AHI-KĀ-ROA

IDENTIFYING THE RESILIENCE OF IWI TO NATURAL HAZARDS

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ABSTRACT

Māori indicators of resilience derive from strong cultural foundations based on key Māori concepts. The resilience of Ngāti Rangi, a central North Island iwi, originates from their continued residence under the shelter of their volcanic ancestor, Mt. . Ruapehu, for over 1,000 years; ahi-kā-roa. The research considered the relationship between marae placement and volcanic processes, particularly volcanic flows, and prioritised Ngāti Rangi marae for civil defence use during an emergency. Several discussions were held with members of Ngāti Rangi to understand what key cultural factors make up their resilience. Emerging findings were that (1) a correlation exists between key Māori concepts and the resilience of Ngāti Rangi which strongly formed their baseline indicators; (2) ahi-kā-roa, physically supported by population and active marae, is a measurable construct for resilience. The findings also blended together mātauranga Māori and natural hazards research, which is lacking in current emergency management approaches.

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Ko Tapeka te marae

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Ko Ngāti Turumakina te hapū

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Chapter 1: INTRODUCTION

1.1 General introduction

The incorporation of the human facet of emergency management, more specifically with volcanic hazard management, within New Zealand is becoming increasingly recognised. The rise of resilience-based research in conjunction with natural hazard research can provide a bridge to the human facet of this discipline.

The exploration of resilience specific to Māori and particularly iwi (tribes) is slowly gaining traction, but the research has yet to define the factors that contribute to resilience of Māori. Mātauranga Māori, traditional knowledge held by iwi Māori, can present a set of experiences through generations of interactions and exposure to volcanic activity that can contribute positively to current emergency management strategies.

This research examines and identifies indicators that contribute to the resilience to volcanic events for one iwi, Ngāti Rangi. Ngāti Rangi reside on the southern reaches of Mt. Ruapehu and hold ahi-kā-roa (long-term occupation) in the Central Volcanic Plateau of the North Island, New Zealand. They also have an ancestral connection to the maunga (mountains) of that area, specifically Mt. Ruapehu. Their indicators provide an initial framework or baseline for measuring iwi resilience to natural hazards broadly, and volcanic hazards specifically.

1.2 Research Objectives and Aim

The focus of this research is based on identifying the resilience of iwi to natural hazards. The main objective was to identify the cultural attributes that contribute to the resilience of Ngāti Rangi, an iwi that resides on the southern side of Mt. Ruapehu. The main research objective is to provide a framework to

adequately measure the resilience of Ngāti Rangi to volcanic hazards. This framework may also be useful to other iwi who are exposed to such hazards.

The specific objectives of this research were to:

Objective 1: Provide an understanding of resilience and its weighting within emergency management and unravel what resilience means to Māori and more specifically Ngāti Rangi. Identify key indicators that represent Ngāti Rangi and their resilience to volcanic processes based on their mātauranga Māori and collection of experiences derived from their residence at the foot of Mt. Ruapehu.

Objective 2: Examine the volcanic climate of the Central North Island and its resulting impacts on the local communities that reside in the area whilst gaining perspective on the Ngāti Rangi relationship and perspective of Ruapehu and his volcanic activity.

Objective 3: Define the risks posed to Ngāti Rangi marae[1] from natural hazards within the area to further articulate which marae are suited as Civil Defence Shelters.

Objective 4: Examine key models that measure resilience and develop a framework to assess iwi resilience to natural hazards.

1.3 Thesis Outline

This thesis is outlined as follows:

Chapter One: This Chapter is fundamentally introductory. It seeks to provide descriptions on the location of this research, focusing largely on the geomorphological formation of the Central Plateau, in particular Mt. Ruapehu.

[1] In this thesis, the term 'marae' is used to denote not only the 'marae ātea' or the courtyard in front of the 'wharenui' or meeting house, but the whole complex of buildings that exist within the grounds.

Subsequently it denotes the generic hazards presented and experienced by the region and how local authorities and advisory groups approach hazard management.

Chapter Two: This Chapter is dedicated to a literature review, which focuses heavily on content connected to resilience-based research; its development and evolution. It touches briefly on models that aim to measure resilience and then strives to introduce indigenous communities that co-exist with natural hazards. The Chapter finishes with a New Zealand focus, firstly describing the historical interaction between Māori and natural hazards and finally the guiding emergency management legislation.

Chapter Three: This section predominantly seeks to understand Ngāti Rangi, their relationship to Mt. Ruapehu and the founding perspectives that drive their interaction with volcanic processes. Key generic Māori concepts that underpin the approach of Māori to natural hazard management have been explored. These concepts substantiate the importance of incorporating local and historically derived iwi knowledge into natural hazard management.

Chapter Four: 'Ko Ruapehu te Maunga' comprises the volcanic specific data eminating from Ruapehu. Its focus is on the primary volcanic processes that have the potential to impact on the local and national communities. It aims to articulate the likelihood of these separate volcanic events with historical insights into frequency and impacts.

Chapter Five: Chapter Five contains the methodology used to obtain the data for this study.

Chapter Six: The results Chapter focuses on two main elements: perspectives, history and experiences of key Ngāti Rangi participants as a result of discussions and interviews, and a risk analysis of individual Ngāti Rangi marae.

Chapter Seven: The seventh Chapter of this thesis contains a discussion. Its key focus is the resilience of iwi and its links to the key Māori concepts described in Chapter 2, while seeking to prioritise individual marae based on the risk analysis

results. This Chapter also discusses and outlines a proposed framework that seeks to guide other users in measuring the resilience of iwi to natural hazards.

Chapter Eight: The final Chapter provides a conclusion to this research.

1.4 Study Area

The study area for this research encompasses the Ngāti Rangi tribal lands predominantly focusing on marae and volcanic flows, or more explicitly lahars originating from Mt. Ruapehu in the Cental North Island of New Zealand. This land area equates to 2,498 km^2 and has a total population of 4,911 with 1,917 of this total identifying as Māori (Statistics New Zealand, 2013). In this area, the research has concentrated on historic and current lahar flow paths, which are confined to major catchments on the southern side of Mt. Ruapehu.

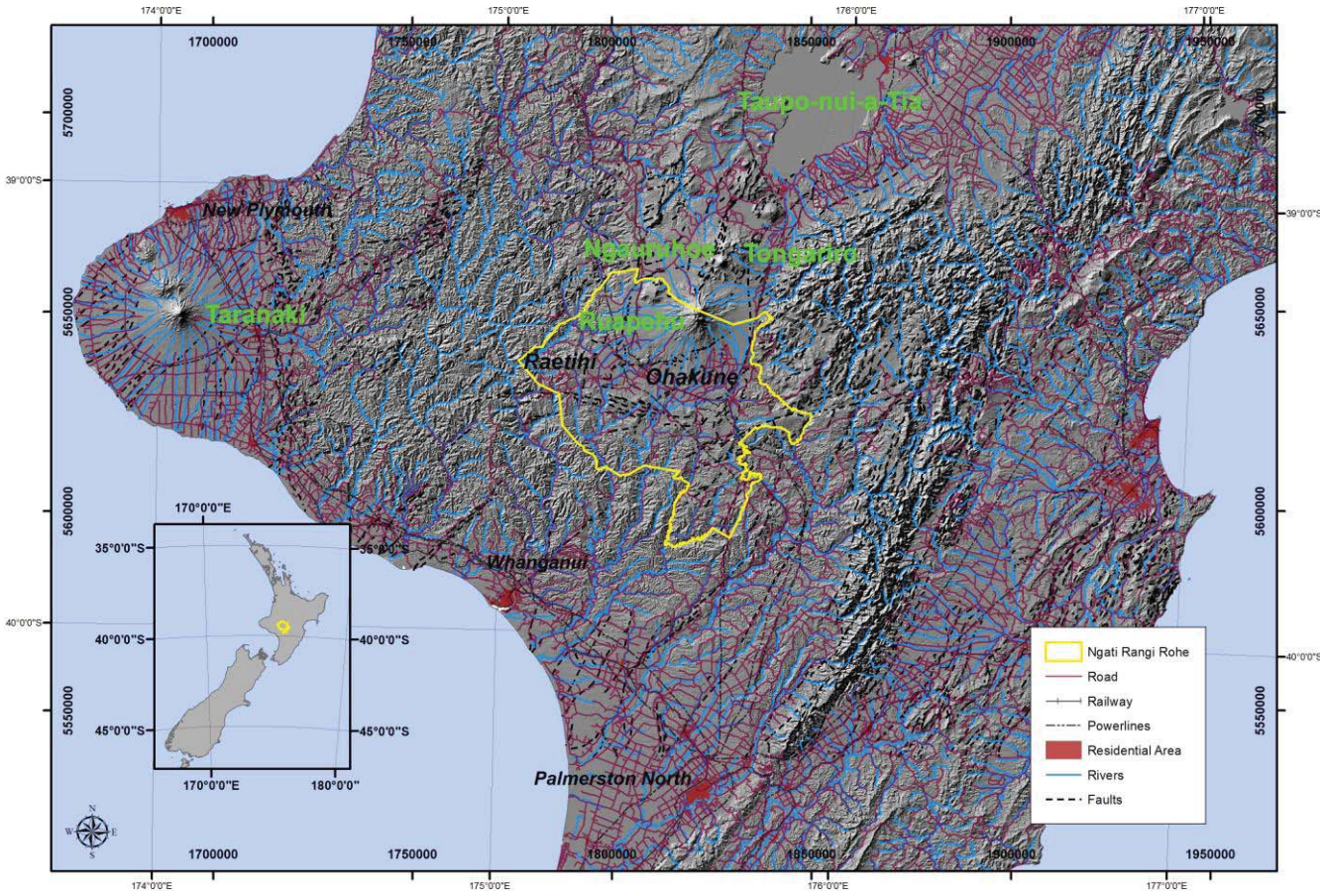


Figure 1. Ngāti Rangi Rohe: Central North Island, New Zealand

1.4.1 Taupō Volcanic Zone - Ruapehu

The converging of the Australian and Pacific tectonic plates provides the driver of volcanism within New Zealand. As a product of this convergence the Taupō Volcanic Zone is a back arc rift (Acocella et al., 2003). Central to this study is Ruapehu, situated at the southern end of the Taupō Volcanic Zone (TVZ). Ruapehu is the largest and most active volcano in the North Island standing at 2797 m high (Neall et al., 2010). The TVZ displays major geomorphological features, which provide an illustration of the formation of the landscape through historical eruptions.

