted that monitoring tools do not necessarily need to be sophisticated. Good monitoring tools need to cater to a variety of people by providing a range of monitoring approaches. This study identified two key requisites for monitoring; environmental observations and scientifically robust measurement. These two monitoring approaches can be separated on the basis of their methods, measurements and interpretive value.

### **4.2.1 Environmental Observations**

Sometimes we get so involved in making scientific measurements that we fail to use our qualitative power of observation (Texas, 2006). Simple observations can provide valuable information about the state of the environment. Taking time to walk the beach while making key observations provides a holistic view of the environment, this will help with the interpretation of the quantitative data collected. Environmental observations also play a key role in environmental education, because by encouraging a holistic view groups gain a better understanding, awareness and knowledge of the dynamic processes that act in the coastal environment.

Smith (2002) assessed a number of physical attributes of the coastal environment (geoindicators) that can assist in the assessment of the stability of the coast. Geoindicators occur in four categories: indicators of accretion, cyclic stability, stability, and erosion. Environmental observations attempt to measure these indicators; however they are not bound by the rigours of scientific accuracy (Illenberger & Associates, 2001). Hence, this study focuses on the types of environmental indicators present in the coastal environment and thus the types of observations that could be made by coastal community groups when conducting field work at the coast.

Two categories of observations were identified. There are those observations that may not necessarily be key deterministic indicators of change, but are essential for the meaningful interpretation of quantitative data, and those that are key deterministic indicators of change. For example a non-deterministic observation might be whether the tidal state is high, mid or low at the time of monitoring and whether it is rising or falling. This information alone is not very useful. However, when coupled with rip current and wave information, it may give a comprehensive understanding at what stage of the tide prevalent rip currents are most persistent and bather safety is compromised. A good deterministic observation of accretion is the build-up of sand around objects and structures on the beach. Figure 4.1 illustrates a restoration area being fenced off at Ngarunui Beach Raglan. Figure 4.2 shows the same fencing, nine months later and how there has been net accretion over that period.



**Figure 4.1: Tex Rickard and Hautai Greensill erecting dune management fencing, Ngarunui Beach, March 2004. Photo by A. Greensil**



**Figure 4.2: Evidence of accretion Ngarunui Beach Raglan, November 2004. Photo by A. Greensil**

Deterministic observations of coastal erosion can be separated into two groups: those associated with infrequent, high intensity storms; and those associated with the slow and continuing removal of sediment from the beach (Smith, 2002). A key deterministic observation of erosion caused by a storm event might be the presence of scarping of the foredune (Figure 4.3).



**Figure 4.3: Coastal erosion, Ngarunui Beach Raglan, November 2004. Photo by T. Hume**

A severe storm event will lower the beach level indicating that the toe of the dune is vulnerable to attack by wave action. Continual wave attack on the dune toe will undermine the dune face, allowing it to slump, removing vegetation and exposing the dune face allowing it to be readily eroded by the wind, waves and human activity (Smith, 2002). The presence of an old dune scarp is evidence of past erosion and an indicator of how the coast might retreat in future.

### **4.2.2 Scientifically Robust Measurements**

Despite environmental observations serving a key deterministic and important education role, it is essential for best interpretive value that a monitoring programme also consists of scientifically robust measurements.

Such measurements are objective because they use methodologies that are transparent, reproducible and standardised allowing other researchers to reproduce them. Scientifically robust measurements will withstand scrutiny by other science practitioners. Furthermore when such measurements are made consistently and adhere to the predefined methodologies, the data collected can be used to make sound statements and future comparisons (Miller and Paul, 2007). Scientific measurements are important from a regulatory perspective, because they are not subjective; they are independent from individual opinion or judgement. Errors associated with this type of measurements typically occur as a result of human error, not as an error in methodologies.

A well-tried scientific measurement that is commonly used in the coastal area is beach profiling. A beach profile is a topographic transect of the beach, typically running from a starting point on the landward side of the foredune or beach ridge to low water mark, measured perpendicular to the shoreline. Beach profiles are an important coastal management tool as they are the primary method of measuring event and annual scale changes in beach morphology and how sediment is being added to or stripped from the beach. These measurements are essential for deciphering shoreline erosion and accretion trends and tracking post storm beach recovery (Auckland Regional Council, 2002). They provide information on shoreline advance and retreat, beach state (eroded, stable, or accreted), and enable calculations of run up levels and sediment volumes.

## 4.3 MONITORING TOOLS

### 4.3.1 Selection of Monitoring Parameters and Indicators

The first step in choosing monitoring parameters is to identify what's important to the users and what they want to find out from monitoring. Knowing exactly why you want to undertake monitoring is extremely important when developing a monitoring programme because it determines the approach you will take. During the development of this research it was established that most coastal monitoring objectives align with three governing monitoring themes; coastal stability; beach and water safety; and human impacts. Initially a large array of potential monitoring parameters that aligned with these three themes was identified. To identify the most useful parameters in this array an adaptation of Illenberger & Associates (2001) method for selecting parameters for community groups was used. Firstly seven selection criteria were defined namely; 1) is the parameter a tool for environmental change?, 2) is the parameter a robust indicator of change?, 3) does the parameter provide an early warning of potential problems?, 4) is the parameter monitored with relative ease?, 5) is the parameter easy to understand?, 6) is the parameter a fundamental and valued aspect of the coastal environment?, and 7) is the parameter cost effective to monitor?. For each of the selection criteria a parameter was given a 1 if it fulfilled the selection criteria and a 0 if it did not. If a parameter received a total score of 7 it would be seen to have excellent potential as a monitoring parameter for community groups, and conversely if a parameter received a total score of 0 it would be seen to have poor potential. However, if a parameter received a 3 or 4 it does not necessarily mean that it is a mediocre monitoring parameter for community groups, because each of the selection criteria have been given a weighting. The weighting was applied in an attempt to rank the criteria in order of importance. The most significant and thus most heavily weighted selection criteria is based on the key guiding objectives of this thesis which are related to education. Table 4.1 below outlines the three governing monitoring themes, the parameters chosen which align with these themes, whether the parameter meets the selection criteria and the overall rating of the parameter as a coastal monitoring tool.

Table 4.1: Coastal Monitoring parameters and indicators

Coastal monitoring parameters / indicators	CRITERIA								Total score max = 7	Weighted rating: max = 100
	Tool for environmental education	Robust indicator of change	Provide an early warning of potential problems	Monitored with relative ease	Easy to understand	Fundamental & valued aspect of the environment	Cost effective			
Weighting	25	16	15	14	12	10	8			
<b>Coastal stability</b>										
Width of high tide beach	1	1	1	1	1	1	1	1	7	100
Evidence of erosion	1	1	1	1	1	0	1	1	6	90
Degree of active scarping	1	1	1	1	1	0	1	1	6	90
Degree of vegetation cover & main species	1	1	1	1	1	1	1	1	7	100
Evidence of active sand accumulation	1	1	1	1	1	0	1	1	6	90
Erosion lag	1	1	0	0	0	0	1	1	3	49
Dune toe strandline	1	1	1	0	1	1	1	1	6	86
High water strandline	1	1	1	0	1	1	1	1	6	86
Beach profile	1	1	1	0	1	1	1	1	6	86
<b>Beach and water safety</b>										
Number of alongshore bars	1	0	1	1	1	0	1	1	5	74
Number of rip currents, their spacing & type	1	0	1	1	1	0	1	1	5	74
Width of surf zone	1	0	1	1	1	0	1	1	5	74
Sneaker waves	1	0	1	1	1	0	1	1	5	74
Longshore current direction and speed	1	0	1	1	1	0	1	1	5	74
Vehicles on the beach	1	0	1	1	1	0	1	1	5	74
Horses on the beach	1	0	1	1	1	0	1	1	5	74
<b>Human impacts</b>										
Vehicle damage evident	1	0	1	1	1	0	1	1	5	74
Horse damage evident	1	0	1	1	1	0	1	1	5	74
Number of controlled beach access points	1	0	1	1	1	0	1	1	5	74
Number of uncontrolled beach access points	1	0	1	1	1	0	1	1	5	74
Beach user numbers	1	0	1	1	1	0	1	1	5	74
Litter count	1	0	1	1	1	0	1	1	5	74
Storm water discharge	1	0	1	1	1	0	1	1	5	74
<b>Weather conditions and sea state</b>										
Tidal observations	1	0	0	1	1	0	1	1	4	74
Wind direction and speed	1	0	0	1	1	0	1	1	4	74

### **4.3.2 What the Monitoring Parameters/Indicators tell us about the Coastal Physical Environment**

The measurement of monitoring parameters/indicators provides information on the environment in several ways. By making measurements people become engaged in the study of their environment and are thus forced to look logically and critically for change. By making measurements and recording their findings they also become knowledgeable about the size of the changes and where and how frequently they occur. In other words they become more objective in their assessment of change in the coastal physical environment.

The coastal monitoring parameters/indicators shown in Table 4.1 provides the following information on the coastal physical environment.

#### **Width of high tide beach**

The width of the high tide beach is the distance between the toe of the foredune or beach ridge and the high water line. The width will be large on a low gradient dissipative beach and small on a steep reflective beach. However, on any one beach the width will vary with time and is a very good indicator of the erosive state of the beach. When the width is short, the beach is typically steep and in an eroded state, and because there is little distance between the dune toe and the sea, the dune exposed to wave attack during storm event. When the distance is large there has generally been a migration of sediment onshore, and the beach is in an accreted state, meaning there is a healthy storage of sand to provide a buffer against the next storm event. Beach width data lends itself well to plotting and building width/time graphs. The value of the record increases with time.

#### **Evidence of erosion**

A number of key observations and indicators such as fences and structures falling onto the beach; tree stumps, roots, peat and mud exposed on the beach; and the presence of objects such as rocks that are usually covered by sand provide evidence as to whether the beach is eroding. These observations or “evidence” provide vital information on the state of the beach, while providing a holistic view of the environment, which will help with the interpretation of the quantitative data collected.

### **Degree of active scarping**

Scarping of the foredune is an indicator of rapid erosion. The degree of active scarping of the foredune is a measure of how the beach has responded to recent storm events. It also gives an indication of the beaches potential vulnerability to storms in the near future. When dune scarping occurs it means that the beach is in an eroded state (or that wave run-up was exceptionally high). Scarping leaves the foredune in a somewhat vulnerable state, making it less resilient and therefore not in a good shape to survive subsequent large event.

### **Degree, condition and main species of vegetation cover**

The degree, condition and main species of vegetation on the foredune has a huge influence on the stability of the foredune. The lack of vegetation indicates an unstable dune. Vegetation stabilises otherwise mobile sand by trapping, binding and covering it. When plants are in a good condition and cover the foredune it means that there is a good opportunity for sand to accumulate on the dunes. The main species of vegetation cover is also important because research has shown that only specialised sand-binding plants such as Spinifex, Pingao and Sand tussock can aid in the successful trapping and binding of sand. Also in order to monitor the success of coast care planting projects it necessary to monitor the degree and condition of vegetation cover.

### **Evidence of active sand accumulation**

Like coastal erosion a number of key observations and indicators provide evidence as to whether the beach is accumulating sand. These observations or “evidence” also provide vital information on the state of the beach, while providing a holistic view of the environment.

### **Erosion lag**

Erosion lags are heavy-mineral concentrations usually present as a band that has been formed by the winnowing away (by wind or water) of the lighter sand grains leaving darker (mafic) minerals such as magnetite, illmenite and garnet. Erosion lags indicate that the beach has been cut down during events and where such accumulations are rather permanent it means that there is never going to be much build-up of sand at that part of the shore.

**Dune toe strandline and high water strandline**

The width of the high tide beach is a function of the dune toe location and the high water mark. Mapping the dune toe and high water strandline provides information on the alongshore variations in the width of the high tide beach. This information is important because it indicates areas of the beach that may have a short high tide beach width, meaning that the foredune may be susceptible to wave attack during a storm event. Alongshore fluctuations in the high tide beach width may also highlight the location of rip head embayments. Also dune toe and high water strandlines from different times can be plotted on the same map for a comparison of the changes in beach width over time. This is one method of determining the rate of shoreline change along a coast.

**Wave run-up**

Under big seas and at times of high spring tide waves run up high up the beach face and can even overtop dunes and gravel barriers to flood the low areas behind. Ideally observer needs to be on the spot during storms to measure this, but it provides very important information for design purposes. Run-up level can be determined after the event by recording the level to which floats (wood, seaweed etc) are left stranded after a storm. Run up information can be related to the size of the event and used to design the height of artificial dunes and floor levels of buildings along that part of the coast. The key thing to measure is the height which the run up reached, and this needs to be measured by way of a distance above some level such as the average high tide level of the day or some other reference level such as the beach survey profile bench mark.

**Beach profile**

Beach profiles are an important coastal management tool as they are the primary method of measuring event and annual scale changes in beach morphology. These measurements are essential for deciphering shoreline erosion and accretion trends and tracking post storm beach recovery (Auckland Regional Council, 2002). They provide information on shoreline advance and retreat, beach state (eroded, stable, or accreted) and enable calculations of run up levels and sediment volumes. Also beach profiles can be used to monitor the effects of coastal development and

structures on sand movement. For example the influence of groynes not development on localised sediment transport.

### **Number of longshore bars**

When sediment is eroded from the beach and moves offshore it's generally deposited to form a longshore bar. Monitoring the number of longshore bars present on a beach is important in determining where the sand is going once it is eroded from the beach. If eroded sand is rearranged locally in longshore bars and troughs there is a good chance the sand will be returned to the beach at a later date under long low swell conditions.

### **Number of rip currents, spacing and type**

Rip currents are a fast moving jet of water that originates within the surf zone and moves seaward beyond the breakers. Rip currents can move at 1-2 meters per second and pose a considerable hazard for beach users. Feeder rips may run along the beach before they travel offshore. Monitoring the number of rip currents on a beach, their spacing and type on a regular basis increases the observer's awareness of rip current occurrence at that beach. Records of rips on beaches can be used to identify potential swimmer hazards and map what parts of the beach are dangerous which provides valuable input to Surf Life Saving and Water Safety Audits of Beaches. This aids surf life saving lifeguards in the forewarning of beach users.

### **Width of the surf zone**

The surf zone is the band of water adjacent to the beach over which waves break. Gaining a better understanding of the surf zone through monitoring is important for a number of reasons with the key reason being water safety. When waves enter the surf zone and begin to break they alter the mean level of water in the surf zone, elevating it. This can be potentially dangerous for beach goers because one moment they can be standing on the sea floor and the next minute the water level can be well over their head. The wider the surf zone the more dangerous the beach is for beach goers.

**Sneaker waves**

Sneaker waves are surges of water up the beach that occur under certain large surf conditions and at intervals of every few minutes or so. It's a special type of run-up that's related to groups of waves rather than individual large waves. It's the type of up-rush of water that knocks small children off their feet and drags them seawards, catches vehicles driving along the beach and washes fishermen of rocks. Recording where they occur and how far they rush up the beach and what type of sea conditions generate them, provides information that can be fed into developing water safety plans for a beach. This evidence may lead to appropriate signage warning of the "sneaker wave danger" being erected along the shore as is done on the Oregon Coast.

**Longshore current direction and speed**

The longshore current is the movement of water along the shoreline and is driven by three factors: 1) waves approaching at an angle to the shoreline, 2) tidal currents, and 3) the wind. The longshore current direction and speed is an important coastal monitoring parameter because of its significance in the movement of sediment along the beach. In some cases beach sediment transport involves the local rearrangement of sand into offshore bars and trough or into rip head embayment's (Komar, 1998). However, in other cases hundreds of thousands of cubic meters of sediment maybe displaced along the coast each year (Komar, 1998). Given this, it is important to have an understanding of the longshore current direction and speed at your beach. Monitoring longshore current is also important for water safety reasons beach they feed rip currents.

**Vehicles and horses on the beach, beach user numbers, vehicle and horse damage, litter count, storm water discharge.**

Tracking the topography of the beach shows us how the beach changes, but it doesn't tell us why the beach changes. Coastal erosion is described as a natural process; however humans have a history of contributing to, exacerbating and accelerating the process. Noting whether there are vehicles and horses on the beach, the number of beach users, and evidence of human impacts helps with establishing the big picture of what is really going on at your beach. Also

vehicles, horses, litter and storm water on the beach can be potentially hazardous to beach goers and the coastal environment.

### **Number of controlled and uncontrolled beach access points**

Measuring the amount of uncontrolled beach access points is important because it gives an indication of whether beach access management schemes are effective. If uncontrolled access points are increasing maybe the controlled beach access point are not easily detected from the back beach or are located in the wrong place. Also by measuring the amount of controlled beach access points you can gauge whether uncontrolled access points are arising because of insufficient controlled beach access point. The number of access points to a beach has a direct bearing on water safety. Where there are multiple accesses there is more opportunity for people to reach the water and the risk profile for the beach is greater.

### **Tidal observations, wind direction & speed, breaker wave height, period, direction & type**

Beach processes vary from day to day and the information collected during a beach visit only gives a snapshot of what is going on in terms of wind, waves, and currents for that day. One value of collecting this data is that if the data is collected on a regular basis the observer will get a good feel for the “oceanographic climate” of that beach and also an increased appreciation of the physical processes shaping the coastal environment. However the real value of the information is largely in the aiding interpretation of other parameters. Measuring the wind, waves and tides will help us to understand why the beach changes and answer questions such as: 1) under what sort of wave conditions or state of the tide are rips common? 2) under what wave direction does the beach erode? and 3) under what wave conditions is there a very strong longshore current?.

### **Photographs**

Photographs are an important part of monitoring because they provide a qualitative record of the state of the beach and the observations that have been made during a field excursion. Taking photographs from the same vantage point each time will increase their value for interpreting beach changes.

### **4.3.3 Monitoring Methodologies**

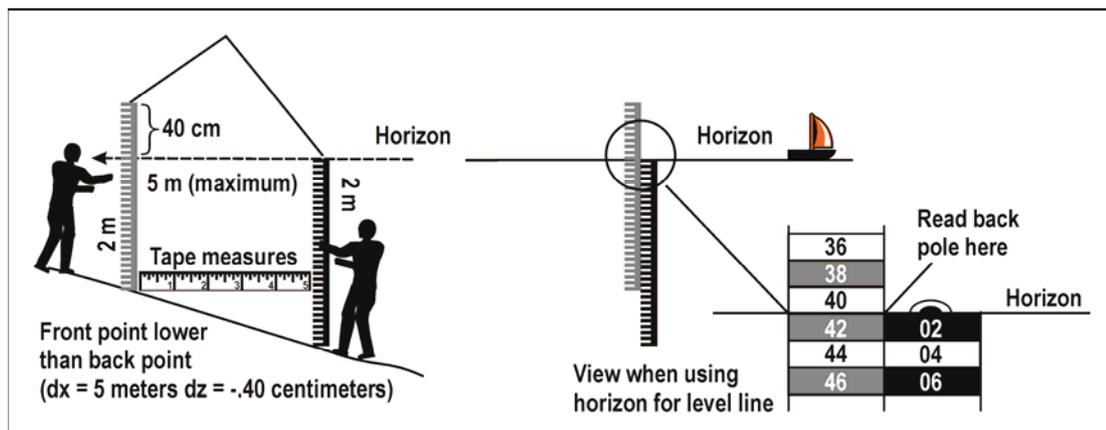
The key in the development of monitoring methodologies was to provide groups with a range of methodologies, some requiring little time and minimal technical skills and others requiring more time and specialised technical skills. Choosing appropriate methodologies is critical to designing a successful and meaningful monitoring programme. It's important that monitoring methodologies are suited to the monitoring objectives of each group. Groups with objectives that centre on education may use methodologies that require little time and minimal technical skills, while groups with a primary focus on documenting change in the coastal environment may use methodologies that require more specialised technical skills. As noted in Chapter 2, once a group has established its monitoring objectives, methodologies and framework it's important to review the monitoring strategy to insure that it realizes the need for monitoring. Monitoring methodologies are critical when working within the constraints of the Resource Management Act. Good monitoring methodologies will help ensure that the data collected through community based monitoring is objective and scientifically robust, allowing it to stand-up to scrutiny in Consent Hearings and the Environment Court.

A review of literature highlighted that there are a wide variety of methodologies for measuring aspects of the coastal environment all with their own advantages and disadvantages. Rather than reinventing the wheel by developing new methodologies for the parameters listed in Table 4.1, some of the methodologies outlined in the field procedure manual are founded on established methodologies that have been adapted to suit this research.

### **4.3.4 Coastal Monitoring Procedure Manual**

From the monitoring methodologies, a Coastal Monitoring Procedure Manual was developed. The aim of the manual is to provide guidance for persons undertaking monitoring of physical environmental variables on their coast. The manual has ten sections namely: Introduction; Marking out the beach profile lines; Measuring the beach profile; Measuring the shoreline position; Wind and wave climate; Water and beach safety; Evidence of erosion and accretion; Human impacts; Photos; and End of the day procedures. It provides instructions on how to prepare for a day in

the field, methodologies for observations and scientific measurements of the various coastal monitoring parameters listed in Table 4.1, instructions on how to take useful monitoring photographs, and instructions on jobs that need to be done following monitoring to secure the dataset. A number of illustrations have also been developed as part of the manual to illustrate how scientific measurements should be carried out. One key illustration demonstrates how to carry out beach profile measurements using the Emery pole methodology (Figure 4.4).



**Figure 4.4: Conducting a beach profile survey (Emery method)**

In addition, beach photographs taken and collected by the author (examples below Figure 4.5 & 4.6) have been incorporated into the manual to provide examples of what observers should be looking for while in the field.



**Figure 4.5: Illustration of dune scarping, Ngarunui Beach, Raglan**



**Figure 4.6: Illustration of a shore normal rip current, Ngarunui Beach, Raglan**

The Coastal Monitoring Procedure Manual has not been developed as a stand alone document. It was not developed as a document that would be taken into the field. Instead, it is proposed that during the implementation of the monitoring tools, trained personal will demonstrate the monitoring procedures to each participating group during a number of field excursions. During these excursions groups will be provided with a “cheat sheet” as well as field diagrams and illustrations (discussed in the following section) which will prompt them on how to complete their field forms. Once a group is established demonstrators will follow the group’s progress by participating in a number of refresher excursions to ensure that the methodologies are being followed correctly.

A complete copy of the Coastal Monitoring Procedure Manual that was developed as part of this thesis can be found in Appendix C1.

#### **4.3.5 Monitoring Forms**

With different groups having different reasons for monitoring and therefore different data needs, one set of forms is not going to be suitable for every group. Additionally one form containing all possible monitoring parameters is unpractical and unnecessary. It is proposed that during the development of the monitoring strategy a set of customised field forms will be developed for each group. By customising the forms, groups are only presented with information that is relevant to them, reducing the amount of confusion on what needs to be collected in the field, and cutting down on the amount of unnecessary paper.

A number of forms have been developed as part of this research to aid groups in monitoring; these include pre survey preparation and field equipment checklists, and field data entry forms.

The following forms have been trialled in the field (refer to section 4.4) and, even though the content of the field forms will differ between groups, the proposed layout of the various forms will remain generally consistent. Trials showed that field guidance notes and forms should; avoid an untidy and crowded appearance, use large type size and mixed case letters, keep paper required in the field to a minimum, and formulate things so they are easy to follow.

The subsequent forms are sample monitoring forms for the target audience Coast Care.

#### **Pre survey preparation checklist**

A pre survey preparation checklist was developed so that groups had a step by step guide outlining the key tasks that need to be conducted prior to a field excursion. Tasks are separated into four groups; tasks that need completing; one month prior to survey, one week prior to survey, one day prior to survey, and on the day of survey. Key points for each task are detailed and a tick box is provided alongside.

TASKS	KEY POINTS	CHECKS
<b>Month prior</b> to survey	<ul style="list-style-type: none"> <li>When selecting a survey date ensure that you allow for about 3 hours of surveying time on either side of low tide</li> <li>During the summer months, also take into account that weekends may not be the best time to survey because of the presence of the public</li> </ul>	<input type="checkbox"/> Check tides  <input type="checkbox"/> Take into account beach users
<b>One week prior</b> to survey	<ul style="list-style-type: none"> <li>Determine vehicle availability and arrange transport to site</li> <li>Check the weather forecast</li> <li>Check tides</li> <li>Finalise survey date and time</li> <li>Check camera and GPS batteries to insure they are fully charged</li> <li>Arrange any equipment that may need to be borrowed or sourced</li> </ul>	<input type="checkbox"/> Transport  <input type="checkbox"/> Weather  <input type="checkbox"/> Tides  <input type="checkbox"/> Date & time  <input type="checkbox"/> Batteries  <input type="checkbox"/> Equipment
<b>Day prior</b> to survey	<ul style="list-style-type: none"> <li>Gather together and check all field equipment is accounted for and in working order</li> <li>Prepare relevant field sheets</li> <li>Review field protocols</li> </ul>	<input type="checkbox"/> Tick off equipment on check list  <input type="checkbox"/> Field sheets  <input type="checkbox"/> Review protocols
<b>Day of survey</b>	<ul style="list-style-type: none"> <li>Complete desk top survey</li> <li>Prepare food and drink</li> </ul>	<input type="checkbox"/> Desk top survey  <input type="checkbox"/> Food and drink

**Figure 4.7: Pre survey preparation checklist**

**Equipment checklist**

The equipment checklist was developed to help groups prepare for a day in the field. Again the equipment checklist is customised to each individual monitoring programme. (The monitoring equipment will be discussed in section 4.2.5)

EQUIPMENT	CHECKS
Field forms	<input type="checkbox"/>
Clipboard	<input type="checkbox"/>
Pens, Pencils	<input type="checkbox"/>
30 or 50m tape	<input type="checkbox"/>
Emery poles (x 2)	<input type="checkbox"/>
Marker flags (x10)	<input type="checkbox"/>
GPS system	<input type="checkbox"/>
Clinometer	<input type="checkbox"/>
Compass	<input type="checkbox"/>
Spare batteries	<input type="checkbox"/>
Digital camera	<input type="checkbox"/>
Note book	<input type="checkbox"/>
Water bottle and lunch	<input type="checkbox"/>
Plastic bag for rubbish	<input type="checkbox"/>

**Figure 4.8: Equipment checklist**

**Field data entry forms**

The field data entry forms have been formulated in a manner that makes them easy to follow and thus easy to complete. Parameters have been grouped into themes and the forms separated into numbered sections. Each form has a “cheat sheet” that accompanies it and the numbers on the form correspond to the field instructions on the “cheat sheet” (see Figure 4.10 for the cheat sheet accompanying this form).

**FIELD FORM (Coast Care)**

<b>Group name:</b>		1
<b>Beach name:</b>		
<b>Location:</b>		
<b>Observers:</b>		
<b>Date:</b> /    /		<b>Time:</b> :    am pm
<b>Tides:</b> High    :		Low    :    Range    m
<b>Grid reference From:</b>		To:

<b>Weather conditions</b>	2	<b>Wave climate</b>	3
<b>Comments:</b>		<b>Comments:</b>	
Tidal level <input type="checkbox"/> Low <input type="checkbox"/> Mid <input type="checkbox"/> High <input type="checkbox"/> Rising <input type="checkbox"/> Falling		Breaker height <input type="text"/> m	
Wind speed <input type="text"/> m/s		Period <input type="text"/> s    Direction <input type="text"/>	
Wind direction <input type="text"/>		Type: <input type="checkbox"/> Plunging <input type="checkbox"/> Spilling <input type="checkbox"/> Surging	

<b>Erosion or accretion evidence</b>	4	<b>Vegetation</b>	5
Degree of active scarping <input type="text"/> %		Degree of coverage	
Evidence of sand build-up <input type="checkbox"/> yes / <input type="checkbox"/> no		Foredune <input type="text"/> %    Dune face: <input type="text"/> %	
Evidence of erosion <input type="checkbox"/> yes / <input type="checkbox"/> no		Main species <input type="text"/> spinifex / pingao / marram	
Width of high tide beach <input type="text"/> m		<b>Comments:</b>	
Photo files: <input type="text"/>			

<b>Litter count</b>	6	<b>Human impacts</b>	7
Plastic <input type="checkbox"/>	Wood <input type="checkbox"/>	Rubber <input type="checkbox"/>	Vehicle damage <input type="checkbox"/> yes / <input type="checkbox"/> no
Glass <input type="checkbox"/>	Cloth <input type="checkbox"/>	Metal <input type="checkbox"/>	No. controlled beach access pts <input type="text"/>
Styrofoam <input type="checkbox"/>	Paper <input type="checkbox"/>	Other <input type="checkbox"/>	No. uncontrolled beach access pts <input type="text"/>
<b>Description:</b>			
<input type="text"/>			
<input type="text"/>			

<b>Beach profiles</b>						8
Distance	<input type="text"/> m	<input type="text"/> m	<input type="text"/> m	<input type="text"/> m	<input type="text"/> m	<input type="text"/> m
Slope	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Cross-shore profile	<input type="checkbox"/> yes / <input type="checkbox"/> no	Time:	<input type="text"/> : <input type="text"/> am pm			
Alongshore dune toe strandline	<input type="checkbox"/> yes / <input type="checkbox"/> no	Time:	<input type="text"/> : <input type="text"/> am pm			
Alongshore HWM strandline	<input type="checkbox"/> yes / <input type="checkbox"/> no	Time:	<input type="text"/> : <input type="text"/> am pm			

**Figure 4.9: Coast care field data entry form example.**

## Field instructions “cheat sheet” (Coast Care)

The “cheat sheet” prompts observers on how to fill out the various sections of the field form when out in the field.