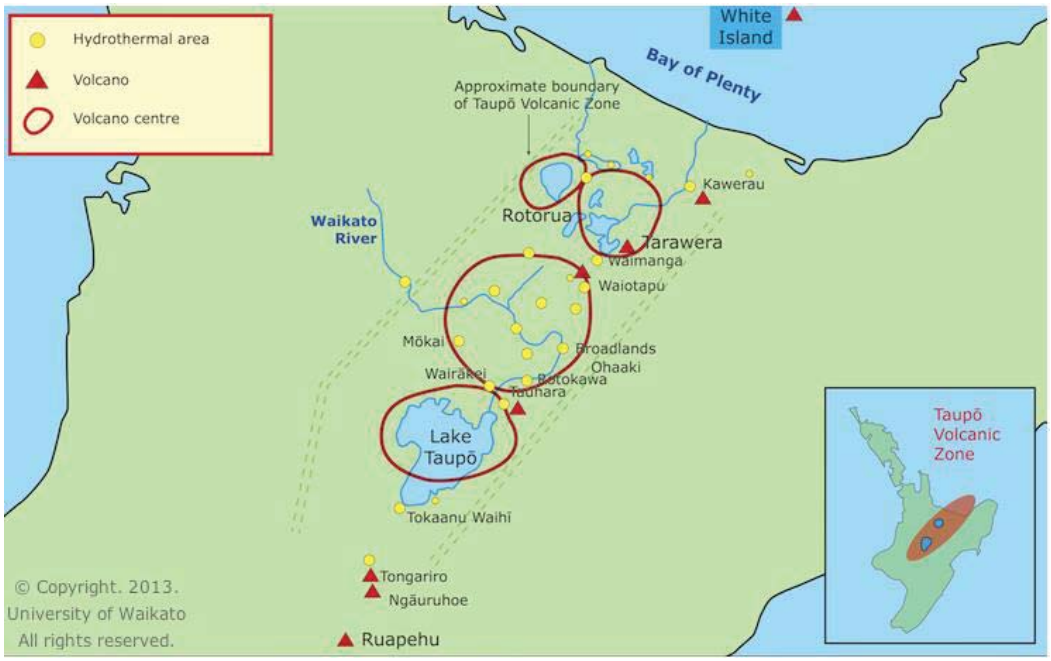


Figure 2. Taupō Volcanic Zone (TVZ): Mt. Ruapehu located at the southern end of the TVZ.

(Science Learning, 2010).

Ruapehu, along with Tongariro and Ngauruhoe, is located within the Tongariro National Park, one of New Zealand's United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage sites[2]. The Tongariro National

[2] Other New Zealand UNESCO sites are the New Zealand Sub-Antarctic Islands which consist of five island groups (The Snares, Bounty Islands, Antipodes Islands, Auckland and Campbell Island) and Te Wahipounamu – South West New Zealand (UNESCO, 2014b).

Park is recognised not only for the natural values the landscape delivers, but also for the cultural values associated with these maunga (UNESCO, 2014a). This recognition indicates the cultural importance placed on this area by local iwi and by UNESCO who govern the World Heritage List and locations worldwide and awarded this dual status in 1993 (recognition of cultural and environmental values) (Keys & Green, 2004). The Tongariro National Park is managed by the Department of Conservation, a Crown entity (Department of Conservation, 2006b). Despite the recognition of the cultural significance of the Tongariro to local iwi and hapū (sub tribes), they have little involvement in its management.

1.4.2 Hazards of the Region – Tongariro Volcanic Centre

Mt. Ruapehu is a composite andesitic stratovolcano built up over a series of smaller cones throughout a sequence of eruptions, with the oldest dated rocks listed as 230,000 years old (Houghton et al., 1996). There is evidence of a historic lava flow present in preserved andesite pebbles in the Whanganui District that are at least 300,000 years old (Neall et al., 1999). Stratovolcanoes are susceptible to collapse, thus creating debris avalanches and lahars that inundate the surrounding ring plain and outer reaches (Houghton et al., 1996).

The ring plain surrounding Ruapehu is formed principally from deposits of tephra, debris flow and hyperconcentrated flood flows (Donoghue, 1991). Glaciers have contributed to erosion of Mt. Ruapehu during the Last (Otira) Glaciation, where they were largely more extensive (Hackett, 1985) in comparison with the glaciers today.

The point of difference that makes Ruapehu unique from other volcanoes worldwide is the presence of the Crater Lake (referred to as Te Wai-ā-moe by Ngāti Rangi), which exists over the active vent. The presence of the Crater Lake during activity allows for phreatomagmatic eruptions dominated by magmatic and hydrovolcanic fragmentation (Chester, 1993). Ruapehu has undergone

several major phreatomagmatic eruptions in the last 50 years including 1969, 1971, 1975, 1995, 1996 (Cronin et al., 1996) and 2007 (Kilgour et al., 2010).

Evidence of tephra erupted from Ruapehu is preserved on the eastern side of Ruapehu, largely deposited by westerly winds (Donoghue et al., 1997). By worldwide standards, Ruapehu erupts quite frequently in comparison to other volcanoes (Houghton et al., 1996); however, the volume of eruptive material is relatively low, being usually within the parameters of $10^4 – 10^7$ m^3 (Houghton et al., 1987). The volume of ejected material contained within the plume is significantly smaller in proportion to other volcanic eruptions in the past; notably in comparison to Mt. St Helens (1980), Tarawera (1886), Mt. Pinatubo (1991), Taupō (181) and Tambora (1815). Ruapehu eruptions are significantly smaller by worldwide standards (Houghton, et al., 1996).

The current risk climate for the Ngāti Rangi iwi located in the southern reaches of the Taupō Volcanic Zone varies from earthquakes to flooding, with the main focal point of this research revolving around volcanic hazards. Volcanic activity is considered fourth on the list of localised hazards within the Manawatū-Whanganui region, which shares Mt. Ruapehu with the Waikato region:

1. Earthquake
2. Locally generated tsunami
3. Human pandemic
4. Volcanic activity at Mt Ruapehu
5. Sea level rise
6. Volcanic activity at Mt Taranaki
7. Beach erosion and flooding
8. Flooding
9. Agricultural drought
10. Cyclones

(Horizons Regional Council, 2014).

1.4.3 Central Plateau Volcanic Advisory Group

Another means to address and discuss volcanic activity was to bring together all factions of volcanic expertise, emergency managers, iwi, planners and other stakeholder representatives within the Central Plateau to create the Central Plateau Volcanic Advisory Group (CPVAG). The purpose of the CPVAG is to provide a forum for discussion, research and planning for the hazards present within the Central Plateau. It is based largely on an integrated approach to managing volcanic hazards in this area and aligns with the Civil Defence and Emergency Management 4Rs approach. The main outcome of this advisory group is to work directly with the local communities with and through members to increase community resilience to volcanic hazards within the Central Plateau (Central Plateau Volcanic Advisory Group, 2009).

The core vision of the Central Plateau Volcanic Advisory Group is: *'Communities understanding and managing their volcanic hazards'* (Central Plateau Volcanic Advisory Group, 2009, p. 6). As a means to further understand the potential risks, likelihoods of occurrence, durations, and areas threatened from future eruptions within the Central Plateau, the group developed a scenario table based on historic activity of Ruapehu.

			Small	Moderate	Large	Very Large
LIKELIHOOD			1 per year	1 in 10 years	1 in 50 years	1 in 500 years
AREA AT RISK	None	None	Summit Area Whangaehu Lahars Lake edge	Summit Area Whangaehu, Whakapapa Ski field Lahars	Summit Area Whakapapa, Turoa, Tukino Ski fields Lahars Ash fall beyond ring plain	
MAGMA VOLUMES			<0.001 km^3	<0.01 km^3	0.01 – 0.1 km^3	>0.1 km^3
LAHAR VOLUMES (% of lake volumes)			<1%	1-10%	10-30%	>30%
ASSOCIATED HAZARDS	None	Increased gas at summit area. Possible felt seismicity	Geysering in lake, increased wave action	Ballistics to 3km Lahars in 2-3 catchments Ash fall to <10km	Ballistics, ash falls to >10km, lahars in multiple catchments	Ballistics lahars in multiple catchments, Significant ash fall
TYPICAL DURATION			Hours to weeks	Days to weeks	Days – weeks – months	Months - years

Table 1. Mt. Ruapehu Eruption Scenarios indicating small through to large active scenarios.

(Central Plateau Volcanic Advisory Group, 2012, p. 5).

Table 1 presents typical scenarios regarding different eruption sizes, vulnerable areas, and lahar volumes. These data inevitably allow some comprehension of the potential risks at a local and national level.

1.4.4 Horizons Regional Council Approach

In addition to the CPVAG, the Horizons Regional Council approach towards emergency management is by creating resilient communities. This is executed through bridging established measures, such as land use management and risk reduction (Britton & Clark, 2000). The Manawatu-Wanganui Civil Defence and Emergency Management (CDEM) focuses its risk management on four key areas, social, built, economic and natural environment (Lloyd, 2009), and they too are involved are involved with the CPVAG.

1.4.5 New Zealand Volcanic Warning Systems

New Zealand has a number of warning systems in place to communicate the level of volcanic activity. The Volcanic Alert Level System is used to indicate the current level of activity with any New Zealand volcano.