### 1. Form header

The group name is the **name of your monitoring group**. The name of the **beach name from the 1:50 000 topographic map**. The **location of the monitoring site** i.e. south end Ngarunui beach or north end Ngarunui beach. The **date in day/month/year** and the time in hour: minutes, circle am or pm. The **New Zealand Map Grid reference (easting and northing)** or **GPS World Global system 1984 (latitudes and longitudes)**. Note the **times of high and low tide and the tidal range** from the desktop study.

### 2. Weather conditions

Give a brief **description of the weather** in the comments section, **estimate the tidal level and decide whether it is rising or falling (is there a wet/dry line above the tide level?)**. **Estimate the wind speed** using the Beaufort wind scale (See supplementary sheet 4). **Define the wind direction**, this is the direction the wind is blowing from in terms of the cardinal N,E,W,S or ordinal NE, SE, SW, SE direction on the compass.

### 3. Wave climate

Give a brief **description of the wave climate** in the comments section. **Estimate the average wave height**; use another observer standing at the waters edge as a scale. **Estimate the wave period** by measuring the time in seconds that it takes for 10 waves to pass some point in the surf zone, and then dividing that number by 10. Move to a high point and **define the wave direction** as the direction the waves are approaching from. **Determine the breaking wave type** by using the **breaking wave type diagrams** (See supplementary sheet 2).

### 4. Erosion or accretion evidence

**Determine how much of that beach section has been actively subjected to wave erosion (scarping)? Is there any evidence of active sand build up or erosion? Photograph this evidence. Measure the width of the high tide beach** (the distance from the toe of the dune to the wet/dry line).

### 5. Vegetation

How extensive is the vegetation cover on the foredune and the dune face. **Use the degree of vegetation cover scale** (See supplementary sheet 2) **to determine the degree of vegetation cover**. Use the vegetation type image (See supplementary sheet 2) **to determine what the main species of cover is**. Give a brief **description of the vegetation** in the comments section.

### 6. Litter count

**Collect the litter** in the near vicinity to your profile, ignoring biodegradable litter such as food remains and dead animals. **Record the number of each type of litter** listed on the field sheet. **Note any patterns to the distribution** of the litter you may observe.

### 7. Human impacts

Is there **evidence of vehicles damage** to the beach or dunes? **Define the number of controlled beach access points** (fenced access, stairs and boardwalks). **Define the number of uncontrolled beach access points**. **Estimate the number of people on the beach**. **Note other human impacts**.

### 8. Beach profile

**Complete the distance and slope measurements** for the different compartment of the profile. **Did you conduct alongshore strandlines using the GPS? Did you conduct beach profiles using the emery method?** If yes note the times when they were conducted.

**Figure 4.10: Field instructions for Coast Care group.**

### Beach profile field form

This form was developed to capture beach profile data that is collected using the Emery method. This form also has a “cheat sheet” (see Figure 4.12) that accompanies it, outlining how to mark out and conduct a beach profile survey.

Beach Profile Field Sheet					
Profile name	_____				
Date	_____				
Time	_____				
Oberseved by	_____				
Point #	dx (m)	dz (m)	X (m)	Z (m)	Notes
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

**Figure 4.11: Beach profile field form.**

## Field instructions “cheat sheet”

### Marking out the beach profile lines

1. Standing on the dune crest sign back to the profile marker using a sighting compass and your profile bearing to line yourself up on you profile line. Have a team member move towards you along the profile line placing stakes between you and the profile marker.
2. Still standing on the dune crest, turn 180 degrees so you are looking towards the sea. Sight toward the water in the direction of the true profile bearing. Have a team member move to the waters edge staying on the profile line. Have them place a stake here.
3. Now have the team member move toward you along the profile line. Have them place a stake or some other marker at all key features on the profile (see supplementary sheet, Figure 2).

### Measuring a beach profile using Emery method

1. Record start time and date. Start at the profile marker point, this is point #1 and is always  $dx=0$ ,  $dz=0$ . Place one rod next to the profile marker. This is now point #2.
2. Move the other rod seaward along the profile to the 3<sup>rd</sup> survey point. Maximum distance between the rods should be about 5 meters. Shorter distances if changes in slope or key features. Use the profile markers to make sure you are lined up on the profile line.
3. Measure the horizontal distance between the two rods while keeping the tape horizontal. Record this distance in the  $dx$  column in centimetres.
4. If the seaward rod is lower than the back rod then the observer draws an imaginary line between the horizon and the top of the seaward rod. Where that imaginary line intersects the back rod, read the number of the back rod and record at point 2# in the  $dz$  column as a negative number (see supplementary sheet, Figure 3).
5. If the seaward rod is higher than the back rod, then the back rod holder draws an imaginary line between the horizon and the top of the back rod. Where that imaginary line intersects the seaward rod, read the number on the seaward rod and record as positive in the  $dz$  column (see supplementary sheet, Figure 4).
6. Once the observer has sighted and recorded the horizontal distance ( $dx$ ) and vertical elevation ( $dz$ ), the observer removes the BACK ROD and moves forward to the exact location of the seaward rod. The seaward rod remains in place and becomes the back rod; the assistant takes what was the back rod to the next survey point. Repeat steps (5-8).

**Figure 4.12: Field instructions for marking out and measuring a beach profile.**

### Supplementary field sheets

Accompanying the field forms are four supplementary sheets (or two double sided sheets) which illustrate by way of diagrams and photographs; a cross sectional beach profile, how to mark out and conduct a beach profile survey and also things that groups should be looking for while in the field.

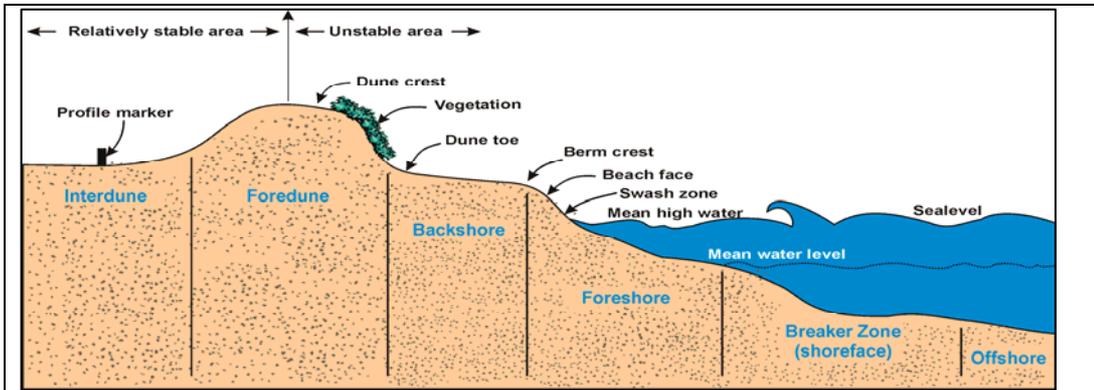


Figure 1: Beach profile cross section

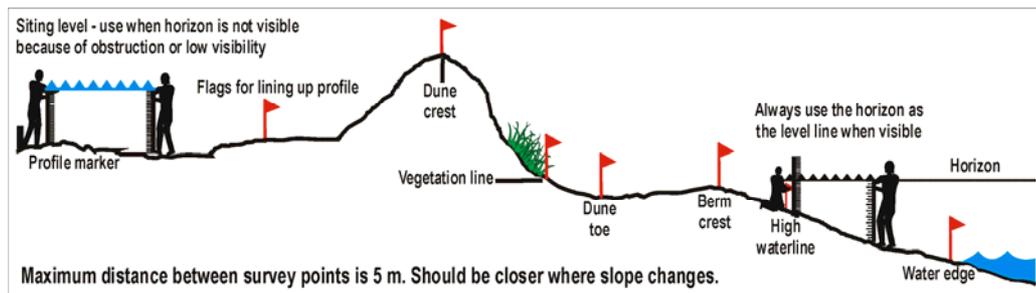


Figure 2: Marking out a beach profile

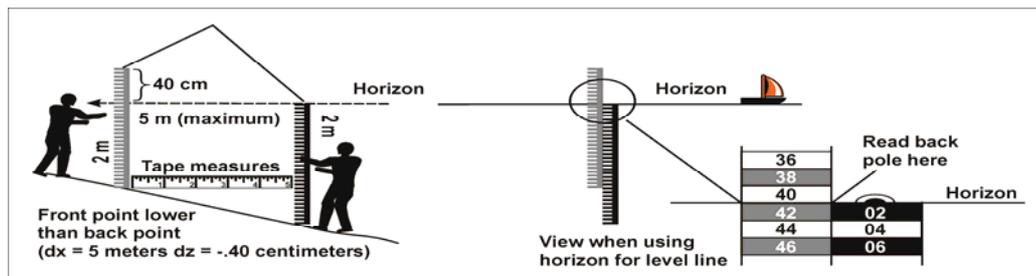


Figure 3: Conducting a beach profile (Emery method)

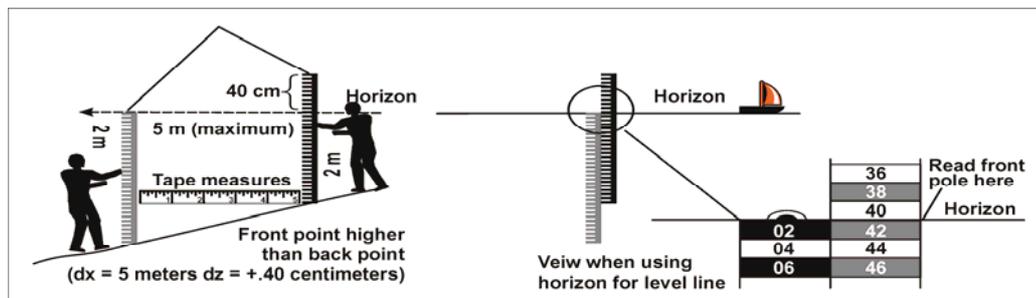


Figure 4: Conducting a beach profile (Emery method)

Figure 4.13: Supplementary field sheet No.1.

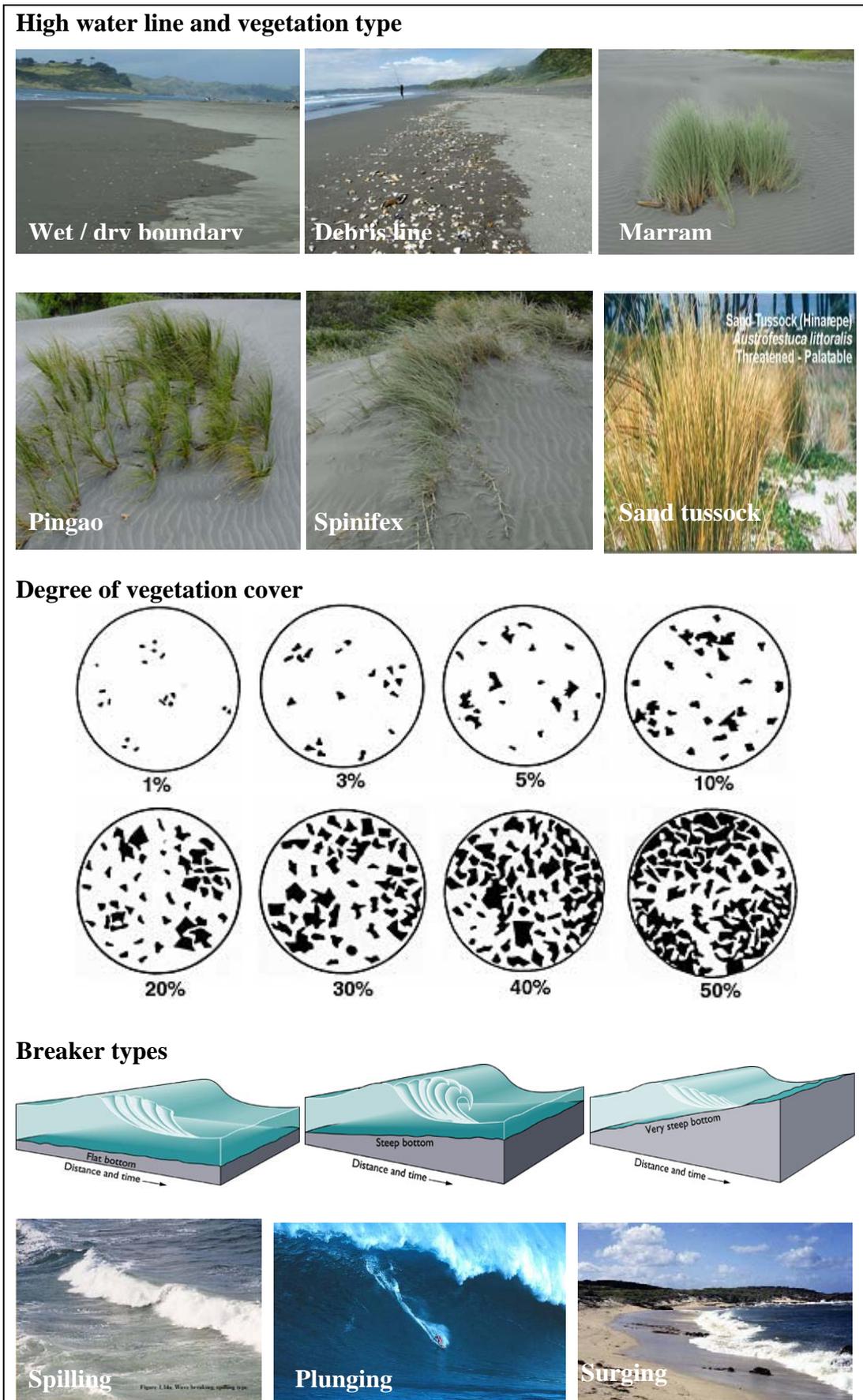


Figure 4.14: Supplementary field sheet No.2.

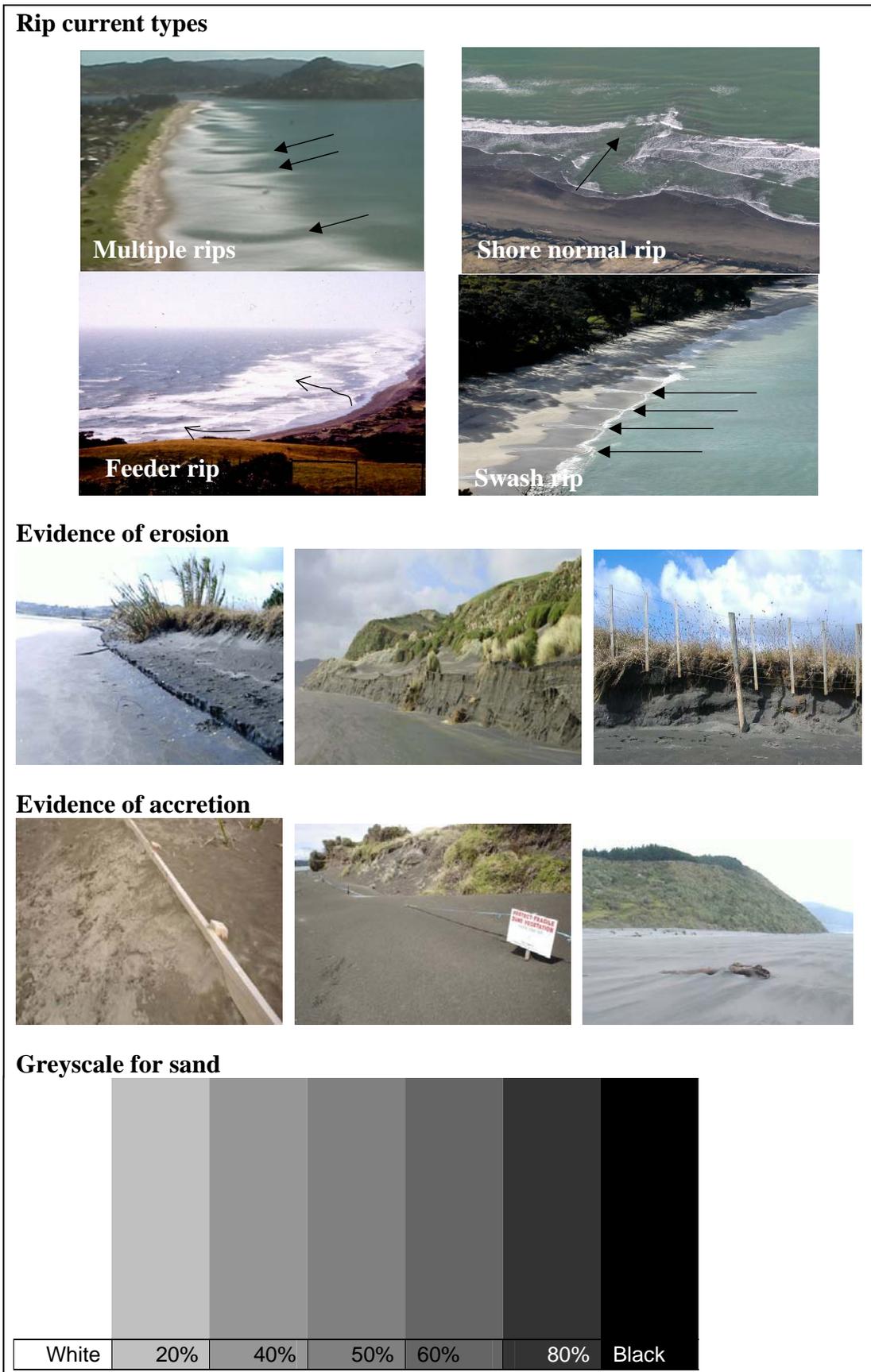


Figure 4.15: Supplementary field sheet No.3.

<b>BEAUFORT WIND SCALE</b>			
<b>#</b>	<b>m/s</b>	<b>Common signs for recognition</b>	
0	0-1		Smoke rises vertical
1	1-2		Smoke drifts slowly
2	2-3		Leaves just move
3	4-5		Leaves move constantly
4	6-8		Small branches move
5	9-11		Small trees sway
6	12-14		Large branches move
7	15-17		Large trees sway
8	18-20		Small branches break
9	21-24		Large branches break
10	25-28		Small trees uprooted

**Figure 4.16: Supplementary field sheet No.4.**

### **4.3.6 Monitoring Equipment**

A list of the monitoring equipment required to carry out the scientific measurements and observations noted in this chapter are listed in Figure 4.8. The monitoring equipment selected for this research is simple, suitable for the task and easily used. All the equipment listed in Figure 4.8 (excluding the GPS and Clinometer) can be sourced with ease.

### **4.3.7 Supplementary Information**

To further assist observers with the interpretation of the Coastal Monitoring Procedure Manual, a terms and definitions glossary was developed. The glossary includes all technical coastal terms that are noted in the monitoring methodologies as well as additional definitions of a range of coastal features. Similar to some of the monitoring methodologies and rather than reinvent the wheel, some of the definitions are adaptations of definitions found in other glossaries. The terms and definitions glossary can be found in Appendix C4.

## **4.4 TOOL ASSESSMENT AND TRIAL**

Once the monitoring tools were completed they were peer reviewed and revised. Then a crude trial of the tools was conducted to ensure that the methodologies were functional and that the forms were unambiguous and easy to fill out.

The field procedure manual, methodologies, and equipment were initially trialled on Ngarunui Beach, in Raglan by a layman who is part of one of the proposed pilot study groups. The participant was given a draft copy of the field procedure manual and was asked to become familiar with it. Two field excursions then took place. During the first field excursion the author demonstrated the field procedures to the participant. During the second field excursion the author followed the participant's progress while using the tools. A number of comments were made by the participant regarding the draft field procedures during this excursion. Some of the key issues highlighted included:

- The importance of taking time at the start of the survey to clearly mark out the profile transect and the key features of the profile.

- The need for instructional information that participants can use in the field to prompt them on what they need to be doing “cheat sheet”.
- The need for pictures and figures that can be used in the field to illustrate what participants should be looking for.
- The need for some of the more technical field equipment to have instructions on how you use them and how they work.

All the issues raised by the participant were taken into consideration and measures were taken to accommodate them in revisions of the manual. Overall the participant found that all observations and measurements were practical, and the methodologies functional.

The field forms were also trialled by a group of fifty students enrolled in a first year environmental science course with the Earth and Ocean Science Department at the University of Waikato. Students were split into groups of four and assigned a piece of beach to survey. The groups were given a coastal monitoring field form similar to that drafted for a secondary school science class. Groups had little to no prior exposure to the form, and were given one hour to complete the survey. The key finding of this trial was that even with little to no prior exposure to the form groups found that they were able to follow the order of the form with ease, knew what was required, and had adequate space to record measurement enabling them to complete the form with ease.

Overall, the trial of the tools was just to insure that the tools are functional before they are initially piloted. In addition, though, a number of key considerations were highlighted during the trials, which are significant for the implementation of these tools. These will be discussed in Chapter 7.

#### **4.5 SUMMARY AND DISCUSSION**

This chapter discussed that approach that was taken in the development of the monitoring tools. It also outlined how the monitoring parameters were selected, how the monitoring methodologies, field procedures manual and field forms were developed and how the monitoring tools were initially evaluated and trialled.

This chapter also made evident the fact that while monitoring methodologies and field procedures, forms and equipment can be developed with somewhat relative ease, the success or failure of monitoring tools primarily rests on their implementation. In order for monitoring tools to be successful a number of key steps must be taken during their implementation and is important in this process. These steps include site selection, the establishment of profile transects, and parameter selection. Therefore, in order for the tools to be effective in achieving the monitoring objectives and thus meaningful data collected, the monitoring tools must only be implemented with the aid of trained individuals or science practitioners until such time when groups become competent and suitable supplementary documents are developed to aid groups with their implementation. The implementation strategies for the monitoring tools are detailed in a Chapter 7.

## 5. Web tools

### 5.1 INTRODUCTION

Monitoring for community groups does not simply end in the field. Once a group collects data in the field, what do they do with it? How do groups process, analyse and store their field data in a meaningful way? The analyses and interpretation of monitoring data is often left up to a science practitioner, with little feedback to the groups, which can often result in the monitoring group feeling a sense of disempowerment. It is important that groups take ownership of their data and feel empowered by their monitoring. The majority of monitoring programmes reviewed for this research provide their participants with web-based tools for data entry, analysis and archiving.

The growth of the World Wide Web and use of the internet in particular, combined with rapid technological advances in computing power, have signalled a change in how things are delivered, with web-based tools being more and more common. The WWW is also commonly utilised as a cost effective, practical and extremely valuable method of information transfer and dissemination and networking

The WWW can provide Community Coastal Monitoring Groups with; a central hub for the exchange of dialogue, a mechanism for data entry, analysis and storage, instant feedback, and links to other resources and information.

As discussed above, monitoring participants need to feel empowered by their monitoring and research suggests that groups who are not afforded a web-based data entry, analysis and archiving tool find that the lack of an electronic database proves to be an obstacle to meaningful monitoring (Chard et al., 2005). Those who are afforded these web-based monitoring tools noted that they are a highly positive and valued aspect of their monitoring programme.

Therefore it is evident that data processing, analysis and archiving are a vital part of coastal monitoring for a community group and thus in order for CCMT to be successful web-based tools must be developed to perform a number of functions.

This chapter discusses the proposed development of web-based tools for Community Coastal Monitoring. It provides some background information about the proposed development of the web-based tools and outlines the design brief. It also outlines and describes the proposed functionalities of the tools. The proposed web tools are based on a review of literature, an examination of how other web tools have been developed and an evaluation of the Wai Care Web Tools Review (Chard et al, 2005).

## **5.2 BACKGROUND INFORMATION**

The Community Coastal Monitoring web-tools will essentially be modelled on pre-existing Community Monitoring web-tools including those developed by the Auckland Regional stream health monitoring programme Wai Care.

Basically the tools will be encompassed in a Community Coastal Monitoring webpage that will be developed by the author and accessed via the NIWA website ([www.niwa.co.nz](http://www.niwa.co.nz)). The webpage will be hosted in NIWA's National Centre for Coasts and Ocean and will ultimately be part of the *NZCoast* initiative, which looks at classifying New Zealand's coast and beaches based on a range of parameters including geomorphology, sediment type and wave climate.

The NIWA web team will assist in the development and delivery of the webpage, including the development of the computer scripting language that drives the various webpage functions. However all content, layout and functionality of the test site developed in this thesis has been defined and developed by the author using Mi-Source Web editing tool.

Preliminary work has begun on the development of the Community Coastal Monitoring web-based tools. However at this stage they are incomplete and not fully functional. Preliminary development of the page can be viewed at [www.niwa.co.nz](http://www.niwa.co.nz) using a designated username and password. Snapshots of the data entry screens are shown later in this chapter.

### **5.3 DESIGN BRIEF**

The primary objective is to develop an accessible and user-friendly system for entering, storing and analysing coastal monitoring data. However, because the tools are being delivered over a webpage, the web can also be utilised for a number of other functions including information transfer and dissemination.

#### **5.3.1 Web Tools**

##### **Data entry mechanism**

Each group needs a secure data entry mechanism so that they can transfer their raw field data into electronic form for storage and analysis. The data entry mechanism must be customized to suit the needs of each individual group and there must also be a built in data quality assessment to ensure that the data being entered is suitable. Entry by the user is password protected.

##### **Data storage**

Once groups have entered their data into the data entry mechanism, the data needs to be stored in a database or archive so that it can be accessed at a later date for analysis.

##### **Data analysis**

There are various methods for analysing data. Coastal Monitoring Groups basically need to be provided with immediate feedback from their monitoring data by way of graphs and images. Monitoring groups also need to be able to compare current data collected in the field with historic archived data in order to determine change.

#### **5.3.2 Information Transfer and Dissemination**

Guiding objectives for this research include increasing awareness of coastal hazards amongst coastal communities, contributing to a better understanding of how to sustain good management of the coastal resources, enhancing science education on dynamic physical processes in the coastal areas and providing a valuable educational resource for community groups and secondary schools.

The WWW is a popular mechanism for information transfer and dissemination and in this instance can be utilised to provide the community with a range of information on the coastal environment and coastal monitoring.

## **5.4 WEB TOOL DEVELOPMENT**

### **5.4.1 Login**

Login accounts are a security precaution and when a new coastal monitoring group is established they will be allocated a login user name and password. Once a group is logged in to their monitoring account they will be able to view and edit their individual group information, including group members, contact details, and monitoring site information. They then also have access to the data entry mechanism, personal monitoring archive, and data analysis tools.

Groups can login to their personal monitoring account from the login box on the left hand side of the Community Coastal Monitoring home page.

### **5.4.2 Data Entry Mechanism**

To enter data you need to be logged in using the login box on the home page. This ensures that an authorized coastal monitoring group has collected the data being entered into the online database.

Since CCMT is customized, with different groups collecting different information, data entry also needs to be customized. When a new group is established they are presented with a list of all possible coastal monitoring parameters. From this list groups select the key parameters that they measure in the field. The data entry mechanism then creates a customized data entry template for that particular group (see Figure 5.1 & 5.2 for example). Once a group has defined their customized data entry template this template will appear every time they enter their field data. Having a customized data entry template is important because groups are only presented with the information that is relevant to them, reducing confusion.

When groups enter data into the templates they are faced with three data entry systems; 1) tick boxes, 2) drop down menus, and 3) free cells. Tick boxes are usually employed for monitoring parameters that demand a yes/no answer e.g. is vehicle damage to the beach evident? A comments box where participants can elaborate usually follows tick boxes. Drop down menus are usually employed when a parameter demands only a select amount of possible answers and when the possible answers are known. For example rip current type and wave type, and wind and wave direction. Free cells are employed for entering comments or parameters that demand a range of possible answers For example the width of the surf zone that could be noted as being anywhere between 0 to 300+ meters in width (see Figure 5.1 & 5.2 for example of these).

Once a group has entered their field data into their customized data entry template, the data undergoes a quality assurance check, before it is submitted to the coastal monitoring archive. This automated check is achieved by each monitoring parameter has being limits. Limits define a sensible data range for the various parameters. Limits have been employed to make sure that the data is scientifically acceptable and to ensure data quality. If the data entered into the data entry mechanism does not lie within the limits set for that particular parameter the system may chose to reject the input data or suggest to the user that they verify the data. For example a participant may be entering in a wave period measurement of 10 seconds and instead of entering in 10 the participant accidentally adds an extra zero making it 100 seconds. The data entry mechanism would recognize this number as lying outside the limits set for wave period and would suggest that they re-evaluate their data.

Along with the customized data entry form there will be additional data entry forms and mechanisms. These include: a beach profile data entry form; a mechanism for uploading GPS data; and a mechanism for uploading photos.