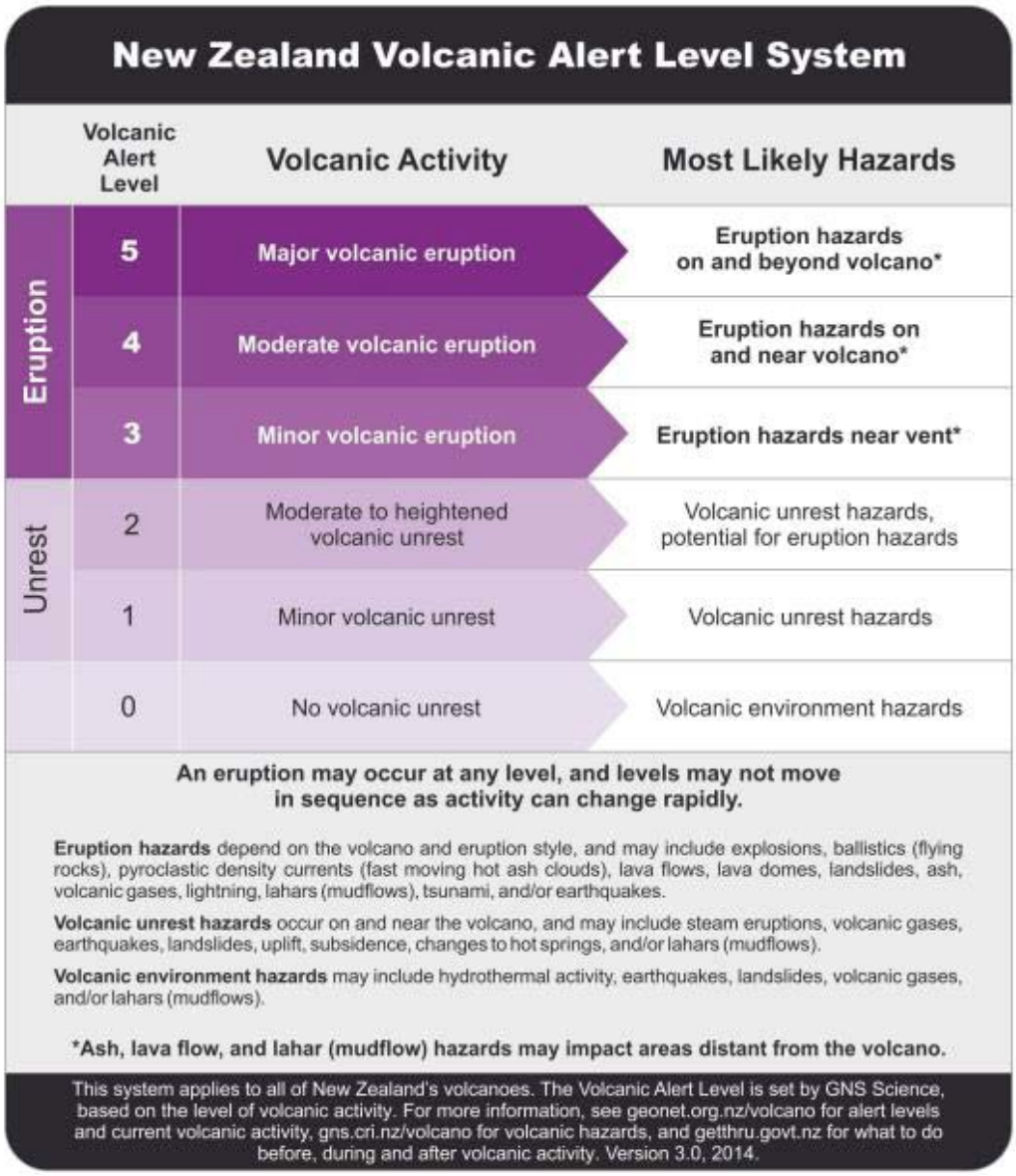


Figure 3. New Zealand Volcanic Alert Level System applicable to all New Zealand volcanoes and separating volcanic unrest (VAL 0-2) and eruption (VAL 3-5).

(GeoNet, 2013).

Another system currently in place specifically for Ruapehu and/or Tongariro lahar events is the Eastern Ruapehu Lahar Alarm & Warning System (ERLAWS)

(Becker et al., 2010; Keys & Green, 2004). This system was installed to monitor lahar activity primarily for the Crater Lake dam break of 2007, but it remains in place for future lahar events. The Whangaehu River catchment is the main channel for volcanic flows commencing at Te Wai-ā-moe (Crater Lake) and traversing through the southern reaches of the catchment and culminating at the Tasman Sea. Lahar behaviour is determined by several factors, which include the trigger mechanism, the nature of source material, event size and the hydrological conditions of the river at the time of the event (Hodgson et al., 2010).

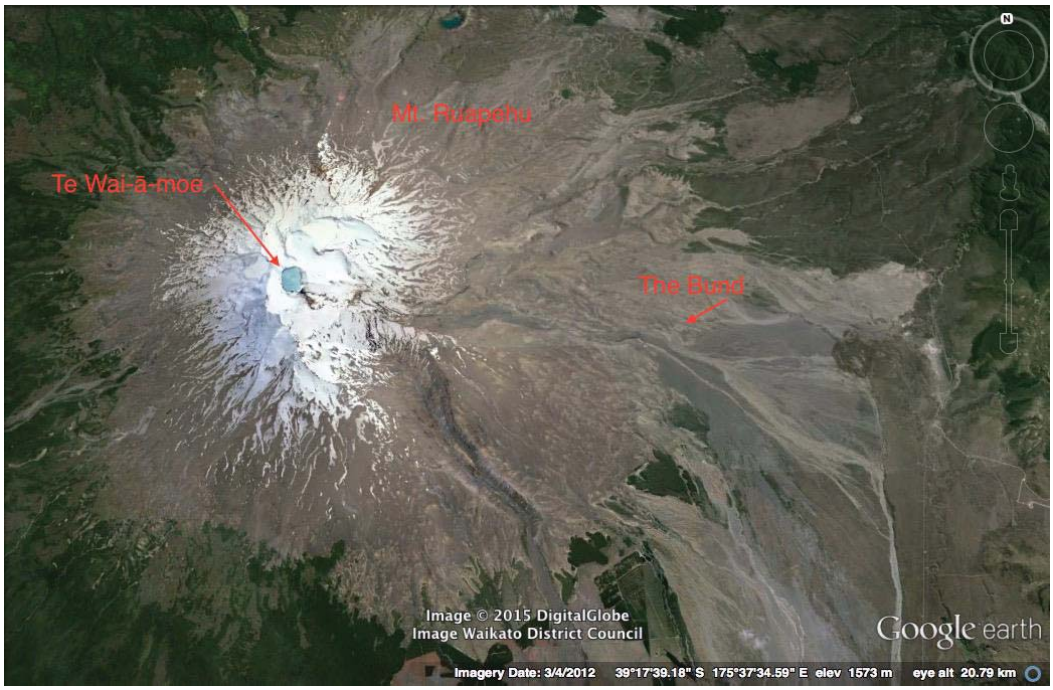


Figure 4. Birds eye view of Mt. Ruapehu central North Island, New Zealand: This Figure outlines the volcanic ring plain that extends outwards from the main cone. The Bund built prior to the 2007 was aimed at reducing the likelihood of a lahar flow into Lake Taupō. Te Wai-ā-moe – The Crater Lake.

The Volcanic Explosivity Index in Table 2 showcases volcanic eruptions in relation to their explosiveness, volume of ejecta and the height of the ash cloud. Within recent history, Ruapehu experienced an eruption with a VEI Index of 2 based on the 1971 eruption.

VEI Index	General description	Ejecta volume (m^3)	Plume height (km)	Eruption Classification	Examples
0	Non-explosive	$<10^4$	<0.1	Hawaiian	Kilauea
1	Gentle	$>10^4$	0.1-1	Hawaiian/ Strombolian	Nyiragongo (2002)
2	Explosive	$>10^6$	1-5	Strombolian/ Vulcanian	Ruapehu (1971)
3	Severe	$>10^7$	3-15	Vulcanian/ Pelean	Nevado del Ruiz (1985)
4	Cataclysmic	$>0.1km^3$	10-25	Pelean/ Plinian	Eyjafyallajokull (2010)
5	Paroxysmal	$>1km^3$	20-35	Plinian	Mount St. Helens (1980)
6	Colossal	$>10km^3$	>30	Plinian/ Ultra-Plinian	Pinatubo (1991)
7	Super-colossal	$>100km^3$	>40	Ultra-Plinian	Tambora (1815)
8	Mega-colossal	$>1,000km^3$	>50	Supervolcanic	Yellowstone (Pleistocene)

Table 2. Volcanic Explosivity Index: Indicating the size, height and volume of ejected material from a volcano during a volcanic eruption.

(Adapted from Pyle, 2000, p. 273; Wheeling Jesuit University, 2014).

1.4.6 Tongariro National Park

The Tongariro National Park Management Plan 2006-2016 guides the Department of Conservation management of the area (Department of Conservation, 2006b). This document outlines the roles and responsibilities of the Department and the policies that guide the use of this area. Notwithstanding this, the responsibility of managing natural hazards lies with the district and regional councils, while monitoring changes in, and conducting research on volcanic activity is undertaken in conjunction with research providers such as the Institute of Geological and Nuclear Sciences (GNS Science)[3] and Massey University[4]. The Department of Conservation describes the risks from natural hazards as taking *'two main forms'* (Department of

[3] GNS Science are a Crown Research Institute dedicated to research in earth science, energy & resources, natural hazards and environment & materials (GNS, 2015).
[4] Massey University, Palmerston North and in particular Volcanic Risk Solutions focuses on volcanic hazard and risk management research (Massey University, 2015).

Conservation, 2006b, p. 93): (1) flows such as lahars, pyroclastic flows, lateral blasts, landslides/floods and lava flows, and (2) air-borne materials such as rocks, tephra and toxic gases.

Ruapehu is unique in the sense that the Crater Lake, Te Wai-a-moe, is located over the vent of the volcano. Keys and Green (2004) observe that only one other crater lake (Mt. Kelut in Java, Indonesia) similar to that of Ruapehu exists within the world, indicating the importance of Ruapehu to the scientific research community.

1.4.7 Case Study: Ngāti Rangi

The case study chosen for this research is Ngāti Rangi, a Central North Island iwi who have held ahi-kā-roa (unbroken occupation) over the area for 1000 years and are a pre-fleet iwi[5]. They have an intense and living relationship with their ancestral maunga (mountain), whom they refer to as Matua te Mana. As the human voice for their maunga, Ngāti Rangi know of and protect his special places and understand what it means to be living with a volcano and subsequently avoid specific areas.

Ngāti Rangi are a highly organised iwi represented by their legal entity Ngāti Rangi Trust, which is guided by their rūnanga (governing body) Te Kāhui o Paerangi. Te Kāhui o Paerangi is made up of representatives of the 15 Ngāti Rangi marae[6]. The marae are also grouped in 'clusters' or 'paepae[7]' based on their geographical location in relation to principal river catchments. These clusters or paepae are: Ngā manga o Hautapu (Hautapu Paepae), Te Wera o Whangaehu (Whangaehu Paepae), Ngā ia o Mangawhero (Mangawhero Paepae) and Te Waimarino (Makōtuku-Manganui Paepae).

[5] A 'pre-fleet iwi' is a term used to describe iwi that arrived to Aotearoa outside of the great waka migration through the Pacific Ocean.

[6] Figure 11 p. 106 provides a visual structure to Te Kāhui o Paerangi Rūnanga

[7] Paepae is often used to describe the seating in which speakers at a powhiri (official welcome at a marae) are placed. In this term, it describes the key representatives of each cluster group.

Ngāti Rangi Trust has a current relationship with Massey University and in particular, the Volcanic Risk Solutions unit within the Institute of Agriculture and Environment. Ngāti Rangi have been consulted on past natural hazard mitigation measures post the 1995/96 eruptions and prior to the 2007 lahar. This research project is based around identifying a means to measure how resilient iwi are to natural hazards, more importantly volcanic hazards or processes. There are many iwi around New Zealand that reside in and around active volcanoes; the Central Plateau being home to both Ruapehu and Tongariro, highly prized by their respective iwi[8]. A more detailed description of Ngāti Rangi is given in Chapter 3.