Upload Data - Windows Internet Explorer

http://www.niwasience.co.nz/ncco/coastal\_monitoring/data/data\_entry

NZTA  
Taihoro Nukurangi

National Centre for  
**Coasts & Oceans**

Research National Centres Online Services Education News & Events Publications Contact About Us

> NIWA Science > National Centre for Coasts & Oceans > Community Coastal Monitoring Program >  
Data > Upload Data

## Upload Data

**Site and group information**

Beach name: Ngarunui Beach

Location: Raglan

Site number: 1

Grid reference: 6191486 N 2843784 E

Observers: Darcel Rickard  
Paerau Brown

Date: 10 July 2007

Time: 10 20 AM

**Upload Data**

- Coasts & Oceans Update
- News & Publications
- Wave Forecast
- Marine Environment Classification
- Courses
- Workshops
- Community Coastal Monitoring Program
- Managing our Coast
- Data
  - Upload Data
  - Findings
  - Results
- Linkages
- Manuals
- Our Beaches
- For Schools
- Contacting the NCCO

**National Centres**

- Aquatic Biodiversity & Biosecurity

Trusted sites 100%

Figure 5.1: Snapshots of the data entry form

Upload Data - Windows Internet Explorer

http://www.niwasience.co.nz/ncco/coastal\_monitoring/data/data\_entry

Wave direction: NE

**Water and beach safety**

Number of alongshore bars: 5

Width of surf zone: 25

Alongshore current direction: N

Alongshore current speed: 3

Number of rip currents: 4

Rip current spacing: Regular

Rip current type: shore normal

Sneaker wave: N/A

Width of high tide beach: 40

Vehicles on the beach: No

Horses on the beach: No

**Human impacts**

Vehicle damage evident:  Yes  No

Comment:

Trusted sites 100%

Figure 5.2: Snapshots of the data entry form

### **5.4.3 Data Storage/ Archiving**

Once a group has completed entering their field data and an initial data quality check has been conducted, the data may then be submitted to be stored in the coastal monitoring database. The National Institute of Water and Atmospheric Research will administer the database and groups will be able to define who has access to their monitoring data. Groups may elect to restrict access to themselves or make the data public through the Website. Monitoring data will be archived by group name, monitoring location and date. Groups will also be able to export their monitoring data from the database in an excel spreadsheet format.

### **5.4.4 Data Analysis**

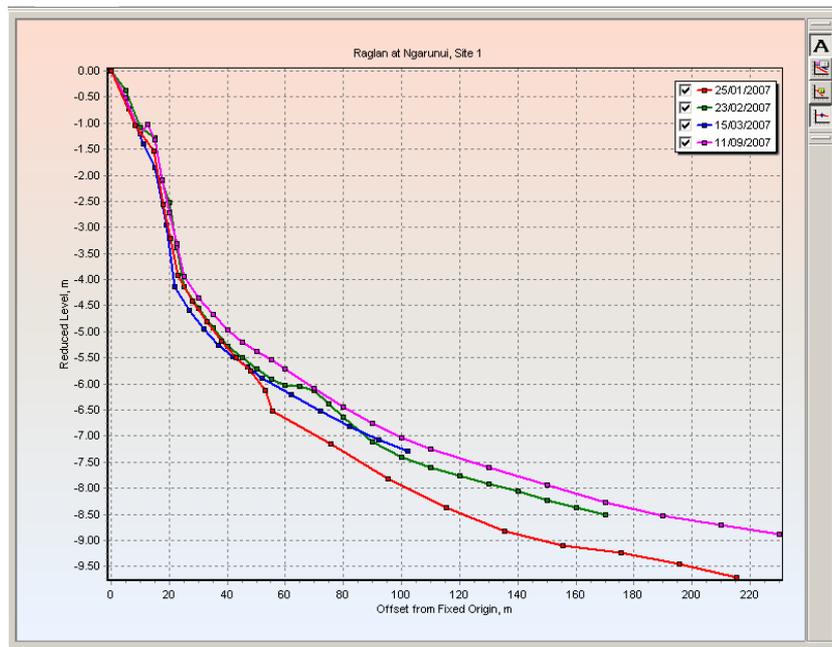
There are numerous methods for analysis data. When groups conduct coastal monitoring using CCMT they are observing, measuring and recording the condition of the beach system at that point in time. For groups to gain an understanding of how the beach system has been modified they need to be able to compare current monitoring data with earlier monitoring data.

Once a group has completed entering their monitoring data and submitted it to the Community Coastal Monitoring Database, the data analysis mechanisms will conduct an automatic comparison between the current data and the data directly adjacent. This enables groups to get an indication of how their beach has changed since they last conducted monitoring. This instant feedback is important for groups because it gives them instant gratification that what they are doing is meaningful and worthwhile.

Filter and buffer functions will provide access to user defined statistics and tool bars will also allow the end user to select, display and compare archived monitoring information. There will also be a function that allows data to be exported in spreadsheet format.

When presenting data it is important that you target your audience and in this case it is important that data is presented to the public in a clear, concise and unambiguous manner. Monitoring results will be presented on the webpage using

tables and basis graphs, including simple spaghetti plots of beach profiles for instance (see Figure 5.3). The web page will also report back to the end user on the state of their beach by generating simple report cards based on a hazard assessment and beach state evaluation.



**Figure 5.3: Snapshots of the beach profile data plot**

GPS high water and dune toe position strandlines will be overlaid on topographic maps, so that groups can see the longshore variations in beach width and also the changes in beach width over time when strandlines are plotted collectively.

If groups require a more comprehensive analysis of their coastal monitoring data links to facilitating bodies will be available so that experts can be employed to make these analyses.

## 5.5 INFORMATION DISSEMINATION AND TRANSFER

### 5.5.1 Education Information

A large amount of educational information about the coastal environment already exists; the key is to make it readily available to the community. Education information that is relevant to coastal monitoring will be made available via the

Community Coastal Monitoring webpage. It will include scientific, technical and basic information for a range of topics including the New Zealand coastal situation, coastal management, coastal processes and coastal monitoring.

### **5.5.2 Downloads and Links**

#### **Downloads**

All CCMT documents including procedure manuals, field forms, checklists, and supplementary information will be made available for download via the webpage.

A range of educational resources developed for teachers will also be made available for download. Resources include educational scientific information, proposed teaching plans and curriculum information.

It was suggested in the Wai Care Tool Review (Chard et al., 2005) that a technical report be made available for download via the Wai Care webpage. The Community Coastal Monitoring Webpage will provide links to download facilities for various technical reports that are relevant to coastal monitoring.

#### **Links**

The web page will provide community groups with links to real time coastal data, including Cam-Era coastal video imaging system (NIWA), wave buoy reports and forecasts (ECAN, NIWA), Wind reports (NIWA), Tide state forecasts and reports (NIWA), and Weather and Climate reports and forecasts (Victoria University, Wellington). Real time data will help with the interpretation of beach profile measurements and observations because unless an observer has process measurements every day, they will not be able to correctly relate the processes to the observed changes. Also real time coastal data allows the end user to "calibrate" the continuous data for their beach location.

Linkages to Regional, Unitary and District Councils, Science practitioners, Technical experts, and Community organizations that are involved with coastal management will also be made available on the webpage.

## 5.6 DISCUSSION

### 5.6.1 Web tool trial

Once the web tools have been fully developed they also need to be trialled. It is proposed that during the implementation of the monitoring tools users will test the web-based data entry, storage, and analysis mechanisms to improve their functionality. Additional research by way of a survey questionnaire or focus groups is proposed to get structured feedback on the difficulties faced with using the tools and/or the positive aspects.

A prototype of the webpage can be accessed via the NIWA website <http://www.niwascience.co.nz/> using a predefined users name and password that can be obtained by emailing the author on [d.rickard@niwa.co.nz](mailto:d.rickard@niwa.co.nz).

### 5.6.2 Access to monitoring data

It has been noted that groups may not feel comfortable entering their data into a facility that can be accessed by a range of people including other community groups, regulators, and science practitioners.

Currently groups define who has access to their monitoring information be it only members in their group, and regulators, and/or science practitioners, and/or the public. However, groups may still feel uncomfortable using the web tools. These views must be taken into consideration and an alternative must be developed for their needs. One option is that the tools offered online could be reproduced on a compact disc that groups could install on a locally owned computer, another option is that groups simply enter data into an electronic spreadsheet, such as excel.

Web based monitoring tools have been noted as a highly positive and valued aspect of monitoring programmes and it is recommended that all groups be encouraged to utilise them. The web based approach to data management has a range of benefits including data analysis mechanisms, instant feedback and a secure method of data storage. For instance if a group discontinues monitoring for

one reason or another, their monitoring data is still retained in secure place until they take up monitoring again thus future proofings their investment.

Importantly by utilising the web tools their data is stored in a National database that contributes to the improved temporal and spatial data coverage of information that is available from the New Zealand coastline.

## **5.7 SUMMARY**

Monitoring for community groups does not simply end in the field. The majority of monitoring programmes reviewed for this research provide their participants with web-based tools for data entry, analysis and archiving. Web tool are a highly positive and valued aspect of monitoring programmes. This chapter discusses the recommended development of web-based tools for the input, analysis and storage of community coastal monitoring data. It outlined and describes the proposed functionalities of the tools and how the WWW could be utilised for a number of other functions including information transfer and dissemination and contributing to a National database.

## 6. Science Education

### 6.1 INTRODUCTION

Generally monitoring tools are developed with two key purposes: education and the collection and dissemination of data/information. Five of the guiding objectives for the development of the tools in this study relate to education; with only one objective focused towards data collection. Therefore, the primary driving force behind these tools is unquestionably education, which is why secondary school science classes along with community groups as a key target audience for these tools. When these community coastal monitoring projects are up and running at different sites about the New Zealand coastline, all measuring in a robust and scientifically defensible manner, they will contribute to a more effective national monitoring network allowing scientists, students and the public to gain a better understanding of coastal processes, hazards and natural shoreline change around the New Zealand coastline.

Preliminary discussions with science educators revealed that in order for the tools to be implemented at a secondary school science level they must be aligned with the national curriculum and qualifications. Consultation highlighted that teachers could be reluctant to use the tools if there is no direct link with the New Zealand Science Curriculum or cannot be easily accommodated by the science achievement standards<sup>1</sup>.

This chapter investigates the requirements for the successful implementation of CCMT into schools. It links the tools to science education in New Zealand through the discussion of science literacy, the New Zealand Science Curriculum, National Achievement Standards, CREST and Science and Technology Fairs. This chapter also briefly investigates the concept of teaching science in context and its importance as a learning tool.

---

<sup>1</sup> Science achievement standards are National Standards of Achievement based on the New Zealand Science curriculum. These standards contribute to a National Certificate of Educational Achievement (NCEA).

## 6.2 SCIENTIFIC LITERACY

In its simplest form scientific literacy “stands for what the general public ought to know about science” (Durant, 1993, p.129) (cited in Laugksch, 2000). Laugksch (2000) conducted a review of the concept of scientific literacy and provides a conceptual overview of the term. He outlines Showalter’s (1974) delineation of science literacy which Rubba & Anderson (1978) (cited in Laugksch, 2000) describes as having “a degree of specificity not found in other definitions of this concept” at the time (Rubba & Anderson, 1978, p.450).

Showalter’s (1974) delineation of science literacy consists of seven dimensions, integrates 15 years of relevant literature and is detailed below (Laugksch, 2000).

A scientifically literate person:

- understands the nature of science knowledge
- accurately applies appropriate science concepts, principles, laws, and theories in interacting with their universe
- uses processes of science in solving problems, making decisions, and furthering their own understanding of the universe
- interacts with the various aspects of the universe in a way that is consistent with the values that underlie science.
- understands and appreciates the joint enterprises of science and technology and the interrelationship of these with each and with other aspects of society
- has developed a richer, more satisfying, more exciting view of the universe as a result of their science education and continues to extend this education throughout life
- has developed numerous manipulative skills associated with science and technology

The attributes of a scientific literate person as defined by Showalter’s (1974) provide a useful reference framework for informing this research.

Scientific literacy can be enhanced through science education and as Hume (2006) explains “a growing number of science educators recognise the importance of education in the public understanding of and about science”(p.58). Milne (2004)

supports the importance of science education in public understanding of and about science by suggesting that the overarching goal of science education is ultimately the development of a scientifically literate society. It is evident that by educating an individual, this action contributes to their scientific literacy and thus the building of a scientifically literate society.

In New Zealand an individual's science education usually formally begins at the age of five when they begin primary school. Science education is a required school subject in New Zealand up to year 10 (14-15 years of age), with students in years 11 -13 (15-18 years of age) optionally able to specialise in one or more science disciplines. It's important that an individual gains a rich and satisfying science education while at school, which can then be enhanced throughout their life, adding to their scientific literacy. Ryder (2001) emphasises that "school science is only the beginning of the process of learning to engage with science as an adult. Individuals will continue to learn science beyond school age..." (p.38).

Science education in schools is governed by the New Zealand Science Curriculum. Thus in order to implement CCMT into secondary school science classes it is important to first ensure that the tools align with the New Zealand Science Curriculum.

Currently within many New Zealand coastal communities, misconceptions surround coastal processes, hazards and natural shoreline change. One of the common misconceptions is that coastal erosion is unnatural and that it is human induced, where as coastal erosion is a common and natural process around the New Zealand coastline, and only really noticed and of concern when property is threatened (Environment Waikato, 2002). At present many coastal communities are unable to take an informed position on coastal hazard issues in their area because of a real lack of understanding about the nature of science and how scientific knowledge is generated in the context of natural and unnatural coastal processes. Consequently, there are cases where the mitigation of issues by community groups has resulted in a negative environmental outcome because of ill informed choices regarding coastal hazards and the risks associated with them. Thus, in light of coastal hazards potentially being exacerbated by climate change,

it is important to contribute to the development of resilient communities through the increase of scientific literacy.

The National Science Education Standards (1996) provided by The United States Centre for Science, Mathematics, and Engineering Education (CSMEE) define science literacy as:

“the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity” (pg 22).

CCMT can contribute to the development of science literacy by providing communities with a valuable educational resource and engaging them in the study of their coastal environment so they come to understand the nature of science knowledge. This can in turn increase their awareness of coastal hazards, contribute to a better understanding of how to sustain good management of the coastal resources, enhance their overall knowledge of dynamic physical processes in coastal areas, and encourages a caring and responsible attitude towards the coast. Ultimately it will allow them to engage in meaningful discussions on scientific issues in the coastal environment, pose and assess arguments based on the evidence presented, provide valid conclusions and take a scientifically informed position.

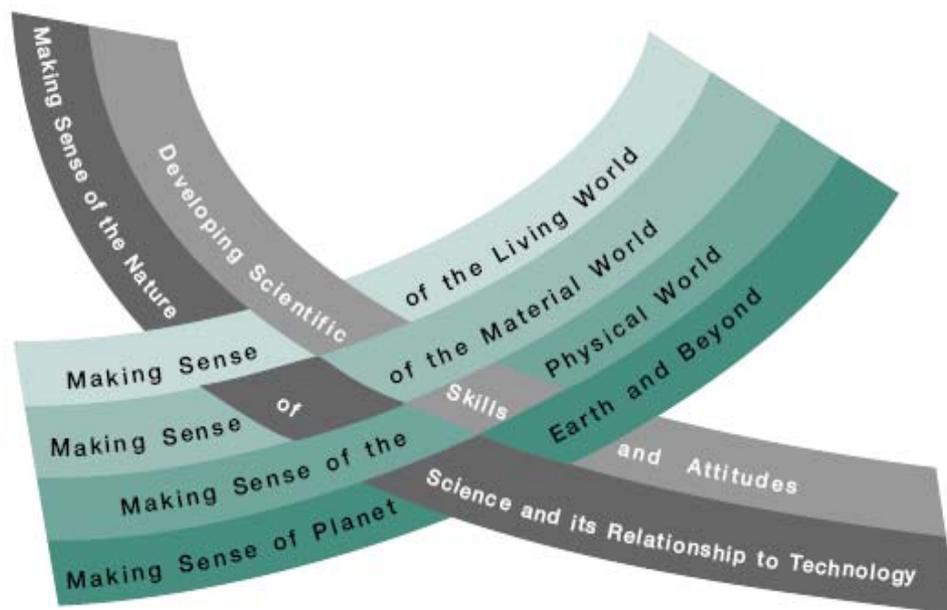
### **6.3 NEW ZEALAND SCIENCE CURRICULUM**

The New Zealand Science Curriculum provides the basis for science programmes in schools. A new curriculum was launched on 6 November 2007, after an extensive consultation process conducted by the Ministry of Education. The Curriculum document replaced seven separate curriculum documents and will be fully in place at the beginning 2010. In the interim, schools are able to use both the new and existing curricula in the planning and reviewing of their programmes of learning. As such both documents have been consulted in the preparation of this chapter.

### 6.3.1 Science Learning Strands and Outcomes

In the New Zealand science curriculum the fundamental science education aims and broad learning outcomes are organized into a number of learning strands. Figure 6.1 has been sourced from the old curriculum documents and details six learning strands. In the new curriculum, a significant point of difference is that the original six learning strands have been reduced to five. The strands “Developing Scientific Skills and Attitudes and Making Sense of the Nature of Science and its Relationship to Technology” have been combined into one overarching strand, “The Nature of Science”. The Nature of Science strand underpins the remaining four strands The Living World, Planet Earth and Beyond, The Physical World, and The Material World that provide the broad contexts for learning science.

Each strand contains a set of three to four science education aims called the “achievement aims”. For each achievement aim eight progressive levels of broad learning outcomes call the “achievement objectives” have been developed.



**Figure 6.1 : Science learning strands (Ministry of Education, 1993)**

The division of science into five learning strands is purely a convenient method of categorising the achievement aims and achievement objectives. It definitely does not imply that learning in each strand has to be independent of each other. Instead

an integrated approach to science should be taken with achievement objectives taken from a number of the strands to form a comprehensive programme of study (Ministry of Education, 2007).

For this research, three of the five learning strands have been highlighted because of their direct relevance to this research: The Nature of Science, Planet Earth and Beyond and The Physical World will be discussed in detail in the following sections

### **6.3.2 Science Achievement Aims**

The science achievement aims within the five learning strands set the themes and goals for each learning strand.

#### **The Nature of Science**

The Nature of Science is the core science learning strand and is compulsory learning for all students up to year 10. It has four achievement aims; understanding of science, investigation in science, communication in science and participating and contributing. In this strand students gain an understanding of science, and acknowledge science as a socially valuable knowledge system (Ministry of Education, 2007). Students learn how science ideas are communicated, how to carry out scientific investigation, and how scientific knowledge is linked to everyday decisions and actions.

#### **Planet Earth and Beyond**

This strand is about Earth's various systems and their complex interactions, and also encompasses the solar system and the universe. Students learn about the geosphere, hydrosphere, atmosphere and biosphere. They come to understand how all these systems are linked via a complex web of processes and how humans can affect this web in a positive and negative manner (Ministry of Education, 2007). Students also gain an understanding of how earth and its various systems interact with the solar system including the Moon, Sun and other systems in the universe (Ministry of Education, 2007).

**Physical World**

This strand explores and investigates a number of physical phenomena including light, sound, heat, electricity, magnetism, waves, forces and motion (Ministry of Education, 2007). Students gain an understanding of the interactions that take place between different parts of the physical world and apply their understanding to various applications.

**Direct links to Community Coastal Monitoring Tools**

CCMT can be directly linked to the science education fundamental aims as students can: gain a better understanding of science by being engaged in the study of the coastal environment; learn how to carry out scientific investigation; and learn how scientific knowledge contributes to everyday decision making and actions. Students can also gain through hands-on measurements of the beach an understanding of the various physical processes that take place in the coastal zone and how these processes effect, relate and interact with earth and its various systems.

**6.3.3 Levels of Achievement**

As indicated earlier achievement objectives for each strand occur as eight progressive levels of achievement (Figure 6.2). Level one achievement objectives describe the expected learning at a junior level (Y1 & 2/J1), while level 8 achievement objectives describe the expected learning at a senior secondary level (Y13/F7).



Table 6.1. Level 6 Science Achievement Objectives, specific learning outcomes and how CCMT contributes to them both.

	<b>Level 6 Achievement Objectives</b>	<b>Examples of specific learning outcomes SLO</b>	<b>CCMT contribution to SLO</b>
<b>The Nature of science</b>	<p><b>Investigating in science</b>  <b>A01</b> Develop &amp; carry out more complex investigations, including using models.</p> <p><b>A02</b> Show an increasing awareness of the complexity of working scientifically, including recognition of multiple variables.</p> <p><b>Communicating in science</b>  <b>A01</b> Use a wider range of science vocabulary, symbols, &amp; conventions.</p> <p><b>A02</b> Apply their understandings of science to evaluate both popular &amp; scientific texts (including visual &amp; numerical literacy).</p> <p><b>Participating &amp; contributing</b>  <b>A01</b> Develop understanding of socio-scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions &amp; to take action where appropriate.</p>	<p>Prepare &amp; carry out a beach survey.</p> <p>Demonstrate appropriate scientific inquiry skills, attitudes, &amp; practices when seeking answers to questions.</p> <p>Demonstrate the use of suitable vocabulary related to their investigations of the coastal environment.</p> <p>Investigate &amp; present a variety of measures that can be used to minimize coastal erosion e.g. dune fencing, sea walls, terracing, dune planting, replenishment.</p> <p>Investigate environmental, social, &amp; economic factors that should be considered in making informed decisions about coastal land use &amp; management.</p>	<p>Provides students &amp; teachers with the tools to carry out a beach survey.</p> <p>Enhances science education by providing hands on learning.</p> <p>Engages student in the study of their coastal environment.</p> <p>Engages student in the study of their coastal environment.</p> <p>Engages student in the study of their coastal environment.</p>
<b>Planet Earth &amp; beyond</b>	<p><b>Earth systems &amp; interacting systems</b>  <b>A01</b> Investigate the external &amp; internal processes that shape &amp; change the surface features of New Zealand.</p>	<p>Identify where erosion has occurred as a result of wind, waves &amp; human activities.</p> <p>Recognize the relationship between shoreline change &amp; coastal processes.</p>	<p>Provides students with the tools to conduct beach observations</p> <p>Provides students with the tools to conduct beach profile surveys &amp; wind &amp; wave climate investigations.</p>
<b>Physical world</b>	<p><b>Physical inquiry &amp; physics concepts</b>  <b>A01</b> Investigate trends &amp; relationships in physical phenomena (in the areas of mechanics, electricity, electromagnetism, heat, light &amp; waves, &amp; atomic &amp; nuclear physics).</p>	<p>Collect, interpret, &amp; analyze meteorological data related to a storm surge event.</p>	<p>Provides students with the tools to carry out tide &amp; wave climate investigation.</p>

Table 6.2. Level 7 &amp; 8 Science Achievement Objectives and how CCMT contributes to examples of there specific learning outcomes

	<b>Level 7 and 8</b>	<b>Examples of specific learning outcomes SLO</b>	<b>CCMT contribution to SLO</b>
<b>The Nature of science</b>	<p><b>Investigating in science</b>  <b>A01</b> Develop &amp; carry out investigations that extend their science knowledge, including developing their understanding of the relationship between investigations &amp; scientific theories &amp; models.</p>	<p>students write an essay outlining the decision-making process involved in selecting a beach survey site;</p>	<p>Engages student in the study of their coastal environment.</p>
	<p><b>Participating &amp; contributing</b>  <b>A01</b> Use relevant information to develop a coherent understanding of socio-scientific issues that concern them, to identify possible responses at both personal &amp; societal levels.</p>	<p>Critically assess &amp; give an account of conflicting points of view by reviewing a coastal hazard item presented in the popular media.</p>	<p>Engages student in the study of their coastal environment.</p>
<b>Planet Earth &amp; beyond</b>	<p><b>Earth systems &amp; interacting systems</b>  <b>Level 7 – A01</b> Develop an understanding of the causes of natural hazards their interactions with human activity on Earth.</p>	<p>Describe the effects of wind, waves, &amp; human activity on the coastal landscape.</p>	<p>Provides students with the tools to conduct beach observations and profiles.</p>
	<p><b>Level 8 – A01</b> Develop an in-depth understanding of the interrelationship between human activities &amp; the geosphere, hydrosphere, atmosphere, &amp; biosphere over time.</p>	<p>Explain the possible impact of offshore sand dredging practices on beach erosion patterns.</p>	<p>Engages student in the study of their coastal environment.</p>
<b>Physical world</b>	<p><b>Physical inquiry &amp; physics concepts</b>  <b>A01</b> Investigate physical phenomena &amp; produce qualitative &amp; quantitative explanations for a variety of unfamiliar situations.</p>	<p>Observe &amp; describe properties of waves.</p>	<p>Provides students with the tools to carry out tide &amp; wave climate investigation.</p>
	<p><b>Level 7 – A02</b> Analyse data to deduce complex trends &amp; relationships in physical phenomena.</p>	<p>Explain how tides are caused &amp; describe their effects on shorelines.</p>	
	<p><b>Level 8 – A02</b> Analyse &amp; evaluate data to deduce complex trends &amp; relationships in physical phenomena.</p>	<p>Describe &amp; explain the seasonal variations in a cross shore beach profile.</p> <p>Make &amp; justify predictions based on observed patterns, collected data, or data provided from other sources</p>	<p>Provides students with the tools to conduct beach profile surveys &amp; wind &amp; wave climate investigations.</p>

#### **6.4 NATIONAL ACHIEVEMENT STANDARDS**

Once students reach Years 11-13 they can begin to gain Science Achievement Standards, based on the New Zealand Science Curriculum. These standards contribute to a New Zealand Qualification called the National Certificate of Educational Achievement (NCEA).

The National Certificate of Educational Achievement (NCEA) is the current senior secondary school national qualification in New Zealand that was implemented in 2002 to replace School Certificate, Sixth Form Certificate and University Bursary. Students are assessed for NCEA using two types of National standards; Achievement standards and Unit standards. The National Standards most relevant to this research are Achievement Standards. Achievement Standards are based on the New Zealand Curriculum and cover subjects previously covered by School Certificate, Sixth Form Certificate and University Bursary. These standards are developed by expert panels from the Ministry of Education and are detailed in a set of matrices, one for each individual subject. As a national qualification NCEA is considered “high stakes” to all stakeholders including students, teachers, schools and parents.

Thus for the CCMT to be successfully implemented into schools they need to be linked to the National Achievement Standards and NZSiC. Thus a review of the achievement standards matrices has been conducted to identify the links between the two. Two matrices were of primary interest for this research; Science and Physics. The complete version of these two matrices can be found on the Ministry of Education web site <http://www.minedu.govt.nz>, or in Appendix D2 of this thesis. A summary of the achievement standards that can be directly linked to the CCMT are detailed below.

### **6.4.1 Science Matrix**

#### **Investigation**

Level 1.1 - Carry out a practical science investigation with direction.

Level 2.1 - Carry out a practical scientific investigation with supervision.

Level 3.1 - Carry out a practical scientific investigation with guidance.

#### **Research**

Level 1.2 - Process information to describe a use of science knowledge with direction.

Level 2.2 - Research information to present a scientific report.

Level 3.2 - Research a current scientific controversy.

#### **Planet Earth & Beyond**

Level 1.5 - Describe aspects of geology.

Level 2.5 - Describe New Zealand's geological history.

Level 3.5 - Describe geological processes affecting New Zealand.

#### **Physical World**

Level 1.6 - Describe aspects of physics.

### **6.4.2 Physics Matrix**

#### **Level 1**

1.1 - Carry out a practical physics investigation with direction.

1.2 - Process information to describe a use of physics knowledge with direction.

1.3 - Demonstrate understanding of wave and light behaviour.

#### **Level 2**

2.1 - Take measurements of physical quantities and analyse data graphically to determine a relationship.

2.3 - Demonstrate understanding of waves.

#### **Level 3**

3.1 - Carry out a practical physics investigation with guidance that leads to a mathematical relationship.

3.3 - Demonstrate understanding of wave systems.

### **6.4.3 Direct links to Community Coastal Monitoring Tools**

By utilizing the CCMT students are able to: carry out scientific investigation with direction, supervision, or guidance; describe coastal erosion and various geological processes in the coastal environment; and conduct research into controversial coastal issues such as the debate of hard solutions (e.g. sea walls) vs. soft solutions (e.g. replenishment and dune planting). Students can also carry out an investigation, take measurements, and demonstrate an understanding of waves.

Additionally by conducting a scientific investigation as part of their National Achievement Standards, students are eligible to enter their Coastal Monitoring research into the CREST and Science Fair initiatives that are described below.

## **6.5 CREST AND SCIENCE FAIR**

### **6.5.1 CREST**

The Creativity in Science and Technology (CREST) scheme is an international awards programme that originated in the UK and was introduced to New Zealand in 1988. The CREST scheme rewards innovative and creative thinking in science and is currently being administered by the Royal Society of New Zealand.

As part of CREST students undertake a scientific investigation or technological practice of their own, working with the community or other science practitioners or experts to investigate a real life issue. CREST provides students with the opportunity to improve their science literacy at lower levels of achievement, and extend their abilities at higher levels of achievement.

A key aspect of the CREST scheme is that it sits within the New Zealand Curriculum Framework as a curriculum support activity that can be easily incorporated into science investigation achievement standards at levels 1, 2 and 3.