[8] Ngāti Tūwharetoa are the main iwi to the north of Ngāti Rangi and also share the maunga within the Tongariro National Park. Ngāti Hikairo are recognised as hapū of Ngāti Tūwharetoa and hold ahi-kā at the base of Tongariro. Ngāti Uenuku have whakapapa links to Ngāti Rangi and share many marae, whānau and hapū. They reside at the southern end of Ruapehu.

Chapter 2: Literature Review

2.1 Introduction

This Chapter examines the literature on resilience and explores the complexities that are held within this discipline. It goes further to review the importance of resilience within natural hazards research and its management and look at models that measure resilience. Finally, it looks to identify whether a relationship exists between resilience research and indigenous communities worldwide, including Māori communities. The chapter ends with a brief examination of current legislation and emergency management strategies that guide civil defence within New Zealand.

2.1.1 Resilience

'Waves of adversity and layers of resilience'

(Glavovic, 2005 as cited in Seville, 2009).

The evolution of the term resilience and the acknowledgement of its importance within emergency management for communities, towns and cities are paramount. The use of resilience as a term, an approach, and a framework is imperative to communities as a means of strengthening and protecting their livelihoods, assets, and ways of life. Discerning between and defining each of these individual 'traits' of resilience from the vast body of research is highly complicated due to the multiple definitions and applications in a range of subjects. For resilience to provide meaning and significance to communities, it is required to act as a tool for strengthening, protecting and providing communities with the means to not only survive a natural hazard event, but to ultimately recover.

Glavovic (2005) describes resilience as dynamic. His analogy captured in the above quote can be used to describe how systems and threats interact, or the interaction between the resilience of communities and crises. It indicates that with enough effective layers of resilience, threats will not destroy the whole. The effectiveness of these layers of resilience will also be based on what the system has previously experienced (Seville, 2009).

Glavovic's description of resilience is one of many definitions of resilience that exist in a wider context besides natural hazards research. It is widely acknowledged that Holling (1973) initiated the concept of resilience within ecology (Mayunga, 2007; Ainuddin & Routray, 2012; Norris et al., 2008; Burton, 2015). Timmerman (1981) however was potentially the first to assign the definition of resilience in relation to natural hazards. Thereafter, the definitions and understanding of resilience have increased exponentially. Zhou et al. (2010) define resilience simply as *'the capacity to resist and recover from loss'* (p. 22), which provides a clear representation of a definition of resilience. In spite of the simplicity with which resilience might be explained, the literature on resilience and its meaning is categorised by many divergent research paths and perspectives, resulting in no generally accepted definition. The concepts and terminology inherent within natural hazards research have wide and varied definitions that are based on the theoretical perspectives and outcomes sought by this research community. As wide as these definitions and perspectives are, so too are the criticisms over the use and perceived inappropriateness of the term resilience (Bodin & Winman 2004; Carpenter et al., 2001; Cowen, 2001; Klein et al., 2003: as cited in Norris, et al., 2008).

Not only is the research on resilience highly varied in nature, the lack of clarity surrounding the countless definitions available is problematic. Some argue that the use of resilience by the general public in reference to an event and its repercussions represents a misuse and misinterpretation of the term. Cannon

(2008) suggests that the inappropriate use of the term resilience in the post-disaster phase can distort the significance of its meaning and importance within the natural hazards sector. Cannon is concerned that the surviving communities are described as resilient simply because they still exist; their suffering and loss are not usually taken into account.

There are also noted theoretical differences in the natural hazards research field, which generate various individual meanings of resilience. According to Zhou et al. (2010), fundamental conceptual differences exist within this research field. These conceptual differences dictate the avenue of focus for natural hazards research. Zhou et al. (2010) categorised the divergent research paths into three systems: the social system, the ecological system, or a combination of the two. In these systems, the authors identify several themes of research, such as resilience as a biophysical attribute, a social attribute, a social-ecological attribute, and a geographically centered attribute. Norris et al. (2008) explain community resilience as a metaphor, a theory, a set of capacities and as a strategy.

Frazier et al. (2013) examine aspects of resilience that are researched rather than conceptual differences, such as those outlined by Zhou et al. previously. These aspects include: (1) research on resilience as a process (Cutter et al., 2008), which is centered around a community's continued growth towards not only becoming resilient but supporting their involvement in decision-making; (2) knowledge pursuit; and (3) constantly improving the growth of community capacity. The other aspect of research on resilience is focused on an outcome; that is, how a community can cope with and recover from a hazard event.

Resilience is also tied into the current capacity of a community, which Thouret (2010) describes as being dependent on a number of factors. These factors

include the economic and cultural potential of the community and the strength of its preparedness to adequately deal with a disaster. There are a number of other inherent factors or values, which promote the resilience of a community, predominantly the cultural and spiritual connections not only with immediate family members but also a wider family grouping. Adger (2000) goes further to note that dependency on an ecosystem is indicative of inherent resilience particularly when it is unharmed by the changing economic climate.

2.1.2 The Importance of Resilience within Natural Hazards Research

The importance of resilience within natural hazards research or emergency management is its use as an outcome of actions to lessen a community's risk to natural hazards, whilst enabling them with the capability to recover from disaster. Resilience is coming to the forefront of disaster management due to the increasing impacts on human societies, livelihoods and property from natural disasters (Cutter et al., 2008; Orencio & Fujii, 2013; Zhou et al., 2010). The location of communities and at times, their lack of knowledge of natural hazards make resilience a priority for them.

The importance of resilience also rests with the capacity of the community response to a disaster (Cannon, 2008; Zhou et al., 2010). Through quantifying the level of resilience of a community initially, preparations for recovery and assessing potential losses can then occur (Frazier et al., 2013). This analysis can result in recognising, developing and strengthening the deficits that exist within the systems aimed at protecting assets and livelihoods (Cannon, 2008). Cutter et al. (2008) view resilience as an important and positive substitution to the use and measurement of vulnerability.

DESCRIPTIONS AND DISCUSSIONS SURROUNDING RESILIENCE
Resilience is dynamic and so too is its interaction with threats (Glavovic, 2005).
Holling (1973) credited with the first description of resilience within ecology.
Timmerman (1981) provided a description of resilience in the context of natural hazards.
Cannon (2008) suggests the misuse of the term resilience leads to a distortion of the underlying meaning of resilience within the natural hazards sector.
Norris et al. (2008) explain community resilience as a metaphor, a theory, a set of capabilities and a strategy.
Frazier et al. (2013) focus on the process of communtiies achieving resilience; through involvement in decision making, knowledge pursuit and building capacity.
Thouret (2010) focuses on understanding the current capacity of communities and its contribution to their resilience.
Due to increasing impacts on people and property from natural disasters, resilience is becoming the forefront of disaster management (Zhou et al., 2010; Orencio & Fujii, 2013; Cutter et al., 2008).
Zhou et al. (2010) and Cannon (2008) mention that the importance of resilience is tied to the ability of communities to respond to disaster.
Cannon (2008) also views resilience as a positive substitution to the use and measurement of vulnerability.

Table 3. Discussions on Resilience: What has been described already.

2.1.3 Resilience and Indigenous Communities

Understanding the level of resilience within a community is vital for preparatory measures before an event, for the recovery phase, and to gain perspective on the potential economic losses (Frazier et al., 2013). Frazier et al. also discuss the difficulties in attempting to quantify resilience due to the 'qualitative nature of resilience indicators' (2013, p. 95). Paton (2000), therefore, outlines four key components of resilience below:

1. Communities require adequate resources to deal with issues relating to their safety and core services after an event.
2. These communities must be able to effectively use these resources and deal with emerging issues and problems through adaptive capacity.

3. Planning and development that enable community resilience must take into account the availability of resources.
4. Adequate management of these resources to ensure their sustainability over time against times of quiescence and changes in goals, functions, and community needs.

In conjunction with these four components, Pomeroy (2011) depicts some characteristics that support a resilient rural/farming community, which could be applicable to Ngāti Rangi in the context of their community. Therefore, Pomeroy describes the resilience of rural communities as having:

1. Strong economic base;
2. Stable succession structures;
3. Strong service infrastructure;
4. Integrated approach to challenges and decision making;
5. Adequate planning and preparation for hazardous events;
6. Community networks and participation;
7. Self belief;
8. Positive profiling of the community;
9. Community empowerment and institutional relationships;
10. Accessibility to relevant information;
11. Strong volunteering ethos and capacity; and
12. Effective leadership.

These resilience characteristics provide some crossover to indigenous communities that continue to be rural based. It also coincides with the 'Resilience vs. Preparation' perspective of what best represents resilience as a community centered, long-term view, which is outlined in Table 4.

Resilience	Preparedness
Relationship-based	Plan-based
Whole community	Government agencies
Long term	Short term
Ongoing	Disaster-centred
Based on strengths	Risk focused
Broadly defined	Narrowly defined
Sustainable development	Build back the same

Table 4. Describing the difference between a community being prepared for and responding to individual events vs. a resilient community with long term vision and goals, driven by local communities as opposed to government led initatives.

(RAND Corporation, 2014, p. 1).

Various aspects of resilience research and measurement of indigenous communities are littered throughout natural hazards research but are described in the following ways: disaster prevention (Alcántara-Ayala, 2002), disaster risk reduction (Mercer et al., 2010), and assessing the vulnerability of communities to natural hazards. Work with indigenous communities within the Pacific region has provided examples of capacity building and incorporating indigenous cultural knowledge into western scientific methodology to adequately prepare for and deal with natural hazards. For example, the community of Savo Island in the Solomon Islands is exposed to a high level of volcanic activity with a history of large fatalities (Petterson et al., 2003). Outside expertise and assistance was sought to initiate the development of strategies to address the risks from volcanic activity on the island (Petterson et al., 2003).

The development of these strategies to address the risks from volcanic activity on Savo encompassed in-depth work with the local community. This work included workshops and identifying and using local knowledge of hazards in conjunction with science to develop a disaster management plan. This process

identified in some respects how crucial the political, economic and infrastructural climate is in supporting the resilience of these island nations; political drivers secured the expertise thus enabling the development and implementation of the disaster management plan. Despite the best intentions in aiding indigenous communities in developing strategies to deal with natural hazards, there can be a multitude of barriers to undertaking this work. One of the challenges identified in work carried out on Ambae Island, Vanuatu, was initially the lack of acceptance by the local population of scientific knowledge (Cronin et al., 2004b).