CCMT give students the opportunity to conduct hands-on scientific investigations in science investigation achievement standards at levels 1, 2 and 3 as listed in section 6.4.1. The tools allow students to gather environmental data to investigate real life issues, such as coastal erosion and water and beach safety, through a

number of field excursions. Successful implementation of the tools will also allow students the opportunity to work with the community, science practitioners and other technical experts to gain a better understanding of the issue, thus enhancing their science education.

Initiatives such as CREST are important aspects of a student's education in science because it allows them to gain a better understanding of the nature of science, and how science impacts and relates to everyday life and decisions. A complete overview of how CREST can be mapped onto science achievement standards can be found on the CREST web site [www.crest.org.nz](http://www.crest.org.nz), or in Appendix D3 of this thesis.

### **6.5.2 Science and Technology Fairs**

Science Fair is a similar initiative to CREST, and is also coordinated by the Royal Society of New Zealand. Science Fair encourages innovative and creative thought by affording students the opportunity to conduct meaningful scientific investigations of their own. Projects for Science Fair may be in any area of science and all Year 7 to 13 students are eligible to compete. Students generally exhibit their work at a Regional Science Fair, and then selected exhibits go on to compete in the National Science Fair. Science Fair is able to be linked with the science curriculum in the same method as CREST, and thus science Fair Projects may also involve the use of CCMT.

In addition to CCMT providing students with the opportunity to conduct hands on scientific investigation that can result in CREST and Science Fair projects, they also provide teachers with the opportunity to teach science in an interesting and relevant context.

## **6.6 TEACHING SCIENCE IN CONTEXT**

Teaching science in context is an important and sometimes difficult aspect of a science educator's job; however it is extremely important for students learning sciences. Context allows students to see the relevance of science. Making science relevant ultimately increases their interest in the subject, thus making them more

engaged and motivated in learning (Rodrigues, 1993). Providing learning in context also promotes positive attitudes towards science and learning because students feel like they can contribute to the learning process and accordingly gain a sense of empowerment from their contribution (Rodrigues, 1993).

Research has also shown that high school science courses with content that is interesting and shown to be relevant to our livelihood are crucial to encourage students to pursue a career in science (Hepner & Gibeaut, 2004).

The coastal environment provides an ideal context in which to teach science especially for schools in coastal communities. The CCMT provide teachers and students with the means to conduct hands-on scientific investigations at the coast to meet the requirements of the science curriculum. In using the CCMT and the coast as a context for learning, student can gain an enhanced science education while increasing their awareness and understanding of coastal hazards and the dynamic physical processes that take place in the coast environment.

## **6.7 DISCUSSION AND SUMMARY**

This research into science education has highlighted that there are opportunities for the CCMT to be diversified and extended so that they may be incorporated into not only more strands of the Science Curriculum but also into other areas of the New Zealand Curriculum. Currently the tools do not directly link with the science learning strands the Living World and the Material World. However, teachers could simply use the CCMT as an entry point that can lead on to teaching of the other strands. The Texas High School Coastal Monitoring Programme described earlier (Chapter 2) solely focuses on physical processes and beach dynamics; however they use the monitoring programme and the coastal environment as a context to teach a whole range of science disciplines including Biology, Earth Science, Physics, the Nature of Scientific investigation, and Science and Society. A copy of The Texas High School Coastal Monitoring Programme curriculum outline and lesson plan can be found in Appendix D4. Similarly teachers using the CCMT could develop or adapt additional tools and units that could look at the Biology and Chemistry of the coast environment.

There could also be potential links with the Social Studies and Geography curriculum.

Ultimately the coastal environment provides an interesting and relevant context to teach science, with CCMT providing the platform for teachers to do so. Community based coastal monitoring enhances a students education through a hands-on approach to learning science. It is also easily incorporated into the school curriculum and links with the New Zealand Curriculum and a number of Achievement Standards.

## **7. Implementation**

### **7.1 INTRODUCTION**

Numerous monitoring tools have been developed in the past to record change in the environment and assist resource management. In many instances these tools cater towards the needs of the end users, and are scientifically robust, simple, and affordable. Nonetheless, some of these tools are seldom used. The major shortcoming of these kinds of tools is generally inadequate implementation.

Implementation is not simply a matter of handing over the tools. Effective implementation involves a number of processes that take place in a number of stages. My research suggests implementation is best undertaken in four stages; 1) an initial pilot and review stage, 2) a consultation stage, 3) a secondary pilot stage and review, and 4) a national implementation stage. During the development of this thesis, stage one (initial pilot and review) of the proposed implementation strategy was initiated.

This chapter outlines a successful strategy for implementing the Coastal Monitoring Tools. It details the four proposed implementation stages, outlines the potential barriers to successful implementation of the tool and also discusses a number of key components that relate to successful implementation.

This strategy is based on a review of literature, an examination of how other tools have been implemented and consultation with successful groups such as Wai Care, undertaken as part of this thesis.

### **7.2 INITIAL PILOT STUDY AND REVIEW**

Even though the monitoring methodologies, data sheets and accompanying information have been developed in consultation with the end users, or with them in mind, it is fundamental for the success of the tools that members of the community test them. The key intention of an initial pilot study is to review and improve the tools. Pilot studies allow community groups to provide feedback on

the successes or shortcomings of the tools, thus highlighting aspects that might limit successful uptake and implementation.

During the development of the tools, five key groups were identified to participate in the initial piloting of the tools. These were, two Coast Care groups, one secondary science class, one hapu group and one surf life saving club. Additional groups were considered for participating in the initial pilot study but were not used. However, it is intended that a second pilot phase will take place for a longer duration involving more groups. These groups included Mt Maunganui Coast Care, Tairua Beach Care, Pauanui Beach Care, Mt Maunganui College, Matakana Island Beach Care, Thames High School, Mahia Peninsula, Mataora Beach Care, Kingsgate College, and Waikato Diocesan.

The initial pilot study groups cover all four target audiences and thus have a range of monitoring objectives and needs. Preliminary discussions were conducted with the five groups to gain a better understanding of their objectives and their needs for monitoring. Following these discussions, “needs profiles” of each of the groups were drafted and are presented in the subsequent pages. These profiles include a brief description of their situation, the key activities of each group and their needs from monitoring. Before the commencement of the initial piloting of the tools, additional dialogue will take place between the coordinator and the pilot groups to insure that all their monitoring needs are being met.

### 7.2.1 Needs Profiles of Initial Pilot Study Groups

Table 7.1: Onemana Beach Care Group needs profile

<b>Target group</b>	Coast Care
<b>Regional Council</b>	Environment Waikato
<b>District Council</b>	Thames Coromandel
<b>Regional Council contact</b>	Jim Dahm (Contracted Beachcare coordinator)
<b>Key community member</b>	Mr Barry Turk
<b>Group established</b>	2006
<b>The situation</b>	Onemana Beach is located on the East coast of the North Island, just 10 minutes north of the popular east coast settlement Whangamata. Onemana Beach Care is a relatively new Coast Care group, which mainly consists of retirees in the community.
<b>Key activities of the group</b>	Restore and maintain vegetation on foredune.  Manage pedestrian and vehicle access to the beach.  Encourage education on dune care ethics.  Undertake backdune planting of native shrubs.
<b>Reasons for conducting monitoring</b>	To monitor the success of dune restoration work as a means of stabilising the foredune and building a dune buffer.  To monitor pedestrian and vehicle access to the beach and the impacts they have.
<b>Monitoring theme/s</b>	Coastal stability and human impacts.
<b>What needs to be monitored</b>	Beach profile, width of the high tide beach, degree of vegetation cover, evidence of active sand accumulation, and pedestrian beach access points to the beach.
<b>Survey frequency</b>	Fortnightly

Table 7.2: Taylor Road/Papamoa East Coast Care needs profile

<b>Target group</b>	Coast care/ Private property owner
<b>Regional Council</b>	Environment Bay of Plenty
<b>District Council</b>	Tauranga City Council
<b>Key community member</b>	Prue Burt
<b>Group established</b>	1994
<b>The situation</b>	Papamoa East is a coastal township lying between Mount Maunganui and Maketu in the Bay of Plenty. Development in this area is located in close proximity to the sea with just 15-20m between the sea and the development. The beach is subject to cyclical erosion events with the frontal dune commonly degraded and subject to blowouts.
<b>Key activities of the group</b>	Restore and maintain native sand binding species on the foredune.  Manage pedestrian and vehicle access to the beach.  Undertake backdune planting of native shrubs.
<b>Reasons for conducting monitoring</b>	It has been observed that storm events can cause severe erosion of the foredune in this area. Foredune planting has decreased the severity of storm induced erosion at this site, but to what extent is unknown.
<b>Monitoring theme/s</b>	Coastal stability
<b>What needs to be monitored</b>	The fluctuation of the beach width at Papamoa East, with particular interest in the post storm effects adjacent to Miss Burt's home.
<b>Information to collect</b>	Beach profile, shoreline position, width of the high tide beach, degree of vegetation cover, degree of active scarping.
<b>Survey frequency</b>	Bi-monthly and post storm events

Table 7.3: Raglan Area School needs profile

<b>Target group</b>	Secondary school science class
<b>Regional Council</b>	Environment Waikato
<b>District Council</b>	Waikato District Council
<b>Key staff member</b>	Lee Cobson
<b>The situation</b>	Raglan Area School is located in the popular west coast surf town of Raglan. Raglan Area School already use the coastal environment as a context to teach a number of subjects in the New Zealand Curriculum including science. Currently senior science students conduct water quality analysis, and investigate sediment distribution patterns along the west coast. The community coastal monitoring tool will provide them with the opportunity to diversify their teaching programme.
<b>Key activities of the group</b>	Science education
<b>Reasons for conducting monitoring</b>	Provide students with an inquiry-based learning experience, while increasing their understanding of the relationship between coastal dynamics, beach morphology and shoreline change.
<b>Monitoring theme/s</b>	Coastal stability, Human impacts, Water and Beach Safety.
<b>What needs to be monitored</b>	Beach profile, width of the high tide beach, degree of vegetation cover, evidence of active sand accumulation, and beach access points.
<b>Survey frequency</b>	Bi-monthly

Table 7.4: Te Kopua needs profile

<b>Target group</b>	Hapu group
<b>Regional Council</b>	Environment Waikato
<b>District Council</b>	Waikato
<b>Key community member</b>	Mr Tex Rickard
<b>The situation</b>	The research was developed in partnership with Ngāti Tahinga, a Hapu located at the mouth of the Whaingaroa Harbour on the West Coast of the North Island. Ngāti Tahinga has been dealing with the effects of coastal erosion for the past twenty years, with more of their whenua papatipu being claimed by the sea every year.
<b>Key activities of the group</b>	Restore and maintain vegetation on foredune  Manage pedestrian and vehicle access to beach  Encourage education on dune care ethics  Installing brushwood fences on the foreshore to capture wind blown sand to build-up a protective dune
<b>Reasons for conducting monitoring</b>	Ngāti Tahinga's major concerns with coastal erosion are the subsidence of their whenua papatipu into the sea and the inundation and loss of their papakainga, Te Kopua.
<b>Monitoring theme/s</b>	Coastal stability and human impacts
<b>What needs to be monitored</b>	Beach profile, width of the high tide beach, degree of vegetation cover, evidence of active sand accumulation, and beach access points.
<b>Survey frequency</b>	Fortnightly

Table 7.5: Whangamata Surf life saving Club needs profile

<b>Target group</b>	Surf life saving
<b>Regional Council</b>	Environment Waikato
<b>District Council</b>	Thames Coromandel
<b>Surf life saving region</b>	Bay of Plenty
<b>Key community member</b>	Nathan Hight
<b>The situation</b>	Surf life saving club's in New Zealand already have a range of water and beach safety parameters that they collect routinely as part of the patrol captains daily report form. However, there are additional parameters that can be monitored that will assist with the hazards assessment for that beach. Additionally the use of scientifically robust monitoring methodologies will add to the validity of their current monitoring.
<b>Key activities of the group</b>	Prevent death by drowning of those swimming and undertaking activities at the beach.  Promote general beach, surf and fishing safety.
<b>Reasons for conducting monitoring</b>	To monitor hazards on the beach including rip current presence or absence and location.  Gain a better understanding of the relationship between coastal dynamics, beach morphology and shoreline change.
<b>Monitoring theme/s</b>	Water and Beach Safety, Coastal stability
<b>What needs to be monitored</b>	Beach profile, width of the high tide beach, degree of vegetation cover, evidence of active sand accumulation, and beach access points.
<b>Survey frequency</b>	Daily for specific parameters during the patrol season. Otherwise fortnightly.

### 7.2.2 Group Involvement and Field Trials

It is proposed that the initial pilot study will be scheduled to run for nine months, with two stages the first being field trials which will take approximately eight months; followed by a stage of evaluation and review.

The five participating groups will each receive a customised monitoring kit complete with field equipment, a coastal monitoring procedure manual, pre-survey preparation and field equipment checklists, and customised field forms including data collection forms, a cheat sheet, and field diagrams.

Groups will take part in four introductory field excursions. During the first field excursion, groups will be issued with their monitoring kits, the rationale and scope of the project will be reviewed, and the significance and application of the various monitoring procedures outlined. During the second field excursion a suitable survey site will be identified and profile markers established. Groups will also walk their survey site and recognize how to identify key features in the coastal environment. They will also be shown how to plan a field excursion. During the third field excursion the coordinator will demonstrate the various field procedures that are relevant to that individual group, while participants also become familiar with the field equipment and procedures. During the final field excursion the coordinator will follow the participant's progress in using the tools to insure that the participants understand the monitoring methodologies and are following the procedures set down in the manual.

The tool assessment and trial stage detailed in chapter four highlighted that a participant can conduct monitoring with as little as two introductory field excursions. However, for a group to function successfully and independently Illenberger & Associates (2001) propose a minimum of four introductory field excursions. This trial aligns with this recommendation by proposing a minimum of four introductory field excursions.

The coordinator's involvement with participants does not completely cease following the introductory field excursions. Coordinator involvement has been highlighted as a vital component of successful uptake. Thus the coordinator will

be available during the duration of the pilot study to discuss and aid participants in any problems that may arise.

Following the introductory field excursions, the participants will be introduced to the web tools. They will be guided through the processes of data entry, analysis, storage and other useful features including uploading photos, downloads and links to useful resources. Subsequent to this, participants will be encouraged to conduct monitoring independently at their predefined intervals, which for this initial pilot study is monthly or more frequently depending on the monitoring parameters, as well as following storm events.

### **7.2.3 Evaluation and review**

Following the initial field trials, a period of evaluation and review will take place. Two focus groups will be held, one in the Waikato and one in the Bay of Plenty. The objective of the focus groups is to allow participants to express their learning experiences with the tools and to provide feedback on the successes and/or shortcomings of the tools, while highlighting aspects that might need to be changed or reviewed.

The information will be gathered using qualitative research methods which elicit the opinions, experiences, observations, and recollections of the participants involved. The focus groups will work through a number of key topics, following a general question and answer/discussion process. Topics that will be covered include responses to the coastal monitoring field manual, monitoring equipment, field forms and supplementary checklists/diagrams, handover or introductory field excursions, field experiences, data collection, handling, and quality, website access, navigation and usefulness, data entry, analysis and archiving.

After completion of the focus groups a summary report of finding will be drafted and the monitoring tools revised to incorporate the feedback that was received from participants. Anticipated changes could include the development of new methodologies and additional educational material or the simplification or diversification of the tools. A second edition of the coastal monitoring field manual will reflect these changes.

## **7.3 CONSULTATION**

### **7.3.1 Community Coastal Monitoring Workshop**

The original proposal for this research was developed in consultation with Environment Waikato, Auckland Regional Council and Environment Bay of Plenty. These regulatory authorities are responsible for the sustainable management of the natural resources in their region including the coast, water, soil and air. These Regional Councils also work closely with community groups on a day to day basis by way of pre-existing environmental restoration, monitoring and education initiatives to insure sustainability of these resources. As a result of working closely with the community Regional Councils are able to provide a good insight in to the functioning of community groups and thus provide an interface between science practitioners and the general community. Hence it was recognized early on in the development of the tools that if the tools were to be successful they needed to be developed not only in consultation with the community but also in consultation with Regional Councils and regulators.

Therefore, regulators, science practitioners and selected monitoring participants will be invited to attend a community coastal monitoring workshop which will be run by the coordinators and other science practitioners from the NIWA. The workshop will take place after the initial pilot and review stage and is likely to run over a three day period. The purpose of the workshop will be to introduce the participants to the CCMT, discuss the progress made with the initial pilot study and review, gain buy in and support from Regional Councils, and to consider the goals, objectives and possible participants for the second pilot study. The workshop will also provide the coordinator with the opportunity to discuss data quality with regulators to insure that the data collected by the CCMT in the initial pilot study is useful and relevant from a regulatory perspective.

The workshop is seen as an essential component to the implementation of the tools because Regional and Unitary Councils are seen as the interface between science practitioners and communities. As such Regional and Unitary Councils have been identified as a key driving force in the implementation of the tools regionally at a nation wide level.

It has also been highlighted that during the consultation stage there is a need to consult with science educators on how they can be better accommodated through the possible diversification or adaptation of the tools.

## **7.4 SECONDARY PILOT AND REVIEW STAGE**

### **7.4.1 Secondary Pilot**

Following the community coastal monitoring workshop, a second pilot phase will take place to execute the goals and objectives outlined during the workshop. This study will also be used to trial the revised version of the monitoring manual tools and manuals. It is foreseen that this pilot study will be conducted over a longer duration than the initial pilot study and will also involve more groups. It is also anticipated that Regional and Unitary Councils will have a more active role during the second pilot stage, working closely with coordinators as a natural progression towards the national implementation of the tools.

### **7.4.2 Evaluation and Review**

Similar to the evaluation and review following the initial pilot study, a number of focus groups will be held around the country. This will allow participants the opportunity to express their learning experiences with the tools and to provide feedback on the successes and/or shortcomings of the tools, while indentifying aspects that might need to be changed or reviewed. Additionally, during this review an evaluation form will be send to every participant in the pilot study. This is to insure that all participants have been given the opportunity to adequately express their opinions, experiences, observations, and recollections of the CCMT.

It is anticipated that following the secondary piloting stage, all aspects of the tool development would have been reviewed and any aspects potentially limiting their uptake would have been identified and taken into account.

## **7.5 NATIONAL IMPLEMENTATION**

National implementation of these tools is the ultimate aim because it provides the opportunity for a large national monitoring network to be established. This will improve the temporal and spatial data coverage of information for the New Zealand coastline while providing the data links and improved interactions between Communities, Local Governments and National Government. On a broader scale it will contribute to the sustainable management of the coastal environment as defined in the RMA.

### **7.5.1 The Resource Management Act**

The Resource Management Act 1991 (RMA) was developed to promote the sustainable management of natural and physical resources. Under the RMA Regional and Unitary Councils are obligated to insure the sustainable management of their region's natural resources including the coast, water, soil and air. Environment Waikato (1999) outlines sustainable management as defines in section 5 of the act as:

- allowing people to provide for their social, economic and cultural needs
- safeguarding resources for future generations
- safeguarding the life-supporting capacity of air, water, soil and ecosystems
- avoiding, mitigating or remedying any adverse effects of activities on the environment.

Sustainable management is achieved through the enactment of the act, via a hierarchy of policies and plans at national, regional and local levels.

One of the specific requirements of the act relates directly to environmental monitoring. Part 4 (Functions, powers, and duties of central and local government) section 35 (Duty to gather information, monitor, and keep records) of the act states that 1 “Every local authority shall gather such information, and undertake or commission such research, as is necessary to carry out effectively its functions under this Act” and that 2a “Every local authority shall monitor the state of the whole or any part of the environment of its region or district to the extent

that is appropriate to enable the local authority to effectively carry out its functions under this Act” . These functions include those set out in section 30 (1) of the act.

The RMA also recognises and provides for matters of national importance and the coastal environment gets a special mention as being a matter of national importance. In particular section 6 of the Act details that “all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for...the preservation of the natural character of the coastal environment (including the coastal marine area)....”.

Thus, under the Act Regional and Unitary Councils are not only obligated to insure the sustainable management of their region’s natural resources but they are also required to monitor and recognise and provide for the natural character of the coastal environment.

Community coastal monitoring contributes to the sustainable management of the coastal environment by gathering information that will contribute to and improve the temporal and spatial data coverage of information for the New Zealand coastline.

### **7.5.2 National Implementation at a Regional Level**

Ideally Regional and Unitary Councils will become the driving force behind the implementation of the tools in their individual regions. They will provide the training, support and coordination for all the community groups using the tools in their region, with NIWA acting as facilitator. NIWA’s role will be to manage the tools at a national level by administering the web page and database and also to review, improve and diversify the tools.

As detailed above, Regional and Unitary Councils are the interface between community groups and science practitioners and have the responsibility for monitoring the coastal environment. The tools have the potential to be extremely beneficial on a local, regional and nationally scale. The tools provide Regional

and Unitary Councils with the opportunity to collect a wide range of data and information about their coastal environment at very little expense. The tools also provide a coordinated approach to data collection by community groups, insuring that the data collected is not only consistent but is also robust. Currently very few Regional and Unitary Councils collect adequate data on dynamic shoreline change in their regions, with the Regional and Unitary Councils who do collect this information generally being those with a large rating base and thus adequate funding and resourcing. These tools provide the opportunity for less wealthy and poorly resourced Regional and Unitary Councils to undertake monitoring to meet their requirement under the RMA. In meeting these needs they also build a closer relationship with the community while improving the temporal and spatial data coverage of the New Zealand coastline. Regulators can also use this information to assess whether their policies and plans are insuring the sustainable management of the coastal environment (Iremonger, 2007).

### **7.5.3 Barriers to Successful Implementation**

There are limiting factors with the national implementation of the tools at a regional level. Generally the extent to which the tools will be applied in each region will primarily depend on the local availability of resources to implement the tools, namely funding and a coordinator. The Auckland Regional Stream health programme Wai Care, which is outlined in chapter two, explained that “aside from the value of the provision of the Wai Care kit, coordinator support was the single most essential component of the Wai Care programme” (Chard et al., 2005). Thus Regional and Unitary Councils need to insure that they have the resources available to provide groups with adequate support.

## **7.6 DISCUSSION**

### **7.6.1 Diversify the Tools**

#### **Target audience**

During the implementation of these tools there is an opportunity to expand the target audience for the tools. In addition to the four primary target audiences for the tools a number of other interest groups also have a vested interest in the

coastal environment and may have coastal monitoring needs. These groups include

#### Recreation beach user groups

- Walking groups
- Board rider clubs
- Kite surfer groups
- Fishing clubs
- Boating / Sailing clubs

#### Environmental groups

- Harbour care
- Forest and Bird
- Conservation groups

#### Community groups

- Ratepayer associations
- Beach front property owners

### **Monitoring parameters**

During implementation there is an opportunity to further diversify the tools by adding new physical monitoring parameters to the suite of parameters already available to groups. Monitoring programmes are extremely site specific and there is a possibility that additional monitoring parameter may be identified at various sites during implementation.

There is also an opportunity to develop methodologies for monitoring ecological aspects of the coastal environment, giving the monitoring tools as a whole a more holistic approach to coastal monitoring.

### **7.6.2 Integration with Pre-existing Environmental Programmes**

Even though the coastal monitoring tools have been developed as a stand alone tool kit, it is important to integrate the tools into pre-existing environmental monitoring initiatives. Stand-alone monitoring programmes are vulnerable as they ignore opportunities and fail to move with the times. The tools have been developed in a manner that makes them easily adapted and customised to suit a

range of coastal monitoring needs, making them easily integrated into pre-existing environmental programmes.

Integration with pre-existing programmes has a number of benefits. Integration means that: the tools are not seen to be competing for resourcing and funding with pre-existing groups, the tools may provide groups with the opportunity to enhance their pre-existing efforts by tapping into other expertises and technical skills, pre-existing groups have an opportunity to engage other people who may not of been interested initially in their programme, but are interested in conducting monitoring.

CCMT also facilitates communication between community groups that all have a vested interest in the coastal zone; this creates good community interactions and encourages a holistic approach to coastal management.

A number of territorial authorities also run environmental education programmes. CCMT would have a good synergy with such programmes.

### **7.6.3 Communication**

One additional aspect of successful implementation is communication. Showing that the data has value is extremely important. Participants need to see value in the work they are doing and the people who pay the bills (managers & politicians) need to see value from their investment. For monitoring to be successful there needs to be “buy-in” from not just the community groups but also the regulators who fund the facilitation of the monitoring. The best way to gain “buy-in” is to document the successes of monitoring schemes. This is best achieved through communications in local newspapers, newsletters and other council communications. There needs to be an adequate budget set aside for communication and marketing.

## **7.7 SUMMARY**

This chapter presented an outline of the strategy that was developed for the successful implementation of CCMT. It draws on literature; discussions with

individuals involved in community monitoring initiatives; and personal observations. This chapter also draws attention to a range of components that need to be considered if implementation is to be successful.

In summary this chapter concludes that in order for monitoring tools to be successful, adequate consideration and resourcing must be given to their implementation. Implementation is not simply a matter of handing someone a group of monitoring tool; implementation is a process involving several stages, which could take a number of years.

## **8. Summary and Conclusions**

### **8.1 INTRODUCTION**

New Zealand's population is located in close proximity to the sea and consequently many coastal communities are vulnerable to a range of natural hazards, including coastal erosion, inundation, and storm surge, which come with varying levels of risk to life and property. Within coastal communities there are many misconceptions surrounding coastal processes and also a real lack of accurate science education and public awareness on coastal processes and hazards. Consequently coastal communities are unable to make informed choices regarding coastal hazards and the risks associated with them.

This research contributes to improved management practices that arise from guardianship approaches through the development of sustainable and robust monitoring tools that will enable coastal communities to monitor long-term changes in their coastal environment.

### **8.2 RESEARCH APPROACH**

A rounded approach to this research was informed by an extensive review of literature, consultation and discussion, a survey questionnaire and trialling the methodologies and tools.

The literature review critically examined international and local examples of community based coastal (and non-coastal environmental) monitoring programmes. It looked at environmental monitoring initiatives, highlighting and discussing the key factors, and pros and cons that have led to the success or failure of the various programmes

Consultation for this research was extensive with eight open unstructured interviews and a number of unsolicited discussions with key science practitioners, technical experts and a range of other key informants. Consultation proved to be an informative and important part of this research by providing first-hand insight

into community based monitoring initiatives, coastal management and coastal monitoring tools.

A survey questionnaire was conducted to investigate the value of the coast to communities, establish risk perception and knowledge of the coastal erosion and to determine knowledge of coastal management schemes and willingness to be involved with coastal monitoring.

The tools and protocols developed were trialled in the field to ensure that the methodologies were functional and that the forms were unambiguous and easy to fill out.

### **8.3 KEY RESEARCH FINDINGS**

#### **8.3.1 Tools Relevant to Local Needs**

One of the keys to the successful uptake of monitoring tools by a community group is its relevance to the group. For successful uptake the programme and the tools developed must fit the interests, needs, capability and resources of the group. Community groups are extremely variable with each group having different objectives and agendas and functioning in their own manner. All groups require a different monitoring regimes and agendas because different groups have different requirements, time constraints and intentions. Monitoring tools need to be flexible to accommodate this, as groups are not going to conduct monitoring just for the sake of it. People are only going to monitor something if they think that what they are going to find out is of some use to them. If tools are not relevant, implementation will be extremely difficult and the monitoring programmes difficult to maintain. In conclusion tools have to be developed in a manner that makes them easily tailored and customized to each individual group.

#### **8.3.2 Selecting Scientifically Robust Methods**

Monitoring is more than just measuring things. It is about using methodologies that are matched to the type of beach, using appropriate equipment, collecting appropriate data to which analysis can be applied, incorporating local knowledge

of the environment, and making the results of the monitoring and feedback quickly and readily available to interested parties.

It is difficult for the public to select appropriate and meaningful monitoring methodologies without scientific advice. Monitoring methods need to be matched to beach type, which is a function of sediment type and the energy of the wave and wind environment. This has a direct bearing on the frequency and sampling and the choice of useful parameters or metrics to measure. The monitoring equipment must be suitable for the task and, just as important, be able to be easily used by those doing the monitoring. There are various methods for analysing data, and it is important that relevant time-series and statistical analysis procedures be determined and tested before the data collection begins in order that appropriate data is collected for the task.

Data collection in this manner is most valuable because they are scientifically robust, can be compared between sites, and will stand up to technical scrutiny.

### **8.3.3 The value of Web-based Tools**

Monitoring for community groups does not simply end in the field. Once a group collects data in the field, what do they do with it? How do groups process, analyse and store their field data in a meaningful way? Often data analysis is left to experts often leaving the groups disempowered. Groups need to feel empowered by their monitoring and they need to take ownership of their data. The majority of the successful monitoring programmes reviewed for this research provide their participants with web-based tools for data entry, analysis and archiving. Programmes that have afforded their participants this facility have noted it as a highly valued aspect of their monitoring, while participants that were not afforded this facility found the lack of web-based tools proved to be an obstacle to meaningful monitoring.

### **8.3.4 Trialling Tools and Protocols**

Trialling Tools and Protocols allow community groups the opportunity to provide feedback on the successes or shortcomings of the tools, thus highlighting aspects that might limit successful uptake and implementation.