Breaking through the barrier of the dominance of western science is essential for indigenous cultures, as there are a significant number of deep-seated issues surrounding research, intellectual property and exploitation. These issues have led to indigenous communities distrusting researchers, their methods and their desired outcomes. As a means to alleviate such issues (Bird & Gísladóttir, 2012; Cronin et al., 2004a; Cronin et al., 2004b) researchers have used the principles of the Participatory Rural Appraisal to alter the attitudes and approach of the specialists and to promote community input and knowledge. These principles perhaps parallel kaupapa Māori research, which emphasises elements central to the Treaty of Waitangi such as participation, partnership, and protection (Robertson, 1999) of Māori throughout the research. In Vanuatu, Cronin et al. (2004b) observed that strong cultural customs prevented the indigenous peoples from accommodating standard scientific methods, but also that these methods were inconsistent with those customs and the knowledge and beliefs of the people. The researchers envisaged that Participatory Rural Appraisal would act as the instrument to incorporate traditional knowledge into the development of a hazard management plan without the risk of jeopardising the indigenous community local belief structures (Cronin et al., 2004b).

Despite work by scientists and disaster management researchers to understand and improve the resilience of many indigenous cultures, Campbell (2009) indicates that many Pacific Island nations were once inherently resilient to natural hazards. Traditional disaster reduction measures describe the ways through which indigenous communities succeeded in living with natural hazards. Campbell (2009) categorised these traditional disaster reduction measures into three separate groupings: food security, fragmented agriculture and property security. Firstly, food security was one aspect utilised by these traditional societies where a focus on storing and preserving food was a regular occurrence and sustained these communities during disaster events. Secondly, fragmented agriculture was commonplace and provided another source of food security to local communities through crops not being located in the same place in case disaster events impacted on these areas. Lastly, property security allowed the protection of homes and property through their structure and location.

Colonisation introduced changes to these societies that removed the importance of their traditional and highly social practices and left communities unprepared and ill-equipped to deal with natural hazards (Zimmet et al., 1990). Globalisation and other external pressures may be processes that are out of these communities' control, but still have far-reaching impacts on their internal processes and traditions (Mercer et al., 2010; Pelling and Uitto, 2001). Among these pressures, Paulinson (1993) found market forces to be at fault. These aspects may inhibit indigenous communities from being resilient. Despite this, the traditional disaster reduction measures promote resilience.

2.1.4 Traditional knowledge and resilience

Resilience has a specific focus on capacity building and being prepared enough to adequately respond to and recover from natural hazards. It is argued however, that for traditional communities to adequately prepare for hazards,

traditional knowledge should be used to provide unique insight into information on historical events, as well as previous response methods. It has long been acknowledged that communities residing in a hazard-prone area over a number of generations understand hazard processes, and potentially some previous methods of response towards hazards (Campbell, 2009; Cashman & Cronin, 2008; Cashman & Giordano, 2008). Traditional knowledge and oral traditions, which derive from oral narratives (Cashman & Cronin, 2008), are valuable tools that represent an awareness and understanding of the locality. They provide an account of historical methods used to avoid, mitigate or reduce the impacts associated with natural hazards. In Iceland, historical accounts of ash fall indicated the level of severity and the resulting impact on visibility (Bird & Gísladóttir, 2012), therefore demonstrating for example what work needs to be undertaken prior to the lack of visibility settling in. These historical accounts can provide local communities with moral support. In the study by Bird and Gísladóttir (2012) one participant said: *'I just thought about the past, the stories. How good it was that we had heard the stories, I knew that it had happened again, I knew that it wouldn't last forever'* (Bird & Gísladóttir, 2012, p. 1271).

Those stories from Iceland outlined a natural hazard event, its impacts on the local communities, mitigation measures to undertake and perhaps some indication of its duration. Place names also hold some merit in providing further insight into a location and its history (King et al., 2008) and can be representative of an event that left an imprint on the landscape and the people. In contrast, there is still a lack of understanding on the nature of the hazards in volcanic zones, as well as a real understanding of all possible hazard types. On Java, Indonesia, Lavigne et al. (2008) identified that there was little to no actual understanding of volcanic processes, therefore the local population were not aware of the full range of volcanic hazard types, their associated risks and more importantly the areas on which they impacted. This study highlighted peoples'

perceptions of risks and the importance of bringing into account the human dimension with regards to natural hazard management.

It has been heavily emphasised how imperative the human dimension is to natural hazard management (Bird et al., 2009). Understanding the interaction and relationship local communities have with the land may describe the continued existence of people in the vicinity of volcanoes. Lavigne et al. (2008) support this view by noting the rise in research relating to the human dimension of natural hazard management and, more specifically, the behaviour of people in the face of natural hazards. They outlined three significant areas to further understanding of the human dimension of hazards and the reactions to natural hazard events: (1) the perception of risk, (2) cultural beliefs and (3) socio-economic constraints.

Individual and community perceptions of risk are based on a number of differing factors such as the nature of the hazard, its frequency, duration, past experiences and exposure to the hazard. Despite these factors contributing to risk perception, the lack of understanding of volcanic processes, the low frequency and duration combined with limited or no exposure to past events although living in an active volcanic zone, all contribute to lower perception of risk regarding volcanic hazards. Hazard knowledge and risk perception of Katla[9] by locals in Iceland demonstrated the results of hazard knowledge inherited from their ancestors (Bird et al., 2009). This study indicated that exposure to and experience of volcanic hazards were discussed and recognised by the younger generation and contributed to their level of risk perception. Gregg et al. (2004) note that, in some cases, hazard awareness is not an indication of hazard knowledge and does not carry over to individual preparedness or responsiveness.

[9] Katla volcano is one of the most active volcanic systems in Iceland (Larsen, 2000).

2.1.5 Inherent Resilience and Adaptive Capacity

One key strength and weakness of traditional and indigenous societies in the face of natural hazards is the reliance on their local environment. Gaillard (2007) goes further to mention that due to this reliance, many traditional societies are unable to adequately recover from disasters that directly impact their lands and thus their subsistent lifestyles. Adger (2000) argues that there is a connection between ecosystem and social resilience, since communities dependent on local resources have a reliance on the entire ecosystem, as is the case with fishing communities in Asia (Bayley & Pomeroy, 1996 as cited in Adger, 2000). It is perceived that the total dependence of these societies on their local environment and its resources is a factor inhibiting their capacity for resilience. Resource depletion and the decimation of traditional and current land-use areas are situations that force evacuation and thus relocation of these societies. In these instances, the resilience of a traditional society is determined by the level at which the people resist change or welcome it, relocate or choose to remain in their traditional area, and the level of cultural adaptations that take place their society and culture to survive (Gaillard, 2007; 2006).

Inherent resilience and adaptive capacity is often associated with community resilience. Pacific Island nations, as outlined earlier, were described as being inherently resilient due to traditional practices and cultural traits that have adapted to the local environment and its associated hazards. Iwi also can stake claim to this. Traditional practices and cultural traits have allowed iwi to endure within Aotearoa. Also, maintaining aspects of their cultural and spiritual traditions through oral narratives have aided iwi to adapt to external changes such as colonialism. Harmsworth (2008) and Harmsworth and Awatere (2013) maintain that iwi hold a distinct worldview that guides their daily lives. This distinct worldview can be described as an outlook that is heavily embedded in the past but merges with the present; a combination of traditional and modern concepts and beliefs. This worldview is often used as a basis for future decision-

making and involves looking to the past to better plan for the future. The teachings of ancestors are prominent in this worldview. There remains a close connection with the local environment, which is representative of a link to the wider holistic aspect of whakapapa (simply defined as geneology) and whānau (family)[10]. Iwi also take this focus on and reverence of their history and fuse it with modern lifestyles. Thus this worldview demonstrates a mixture of both modern and traditional aspects that represent iwi and the Māori culture.

Both Durie (2005) and Walker (2004) describe Māori resilience more specifically as endurance. They both discuss the struggles of Māori throughout the colonisation phase and the later stages of growth within Aotearoa. Their work highlights the endurance of Māori to survive and adapt specific cultural traits and practices to flourish and be present in this day and age within Aotearoa. Durie (2005) goes further to mention that there are factors of Māori resilience that have not been further explored such as: businesses, schools, and various other iwi communities, groups and ventures.

2.2 Living with volcanic activity

Communities living in the vicinity of a volcano have several valid reasons for residing in these often-hazardous areas; cultural and spiritual connections, tourism, fertile farmland, and often bountiful water sources (Burby, 1998). Despite the real danger from eruptions (Kelman & Mather, 2008), Burton et al. (1978) observe that 'people not only locate in areas of high, recurrent natural hazard; they survive and prosper there' (p. 4). Table 5 goes further to explain the options communities have to cope with and respond to hazards that exist within the environment.

[10] These Māori concepts are described in further detail in Chapter 3

Dealing with environmental hazards	
Options for dealing with environmental hazards	**Resulting consequence**
1. Do nothing	Disaster occurs
2. Protect society from hazards	Risk transference amplifying vulnerability
3. Avoid hazards	Exacerbate other issues, amplifying vulnerability
4. Live with hazards	Adjustments to livelihoods to incorporate environment hazards and potential opportunities

Table 5. Community Based Options for Dealing with Environmental Hazards.

(Kelman & Mather, 2008 p. 190).

Table 5 aims to highlight a spectrum of options communities can use to respond to hazards within their areas. *Living with hazards* as apposed to *do nothing* highlights how essential it is to firstly, recognise hazards that exist within a community and make the appropriate adjustments to the human dimension rather than the infrastructure dimension, as noted in **Point 2** in Table 5. Communities that make adjustments to their livelihoods in response to the localized hazards within their vicinity are shown to be better off than those that do nothing. Ngāti Rangi are an example of a group of people that live within an environment that has the potential to disrupt daily activities. However, they have a mentality of 'living with hazards' and incorporate that into their lifestyles, rather than avoid the hazard entirely.

Adjusting livelihoods in response to hazard was shown to be beneficial to communities; adjustments to the economic and infrastructural facets of society would also be of benefit to communities.

On a worldwide scale, volcanic events have devastated populations and lives have been lost. Table 6 describes several volcanic events that have had significant impacts on the human population from primary and secondary impacts.

Date	Volcano	Event	Death Toll	Reference
1783-1784	Laki, Iceland	Eruptions of Laki in Iceland caused local deaths and elsewhere in Europe	24% of Iceland's population in 1783-1784	Witham and Oppenheimer, 2004
1815	Tambora, Indonesia	Eruption causing weather alteration worldwide	70,000+	de Boer and Sanders, 2002; Kozák and Čermák 2010.
1886	Mount Tarawera	Eruption overwhelming the surrounding region	108	Nairn, 2010; Keam, 1988; Lowe, 2008
1902	Mount Pelée Martinique	Pyroclastic density current from Mount Pelée in Martinique killing people in St. Pierre	Between 28,000 – 30,000	Blong, 1984; De Boer and Sanders, 2002
1953	Ruapehu	Damaged bridge from Lahar causing train to derail into the Whangaehu River	151	Neall, 1976
1985	Nevado del Ruiz, Colombia	Lahars from Nevado del Ruiz killing people mainly in Armero	Approx. 25,000	Voight, 1990
1991	Mount Pinatubo, Phillipines	Eruption causing weather alteration worldwide	1202	Self et al., 1996; Reily, 2009

Table 6. Recent and historical eruptions resulting in fatal consequences on local and distal populations.

As a means to reduce the effects on local populations and economic productivity, various engineering methods have been used internationally to withhold or divert flows from their natural paths such as:

- Earth dams in Indonesia as a means to protect fertile land
- Drainage tunnels at Mt. Kelut in East Java to siphon out water from the crater lake
- Construction of levees to confine lahar flows

(Neall, 1976).

- Bund at Te One Tapu, Mt Ruapehu.

Figure 5. The Bund: A wall consisting of rocks, soil and rubble built up above a section of the Whangaehu River to restrict lahar flow into the Tongariro catchment.

Less invasive methods used to diminish the risks to people and property from volcanic activity include planning-based mechanisms such as the creation of hazard maps being to guide land-use and planning decisions (Becker et al., 2010). Becker et al. (2010) reveal that despite the intentions behind the creation of hazard maps to inform decision makers, use of these maps within planning has been limited. The influence of historical land-use decisions has often acted as a stimulus for existing planning within New Zealand. Many settlements exist within hazard-prone areas and are at risk predominantly from flooding (Glavovic et al., 2010). Communities were safeguarded from risk primarily through hazard control and well-established settlements within areas at risk required regular maintenance to continue to provide adequate protection to property and people; however many of these protective works can only withstand the hazards parameters for which they are designed (Glavovic et al., 2010). Horizons Regional Council (2013) proposed One Plan Chapter 10 (Natural Hazards) Policies 10-1 – 10-5 outline the Council's roles and responsibilities in relation to localised natural hazards:

- Raising public awareness through education
- Creation of policy to avoid/mitigate natural hazards
- Avoid increase of risk to property, people and infrastructure regarding future development

(Horizons Regional Council, 2013).

2.2.1 Measuring Resilience

Defining resilience is difficult, therefore it can be expected that measuring it will also be difficult. To reinforce this argument, Cutter et al. (2008) state that there needs to be more consistency in measuring and evaluating disaster resilience. Meanwhile, Frazier et al. (2013) and Cutter et al. (2010) imply that using indicators of resilience to hazards can provide baseline data of current community resilience by which to build and develop some mechanisms to address potential inadequacies. Several authors have developed theoretical models to measure resilience, some of which focus on location. One example is the Disaster Resilience of Place (DROP) model. The DROP model is described as a means to *'present the relationship between vulnerability and resilience'* (Cutter et al. 2008, p. 602) and also to address natural hazards at a community based level. A slightly altered derivative of the DROP model was developed by Zhou et al. (2010) and termed the Disaster Resilience of 'Loss-Response' of Location (DRLRL) model. The DRLRL model also has a heavy focus on location as the means of analysis. Another model, Local Indicators of Spatial Association (LISA) reveals how resilience can vary across space and analyses several specific indicators (Frazier et al., 2013). Tobin's (1999) conceptual framework, consisting of three individual models – Mitigation, Recovery and Structure modified and grouped together, has the aim of identifying healthy resilient communities living in hazardous environments. Despite the number of models available that aim to measure resilience, they are often theoretical or untested. Most of these examples also fail to provide adequate detail on how to constructively use and apply these to communities.

Reference	Model for measuring resilience	Methods	Limitations	Applicability to indigenous Communities
Mayunga, 2007	*Community Disaster Resilience Index (CDRI)*	This method utilises the capital-based approach to determine community resilience, which includes social, physical, human and natural categories. A variety of indicators are thus assigned to these capitals as a means to measure resilience. All these indices require some standardized format that allows a score or rank (in order to measure) to be assigned to them.	Still to identify means to adequately measure these forms of capital.	No cultural element available, however, social element could be adapted to include cultural dimensions required to be a total measure of resilience.
Tobin, 1999	*Conceptual framework consisting of three theoretical models*	This framework is based on individual theoretical models; the 'Mitigation model', 'Recovery model', and the 'Structural-cognitive model'. These models were modified and grouped together to identify healthy and resilient communities in hazardous environments. This framework has a heavy focus on the recovery phase and mitigation.	This model lacks an analysis of vulnerability. In saying this, Tobin (1999) believes it better measures resilience.	No cultural element available.
Cutter et al, 2008	*Disaster Resilience of Place Model*	This model aims to demonstrate the relationship between vulnerability and resilience that is applicable to real locations and real issues. It also contains a conceptual framework that describes a set of variables aimed at measuring resilience. Sustainability is a focal point of this model and therefore has close links to the environmental facet of resilience.	There is no current cultural framework included as part of this model.	It perhaps has some merit to be adapted for indigenous communities as it takes into account environmental health and sustainability. Despite this, no current applicability to indigenous communities.
Orencio & Fujii, 2013	*Disaster resilient components based on Analytic Hierarchy Process*	While not a model developed specifically for resilience measurements, it is a methodological approach to decision-making and to resolve issues of multiple scenarios, criteria and people. It is viewed as an effective tool in assigning weights for indicators of risk within a ranking system. The most important element to this approach is the Environmental and Natural Resources Management component - largely due to how crucial the ecosystem is to communities (within that study). This particular model notes the formulas and matrix for measuring resilience.	This is a methodological approach that can aid decision making rather than a model.	No cultural elements available within this framework.

Table 7. Theoretical models aimed at measuring resilience

The focus of the resilience research and its desired outcomes thus determines how and what elements are measured. The models employ a variety of differing indicators used to measure specific outcomes. In contrast, measuring resilience within indigenous or traditional societies as described by Gaillard (2006, 2007) largely relies on relationships within a cultural and environmental context. The adaptability of these cultural traditions and environmental relationships is often a reflection of resilience within an indigenous community. Another indicator of resilience within indigenous communities is the ability of cultural fundamentals to accept change in order to survive. Several factors such as *'understanding the nature of the hazard, the intrinsic social condition of the group, the geographical setting, and the authorities rehabilitation programs'* (Gaillard, 2007, p. 538) often affect traditional societies and their capacity for resilience.

2.2.2 Models

As described earlier in Table 7, there are many models available that aim to measure resilience. However, many of these models target mainstream facets of society that form the basis of societal representation of resilience, such as income, health and education. Cram (2013) adds further to this discussion by noting that models that aim to measure a particular subject are predominantly based on universal indicators. Indigenous cultures and their individuality and belief systems are usually not taken into consideration.

Models have been developed to bridge this gap by including key features that represent indigenous cultures. For iwi, models have been developed to include cultural standards, baselines and indicators that draw from a cultural framework, consistent with a Māori belief system and inclusive of various concepts such as mauri, wairua, manaakitanga and whanaungatanga (Coffin & Allot, 2009; Tipa & Teirney, 2003, 2006). The Cultural Health Index (Tipa & Teirney, 2003, 2006), for example, displays how culturally based indicators are used to assess the health of freshwater systems collaboratively with western-based science indicators. Models

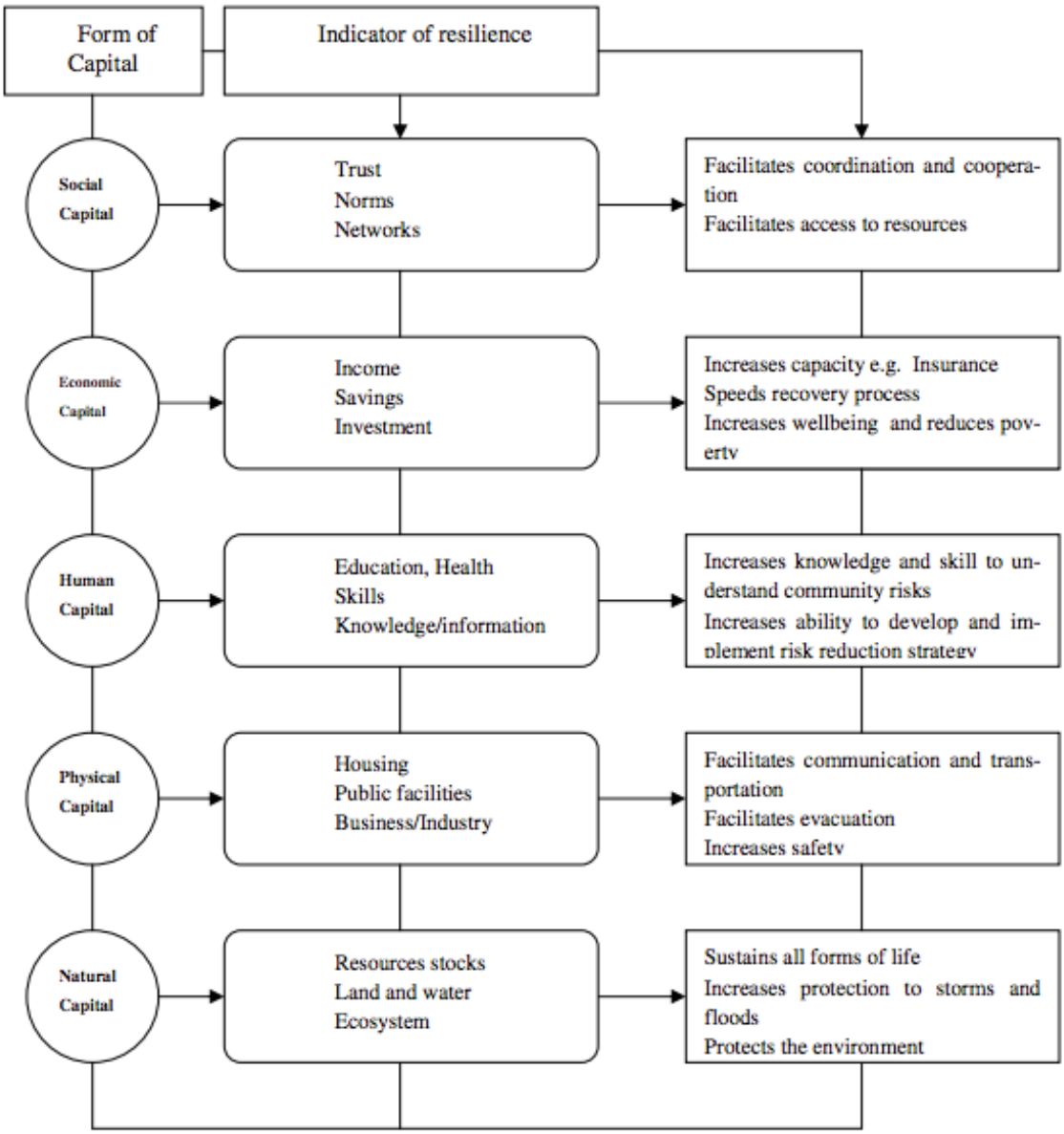
that measure resilience would, therefore, require alteration to take into account a holistic outlook, which incorporates several concepts such as:

- Whakapapa
- a Māori world view
- Ahi-kā-roa
- Mātauranga Māori
- Tūrangawaewae
- Mauri[11]

These concepts can therefore provide a baseline for the creation of indicators that are specific to the cultural and spiritual needs of iwi.