### **8.3.5 Aligning Tools with the National Curriculum**

Preliminary discussions with science educators revealed that in order for the tools to be implemented at a secondary school science level they must be aligned with the national curriculum and qualifications. Consultation highlighted that teachers could be reluctant to use the tools if there is no direct link with the New Zealand Science Curriculum or cannot be easily accommodated by the science achievement standards<sup>2</sup>.

### **8.3.6 Implementation is the Key to Success**

The extent to which the tools will be taken up by groups is primarily dependant on their implementation. Implementation of tools requires resourcing generally in the form of funding and people. The development of an implementation strategy is essential when developing monitoring tools because there is no point in developing a suite of tools if none is ever going to use them.

This research made evident the fact that while monitoring methodologies and field procedures, forms and equipment can be developed with somewhat relative ease, the success or failure of monitoring tools primarily rests on their implementation. Implementation is not simple a matter of handing the tools over to the end user groups. Implementation is a complex processes encompassing a whole number of steps, that are all fundamental in the success of the tools. These stages include the establishment of monitoring programmes, the piloting, review and amendment of the tools, and the delivery of the tools throughout the country. Inadequate implementation can be a major shortcoming of community based monitoring initiatives. In order for tools to be successful, adequate consideration and resourcing must be given to their implementation.

---

<sup>2</sup> Science achievement standards are National Standards of Achievement based on the New Zealand Science curriculum. These standards contribute to a National Certificate of Educational Achievement (NCEA).

### **8.3.7 This Research Developed**

A suite of tools for monitoring coastal physical changes that are hazard related were developed. A Community Based Coastal Monitoring Procedure Manual was developed. Monitoring Parameters were selected; methodologies, field forms, protocols, checklists and supplementary information were developed

A Community Coastal Monitoring Webpage was developed to perform a number of functions. The Webpage encompasses the monitoring data entry, analysis and secure storage mechanisms and it also serves as a central hub for information transfer and dissemination amongst the community. Importantly it also provides the opportunity for data sharing and analysis on a national basis.

An implementation strategy was developed for the successful implementation of Community Coastal Monitoring Tools. It draws on literature; discussions with individuals involved in community monitoring initiatives; and personal observations.

## **8.4 RECOMMENDATIONS FOR FUTURE RESEARCH AND DEVELOPMENT OF COMMUNITY COASTAL MONITORING TOOLS**

### **8.4.1 Realisation of the Implementation Strategy**

The implementation strategy developed for the Community Coastal Monitoring Tools consists of four stages: 1) initial pilot study and review, 2) consultation stage, 3) a secondary pilot stage, and 4) a national implementation stage.

To date the Community Coastal Monitoring Tools have only undergone a preliminary trial to ensure that the methodologies were functional and that the forms were unambiguous and easy to fill out. Although the tools have been developed based on sound scientific principles relating to the coastal environment and physical processes they still need to undergo an initial pilot stage and review, followed by a comprehensive secondary pilot stage. Realisation of the implementation strategy will conclude the development process for the tools because pilot studies allow community groups to provide vital feedback on the

successes and more importantly the shortcomings of the tools. Once these have been highlighted the tools can be re-evaluated and amended appropriately.

#### **8.4.2 Web Tools need to be Trialled and Reviewed**

Once the web tools have been fully developed they also need to be trialled. It is proposed that during the implementation of the monitoring tools users will test the web-based data entry, storage, and analysis mechanisms to improve their functionality. Additional research by way of a survey questionnaire or focus groups is proposed to get some structured feedback on the difficulties faced with using the tools and/or the positive aspects of the web tools.

#### **8.4.3 Monitoring Frequency**

Monitoring frequency is critical to designing a successful and meaningful monitoring programme. How frequent is too frequent? How frequent is not frequent enough? How frequently do I need to monitor if I want to capture a certain type of information? The frequency at which monitoring is conducted is highly dependent on the monitoring objectives. For example if a group was looking at the seasonal changes in beach width then weekly monitoring may be unnecessary. However, if a group wanted to look at rip current persistence at their beach during an event then monitoring may need to be conducted numerous times each week and of course when waves are present. In any case additional research needs to be conducted looking at the required frequency to which monitoring must be carried out to obtain desired results.

#### **8.4.4 Different Beach Types**

The New Zealand Coastal environment is extensive with approximately 12,000 km of open coast and a further 6,000 km of estuarine shore. This area is extremely diverse and encompasses a range of geological settings and diverse wind and wave climates. Monitoring methods need to be matched to the beach type, which is a function of sediment type and the energy of the wind and wave environment. The coastal monitoring parameters and methodologies developed during this research are primarily for sandy beach types. Even though most of the monitoring parameters and methods can be easily modified for other beach types it is

recommended that additional research be conducted to identify appropriate monitoring parameters and methodologies for cliffed, gravelly, rocky and urban/modified coastlines. By defining monitoring parameters and methodologies for these geological settings Community Coastal Monitoring Tools will be able to be implemented more widely throughout New Zealand and with more groups collecting more structured information for a range of beach types around the coastline. The database provided by this will permit a much improved picture of the coastal process and hazards to be developed for the New Zealand Coast.

#### **8.4.5 Identifying Relevant Supporting Information**

In order to determine the content of supporting information to place in monitoring tool kits and on the web site a review needs to be conducted into the information that is currently available to the general public on coastal processes and hazards. Most Regional Councils in New Zealand have an environmental education division who are responsible for the development and distribution of educational information to the general public. Rather than develop a whole raft of new educational information for communities, a better approach would be to conduct a review of the current information, make amendments and then develop new educational information to fill-in the gaps. Additional supporting educational information needs to be current, fresh and strike a note with the audience.

#### **8.4.6 Purpose of the Data**

Community Coastal Monitoring Tools evaluate the condition of the beach system at a point in time. They give an indication of how the beach has been modified and to what extent it still is being modified. They highlight how the nature of the beach system changes with seasonal variations, storm events and human impacts. Thus Community Coastal Monitoring Tools can definitely help to find out what is happening, but if you want to find out exactly why something is happening that is a different story. If groups want a comprehensive understanding of why something is happening experts really need to be employed. Experts can utilise the monitoring information provided by community groups to find out why things are happening. Data links between the community, science practitioner, and regulators are extremely important and additional research should be conducted

into establishing these links and utilising community based coastal monitoring data to publish papers on the New Zealand Coastal environment.

## 9. References

- Auckland Regional Council. 2002. Beach Survey Protocol. Environmental Services. Unpublished report. Auckland Regional Council.
- Blackett, P., Hume, T. 2006. Community Involvement in Coastal Hazard Mitigation: An Initial Scoping Of Process and Pitfalls. Unpublished report. NIWA.
- Chard, J., Hall, K., Kaczor, M., 2005. Wai Care Review: Summary of Findings and Action Plan. Unpublished report. URS New Zealand Limited.
- Collins, R.F (1998). *Risk visualization as a means for altering hazard cognition*. Doctoral thesis, Department of Geography, University of South Carolina, United States of America.
- Dahm, J., 2001. Fragile: A Guide to Waikato Dunes. Environment Waikato.
- Denscombe, M., 1998. *The Good Research Guide For Small-Scale Social Research Projects*. Buckingham: Open University Press.
- Dahm, J., Jenks, G., Bergin, D., 2005. Community-Based Dune Management For The Mitigation Of Coastal Hazards And Climate Change Effects: A Guide For Local Authorities.
- De Vaus, D. A., 2002. *Surveys in Social Research*, St. Leonards, N.S.W, Allen & Unwin.
- Durant, J. R., 1993. What Is Science Literacy? In Durant, J. R. & Gregory, J. (Eds.) *Science and Culture in Europe*. London Science Museum.
- Environment Bay Of Plenty., 2006. *Life's A Beach - A Coastal Education Resource Kit*. Technical Publication. Environment Bay Of Plenty.
- Environment Waikato., 2002. Coastal Hazards & Development Setback Recommendations: Coromandel Beaches. Summary Report. Environment Waikato.
- Environment Waikato., 1998. Stream Sense - A Secondary School Teaching Resource for Monitoring the Health of Stream and Rivers in New Zealand. Technical Publication. Environment Waikato.
- Gibb, J. G., 1978. Rates of Coastal Erosion and Accretion in New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 12 (4): 429-456.
- Hepner, T. L., Gibeaut, J. C., 2004 Tracking Post-Storm Beach Recovery Using Data Collected By Texas High School Students. *Shore & Beach*, 72, 5-9.
- Hepner, T. L., Gibeaut, J. C., 2005. Texas High School Coastal Monitoring Program: Ball, Port Aransas, and Port Isabel High Schools, 2003-2005. Report. Bureau of Economic Geology.

- Illenberger & Associates., 2001. Environmental Education through Monitoring Coastal Change: Community Coastal Monitoring Programme. Report. Coastal Management Office, Department Of Environmental Affairs And Tourism Cape Town.
- Iremonger, S., 2007. Nermn Beach Profile Monitoring. Technical Report. Environment Bay of Plenty.
- Jenks, G., O'Neill, S., 2004. A Review of the Coast Care Bop Programme March 2004. Report. Environment Bay of Plenty.
- Jenks, G., 2006. Coast Care Bop Dune Status Report. Unpublished. Environment Bay of Plenty.
- Komar, P. D., 1998. Beach Processes and Sedimentation. 2nd Edition. Prentice Hall Inc, New Jersey.
- Laugksch, R. C., 2000. Scientific Literacy: A Conceptual Overview. *Science Education*, 84, 71- 94.
- Miller, E., Paul, T. 2007. Measuring Success: Guidelines for the Management of Sand Dune Revegetation Programmes. New Zealand Forest Research Institute Limited.
- Milne, I., 2004. Aims and Goals for Science Education. *New Zealand Science Teacher*, 107.
- Ministry Of Education., 1993. Science in New Zealand - Curriculum. Learning Media, Wellington.
- Ministry Of Education., 2007. The New Zealand Curriculum for English-Medium Teaching and Learning in Years 1–13. Wellington, Learning Media Limited.
- Otaraua Hapu, Shell Petroleum Mining Ltd., Ngāti Rahiri., Taranaki Regional Council., 2003. Kaimoana Survey Guidelines for Hapu and Iwi. Wellington, N.Z Ministry for the Environment.
- Pilkey, O. H., Hume, T., 2001. The Shoreline Erosion Problem: Lessons From The Past. *Water & Atmosphere*, 9 (2), 22-23. National Institute Of Water and Atmospheric Research Limited.
- Register, K. M., Ohrel, R. L., 2006. Volunteer Estuary Monitoring - A Methods Manual. Second Edition Ed., U.S. Environmental Protection.
- Robertson, G. & Peters, M., 2006, Turning The Tide - An Estuaries Toolkit For New Zealand Communities. Taieri Trust.

- Rodrigues, S. G. A., 1993. The Role and Effect of Context in Learning Form Six Oxidation and Reduction Concepts by Female Students. Education Thesis. University Of Waikato.
- Rouse, H., Nichol, S., Goff, J., 2005. Introduction to the New Zealand Coast. Chapter 1. In Goff, J. R., Nichol, S. L., Rouse, H. L. (Eds.) *The New Zealand Coast. Te Tai O Aotearoa*. Palmerston North, New Zealand, Dunmore Press.
- Rubba, P. A., Anderson, H. O., 1978. Development of an Instrument to Assess Secondary School Students' Understanding of the Nature of Scientific Knowledge. *Science Education*, 62, 449-458.
- Stewart, C., Leonard, G. S., Johnston, D. M., Hume, T. M., 2005. The National Coastal Community Survey: Results for Waikato Beach Communities. Science Report, Wellington NZ: Geological & Nuclear Science Ltd.
- Wheeler, K., 2003a. General Information. *Marine Community Monitoring Manual*. Sourced <http://www.naturebase.net/content/view/792/1393>.
- Wheeler, K., 2003b. "Starting Up" - Essential Reading. *Marine Community Monitoring Manual*. Sourced <http://www.naturebase.net/content/view/792/1393>.

# A1 - New Zealand Coastal Society Presentation

Slide 1

## Community Based tools for Coastal Monitoring



Presented by - Darcel Rickard



Slide 2

## NZ Coastal Situation (Thesis rationale)

- Communities built too close to the sea
- Communities vulnerable to a range of natural hazards
- Misunderstandings and lack of awareness surrounding coastal dynamics/ hazards



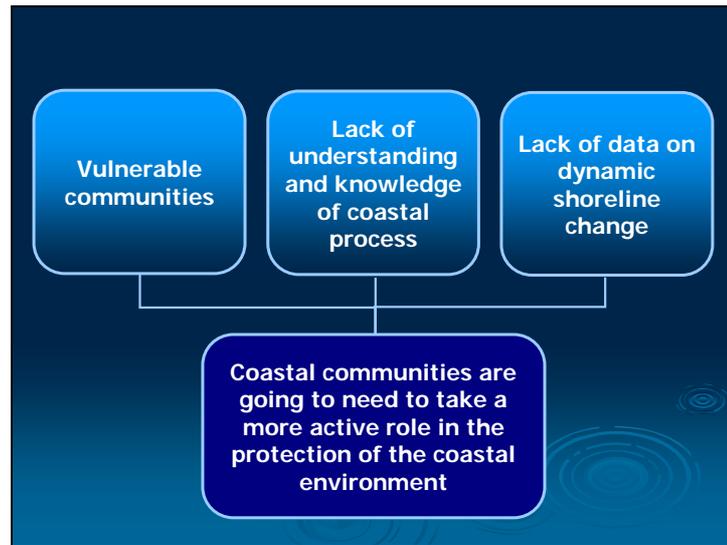
Slide 3

## NZ Coastal Situation (Thesis rationale)

- Poor spatial and temporal coverage of beach process monitoring data
- Regional Councils lack resources to gather information



Slide 4



Slide 5

## Objectives

- Develop a means for coastal communities to monitor long-term changes in their coastal environments
- Develop tools and training protocols for communities to undertake structured scientific measurements of coastal areas and assess the health of the coast
- Provide a valuable educational resource and information base for communities

Slide 6

## Target Audience

- Coast care groups  


"Monitoring project success"
- Surf-life saving clubs  


"Beach safety"
- Secondary schools  


"Learning in context"
- Coastal hapu groups  


"Restoring natural character"

Slide 7

## Monitoring approach

- Different groups = Different needs and objectives
- One size doesn't fit all
- Needs & objectives define monitoring methods
- Monitoring must be relevant
- Methods must take into account the amount of time and effort groups can afford
- Methods must be repeatable & scientifically robust

Slide 8

## Customised Coastal Monitoring Tool-Kit

- Relevant background technical information on coastal processes
- Simple field equipment
- Customised field guide:
  - Monitoring parameters
  - Field procedures/ protocols
  - Field forms for data capture

Slide 9

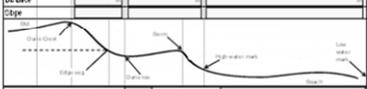
## Monitoring Parameters

- Mainly focuses on physical processes and some social impacts in the coastal environment (not biological at this stage)
- Different levels of monitoring
  - Level 1** - Simple methods, Basic observations,
  - Level 2** - More advanced methods, Basic equipment
  - Level 3** - Advance methods, Specialist equipment and/or skills

Slide 10



Slide 11

FIELD FORM	
Group name:	1
Beach name:	
Location:	
Observer:	
Date: / /	Time: : : am/pm
Grid reference From:	To:
Weather conditions:	2
Tidal level: <input type="checkbox"/> Low <input type="checkbox"/> Mid <input type="checkbox"/> High <input type="checkbox"/> Rising <input type="checkbox"/> Falling	Wave climate:
Wind speed: <input type="text"/>	Breaker height: <input type="text"/>
Wind direction: <input type="text"/>	Period: <input type="text"/> Direction: <input type="text"/>
	Type: <input type="checkbox"/> Plunging <input type="checkbox"/> Spilling <input type="checkbox"/> Surging
Hazards:	4
Number of longshore bars: <input type="text"/>	Rip currents:
Surfzone width: <input type="text"/>	Number: <input type="text"/>
Alongshore current direction: <input type="text"/>	Spacing: <input type="text"/>
Alongshore current speed: <input type="text"/>	Orientation: <input type="text"/>
	Type: <input type="text"/>
Litter count:	6
Plastic: <input type="checkbox"/> Wood: <input type="checkbox"/> Rubber: <input type="checkbox"/>	Human factors:
Glass: <input type="checkbox"/> Cloth: <input type="checkbox"/> Metal: <input type="checkbox"/>	Vehicle tracks: <input type="checkbox"/> yes / no
Ceramic: <input type="checkbox"/> Paper: <input type="checkbox"/> Other: <input type="text"/>	Horse tracks: <input type="checkbox"/> yes / no
	No. controlled pedestrian access pts: <input type="text"/>
	No. uncontrolled pedestrian access pts: <input type="text"/>
	Beach user numbers: <input type="text"/>
	Other human impacts: <input type="text"/>
Cross-shore profile:	3
Distance: <input type="text"/>	
Cliff: <input type="text"/>	
	
Colour intensity of sand: <input type="text"/>	Comments: <input type="text"/>
Degree of active scarping: <input type="text"/>	Comments: <input type="text"/>
Degree of vegetation cover: <input type="text"/>	Main species: <input type="text"/> Spinifex / Ragwort / Manuka
Evidence of sand build-up: <input type="checkbox"/> yes / no	Type: <input type="text"/>

Slide 12

## NIWA external web-based tools

- Data entry mechanism
- Initial data quality check and analysis
- Produce basic results
- Archive for monitoring records
- Reports back
- Builds a NZ database

Slide 13

## Positive Outcomes

- Engage communities in the study of their environment
- Increase awareness of coastal hazards amongst the general public
- Create a permanent record of environmental change
- Increase community resilience and contribute to the sustainability of coastal resources
- Provide a valuable educational resource for tangata whenua, communities and secondary schools

Slide 14

## Acknowledgements

**Dr Terry Hume**  
(NIWA)

**Dr Willem de Lange**  
(University of Waikato)

**Greg Jenks**  
(Coast care Environment Bay of Plenty)

**Jim Dahm & Harley Spence**  
(Beach Care Environment Walkato)

**Tex Rickard & Angeline Greensill**  
(Whaingaroa ki te whenua trust)

**Pablo & Donna Rickard & Paerau Brown**  
(Trusty field assistance 😊)



## A2 - University of Waikato School of Education Presentation

Slide 1



Slide 2



Slide 3



Slide 4

## Talk overview

- Thesis rational
- Aims
- Tool development
- Relevance
- Positive outcomes

Slide 5

Thesis rational

## NZ Coastline Situation

- Extensive highly developed coastline
- Communities built to close to the sea
- Communities vulnerable to a range of natural hazards

Slide 6



Slide 7

Thesis rational

## Knowledge/Understanding

- Many misunderstandings surrounding coastal dynamics
- Lack of accurate scientific education
- Lack of awareness of coastal hazards

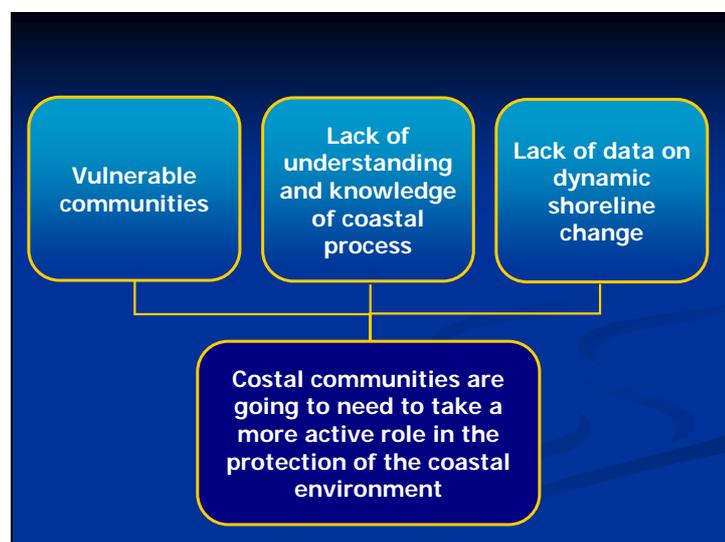
Slide 8

Thesis rational

## Information/ Data

- Lack of information about dynamic shoreline change in NZ
- Regional Councils don't have enough resources to gather information

Slide 9



Slide 10

## Aims of my research

- Develop a means for coastal communities to monitor long-term changes in their coastal environments
- Develop tools and training protocols for communities to undertake structured scientific measurements of coastal areas and assess the health of the coast
- Provide a valuable educational resource and information base for communities

Slide 11

## Target Audience

- **Coast care** groups
- Environmental groups
- Coastal hapu groups
- **Surf-life saving** clubs
- **Secondary science** classes
- Small Regional Councils
- Coastal home owners

Slide 12

## Coast Care

Primary focus dune restoration



Slide 13



Slide 14



Slide 15



Slide 16

### Monitoring Parameters

•Beach name	•Breaker wave height	•Wind direction	•Evidence of active sand accumulation
•Location	•Wave period	•Wind speed	•Degree of vegetation cover
•Site number	•Wave breaker type	•Width of high tide beach	•Condition of vegetation cover
•Grid reference	•Wave direction	•Vehicles on the beach	•Longshore variation in beach width
•Observers	•Number of alongshore bars	•Horses on the beach	•Evidence of erosion
•Date	•Width of surf zone	•Vehicle damage evidence	•Rip-head embayment's
•Time	•Alongshore current direction	•No. of controlled beach access points	•Black sand (lags)
•Weather conditions	•Alongshore current speed	•No. of uncontrolled beach access points	•Wave wash debris
•High tide	•Number of rip currents	•Beach user numbers	•Cross shore profile
•Low tide	•Rip current spacing	•Litter human	•Dune toe strandline
•Tidal range	•Rip current type	•Storm water discharge	•High water strandline

Slide 17

- ### Monitoring approach
- Different groups = Different needs and objectives
  - Monitoring objectives define approach
  - One size doesn't fit all
  - Needs to be relevant
  - Needs to take into account the amount of time and effort they can afford.

Slide 18

- ### Coastal Monitoring Tool-Kit
- Educational scientific information
  - Simple field equipment
  - Customised Field guide:
    - Monitoring Parameters
    - Field Procedures
    - Field Forms
  - Supplementary information

Slide 19

## Pilot phase

- Coast care groups
  - Onemana Beach care
  - Papamoa Coast care
- School groups
  - Raglan Area School
  - First year UoW Environmental Sciences
- Maori Community groups
  - Tainui ki Whaingaroa hapu

Slide 20

## Web-based tools

- Data entry mechanism
- Initial data quality check and analysis
- Produce basic results
- Archive monitoring records
- Report cards

Slide 21

## Linkages to NZ Science curriculum

- Earth Science context
  - Investigation
  - Research
  - Geology (Planet Earth & Beyond)
  - Physics
  - Biology
  - Chemistry

Slide 22

**CURRICULUM OUTLINE – Texas High School example**

**Unit I - Introduction to the Coastal Monitoring Program**

- Lesson A - Introduction to features along a beach profile
- Lesson B - Introduction to the Global Positioning System (GPS for Dummies)
- Lesson C - Field techniques
- Lesson D - Skills needed for data organization and manipulation (graphs, spread sheets, and the Internet)
- Lesson E - Beach profile analysis
- Lesson F - Sand analysis

**Unit II - Physics on the beach**

- Lesson A - Introduction to waves
- Lesson B - Waves and forces
- Lesson C - Understanding the littoral current (hands-on experience with graphs)
- Lesson D - Understanding rip currents (practical application of math and physics)
- Lesson E - Introduction to tides

**Unit III - Earth Science**

- Lesson A - Plate tectonics and the Gulf Coast
- Lesson B - Climate, sea level rise and barrier islands.
- Lesson C - Particle transport (math and physics are everywhere!)
- Lesson D - Sediment composition along the Gulf coast (an introduction to minerals and weathering)

**Unit IV - Biology**

- Lesson A - Sea weed - what is it?
- Lesson B - Shoreline vegetation

**Unit V - Science and society**

- Lesson A - Coastal engineering
- Lesson B - Using the internet as a tool for research

Slide 23

## Positive Outcomes

- More informed tangata whenua, communities and school pupils
- Increased public awareness of coastal processes and hazards
- Better temporal and spatial data coverage for the New Zealand coastline
- Increased community resilience and contribution to sustainability of coastal resources

Slide 24



## A3 - Coastal Hazards Hui Presentation

Slide 1

Coastal Hazards hui  
11th May 2007, Raglan



**Community based coastal monitoring  
a tool for sustainable management**

Darcel Rickard



Slide 2

What???

Develop a means for coastal Tangata whenua and communities to monitor long-term changes in their coastal environments

Develop tools and training needed for communities to undertake scientific investigations of coastal areas

Produce a tool to support the assessment of the health of the coast

Produce a valuable educational resource for tangata whenua, communities and secondary schools



Slide 3

How????

Community tool kit and manual for coastal monitoring and hazard identification

- Educational scientific information
- Simple field equipment
- Field guide: Field Measurements, Field Procedures, Field Forms.
- Hazard assessment checklists



Slide 4

## Hazard Checklist

<p>Visual observations of dune</p> <ul style="list-style-type: none"><li>• Degree of vegetation cover</li><li>• Scarping</li><li>• Evidence of blow out</li><li>• Evidence of sand accumulation</li><li>• Evidence of human impacts</li></ul>	<p>Visual observations of beach</p> <ul style="list-style-type: none"><li>• Width of high tide beach</li><li>• Beach slope</li><li>• Longshore variation in beach width</li><li>• Wave wash debris</li><li>• Rip-head embayments</li></ul>
---	--



Slide 5

## How????

Community tool kit and manual for coastal monitoring and hazard identification

- Educational scientific information
- Simple field equipment
- Field guide: Field Measurements, Field Procedures, Field Forms.
- Hazard assessment checklists
- Simple, inexpensive method for beach profile measurements



Slide 6

## Beach profiling



Slide 7

## How????

NIWA external web-based tools

- Data entry mechanism
- Initial data quality check and analysis
- Produce basic results
- Archive for monitoring records
- Hazard assessment and assessment of the health of the coast
- Report cards



Slide 8

## How????

Introduction of coastal monitoring program into school curriculum

- Incorporate the coastal monitoring programme into High School curriculum
- Integrating the programme into Level 1, 2, and maybe 3 NCEA achievement standards for Science, Geography and/or Physics
- The programme may also be extended into other High school academic activities such as annual science fairs and CREST science awards



Slide 9

## Why????

- Empower coastal communities to make effective and appropriate decisions to mitigate the impact of coastal hazards
- Engage tangata whenua in the study of their environment
- Increase awareness of coastal hazards
- Create a permanent record of environmental change
- Increase community resilience and contribute to the sustainability of coastal resources
- Provide a valuable educational resource for tangata whenua, communities and secondary schools



## Slide 10

### Possible trial location

- Ocean Beach, Raglan - Tangata whenua & Raglan Area School
- Matakana Island –Beach Care Group
- Muriwai Beach – Kingsgate College

### Linkages

- Environment Waikato
- Auckland Regional Council
- Environment Bay of Plenty



## B1 – Application for Ethical Approval

School of Science & Engineering Human Research Ethics Committee  
Protocol No:

### THE UNIVERSITY OF WAIKATO APPLICATION TO THE SCHOOL OF SCIENCE & ENGINEERING HUMAN RESEARCH ETHICS COMMITTEE

Research:

**STARTING DATE: February 2008**

Teaching:

**COMPLETION DATE: February 2007**

1.
  - (a) **Name of applicants:**  
Darcel Rickard
  - (b) **Position:**  
Masters Student
  - (c) **Department:**  
Earth and Ocean Sciences
  - (d) **Phone number:**  
Work: 07 859 1889 – Cell phone: 027 2104 783
  - (e) **Qualifications & Experience** (first applications only):  
Bachelors degree in Science double majoring in Earth Science and Maori. Experience with Social Science research methodologies.
  - (f) **Other personnel involved** (including titles and roles):
2. **Title of Project:**  
Community Based Coastal Monitoring – Developing tools for sustainable management.
3. **Description of Project:**
  - (a) **Justification:**  
My Msc research project involves the development and trial of a community based coastal monitoring tools. The target audience for the monitoring tools are Coast Care groups. Coast Care is involved in caring and working to protect and restore the coastal environment. Coast Care is a partnership between the local community, iwi, District Council and Regional Council. In order to tailor the monitoring tools to Coast Care it is essential to first

conduct some social science research of these groups to establish their needs and ability to undertake certain measurements. Thus this research project is a quantitative study of “Coast Care member’s awareness and knowledge of coastal hazards and management and their values associated with the coastal environment”. This project will be based around one survey questionnaire, and is part of a larger research project which is in partial fulfillment of a Masters degree in Science.

**(b) Objectives:**

To identify the degree of awareness and knowledge that Coast Care members have related to coastal hazards and management.

**(c) Procedure for recruiting participants and obtaining informed consent.**

Participants will be recruited from Coast Care groups in the Environment Bay of Plenty and Environment Waikato Regions. Contact has been made with the Coast Care coordinators from the two above regions and they have given consent to use the various Coast Care groups in their regions to recruit potential participants. It is believed that if the participant completes and returns the questionnaire then they are consenting to take part in the study. Participants will also be provided with an information sheet outlining the purpose of the research project.