Mayunga (2007) proposes a set of disaster resilience indicators that use a capital-based approach, incorporating five forms of capital: social, economic, human, physical and natural. These indicators are described over the page in Figure 6, which importantly shows the benefits or outcomes of resilience indicators displayed during a disaster.

[11] See Chapter 3 for further descriptions of Māori concepts.



(Mayunga, 2007).

Figure 6. Mayunga's Capital-Based Approach: Disaster Resilience Indicators

Another theoretical model developed by Paton and Johnston (2001) aims to measure resilience to hazard effects and is shown in Figure 7.

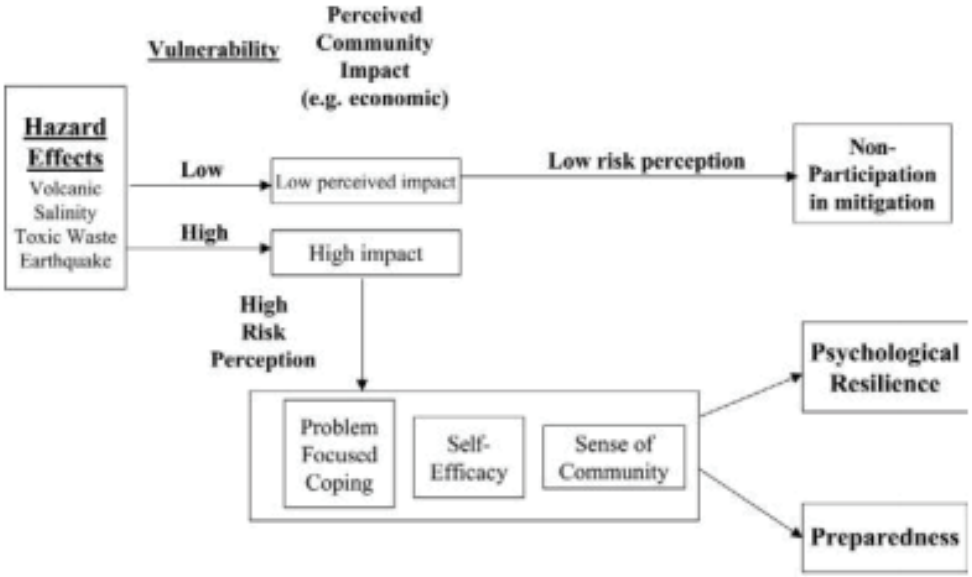


Figure 7. Model to measure resilience to hazard effects focusing on the perception of communities to hazards.

(Paton & Johnston, 2001, p. 271).

This resilience model developed by Paton and Johnston typically favours the risk perceptions of communities towards hazards. It also highlights both low and high impacts from an event, but this classification of events is normally based on the level of risk perceived by a community. This model provides no methodology to implement it or measure resilience. The cultural belief system of the human dimension as described by Lavigne (2008) focuses on the ties that individuals and communities have to their local environment. These cultural beliefs can often dictate the decisions of the individuals regarding their residence in these hazard zones, and can also act as an avenue to describe the events.

A third framework is the Disaster Resilience of Place (DROP) model flowchart (Cutter et al., 2008) and shown in Figure 8. In order to be applicable to iwi, cultural resilience indicators need to be incorporated into this model. This will require adding 'Cultural Systems' to the Built Environment, Social System and Natural System triangle at the left of the flowchart therefore creating a system 'diamond' instead.

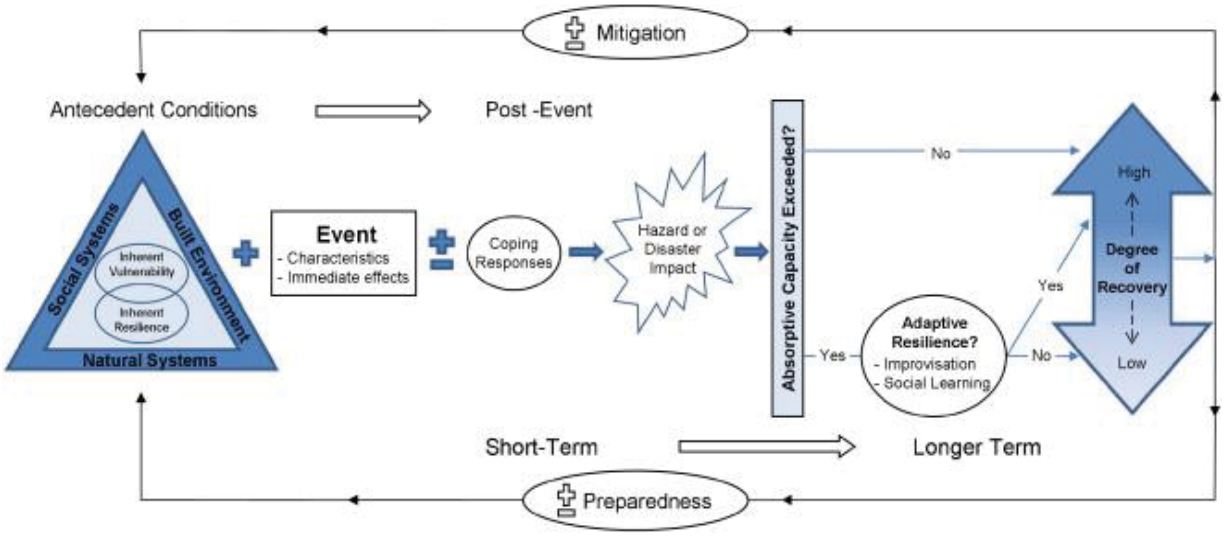


Figure 8. Disaster Resilience of Place (DROP) Model Flowchart outlining an overal process through the entirety of an event.

(Cutter et al., 2008, p. 602).

While several models have been outlined already, the common ground between many of them is the indicators. Indicators require a form of measurement to assess the resilience of communities. The issue with assigning metrics and standard measures as part of developing composite indicators is ensuring they are validated. In addition, Burton (2012, 2015) describes the challenges of developing standard measurements that give weight to resilience of communities during disastrous events, notwithstanding the importance of resilience to risk reduction. Burton (2012, 2015) has also gone further to produce an empirical-based approach for measuring resilience. The component development for Burton's disaster resilience measures was initially founded on 130 variables that were based on three main benchmarks: 1) justification of variables based on literature, 2) consistent quality among the selected variables all from data sources available to the public; and 3) the variables necessitated scaling. The number of variables was then reduced to 98. Burton (2015) also provides the variables used per resilience measurement and justifies each one. These variables target social, economic, institutional, infrastructure and community capital and environmental systems resilience.

Freudenberg (2003) and Nardo et al. (2008) provide a process to create the composite indices required to measure resilience. The process is outlined below:

1. Develop a theoretical framework for the composite
2. Identify and develop relevant variables
3. Standardise variables for future comparisons
4. Weighting and aggregation of the variables
5. Testing variable strength and robustness through undertaking uncertainty measures.

2.3 Māori and Hazards

There is limited literature on Māori and natural hazards within New Zealand. A few unpublished documents have provided further insight into the relationship that exists between iwi and the natural hazards present within their rohe. Proctor (2010) explores how the principles of tikanga can be applied to the management of natural hazards, particularly flooding in Pawarenga in Northland, New Zealand. Proctor (2010) found that tikanga was a valued resource used by locals and concluded that *'tikanga Māori is an inherent part of … resiliency'* (pg. iv).

King et al. (2007) and Lowe et al. (2002) are the few who have explored the relationships between iwi and natural hazards. They found that iwi and hapū (sub-tribe) hold a store of information throughout oral narratives such as 'mōteatea (laments), pēpeha (quotations), whakatauki (proverbs) and waiata (songs)' (King et al., 2007, p. 60). These repositories not only tell stories but also contribute information about historical events and natural hazard occurrences to natural hazard management. King et al. (2008) outline three specific ways that Māori Environmental Knowledge can be applied to natural hazard management: (1) as described previously, stories, songs and place names hold a wealth of knowledge based on experiences and recollections of events; (2) the information extracted from these

avenues can thus be mapped in relation to natural hazards; and (3) it can also provide for Māori involvement in planning for hazards. Most of the current volcanic-based knowledge that exists on New Zealand is largely derived from the European context. Lowe et al. (2002) suggest that the lack of information is partly due to the late settlement of New Zealand by humans. Consequently the recorded history of interactions between people and volcanism is short.

Early Māori bore witness to numerous hazards relating to volcanism. Table 8 indicates the type of hazards to which early Māori would have been exposed.

Hazard Type	*Volcano or centre associated with event*
Pyroclastic fall	Taranaki, Tongariro, Whakaari, Auckland, Okataina
Pyroclastic flows	Taranaki, Tongariro, Okataina
Pyroclastic surges	Okataina
Lava flows	Tongariro, Auckland, Okataina
Lava dome building	Taranaki, Tongariro, Okataina, Tuhua
Lahars	Taranaki, Tongariro
Post-eruptive flooding	Taranaki, Tongariro, Okataina
Debris avalanches	Taranaki, Tongariro, Whakaari
Volcanogenic earthquakes	Taranaki, Tongariro, Auckland, Okataina
Lightning, forest fires	Taranaki, Tongariro, Okataina
Hydrothermal eruptions	High-temp. geothermal systems in the Taupō Volcanic Zone (e.g. Ketetahi Springs)
Volcanogenic tsunami	Not recorded
Acidic rain/volcanic gases	Not recorded

Table 8. Volcanic hazards types pre-historic Māori within New Zealnd potentially experienced.

(Lowe et al., 2002, p. 133).

Despite this information, there is still little that has been published on the actual experiences of early Māori prior to colonisation.