**(d) Procedures in which research participants will be involved:**

Participants will be required to complete one questionnaire. This will involve the participant answering 23 questions relating to values, awareness, knowledge, and management of the coastal environment. The survey questionnaire should take between 10-15 minutes to complete and participants will be asked to return the questionnaires via mail to the researcher.

**(e) Procedures for handling information and materials produced in the course of the research:**

The researcher will store all research material in a locked filing draw when it is not in use, so that confidentiality may be

maintained. Data will be stored for 3 years and then disposed of securely.

**4. Ethical Concerns:** (Outline ethical concerns and proposed solutions under the following headings):

**(a) Access to participants:**

Participants will be recruited from Coast Care groups in the Environment Bay of Plenty Region and Environment Waikato Region. Participants will be given the opportunity by their Coast Care coordinator to collect a questionnaire from the researcher at a Coast Care meeting or workshop. Alternately participants will be approached via mail.

**(b) Informed consent:**

The participant is not obligated to take part in the questionnaire survey. Information will be provided on the front page of the questionnaire outlining the purpose of the research project, so that the participant is fully informed. The participant has the right to abstain from answering any particular questions they feel uncomfortable answering and the participant also has the right to withdraw their involvement in the survey by not completing or returning the questionnaire to the researcher.

**(c) Confidentiality:**

Participant's names will not be disclosed in any report of the findings. Participants are not obligated to provide their names or any personal information. Nevertheless the researcher will exercise best-practice protocols when dealing with any information that may be potentially sensitive for a participant.

**(d) Potential harm to participants:**

None are foreseen.

**(e) Participants right to decline:**

It is believed that if the participant completes and returns the questionnaire then they are consenting to take part in the study.

Participants are not obligated to take part in the survey and have the right to decline involvement.

- (f) **Arrangements for participants to receive information:**  
Participants will all receive an information sheet with the survey.  
Results of the survey will be reported back to all participating Coast Care groups by the end of this year.
- (g) **Use of the information:**  
The information collected from this questionnaire will be used to design relevant and practical monitoring tools for coastal community groups, such as Coast Care.
- (h) **Conflicts of interest:**  
There is no conflict of interest.
- (i) **Other ethical concerns relevant to the research:**  
None are foreseen

#### **ETHICAL STATEMENT**

The researcher will follow the ethical principals and procedures set out in the University of Waikato's "Human Research Ethics Regulations 2005" as outlined in the 2006 University Calendar. The researcher will also follow the code of professional conduct and ethics as set out by the New Zealand Geographical Society Inc. The researcher will ensure that the above conditions are upheld.

- 5. **Legal Issues:** (outline legal issues which may arise in the course of this research)
  - (a) **Copyright:**  
None are foreseen
  - (b) **Ownership of data or materials produced:**  
Ownership of data remains with the researcher
  - (c) **Any other legal issue relevant to the research:**  
None are foreseen
- 6. **Where the research will be conducted:**  
University of Waikato

7. **Has this application in whole or in part previously been declined approval by another Ethics Committee:**  
No
8. **For research to be undertaken at other facilities under the control of another Ethics Committee, has an application also been made to that Committee:**  
No
9. **Is any of this work being used in a thesis to be submitted for a degree at the University of Waikato:**  
Information from this research will be used in a master's thesis, to be submitted in partial fulfilment of degree requirement for a masters degree in Earth Science.
10. **Further conditions:**  
*In the event of this application being approved, the undersigned agrees to inform the Human Research Ethics Committee of any change, subsequently proposed.*

**Signed by Applicant:**

.....

**Date:**

.....

**Signed by the Supervisor:**

.....

**Date:**

.....

**Signed by the Chairperson of Department:**

.....

**Date:**

.....

**The project may proceed / The ethics application requires further work**

**Signed on behalf of the Committee:**

.....

**(Chairperson of the Committee)**

**Date:**

.....

## B2- Questionnaire Information Sheet

### **Community based coastal monitoring – developing tools for sustainable management**

This questionnaire is part of a masters research project at the University of Waikato based around “Community based coastal monitoring – developing tools for sustainable management”. The information collected from this questionnaire will be used to design relevant and practical monitoring tools for coastal community groups and assist your Coast Care group

Participants for this questionnaire have been selected from a number of Coast Care groups throughout the Waikato and Bay of Plenty regions.

All personal information provided in this questionnaire is completely confidential and all participants’ identities will remain anonymous.

Participants are not obligated to fill out the questionnaire and have the right to refuse to participate in this study.

The questionnaire should take roughly 10 to 15 mins to complete, and involves 23 questions relating to values, awareness, knowledge, Coast Care, and the management of your coastal environment.

Once you have completed the questionnaire please return it to your Coast Care coordinator **OR** send it to the researcher by **Friday 20<sup>th</sup> July 2007**. Results of the survey will be reported back to all participating Coast Care groups by the end of this year.

For additional information regarding the study, please feel free to contact:

**Researcher:**

**Darcel Rickard: (07) 859 1889 - National Institute of Water and Atmospheric Research Ltd, PO Box 11-115, Hamilton.**

**Supervisors:**

**Dr Willem de Lange - (07) 838 4024 - University of Waikato, Hamilton**  
**Dr Terry Hume - (07) 856 1729 - National Institute of Water & Atmospheric Research Ltd, Hamilton**



**Thank you kindly for taking the time to participate in this survey**

**B3 – Final Survey Questionnaire**

**Community Based Coastal Monitoring –  
a tool for sustainable management**



**Questionnaire (Coast/Beach Care)**



1. How many years have you lived in \_\_\_\_\_? \_\_\_\_\_ years

2. What were the features of the area that attracted you to live here?(Choose the TWO most important reasons from the list).

- The natural beauty of the coast
- Sea views
- Easy access to the beach
- Fishing and shellfish gathering
- Boating
- Recreation(swimming, surfing, walking, sunbathing, etc)
- Other (please describe)

3. How often do you use the beach? (Tick one)

- Every day
- Several times each week
- Several times each month
- Several times each year
- Once each year
- Less than once each year
- Never

4. What do you use the beach for? (Tick all that apply)

- Swimming
- Surfing
- Walking
- Sunbathing
- Fishing and/or shellfish gathering
- I don't use the beach
- Other (please describe)

5. Do any of the following issues affect your use of the beach? (Tick all that apply)

- Coastal erosion
- Water quality
- Litter
- Water hazards (waves, currents, rips, inundation)
- Other (please describe)

6. What do you think are the main causes of coastal erosion? (Tick all that apply)

- Storms
- Sea-level rise
- Waves
- Wind
- Global warming
- Humans
- Other causes (please describe)
- Don't know

7. For each of the following statements do you agree or disagree (Tick the option that best matches your view)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know
Inappropriate development in coastal areas can put houses at risk from erosion						
Coastal erosion and accretion are natural processes at the coast						
There are a range of methods available to stop coastal erosion indefinitely						
The width of the dune changes during the year						
A good cover of plants on dunes helps build up sand reserves by stopping it from blowing away						

**8. When do you think coastal erosion is likely to affect your community in the future? (Tick one of the following options)**

- within the next week
- within the next two months
- within the next year
- within the next 10 years
- within my lifetime
- not within my lifetime

**9. When do you think coastal erosion is likely to affect you personally in the future? (Tick one of the following options)**

- within the next week
- within the next two months
- within the next year
- within the next 10 years
- within my lifetime
- not within my lifetime

**10. Have you asked any of the following people, organisations, for information about coastal erosion? (Tick all that apply)**

- No. I haven't asked anyone
- Friends or family
- Neighbours
- Regional Council
- Local Councils
- Local Civil Defence
- Research organisations (e.g. NIWA, GNS, Universities)
- Other (please specify)

**11. In the next month or so, do you intend to seek information on coastal erosion? (Tick one)**

No

Possibly

Definitely

**12. Would you be interested in finding out more about any of the following topics related to the coastal environment? (Circle all that apply)**

Hazards ( flooding, tsunami, flooding, cyclones)

Hydrodynamics ( waves, currents, tides, rip currents)

Geomorphology ( erosion & accretion, dune system, beach sediment)

Climate ( sea level rise, global warming)

**13. If you were to seek information on coastal processes what format would you prefer it to be delivered in? (Please tick TWO most preferred)**

Pamphlets

Posters

Information booklet

Lecture/presentations at your Coast Care meetings

Workshops

Internet

Other (please specify)

**14. Do you belong to any of the following groups that work to protect the environment? (Tick all that apply)**

Beach Care/ Coast Care group

Harbour Care

Hapu group

Other (please specify)

No

**15. Are any of these beach management schemes used in your area? (Tick all that apply)**

- Dune planting
- Construction of seawalls/rockwalls
- Beach nourishment (adding extra sand or gravel)
- Zoning of beach areas at risk from erosion
- Other (please specify)
- I am not aware of any beach/dune management schemes used in my area

**16. Have you been involved with any beach/coast care activities e.g. dune planting? (Tick one)**

- Yes (please specify)
- No

**17. Do you think it is necessary to monitor the performance of a beach/dune management scheme? (Tick one)**

- Yes
- No
- Don't know

**18. Has there been (or do you know of) any monitoring of the current beach/dune management scheme for your area? (Tick one)**

- Yes
- No (go to question 21)
- Don't know (go to question 21)

**19. If "Yes", do you know what type of monitoring was/is carried out? (Tick all that apply)**

- No. Don't know
- Photographic record
- Beach profiles
- Beach survey



**23. “Optional”**

If you would like to be contacted in the future by the researcher regarding the findings of the project please place your contact details below. Please note this is “**optional**”.

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Email address: \_\_\_\_\_

For additional information regarding the study, please feel free to contact:

**Researcher:** Darcel Rickard: (07) 859 1889  
National Institute of Water & Atmospheric Research, PO Box 11-115,  
Hamilton.

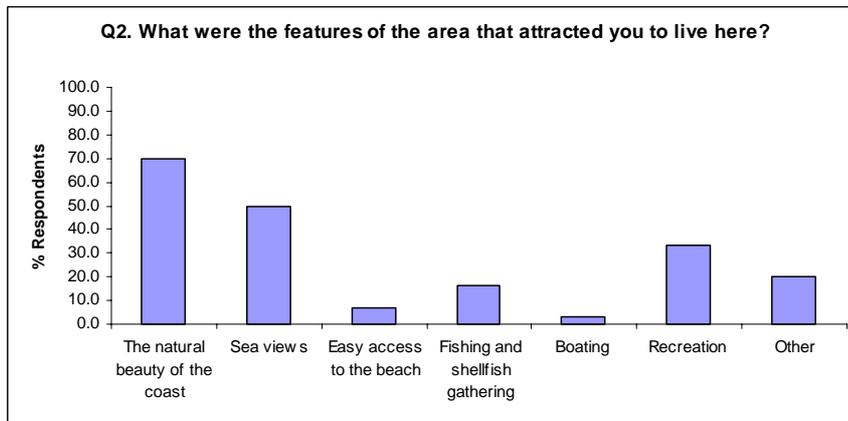
**Supervisors:** Dr Willem de Lange - (07) 838 4024 - University of Waikato  
Dr Terry Hume - (07) 856 1729 - NIWA

**Thank you for taking the time  
to complete this questionnaire.  
Please post the questionnaire  
back to the researcher at the  
above address  
by Friday 20<sup>th</sup> July**

## B4: Coast Care survey questionnaire tabulated results and graphs

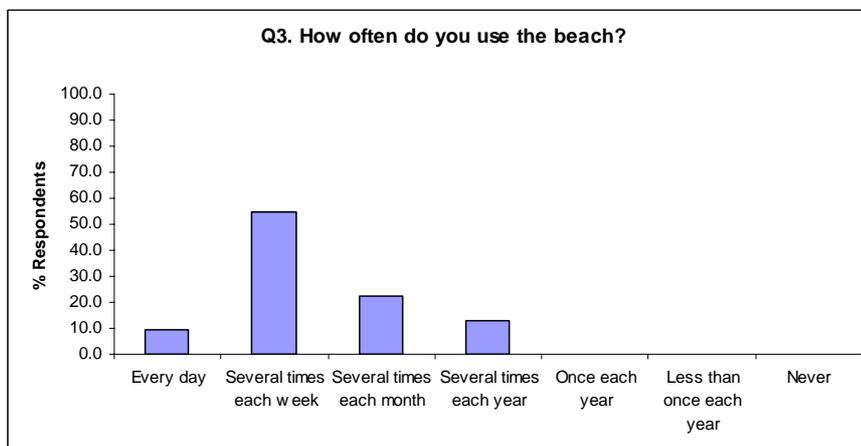
Q2. What were the features of the area that attracted you to live here? (Choose the TWO most important reasons from the list).

	Count	%
The natural beauty of the coast	21	70.0
Sea views	15	50.0
Easy access to the beach	2	6.7
Fishing and shellfish gathering	5	16.7
Boating	1	3.3
Recreation	10	33.3
Other	6	20.0



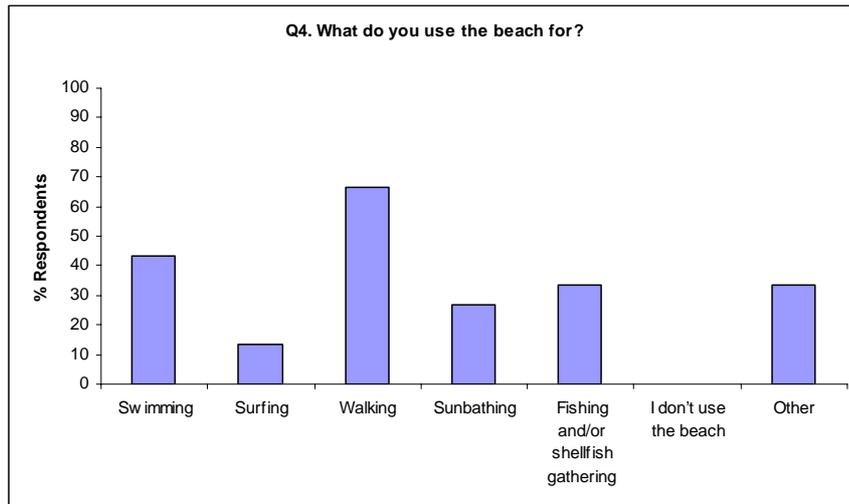
Q3. How often do you use the beach? (Tick one)

	Count	%
Every day	3	9.7
Several times each week	16	54.8
Several times each month	7	22.6
Several times each year	4	12.9
Once each year	0	0.0
Less than once each year	0	0.0
Never		
<b>Total</b>	<b>30</b>	<b>100.0</b>



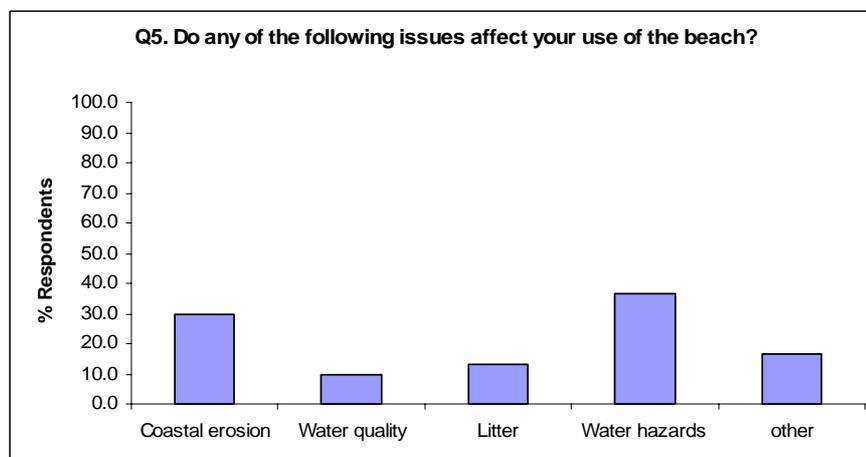
Q4. What do you use the beach for? (Tick all that apply)

	Count	%
Swimming	13	43
Surfing	4	13
Walking	20	67
Sunbathing	8	27
Fishing and/or shellfish gathering	10	33
I don't use the beach	0	0
Other	10	33



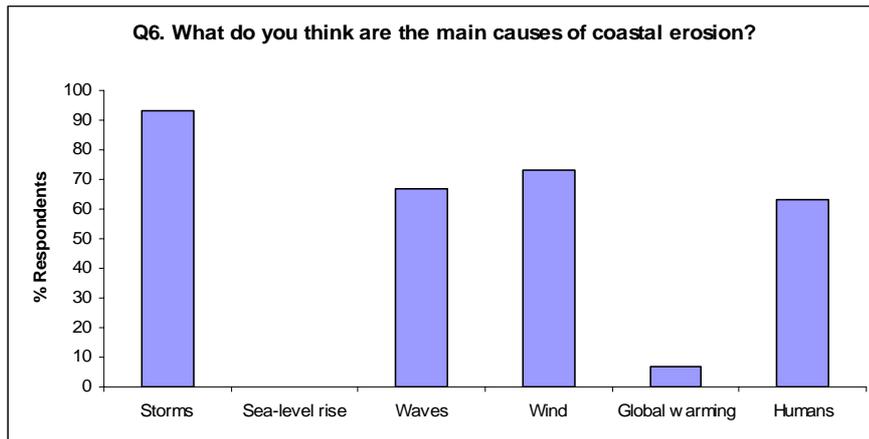
Q5. Do any of the following issues affect your use of the beach? (Tick all that apply)

	Count	%
Coastal erosion	9	30.0
Water quality	3	10.0
Litter	4	13.3
Water hazards	11	36.7
Other	5	16.7



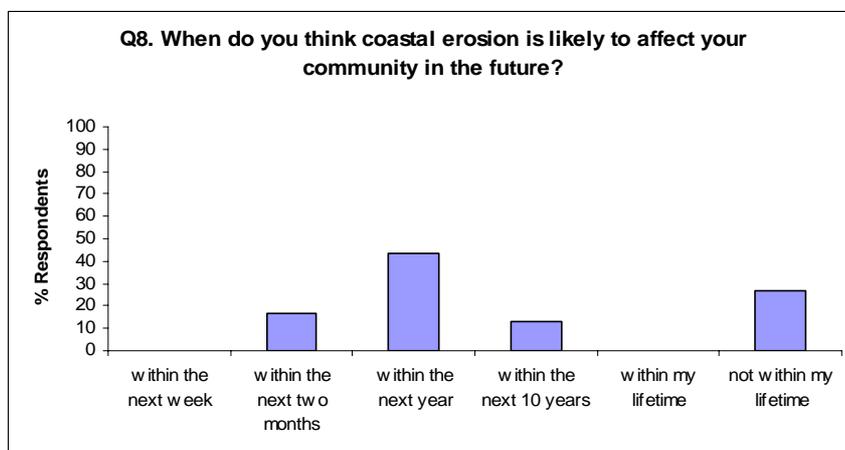
Q6. What do you think are the main causes of coastal erosion? (Tick all that apply)

	Count	%
Storms	28	93
Sea-level rise	0	0
Waves	20	67
Wind	22	73
Global warming	2	7
Humans	19	63



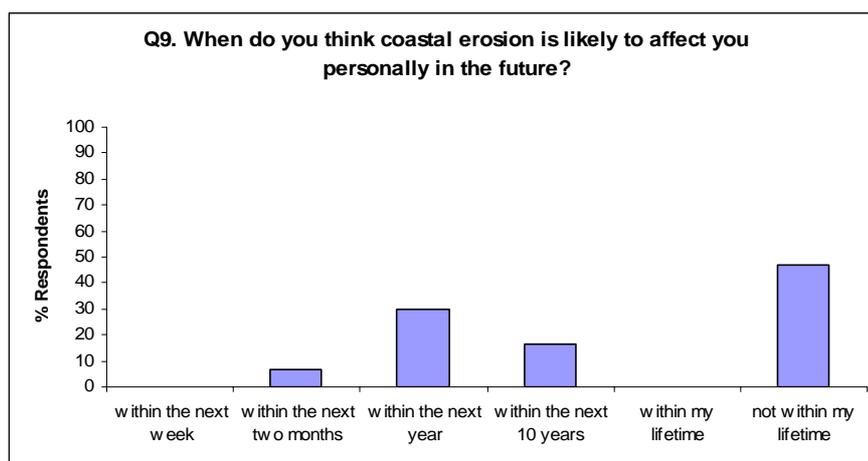
Q8. When do you think coastal erosion is likely to affect your community in the future? (Tick one of the following options)

	Count	%
within the next week	0	0.0
within the next two months	5	16.7
within the next year	13	43.3
within the next 10 years	4	13.3
within my lifetime	0	0.0
not within my lifetime	8	26.7
<b>Total</b>	<b>30</b>	<b>100.0</b>



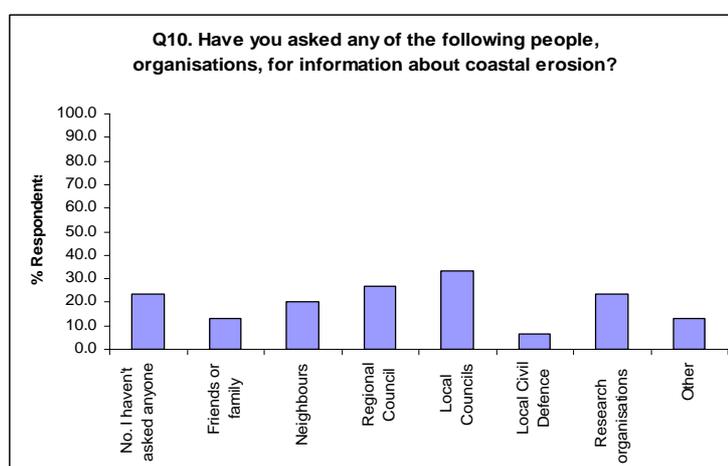
Q9. When do you think coastal erosion is likely to affect you personally in the future?  
(Tick one of the following options)

	Count	%
within the next week	0	0.0
within the next two months	2	6.7
within the next year	9	30.0
within the next 10 years	5	16.7
within my lifetime	0	0.0
not within my lifetime	14	46.7
<b>Total</b>	<b>30</b>	<b>100.0</b>



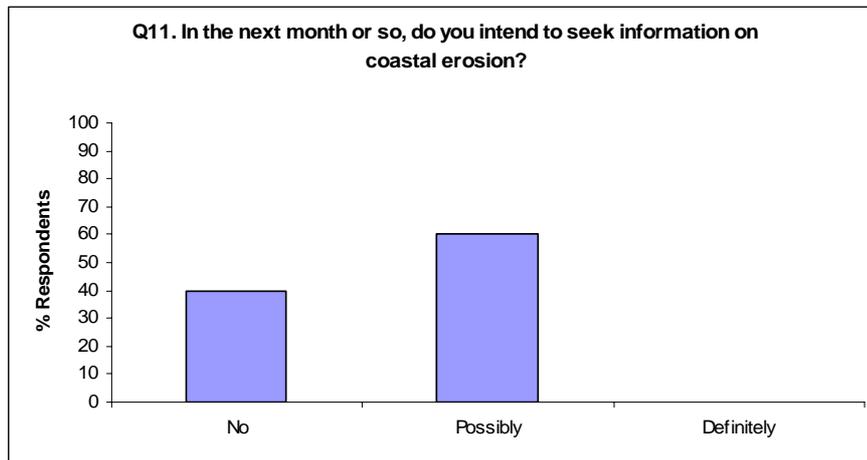
Q10. Have you asked any of the following people, organizations, for information about coastal erosion? (Tick all that apply)

	Count	%
No. I haven't asked anyone	7	23.3
Friends or family	4	13.3
Neighbours	6	20.0
Regional Council	8	26.7
Local Councils	10	33.3
Local Civil Defence	2	6.7
Research organisations	7	23.3
Other	4	13.3



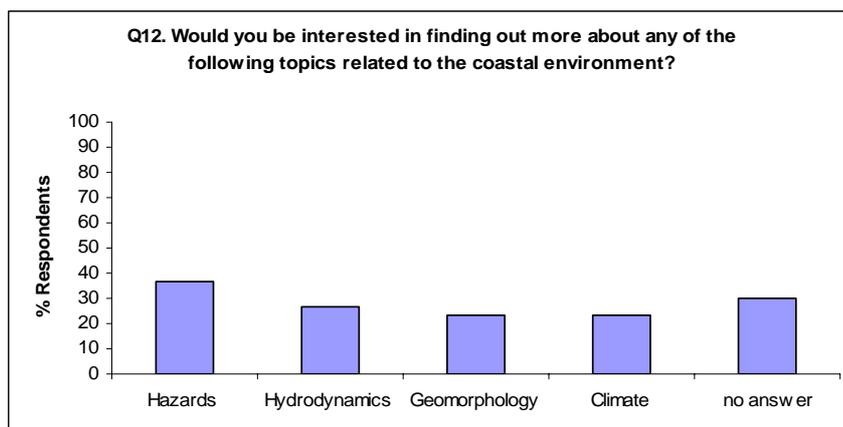
Q11. In the next month or so, do you intend to seek information on coastal erosion? (Tick one)

	Count	%
No	12	40.0
Possibly	18	60.0
Definitely	0	0.0
<b>Total</b>	<b>30</b>	<b>100.0</b>



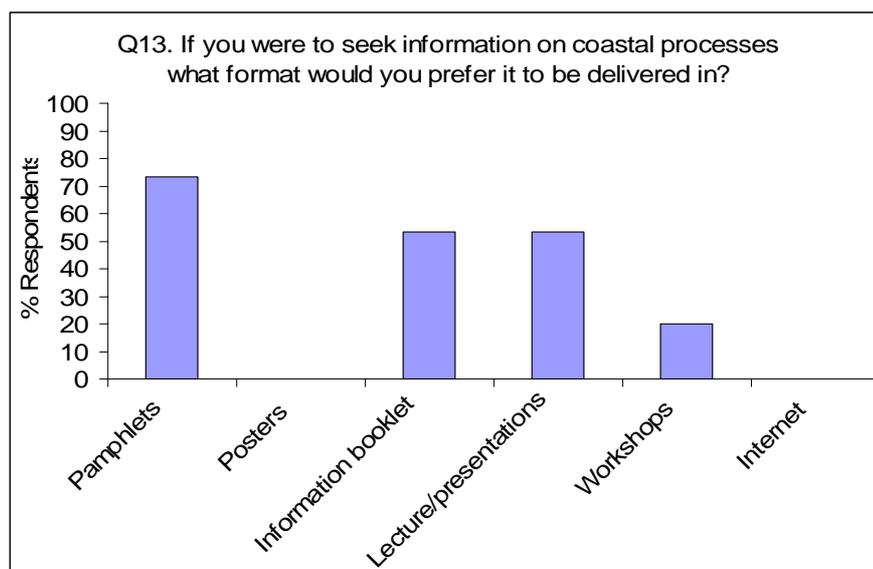
Q12. Would you be interested in finding out more about any of the following topics related to the coastal environment? (Circle all that apply)

	Count	%
Hazards	11	37
Hydrodynamics	8	27
Geomorphology	7	23
Climate	7	23
No answer	9	30



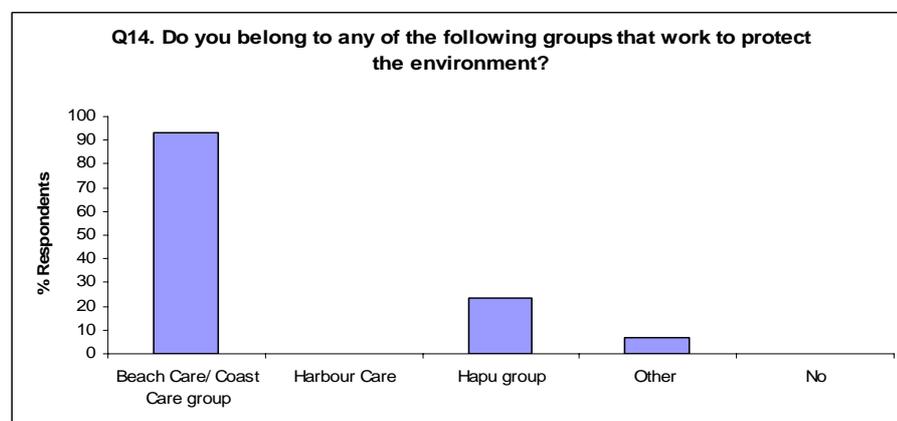
Q13. If you were to seek information on coastal processes what format would you prefer it to be delivered in? (Please tick TWO most preferred)

	Count	%
Pamphlets	22	73
Posters	0	0
Information booklet	16	53
Lecture/presentations	16	53
Workshops	6	20
Internet	0	0



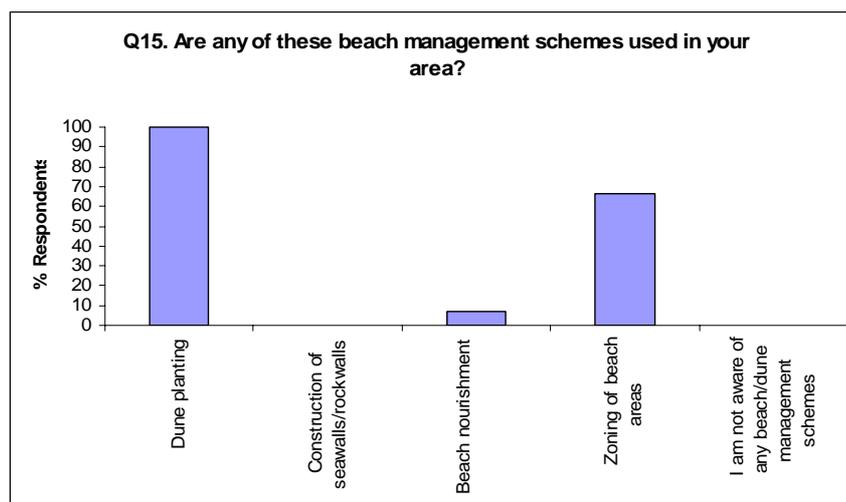
Q14. Do you belong to any of the following groups that work to protect the environment? (Tick all that apply)

	Count	%
Beach Care/ Coast Care group	28	93
Harbour Care	0	0
Hapu group	7	23
Other	2	6.7
No	0	0



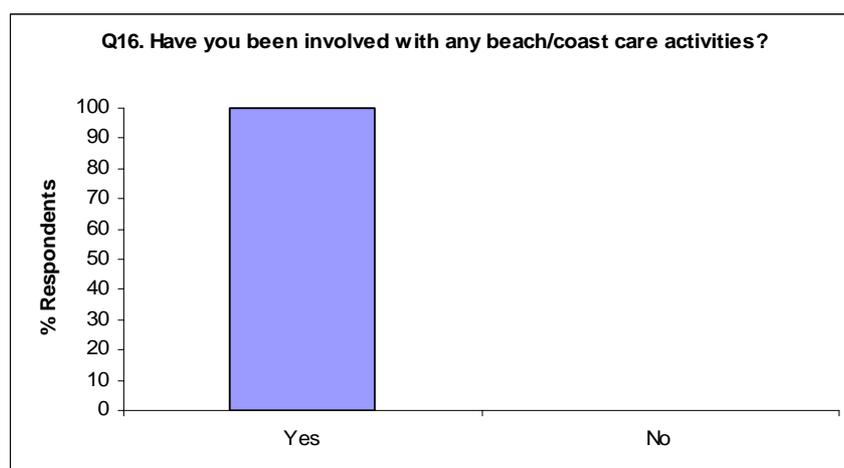
Q15. Are any of these beach management schemes used in your area? (Tick all that apply)

	Count	%
Dune planting	30	57.7
Construction of seawalls/rockwalls	0	0.0
Beach nourishment	2	3.8
Zoning of beach areas	20	38.5
I am not aware of any beach/dune management schemes	0	0.0



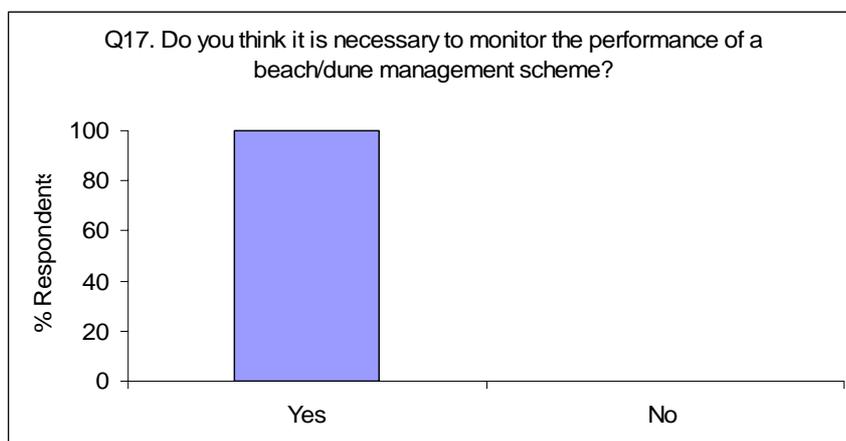
Q16. Have you been involved with any beach/coast care activities e.g. dune planting? (Tick one)

	Count	%
Yes	30	100.0
No	0	0.0
<b>Total</b>	<b>30</b>	<b>100.0</b>



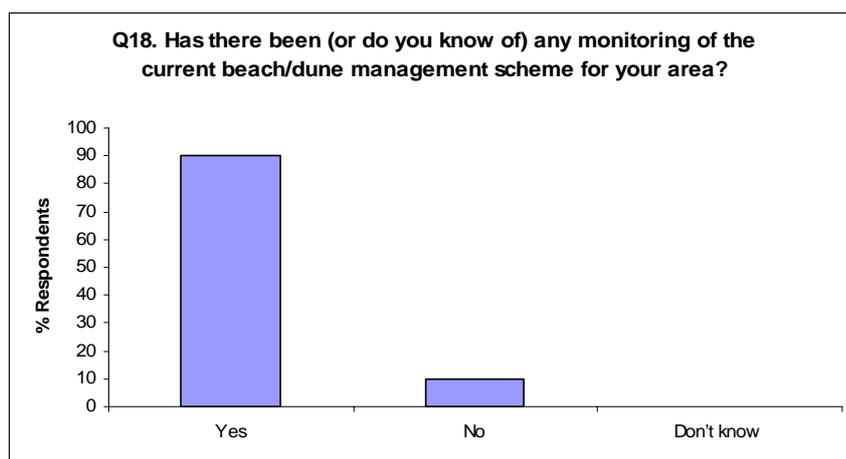
Q17. Do you think it is necessary to monitor the performance of a beach/dune management scheme? (Tick one)

	Count	%
Yes	30	100.0
No	0	0.0
<b>Total</b>	<b>30</b>	<b>100.0</b>



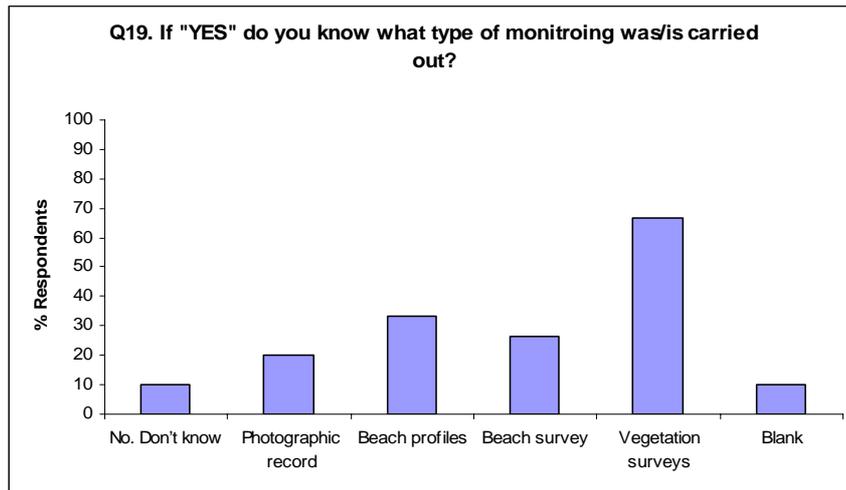
Q18. Has there been (or do you know of) any monitoring of the current beach/dune management scheme for your area? (Tick one)

	Count	%
Yes	27	90.0
No	3	10.0
Don't know	0	0.0
<b>Total</b>	<b>30</b>	<b>100.0</b>



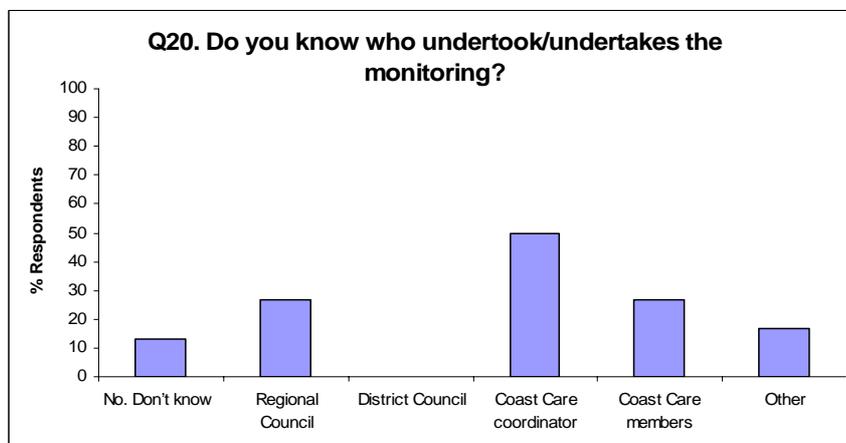
Q19. If "YES" do you know what type of monitoring was/is carried out?

	Count	%
No. Don't know	3	10
Photographic record	6	20
Beach profiles	10	33
Beach survey	8	27
Vegetation surveys	20	67
Blank	3	10



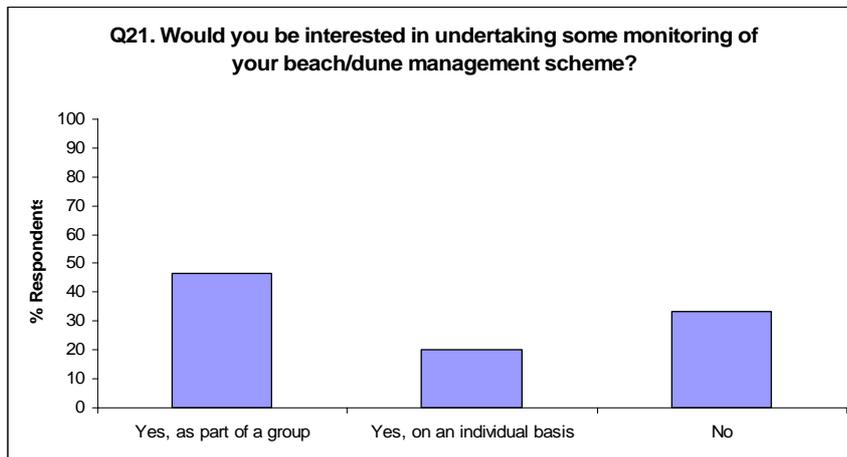
Q20. Do you know who undertook/undertakes the monitoring? (Tick all that apply)

	Count	%
No. Don't know	4	13
Regional Council	8	27
District Council	0	0
Coast Care coordinator	15	50
Coast Care members	8	27
Other	5	17
<b>Total</b>	<b>40</b>	<b>100.0</b>



Q21. Would you be interested in undertaking some monitoring of your beach/dune management scheme?

	Count	%
Yes, as part of a group	14	46.7
Yes, on an individual basis	6	20.0
No	10	33.3
<b>Total</b>	<b>30</b>	<b>100.0</b>



# **Coastal Monitoring Procedures Manual**

---



# **Contents**

---

## **1. Introduction**

- 1.1 Preparation for a day in the field
- 1.2 Weather and tide conditions
- 1.3 Starting the survey

## **2. Marking out the beach profile lines**

## **3. Measuring the beach profile**

- 3.1 Sketch plan “clinometer method”
- 3.2 Emery Method

## **4. Measuring the shoreline position**

## **5. Wind and wave climate**

## **6. Water and beach safety**

## **7. Evidence of erosion and accretion**

## **8. Human impacts**

## **9. Photos**

## **10. End of the day procedures**

# 1. Introduction

The purpose of this manual is to provide guidance for persons undertaking monitoring of physical environmental variables on their coast. It provides instruction on how to prepare for a day in the field and how to make measurements of various indicators of beach state and forcing processes. Illustrations by way of diagrams and photographs provide examples of what observers should be looking for. It provides instruction on jobs that need to be done at the end of the day to secure your dataset.

## 1.1 Preparation for a day in the field

The 'Pre-Survey Schedule' is a check list to ensure that you do all the preparation necessary for the survey. Choose a date for the survey based on weather conditions, tide levels, and the availability of assistants. Where possible try and conduct surveys on days with a large tidal range. That way you will be able to make measurements further down the beach.

## 1.2 Weather and tide conditions

It's a good idea to collect information from online sources the day before or the day of surveying. Relevant weather and tide conditions can be accessed via the linkages page on the coastal monitoring web-site. Alternatively weather and tide data can be obtained from newspapers, tide charts, radio or television. **While in the field give a brief description of the weather conditions during monitoring.** This may be useful when it comes time to interpret the data. For instance, strong onshore winds described on the day of the survey may explain why profile surveys do not extend down to the low tide level or why the nearshore currents were very strong that day.

## 1.3 Starting the survey

When you arrive at the measurement site there are some general observations you should make to 'setup' your work:

1. **Locate the profile marker** using photographs, maps, GPS or other reference marks.
2. **Place a marker at the profile marker** to make its location clearly visible from surrounding vegetation and from a distance.
3. Take about 10 minutes to make general observations at the site, **walk the profile and observe the condition of the beach.** Has it changed since your last visit? Has it eroded or accreted? Have there been human alterations?

4. Sketch a picture of the beach profile and note the key features including the crest of the foredune, edge of vegetation, dune toe, high water line, berm crests, and beach cusps.

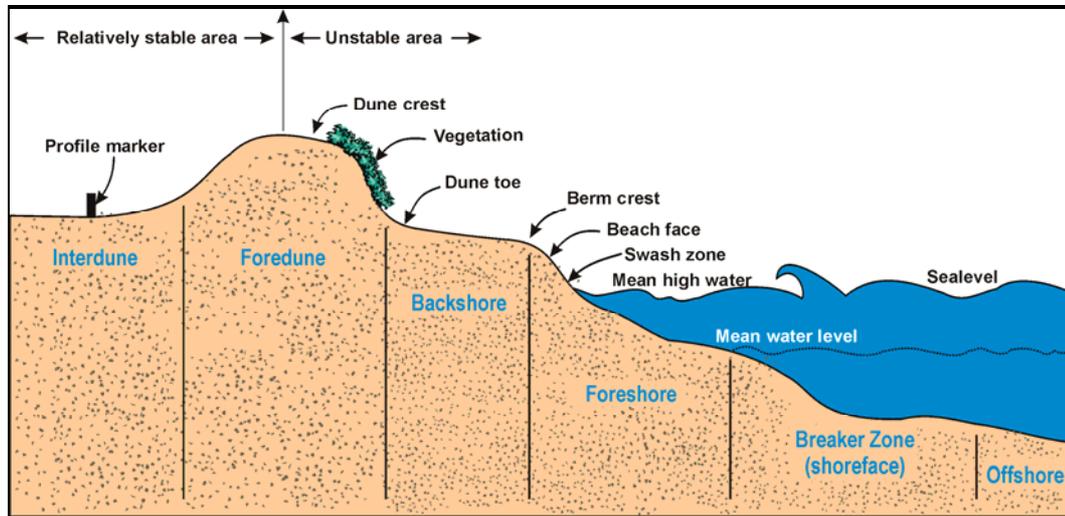


Figure 1: Diagram of a cross-shore beach profile.



Figure 2: Image of a cross-shore beach profile.

## 2. Marking out the beach profile lines

Marking out the beach profile transect before you survey will help you stay on the survey line and ensure that the same transect is surveyed each time. Markers are placed so that at least two of them are visible behind or in front of the surveyors and can be used to line up the survey. Two people are generally required to carry out this task. However, it may also be carried out by one person (see supplementary information). While marking out the profile transect it is also important to mark the position of key features of the profile. To do this:

1. One person goes to the dune crest. Using a sighting compass, site back to the bench mark. Move left or right to obtain the correct bearing (when sighting landward, the bearing will be the reciprocal, i.e., 180 degrees difference, of the value listed in your benchmark notes). **Place a stake at this location.**
2. Standing on the dune crest, have a team member move about half way between you and the bench mark. Line this person up so that they are on the profile. **Have them place another stake.**
3. Still standing on the dune crest, turn 180 degrees so that you are now looking towards the sea. **Sight toward the water in the direction of the true profile bearing.** Have a team member go to the waters edge directing them to move left or right until they are on the profile.
4. **Have them place a stake at this point.**
5. Now have the team member move toward you along the profile, lining them up along the profile.
6. **Have them place a stake or some other marker (even a line in the sand will do) at all key features on the profile, namely the crest of the dune, the seaward edge of vegetation line, the dune toe, berm crest the last high-water line (often delineated by a line of debris or wet/dry boundary), and all other features you may want recorded during the profile survey.**

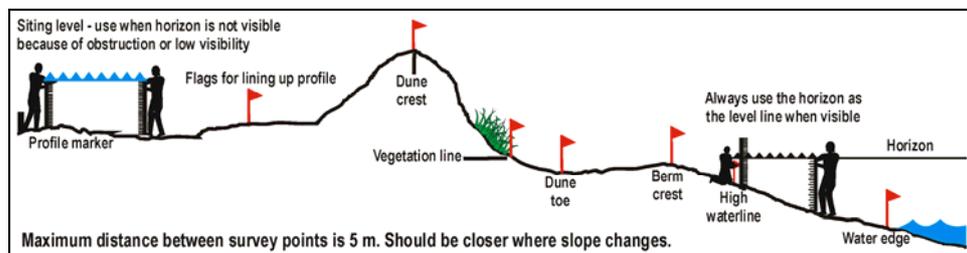


Figure 3: How to mark out a beach profile line.

### 3. Measuring the beach profile

After marking out the profile line, you are ready to measure the profile by using the clinometers method (horizontal distances and slope) and/or the Emery method (horizontal distance and height). Both methods may also be carried out by one person (see supplementary information).

Beach profiles are the primary method of measuring short term changes in beach morphology. These measurements are essential for deciphering shoreline erosion and accretion trends and tracking post storm beach recovery (Auckland Regional Council, 2002).

#### 3.1 Sketch plan “clinometer method”

This method generally requires two people. The observer/recorder sights and reads the clinometers and records the slope angle data, while the assistant measures the horizontal distance with a tape measure and acts as a sighting target for the clinometer measurements. The data is recorded on the profile on the field sheet.

**First define a reference point on the assistant’s body that is the same height above the ground to the observer’s eyes.** If the assistant is a lot shorter than the observer they may have to swap jobs or refer to the methods for conducting the survey using one person.

1. **Record start time and date.**
2. The observer stands on the profile marker. **Measure the horizontal distance between the profile marker and the dune crest.**
3. The observer moves to the dune crest. **Measure the horizontal distance from the dune crest to the edge of vegetation.**
4. **Measure the horizontal distance from the edge of vegetation to the dune toe.** The observer then sights the clinometer at the reference point on the assistant and **measures the slope angle.**
5. The observer moves to the dune toe. **Measure the horizontal distance from the dune toe to the berm crest.** The observer then sights the clinometer at the reference point on the assistant and **measures the slope angle.**
6. The observer moves to the top of the berm. **Measure the horizontal distance from the berm crest to the high water line.** The observer then sights the clinometer at the reference point on the assistant and **measures the slope angle.**

7. The observer moves to the high water line. **Measure the horizontal distance from the high water line to the waters edge.** The observer then sights the clinometer at the reference point on the assistant and **measures the slope angle.**
8. **Record end time.**

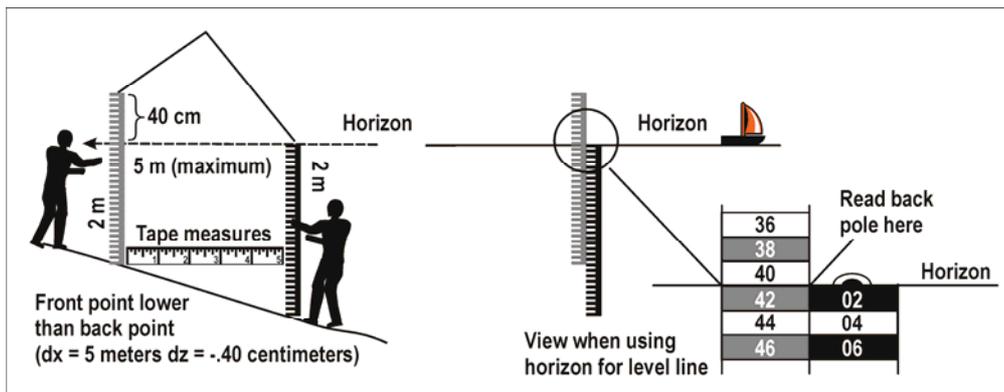
### 3.2 Emery Method

The Emery method is a simple and scientifically robust method for measuring beach profiles. It requires one or two people: an observer who sights and reads the rods and also records data, while the assistant chooses the survey points along the profile, holds the seaward rod vertical, and measures the horizontal distance. **Use the beach profile field sheet to record this data.**

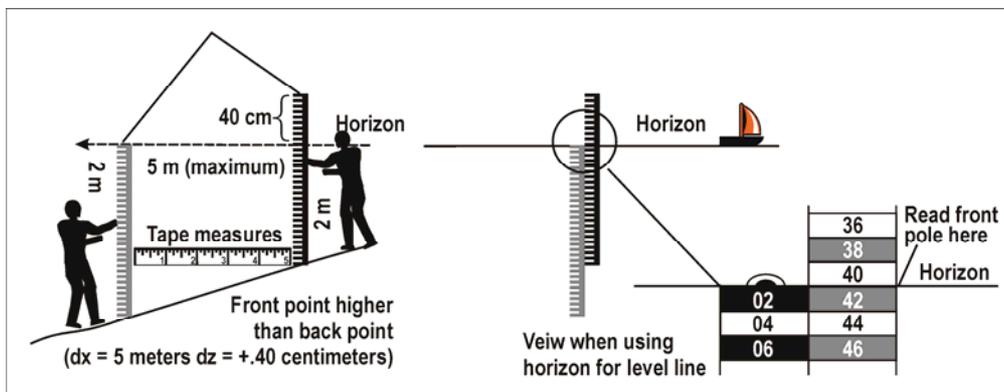
1. **Record start time and date.**
2. Start at the profile marker point, this is point #1 and is always  $dx=0$ ,  $dz=0$ . **Place one rod next to the profile marker.** This is now point #2.
3. **Move the other rod seaward along the profile to the 3<sup>rd</sup> survey point.** The maximum distance between the rods should be about 5 meters. Shorter distances should be measured where there is a change in the slope of the ground or it's necessary to record the location of a key feature (e.g., high water mark) on the profile. Use the profile markers to make sure you are lined up on the profile line.
4. **Measure the horizontal distance between the two rods while keeping the tape horizontal.** Record this distance in the dx column in centimetres.
5. Hold the rods steady and vertical. If the seaward rod is lower than the back rod then the observer draws an imaginary line between the horizon and the top of the seaward rod (see Figure 4). **Where that imaginary line intersects the back rod, read the number of the back rod and record at point 2# in the dz column as a negative number.**
6. If the seaward rod is higher than the back rod, then the back rod holder draws an imaginary line between the horizon and the top of the back rod (see Figure 5). Where that imaginary line intersects the seaward rod, read the number on the seaward rod and record as positive in the dz column.

**Note** - If the horizon is not visible on the day of the survey because of low visibility or an obstruction, a sighting level (like a builder's spirit level) will need to be used instead of the horizon.

8. Once the observer has sighted and recorded the horizontal distance ( $dx$ ) and vertical elevation ( $dz$ ), the observer **removes the BACK ROD** and moves forward to the exact location of the seaward rod. The seaward rod remains in place and becomes the back rod; the assistant **takes what was the back rod to the next survey point. Repeat steps (5-8).**
9. **Record all major features on the profile** in the notes column alongside the  $dz$  values.
7. **Record finish time.**



**Figure 4: Reading Emery rods**



**Figure 5: Reading Emery rods**

## **4. Measuring the shoreline position**

This information is needed to estimate fluctuations in longshore beach width and identify rip head embayments and sites of focused erosion.

The distance measured alongshore may vary from 50 to 100s of meters depending on the site.

1. Standing on your profile line locate the high water line. Pace out 100m (or another predefined distance) along the high water line on each side of the profile line and place a marker.
2. Move to one end of your alongshore transect and stand by the flag that marks the high water. Note the time on your form.
3. Start your GPS system. Walk slowly along the high water strandline toward the flag at the other end of that alongshore transect. The GPS system will be automatically plotting your path as you walk along the beach.
4. When you reach the flag at the other end of that alongshore transect stop the GPS and save your plot.

### **Note**

The high water and edge of vegetation lines are likely to be curved lines that move up and down the beach. It is not necessary to follow every curve. Instead, walk a relatively straight line that is an average of these curves. It's important that you do not stray from your line and that you do not stop for long periods of time.

## 5. Wind and wave climate

Measuring beach profiles show us how the beach changes, but measuring the wind and wave climate will help us to interpret why the beach changes.

Estimate **WIND DIRECTION** by facing directly into the wind (feeling it on your face) then without moving your head, raise the sighting compass and read the wind direction. The wind direction is measured as the direction the wind is blowing (i.e., north, west etc.). Make sure the measurements are made from a location where you are not shielded from the wind in any direction (the middle of the beach well clear of the dunes is a good location).

Estimate **WIND SPEED** using the Beaufort Wind Scale provided.

Estimate **BREAKER WAVE HEIGHT** at the point where they first break offshore. Get another observer to move to the waters edge as a scale.

Estimate **WAVE PERIOD** by measuring the time in seconds that it takes for 10 waves to pass some point in the surf zone, and then dividing that number by 10. To do this:

1. **Focus on an imaginary point in the middle of the surf zone** (or on your lucky day there may be a stationary object in the water such as a surfer).
2. **As the crest of a wave passes your point count that as zero and start your stopwatch.** The next wave is wave number one and so on.
3. When the **10<sup>th</sup> wave passes your point, stop the watch.**
4. **Divide the number of seconds (not minutes) by 10 to get the wave period.**

**WAVE DIRECTION** is quite difficult to estimate from the shore. You will need to go to a high point to make your observation. Look across the breaker zone and focus on the waves where they first break **OFFSHORE**. Turn your head so that you are looking directly into the oncoming waves. Raise your sighting compass and determine the wave direction. The wave direction is the direction the waves are coming from as they approach the shore.

**BREAKER TYPE** is observed for the outer most breakers which are defined as plunging, spilling, or surging. (Figure x). Spilling breaker - Crest cascades down front of wave, Plunging breaker - Crest curls forward & plunges down, Surging breaker - Base of wave surges forward

## 6. Water and beach safety

The number of **LONGSHORE BARS** is estimated by counting the number of breaker lines. If the tide is out you may also be able to detect longshore bars that may become active at high tide by looking for shallow zones oriented parallel to the beach.

**RIP CURRENTS** are best observed from a high point in the area of the beach profiles (e.g., dune crest or a cliff top). You will need to determine/count:

1. The number of rip currents along the beach.
2. The approximate spacing between the rips.
3. Whether the rips run at right angles to the beach, or at some other angle.
4. The type of rip currents (multiple, shore normal, feeder, swash). There may be more than one type.



The **SURFZONE WIDTH** is best estimated from a high vantage point. It is the distance from the waters edge out to where the waves first break. Record your estimate in metres.

Swash or surge up the beach (**SNEAKER WAVES**) is estimated as the distance the water surges up the beach (this can be 10's of metres). This happens during big surf and the big ones occur several minutes apart. Watch the water draw back and then surge up the beach. Estimate the distance between the suck back position and the highest point it reaches on the beach. Make your measurements

1. Watch the waves as they enter the surf zone and move through it to reach the beach. Estimate how far they travel up the beach in addition to the normal wave run up.

**ALONGSHORE CURRENT** is measured at the water edge by throwing a float in the water and determining its speed of travel. To do this you need to:

1. Find a float, something that you can throw offshore at least 30m. An orange, a piece of wood off the beach (make sure your dog doesn't get it) or a brightly coloured small rubber ball is adequate.
2. Go to the water line and throw the float into the surf zone. Note approximately how far offshore from the waters edge you threw the float.
3. Walk back up the beach a couple of metres keeping an eye on the float. Place a marker flag on the beach to indicate the position of the float and start the stopwatch.
4. Walk along the beach following the float as it moves along the shore. Do not take your eyes off the float. When 100 seconds have passed stop and position another marker flag on the beach.
5. Measure the horizontal distance in meters between the two marker flag. This gives the distance that the float has moved along the beach.
6. Divide the horizontal distance by 100 to get the average alongshore current speed.
7. Record the speed and direction (N,E,S,W) the float moved.

If there are **VEHICLES ON THE BEACH** then give a brief description of type (e.g., quad bikes, 4WD, motor bikes, carts), location and number of vehicles.



If there are **HORSES ON THE BEACH** then give a brief description of location and number.

## 7. Evidence of erosion and accretion

The **WIDTH OF THE HIGH TIDE BEACH** is determined by measuring the horizontal distance between the dune toe and the high water line.

### Evidence of erosion

1. Note any indicators of erosion.
  - Scarping of the dunes and dune vegetation falling over the dune front.
  - Rocks exposed which were previously covered.
  - Buildings or structures look threatened.
  - Fences along beach falling down.
  - Seawalls or engineered structures present.
  - Heavy mineral (black sand) concentrations on the beach.
2. Take photos.



### Degree of scarping

1. Standing on the beach, look back towards the foredune.
2. Is there any evidence of wave erosion of the sand dunes (scarping)?
3. If so determine how much of the beach in the near vicinity to you profile has been affected?
4. Note if the scarping looks old or recent



### **Degree of vegetation cover**

1. Standing on your profile transect, place one marker between the profile marker and the dune crest and one marker between the dune crest and the edge of the vegetation.
2. Run two 3m transects at right angles on either side of the two points.
3. At the end of these transects, focusing on an area on 1m square, assess how extensive the vegetation cover is.
4. Using the degree cover scale provided estimate the degree of vegetation cover in that area.
5. Note the dominant species in that area (refer to supplementary information provided on dune plant species)

### **Evidence of active sand build up**

1. Note if there are any key indicators of active sand accumulation (accretion).
  - soft sand
  - incipient foredune accumulating at toe of eroded dune face
  - fences buried
  - plants buried
2. Take photos.





The **COLOUR OF THE SAND** provides information on changing sediment supply, origin, deposition environment and the erosive state of the beach. Sand colour is determined by its composition (proportion of different minerals and shell). The colour of the sand is a good indicator because on a black sand beach such as Raglan the sand becomes noticeably darker after a storm event. This is because the dark minerals in the sand are heavy and thus remains on the beach during a storm event, while the lightly coloured minerals are generally lighter in weight and get carried offshore.

1. **Pick a location on your profile line**, between the high water mark and the water's edge.
2. **Evaluate the colour intensity of the sand at this point by comparing the colour of the sand to the greyscale attached.**
3. **Lay down the greyscale on the sand. Hold your camera approximately 20cm from the ground and take a picture** making sure you include the greyscale and the sand in the frame.
4. Make sure your camera is set on the auto function, is zoomed right out or right in, and that the flash is turned off.

## 8. Human impacts

### Vehicle damage

1. Note if there is any evidence of vehicle damage.



### Controlled and uncontrolled beach access points

1. Note the number of controlled and uncontrolled access points to the beach.



### Beach user numbers

1. Estimate the number of people on the beach at any one time while you are there, and make a note of the activities in which they are engaged.

### Litter count

1. **Collect the litter in the near vicinity to your profile**, ignoring biodegradable litter such as food remains and dead animals.
2. **Record the number of each type of litter** listed on the field sheet.
3. **Note and patterns to the distribution** of the litter you may observe.

### **Storm water discharge**

1. Are there any outfalls from storm drains located on the beach? Take photographs of them and make a note of erosion or other problems related to them.



## **9. Photos**

Make sure when taking pictures that your camera is set on the auto setting, is zoomed right out or right in, and that the flash is turned off. After some trials you may determine your own camera settings, however, it is vital that your camera is set on the same setting (including focus) each time you take monitoring photos.

1. Standing at the 50m marker on your high water line transect, take a photo along the beach looking back toward the profile. Be sure to include some of the surf zone in the photo and the vegetation line if you can.
2. From this point move up onto the dune crest, take a photo looking back towards the profile.
3. Take the same two photos from the other side of the profile.
4. Take the last photo looking up the profile transect from the waterline.
5. Also take photos of any interesting features on the beach.

Note on a sketch the photographs you take, and if necessary, explanatory notes of why you took the photograph.

## **10. End of the day procedures**

When you have completed the field work and are back at home carry out the following procedures:

- Wash or wipe down your equipment to prevent corrosion.
- Check the paper copy forms are legible and then file them away carefully.
- Log the data into the computer.
- Diary the date for the next survey.
- Download GPS and camera
- Archive to online database or excel spreadsheet

## C2 - Terms and Definitions Glossary

### Terms and Definitions

Accretion	The accumulation or build-up of sand or other beach material due to the action of waves, currents and wind.
Aeolian	The processes or landforms formed by action of the wind.
Backshore	The zone of beach lying landward of the high-tide line.
Bathymetry	The shape or topography of the seabed.
Beach	The seaward dipping portion of the beach over which the wave swash and backwash operate. Two ingredients are necessary for beaches to form: waves and sediment.
Beach cusp	One of a series of short ridges on the foreshore separated by crescent-shaped troughs spaced at more or less regular intervals. The cusps are spaced at somewhat uniform distances along beaches. Cusps are typical of coarse grained reflective and intermediate state beaches. They typically form after and not during storm events.
Beach profile	Shore normal topographic survey of the dune-beach profile.
Berm	The nearly horizontal portion of the beach, deposited by wave action, lying immediately landward of the beach face. The rear of the berm marks the limit of spring high tide wave action.
Berm crest	The seaward limit of the berm beyond which is the steep berm face.
Black sand	Heavy-mineral concentrations that form by the winnowing away (by wind or water) of the lighter sand grains, leaving darker (mafic) minerals. The black colour often comes from magnetite ilmenite and garnet. Commonly mistaken for oil pollution.
Coastline	The line that is the boundary between the sea and the land. It is usually mapped as the high water line.
Cobbles	Beach material of rounded rocks ranging in diameter from approximately 64 mm to 256 mm.
Cross-shore profile	side view of a beach extending from the top of the dune line down into the sea
Current ripples	Ripple marks that are short-crested and formed by water current flow such as in a trough (runnel) on the beach.

Cusp	A regular undulation in the high tide swash zone (upper beach face), usually occurring in series with spacing of 10 to 40m.
Drag mark	A line or pattern on the surface of the beach, produced when the wind or the swash drags an object over the surface. Drag marks are produced by shell fragments, clumps of seaweed, and other wrack.
Drift line	Stranded natural and artificial debris (e.g. seaweed, <i>Spartina</i> straw, fishing nets, lumber, driftwood, plastics bottles) indicating the previous landward extent of the high-tide line and/or wave swash.
Dune	A land feature formed from an accumulation of windblown sand, either bare or covered with vegetation.
Ebb tide	The tidal current formed when the tide is "going out".
Ebb tidal delta	The body of sand that protrudes seaward of an inlet formed by ebb tidal currents.
Erosion	The net loss of sand from a beach that leads to the retreat of the shoreline.
Exposed coast	A coast that faces the open sea and is subject to ocean swell.
Fetch	The distance of open water over which the wind can blow to generate waves.
Flood current	The tidal current formed as the tide is rising.
Flood tidal delta	The body of sand, landward of an inlet, formed by flood-tidal currents.
Foam	The bubbly froth on the surface of the sea formed by waves mixing fine organic and mud debris with air.
Foam stripes	Parallel tracks of small furrows and rims formed where a patch of foam moved across the beach.
Foredune	The first sand dune behind the beach. In the NE North Island it is usually vegetated by spinifex grass and Pingao.
Foreshore	The seaward dipping zone on a beach between high- and low-tide levels.
Gravel	Loose, rounded fragments of rock larger than sand (>2 mm diameter), comprising cobbles pebbles and boulders

Groin	An engineering structure installed perpendicular to the beach in an effort to trap sand travelling with the longshore current. Shorter than jetties, groins are almost always placed in groups (or fields). Groins cause sand accretion on the updrift side, but erosion on the downdrift side.
Headland	A land mass having a considerable elevation along the shoreline that breaks up the beaches into smaller units.
Heavy minerals	The mineral fraction of beaches consisting of grains that are heavier than quartz and feldspar (the light minerals).
High water line	The highest reach of the water at high tide. It is sometimes marked by a line of debris.
Inner bar	The landward of two or more sandbars found off a beach.
Intertidal zone	The wet portion of the beach exposed at low tide. The zone between the low and the high tides.
Longshore current	The current flowing parallel to a beach that is created by waves striking the coast at an angle.
Mean high water (MHW)	The average elevation of all high waters recorded at a particular point Mean high water springs (MHWS) is the average height of the high water occurring at the time of spring tides.
Mean low water (MLW)	The average elevation of all low waters recorded at a particular point or station over a considerable period of time, usually 19 years. Mean low water springs (MLWS) are the average height of the low waters occurring at the time of the spring tides.
Mud	A deposit composed of small fragments of rock which have been worn or broken down from a mass by the action of water or waves with particle sizes smaller than 0.063 mm. Mud includes silt (0.063 mm to 0.004 mm) and clay (<0.063 mm) particle sizes.
Neap tide	The minimum tidal range at a beach (least difference between high and low tides), occurring during the first or third quarters of the moon.
Offshore bar	A bar of sand under the water off the beach, usually identifiable by breaking waves.
Offshore breakwater	An engineered structure placed offshore and parallel to the beach. Breakwaters mimic sandbars to cause waves to break, lessening erosion on the beach behind the breakwater but interrupting the longshore drift.

Outer bar	The outermost of two or more sandbars on a beach. The biggest waves break on this seaward-most bar.
Overwash	Beach sand that has been transported inland beyond the beach by storm waves.
Plunging breaker	A wave that breaks on a moderate beach slope (usually 3-11°). The breaker curls over, forming a barrel or tube of air as it collapses. The most forceful type of breaker in terms of generating sand movement on the seafloor.
Prograding	A shoreline of unconsolidated material that is building seaward (or accreting)
Ridge and runnel	The "ridge" of a ridge and runnel system is a sandbar. The "runnel" is the trough-like area between the ridge and the beach.
Rip channel	An elongate area of relatively deep water (1 to 3 m), running seaward, either directly or at an angle, and occupied by a rip current.
Rip current	A fast-moving flow of water from the beach seaward through the surf zone. It consists of three parts: the <i>rip feeder current</i> flowing inside the breakers, usually close to shore; the <i>rip neck</i> , where the feeder currents converge and flow seaward through the breakers in a narrow 'rip'; and the <i>rip head</i> , where the current widens and slows as a series of vortices seaward of the breakers.
Rip embayment	A longshore undulation in the shoreline and swash zone, with regular spacing between 100 and 500 m, which match the adjacent rips and bars. Produced by wave scouring in lee of rips (megacusp or rip embayment) and shoreline accretion in lee of bars (megacusp horn).
Rip feeder current	A current flowing along and close to shore, which converges with a feeder current arriving from the other direction, to form the basis of a rip current. The two currents converge in the rip (megacusp) embayment, then pulse seaward as a rip current.
Ripple marks	Small-scale ridges and depressions in the sand, typically in a repetitive pattern. Different patterns are created by different air, water, and wave conditions.
Sand	Grains of material (minerals such as quartz, feldspar or magnetite, or bits of shells) that range in size from 1/16 to 2 millimeters in diameter.
Sandbar	An area of relatively shallow sand upon which waves break. It may be attached to or detached from the beach, and may be

	parallel (longshore bar) or perpendicular (transverse bar) to the beach.
Scarp	A small sand cliff on the beach indicating rapid erosion.
Sea	The choppy, irregular (confused) water surface formed when waves are locally generated.
Sea level	The average elevation of the water surface of the sea.
Seawall	An engineered wall on the upper beach, installed parallel to the beach in an effort to prevent retreat of the shoreline and erosion of property.
Set-up	Rise in the water level at the beach face resulting from low frequency accumulations of water in the inner surf zone. Seaward return flow results in a <i>set-down</i> . Frequency ranges from 30 to 200 seconds.
Significant wave height	Average height of the highest one-third of the waves for a stated interval of time.
Significant wave period	Average period of the highest one-third of the waves for a stated interval of time.
Spilling breaker	A wave that breaks on a relatively flat beach slope (typically 3° or less). The wave crest literally spills over the top of the wave but does not curl like a plunging breaker.
Spit	An accretionary feature, comprising a long narrow accumulation of sand or shingle, lying generally in line with the coast, with one end attached to the land the other projecting into the sea or across the mouth of an estuary. Spits are prone to overtopping and erosion by the sea. And are hazardous sites on which to build.
Spring tide	A tide that occurs at or near the time of new or full moon, and which rises highest and falls lowest from the mean sea level (MSL).
Storm surge	The rise in water level due to the low atmospheric pressure at the center of a storm, water mounding due to circulation around the low-pressure center, and the effect of water being pushed onshore into shallower depths.
Surf zone	The band of water adjacent to the beach over which waves are breaking.

Surging breaker	A wave that comes ashore on a steep bottom slope (generally greater than 11°) but does not break like spilling or plunging breakers. Instead they created a surge of water and foam moving into the shore.
Swash	The broken part of a wave as it runs up the beach face or swash zone. The return flow is called backwash.
Swash mark	Line formed at the edge of swash advance when a wave breaks. As water soaks into the beach, the material being carried by the swash or floating on its edge is deposited to form the line.
Swash zone	The area of the beach over which wave swash is running up and down the beach.
Swell	Evenly spaced waves formed by winds far from the beach.
Tide	The elevation and depression of the local water level caused by the gravitational pull of the sun and moon on the ocean's waters as the earth rotates.
Topographic rip	A rip current whose flow direction is controlled by a topographic feature (rocks, reef, headland, structure) located in the surf zone. The current is usually deflected seaward by the feature. Also known as headland rips.
Transgressive dune	A dune migrating inland away from the prevailing wind that buries topography.
Transverse dune	A dune form perpendicular (i.e. transverse) to the dominant wind. Usually bare of vegetation; may reach 20-30 m in height, with a wave length of 100-2000 m.
Trough	An area of deeper water in the surf zone. May be parallel to shore or at an angle.
Tsunami	An immense wave formed as the result of an earthquake, submarine landslide, or underwater volcanic eruption.
Wave (Ocean)	A regular undulation in the ocean surface produced by wind blowing over the surface. While being formed by the wind it is called a <i>sea wave</i> ; once it leaves the area of formation or the wind stops blowing it is called a <i>swell</i> wave.
Wave amplitude	Half of the vertical distance between the wave crest and trough.
Wave bore	The turbulent, broken part of a wave that advances shoreward across the surf zone. This is the part between the wave breaking and the wave swash and also that part caught by bodysurfers. Also called <i>whitewater</i> .

Wave crest	The highest point of a wave.
Wave direction	The direction waves are coming from.
Wave frequency	The inverse of the wave period, or the fraction of a wave that passes a given point in one second.
Wave height	The vertical distance between the wave crest and wave trough.
Wave length	The distance between wave crests.
Wave period	The time it takes for a wave crest to pass a given point.
Wave refraction	The process by which waves moving in shallow water at an angle to the seabed are changed. The part of the wave crest moving in shallower water moves more slowly than other parts moving in deeper water, causing the wave crest to bend toward the shallower seabed.
Wave setup	The piling up of water along a coastline by the continually incoming waves. Water brought in by waves comes in faster than it can drain back to sea, elevating the local water level during storms.
Wave shoaling	The process by which waves moving into shallow water interact with the seabed causing the waves to refract, slow, shorten and increase in height.
Wet/dry beach line	The point on the beach where the intertidal zone (wet) part of the beach ends and the dry beach that does not get inundated at high tide starts.
Wind ripple marks	Long-crested ripple marks formed by wind and usually of lower amplitude than water-wave ripples. Typically found on the back of the beach and in the sand dunes.
Wind setup	The piling up of water along a coastline due to onshore winds. Winds blow water up against the beach, elevating the local water level, especially during storms, causing offshore flow of water along the sea floor.

# **D1 – 2007 New Zealand Science Curriculum Achievement Objectives**

## **Level 6**

### **Nature of Science**

*Students will:*

#### **Understanding about science**

- Understand that scientists' investigations are informed by current scientific theories and aim to collect evidence that will be interpreted through processes of logical argument.

#### **Investigating in science**

- Develop and carry out more complex investigations, including using models.
- Show an increasing awareness of the complexity of working scientifically, including recognition of multiple variables.
- Begin to evaluate the suitability of the investigative methods chosen.

#### **Communicating in science**

- Use a wider range of science vocabulary, symbols, and conventions.
- Apply their understandings of science to evaluate both popular and scientific texts (including visual and numerical literacy).

#### **Participating and contributing**

- Develop an understanding of socio-scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions and to take action where appropriate.

## **Living World**

*Students will:*

#### **Life processes**

- Relate key structural features and functions to the life processes of plants, animals, and micro-organisms and investigate environmental factors that affect these processes.

## **Ecology**

- Investigate the impact of natural events and human actions on a New Zealand ecosystem.

## **Evolution**

- Explore patterns in the inheritance of genetically controlled characteristics.
- Explain the importance of variation within a changing environment.

# **Planet Earth and Beyond**

*Students will:*

## **Earth systems**

- Investigate the external and internal processes that shape and change the surface features of New Zealand.

## **Interacting systems**

- Develop an understanding of how the geosphere, hydrosphere, atmosphere, and biosphere interact to cycle carbon around Earth.

## **Astronomical systems**

- Investigate the interactions between the solar, lunar, and Earth cycles and the effect of these on Earth.

# **Physical World**

*Students will:*

## **Physical inquiry and physics concepts**

- Investigate trends and relationships in physical phenomena (in the areas of mechanics, electricity, electromagnetism, heat, light and waves, and atomic and nuclear physics).
- Demonstrate an understanding of physical phenomena and concepts by explaining and solving questions and problems that relate to straightforward situations.

## **Using physics**

- Investigate how physics knowledge is used in a technological or biological application.

## **Material World**

*Students will:*

### **Properties and changes of matter**

- Identify patterns and trends in the properties of a range of groups of substances, for example, acids and bases, metals, metal compounds, and hydrocarbons.
- Explore factors that affect chemical processes.

### **The structure of matter**

- Distinguish between atoms, molecules, and ions (includes covalent and ionic bonding).
- Link atomic structure to the organisation of the periodic table.
- Use particle theory to explain factors that affect chemical processes.

### **Chemistry and society**

- Investigate how chemical knowledge is used in a technological application of chemistry.

## **Level 7**

### **Nature of science**

*Students will:*

#### **Understanding about science**

- Understand that scientists have an obligation to connect their new ideas to current and historical scientific knowledge and to present their findings for peer review and debate.

#### **Investigating in science**

- Develop and carry out investigations that extend their science knowledge, including developing their understanding of the relationship between investigations and scientific theories and models.

## **Communicating in science**

- Use accepted science knowledge, vocabulary, symbols, and conventions when evaluating accounts of the natural world and consider the wider implications of the methods of communication and/or representation employed.

## **Participating and contributing**

- Use relevant information to develop a coherent understanding of socio-scientific issues that concern them, to identify possible responses at both personal and societal levels.

## **Living world**

*Students will:*

### **Life processes**

- Explore the diverse ways in which animals and plants carry out the life processes.

### **Ecology**

- Explore ecological distribution patterns and explain possible causes for these patterns.

### **Evolution**

- Understand that DNA and the environment interact in gene expression.

### **Ecology and evolution**

- Explain how the interaction between ecological factors and natural selection leads to genetic changes within populations.

## **Planet Earth and Beyond**

*Students will:*

### **Earth systems and interacting systems**

- Develop an understanding of the causes of natural hazards and their interactions with human activity on Earth.

## **Astronomical systems**

- Explain the nature and life cycles of different types of stars in terms of energy changes and time.

## **Physical World**

*Students will:*

### **Physical inquiry and physics concepts**

- Investigate physical phenomena (in the areas of mechanics, electricity, electromagnetism, light and waves, and atomic and nuclear physics) and produce qualitative and quantitative explanations for a variety of unfamiliar situations.
- Analyse data to deduce complex trends and relationships in physical phenomena.

### **Using physics**

- Use physics ideas to explain a technological or biological application of physics.

## **Material World**

*Students will:*

### **Properties and changes of matter**

- Investigate and measure the chemical and physical properties of a range of groups of substances, for example, acids and bases, oxidants and reductants, and selected organic and inorganic compounds.

### **The structure of matter**

- Relate properties of matter to structure and bonding.
- Develop an understanding of and use the fundamental concepts of chemistry (for example, equilibrium and thermochemical principles) to interpret observations.

### **Chemistry and society**

- Apply knowledge of chemistry to explain aspects of the natural world and how chemistry is used in society to meet needs, resolve issues, and develop new technologies.

## **Level 8**

### **Nature of Science**

*Students will:*

#### **Understanding about science**

- Understand that scientists have an obligation to connect their new ideas to current and historical scientific knowledge and to present their findings for peer review and debate.

#### **Investigating in science**

- Develop and carry out investigations that extend their science knowledge, including developing their understanding of the relationship between investigations and scientific theories and models.

#### **Communicating in science**

- Use accepted science knowledge, vocabulary, symbols, and conventions when evaluating accounts of the natural world and consider the wider implications of the methods of communication and/or representation employed.

#### **Participating and contributing**

- Use relevant information to develop a coherent understanding of socio-scientific issues that concern them, to identify possible responses at both personal and societal levels.

## **Living World**

*Students will:*

#### **Life processes, ecology, and evolution**

- Understand the relationship between organisms and their environment.
- Explore the evolutionary processes that have resulted in the diversity of life on Earth and appreciate the place and impact of humans within these processes.
- Understand how humans manipulate the transfer of genetic information from one generation to the next and make informed judgments about the social, ethical, and biological implications relating to this manipulation.

## **Planet Earth and Beyond**

*Students will:*

### **Earth systems and interacting systems**

- Develop an in-depth understanding of the interrelationship between human activities and the geosphere, hydrosphere, atmosphere, and biosphere over time.

### **Astronomical systems**

- Explore recent astronomical events or discoveries, showing understanding of the concepts of distance and time.

## **Physical World**

*Students will:*

### **Physical inquiry and physics concepts**

- Investigate physical phenomena (in the areas of mechanics, electricity, electromagnetism, light and waves, and atomic and nuclear physics) and produce qualitative and quantitative explanations for a variety of complex situations.
- Analyse and evaluate data to deduce complex trends and relationships in physical phenomena.

### **Using physics**

- Use physics ideas to explain a technological, biological, or astronomical application of physics and discuss related issues.

## **Material World**

*Students will:*

### **Properties and changes of matter**

- Investigate and measure the chemical and physical properties of a range of groups of substances, for example, acids and bases, oxidants and reductants, and selected organic and inorganic compounds.

### **The structure of matter**

- Relate properties of matter to structure and bonding.

- Develop an understanding of and use the fundamental concepts of chemistry (for example, equilibrium and thermochemical principles) to interpret observations.

### **Chemistry and society**

- Apply knowledge of chemistry to explain aspects of the natural world and how chemistry is used in society to meet needs, resolve issues, and develop new technologies.

## D2 - National Achievement Standard Matrices

### Science Matrix

	Investigation	Research	Living World	Material World	Planet Earth & Beyond		Physical World
<b>Level 1</b>	AS90186 <b>1.1</b> Carry out a practical science investigation with direction  4 credits Internal	AS90187 <b>1.2</b> Process information to describe a use of science knowledge with direction  2 credits Internal	AS90188 <b>1.3*</b> Describe aspects of biology.  5 credits External	AS90189 <b>1.4</b> Describe aspects of chemistry.  5 credits External	AS90190 <b>1.5</b> Describe aspects of geology.  3 credits External	AS90192 <b>1.7</b> Describe aspects of astronomy.  2 credits External	AS90191 <b>1.6</b> Describe aspects of physics.  5 credits External
<b>Level 2</b>	AS90312 <b>2.1</b> Carry out a practical scientific investigation with supervision  4 credits Internal	AS90771 <b>2.2</b> Research information to present a scientific report  3 credits Internal	AS90772 <b>2.3</b> Describe the factors and processes involved in the evolution of New Zealand's plants and animals  4 credits External	AS90766 <b>2.8</b> Describe the chemical properties and effects of fertilisers  4 credits External	AS90767 <b>2.5</b> Describe New Zealand's geological history  3 credits External	AS90764 <b>2.7</b> Describe the nature and life cycle of stars  2 credits External	AS90768 <b>2.9</b> Use physics concepts and principles to describe the behaviour of light  4 credits External
<b>Level 3</b>	AS90727 <b>3.1</b> Carry out a practical scientific investigation with guidance  4 credits Internal	AS90728 <b>3.2</b> Research a current scientific controversy  4 credits Internal	AS90729 <b>3.3</b> Describe genetic processes  4 credits External	AS90730 <b>3.4</b> Describe selected organic compounds and their uses  4 credits External	AS90731 <b>3.5</b> Describe geological processes affecting New Zealand  2 credits External	AS90733 <b>3.7</b> Report on a recent astronomical event or discovery  2 credits Internal	AS90732 <b>3.6</b> Describe selected properties and applications of EMR, radioactive decay, sound and ultrasound  4 credits External

\*A student cannot be credited with this standard **and either** of Biology 1.3 or Biology 1.8, because of significant overlap of assessed outcomes.

## Physics Matrix

<b>Level 1</b>	<p>AS90180 <b>1.1</b> Carry out a practical physics investigation with direction</p> <p>4 credits Internal</p>	<p>AS90181 <b>1.2</b> Process information to describe a use of physics knowledge with direction</p> <p>2 credits Internal</p>	<p>AS90182 <b>1.3</b> Demonstrate understanding of wave and light behaviour</p> <p>5 credits External</p>	<p>AS90183 <b>1.4</b> Demonstrate understanding of mechanics in one dimension</p> <p>5 credits External</p>	<p>AS90184 <b>1.5</b> Demonstrate understanding of heat transfer and nuclear physics</p> <p>3 credits External</p>	<p>AS90185 <b>1.6</b> Demonstrate understanding of electricity and magnetism</p> <p>5 credits External</p>	
<b>Level 2</b>	<p>AS90252 <b>2.1</b> Take measurements of physical quantities and analyse data graphically to determine a relationship</p> <p>4 credits Internal</p>		<p>AS90254 <b>2.3</b> Demonstrate understanding of waves</p> <p>4 credits External</p>	<p>AS90255 <b>2.4</b> Demonstrate understanding of mechanics</p> <p>6 credits External</p>	<p>AS90256 <b>2.5</b> Demonstrate understanding of atoms and radioactivity</p> <p>2 credits External</p>	<p>AS90257 <b>2.6</b> Demonstrate understanding of electricity and electromagnetism</p> <p>5 credits External</p>	<p>AS90258 <b>2.7</b> Demonstrate understanding of physics in an integrated context</p> <p>3 credits Internal</p>
<b>Level 3</b>	<p>AS90774 <b>3.1</b> Carry out a practical physics investigation with guidance, that leads to a mathematical relationship</p> <p>5 credits Internal</p>		<p>AS90520 <b>3.3</b> Demonstrate understanding of wave systems</p> <p>4 credits External</p>	<p>AS90521 <b>3.4</b> Demonstrate understanding of mechanical systems</p> <p>6 credits External</p>	<p>AS90522 <b>3.5</b> Demonstrate understanding of atoms, photons and nuclei</p> <p>3 credits External</p>	<p>AS90523 <b>3.6</b> Demonstrate understanding of electrical systems</p> <p>6 credits External</p>	

## D3 - Mapping CREST onto NZQA Achievement Standards For Science

<b>Mapping CREST onto the NZQA Achievement Standards in Science</b>		
<b>NZQA Science Achievement Standards</b>	<b>CREST Science Award</b>	<b>Comment</b>
<p><b>90186</b> <b>(Science 1.1)</b> Carry out practical science investigation with direction</p>	<p>Bronze Team Award</p>	<p>This is where for 90186 students would complete an individual plan and process and report individually on a group investigation.</p> <p>Students may also develop a group plan and group report using their individual work for this award.</p> <p>The Bronze Team Award can be completed in Year 10 as extension work.</p>
	<p>Bronze Individual Award</p>	<p>This is where for 90186 students would complete the whole process as an individual.</p> <p>The teacher provides the general instruction for the investigation in writing (Refer to EN 3).</p>
<p><b>90312</b> <b>(Science 2.1)</b> Carry out a practical science investigation with supervision</p>	<p>Bronze Individual Award</p>	<p>This is where for 90312 students would complete the whole process as an individual.</p> <p>The teacher provides the context, the question and the broad experiment conditions (Refer to EN 3).</p>
	<p>Silver Individual Award</p>	<p>The students would provide the context, the question and the broad experimental conditions. Consultants need to be used.</p> <p>Consultants would be seen as reference people and discussions referred to in their logbook and reference system.</p>
<p><b>90727</b> <b>(Science 3.1)</b> Carry out a practical science investigation with guidance</p>	<p>Silver Individual Award</p>	<p>This is where for 90727 students would provide the context, the question and the broad experiment conditions. The teacher provides support only (Refer EN 3).</p> <p>Consultants need to be used and would be seen as reference people and discussions referred to in their logbook and reference system.</p>
	<p>Gold Individual Award</p>	<p>This is where for 90727 students would complete the whole process as an individual. The teacher's role is logistic support only, the whole process is student driven.</p> <p>Consultants would be seen as reference people and discussions referred to in their logbook and reference system.</p>

# **D4 - Texas High School Coastal Monitoring Curriculum Outline**

## **CURRICULUM OUTLINE**

### Unit I - Introduction to the Coastal Monitoring Program

- Lesson A - Introduction to features along a beach profile
- Lesson B - Introduction to the Global Positioning System (GPS for Dummies)
- Lesson C - Field techniques
- Lesson D - Skills needed for data organization and manipulation (graphs, spread sheets, and the Internet)
- Lesson E - Beach profile analysis
- Lesson F - Sand analysis

### Unit II - Physics on the beach

- Lesson A - Introduction to waves
- Lesson B - Waves and forces
- Lesson C - Understanding the littoral current (hands-on experience with graphs)
- Lesson D - Understanding rip currents (practical application of math and physics)
- Lesson E - Introduction to tides

### Unit III - Earth Science

- Lesson A - Plate tectonics and the Gulf Coast
- Lesson B - Climate, sea level rise and barrier islands.
- Lesson C - Particle transport (math and physics are everywhere!)
- Lesson D - Sediment composition along the Gulf coast (an introduction to minerals and weathering)

### Unit IV - Biology

- Lesson A - Sea weed - what is it?
- Lesson B - Shoreline vegetation

### Unit V - Science and society

- Lesson A - Coastal engineering
- Lesson B - Using the internet as a tool for research