2.4 New Zealand Civil Defence Emergency Management

The Civil Defence Emergency Management Act (2002) replaced the previous Civil Defence Act 1983. The purpose of the Act in short is to improve and promote the sustainable management of hazards and thus to create a society that is resilient to disasters. Emergency management in New Zealand comprises an *'all hazards, all risks, multi-agency, integrated and community-focused approach'* (Ministry of Civil Defence and Emergency Management, 2008). This approach to emergency management also encompasses the '4Rs' (reduction, readiness, response and recovery), which are the basis of civil defence in this country (Ministry of Civil Defence and Emergency Management, 2008). The 4Rs are regarded as providing an integrated approach to civil defence and emergency management. They are aimed at not only encouraging resilience among communities, but enabling agencies and emergency services personnel to support community resilience. There are also several stakeholders that have interests and responsibilities with regards to natural hazards and their management. The stakeholders described in Table 9 cover all levels from government departments, Non-Government Organisations (NGOs), research agencies such as universities, through to the community.

Stakeholder	*Responsibilities and interests relating to natural hazards planning*
Department of Prime Minister & Cabinet	Coordinating public department and ministries at the decision-making level in reaction to civil defence emergencies.
Ministry for the Environment	Responsible for policies and plans - largely guided by the RMA to reduce risk from hazards.
Parliamentary Commissioner for the Environment	Provides advice to environmental managers about natural hazards.
Department of Conservation	Responsible for the NZ Coastal Policy Statement.
Ministry of Business and Innovation	Has responsibilities under the Building Act (2004).
Ministry of Civil Defence & Emergency Management	National, regional and district scale responsibilities through national strategy, plans and guidelines.
Local Government New Zealand	Provides guidance on policy and training to councils.
Standards New Zealand	Independent organisation responsible for developing safety standards.
Regional Councils	Controls land-use to avoid and mitigate risks posed by natural hazards, also monitors and records hazards.
CDEM Groups	Responsible for CDEM Group Plans that manage risks and hazards guided by the 4Rs.
District/City Councils	Administers the effects of land-use to avoid and mitigate risks posed by natural hazards; also monitors and records hazards.
Communities	Long-Term Council Community Plans.
Private Property Owners	Interest is largely site-specific.
Developers	Interest in local issues and development projects.
NGOs (e.g. Environmental Defence Society)	Involved in planning at all levels with a focus on improving environmental outcomes.
Research Agencies	Provide advice on and research into natural hazards to communities through to central government.

Table 9. Responsibilities and interestes of New Zealand Stakeholders within the civil defence and emergency management planning.

(Adapted from Glavoic, Saunders & Becker, 2010).

Table 9 describes the level of interest and responsibility in New Zealand for natural hazards and in particular, planning and policies developed to protect the interests of the population.

2.4.1 The 4Rs

The four Rs refer to methods and phases of emergency management. The first, Reduction, is an approach that targets initially identifying and analysing risks from hazards to people and property, then eliminating or reducing their impacts. The second, Readiness, is largely focused on developing strategies for use in the event of an emergency, which are aimed at the individual and community response, and also the response plan for emergency services. The third, phase, Response, is undertaken if (A) there is warning prior to an event occuring and/or (B) an event occurs without warning. This phase includes the actions individuals, communities and emergency services take immediately during and after an emergency. The final phase, Recovery, is an integrated approach towards the immediate, medium and long-term recovery after a disaster (Ministry of Civil Defence and Emergency Management, 2008). In order to execute these phases, the National Civil Defence Emergencey Management Strategy was developed.

2.4.2 National Civil Defence Emergency Management Strategy

The National Civil Defence Emergency Management (CDEM) Strategy 2007 (Ministry of Civil Defence Emergency Management, 2008) outlines the CDEM vision, values, principles, and goals. The National CDEM Strategy has four main goals: 1) increasing community awareness, understanding, preparedness and participation in civil defence emergency management; 2) reducing the risks from hazards to New Zealand; 3) enhancing New Zealand's capability to manage civil defence emergencies; and 4) enhancing New Zealand's capability to recover from civil defence emergencies.

New Zealand is exposed to a myriad of natural hazards that have the capability to impact on the local population. This exposure contributes to perceptions of risk. Finnis et al. (2004) suggest that risk perception is crucial to the preparedness of a community. Understanding risks and the resulting consequences can help communities to be better prepared for a specific hazard (Bayley, 2004). Despite the need for local communities to understand the surrounding hazards, emergency management requires a better understanding of the psycological, social, cultural, institutional and political processes that shape how they think and consider the risks, particularly volcanic risk. Cashman and Giodarno (2008) go further to note that understanding of the archaeological, anthropological and oral traditions (Cashman & Cronin, 2008) regarding a volcano are also essential to emergency management and natural hazards research.

2.5 Summary

This chapter has explored a fraction of the disciplines involved and resilience and its research and displays the complexities. The chapter also briefly indicates that resilience-based research is still in its infancy and clarity surrounding its use as an approach or method is a desired achievement for communities. Notwithstanding this, it has been recounted that the benefit in exploring resilience for communities provides a means to identify measurable baseline indicators. Little research been explored with indigenous cultures and resilience and therefore presents a gap within the research field on Māori and resilience.

Chapter 3: Ko Ngāti Rangi te Iwi

3.1 Introduction

Indigenous cultures around the world have unique world views that inform their cultural values, belief systems and link them to the natural world. Royal (2005) argues this worldview sets Māori and other indigenous cultures apart from the mainstream populations. The common denominator among indigenous cultures is that the natural world is perceived as a living being (Hart, 2010; Royal, 2004); this connection with the environment ties indigenous peoples around the world with one another.

In Aotearoa, New Zealand, the Māori view of the world is based on the cultural, spiritual and blood ties that exist between the people and the realms of the atua (gods/deities). This perspective is distinct from that of non-Māori. Therefore, key aspects of the Māori worldview are explored within this chapter. These key concepts outlined are central to understanding a Māori perception of the world and the relationships that exist between these key concepts. The concepts are not listed in order based on importance, but can be viewed chronologically. This, therefore, highlights the complexity surrounding Māori concepts and the importance of the holistic correlation.

Finally this chapter describes Ngāti Rangi, its people and their relationship with their ancestral maunga, Ruapehu, and briefly their residence in the area for 1,000 years.

3.2 Māori Concepts

3.2.1 Te Kore. Te Po. Te Ao Marama

Creation narratives are central to the Māori worldview and our belief system, and provide an interpretation of how the world and Māori came to be. In the beginning there was nothing, and from nothing, three evolutionary states transpired; te kore:

energy, the potential space, the void, nothingness; te po: the dark, the night; and te ao marama: light and reality (Ministry of Justice, 2001). These stages occurred in a chronological order beginning with nothing, this darkness, followed by light and eventually the birth of te ao Māori (the Māori world) with the separation of the primordial parents, Ranginui (the sky father) and Papatūānuku (the earth mother).

The materialisation and growth of Ranginui and Papatūānuku, the first ancestors of Māori, arose during te po, while the birth of te ao marama transpired with the separation of Ranginui and Papatūānuku by their son, Tāne Mahuta (god of the forest). Māori are descendants of these ancient beings. Following the separation of Ranginui and Papatūānuku, their children, the atua (gods), created all things animate and inanimate in the natural world, including people. The different atua governed different domains such as the forests, the waterways, the sea; each atua was responsible for the creation of all things within these dominions. Therefore, all beings in the te ao Māori, including people are linked to these primeval ancestors.

3.2.2 Whakapapa

There are a number of concepts central to Māori beliefs, including but not limited to whakapapa and mauri, described simply as genealogy or lineage and life force (Roberts et al., 1995; Roberts et al., 2004). Whakapapa is central to the creation story; it is in fact the framework for binding all living things together in a seamless link back to the primordial parents. Whakapapa is not merely expressed as genealogy that asserts our physical connections to our forefathers; it is also the journey and knowledge that accompanies our genealogy and provides individuals, whānau, hapū and iwi with a sense of self and a sense of place (Ministry of Justice, 2002). Whakapapa in its simplicity connects Māori to their ancestors; whakapapa ties Māori to the birth of the world and to the beings at the centre of creation (Rochford, 2004; Roberts et al., 2004).

Te Rito (2007) goes further to point out the importance of *whakapapa* in providing a sense of identity for Māori. This sense of identity can stem from gaining an

understanding of the layers or generations that make up an individual, tying them to their past and to their future. Māori scholars, Ranginui Walker and Apirana Ngata explain whakapapa to be a *'comprehensible paradigm of reality … transmitted orally from one generation to the next'* (Walker, 1993, p. 16; as cited in Te Rito, 2007), and as a process involving *'the foundation ancestors as the first generation, the next and succeeding ancestors are placed on them in ordered layers'* (Ngata, 1972, p. 6; as cited in Te Rito, 2007).

The concept of whakapapa also draws upon the Māori concept of creation as its foundation. It is the binding agent bringing together a mass of stories, relationships, myths, knowledge and tikanga (customs) creating a map of each individual, whānau, hapū and iwi which recounts their journey from their beginning of time to the present (Taonui, 2013). It establishes the association between an individual and their whānau, joins whānau to their whenua and connects these elements to this wider and complex nature of whakapapa. As Hakopa explains, whakapapa:

> *"Encompasses Māori notions of identity and is a framework for understanding the Māori worldview. It determines the cosmological connections to the heavens, the earth and all the living things within the environment. It is also the instrument whereby Māori derive their intimate connections to the land and how they articulate their sense of belonging to their sacred places, stretching back hundreds of years. It is the source of their rights to tūrangawaewae, their place to stand in the world, and their personal mana and tapu* (pp. 3-4, 2011)".

Whakapapa therefore provides iwi with the foundations necessary to guide the belief system that is entrenched within the holistic outlook of the Māori worldview. Whakapapa knowledge as coined by Edwards (2011), adds to the explanation of realities that exist within Māoridom that are the key to understanding the culture and identity of Māori and thus harmonising with the Māori worldview. Another essential element of whakapapa is mauri.

3.2.3 Mauri

Mauri, like whakapapa is also central to the Māori worldview and belief system. It is simply described as a 'life force' (Roberts et al., 1995; Roberts et al., 2004) that exists within all things in the natural world, and as an energy within animated beings that allows them to remain in the physical world (Royal, 2012). Pohatu (2011) describes mauri as essentially the wellbeing of people as resonating from a *'common centre'* (Pohatu, 2011, p. 2) that everything draws from. Mauri is often referred to within environmental management as a principal environmental indicator, for example of water quality (Ministry for the Environment, 2001). The Cultural Health Index (Tipa & Teirney, 2003), which is a tool available for iwi nationwide to measure the health of their rivers and streams, was originally based on the assessment of mauri within waterways.

3.2.4 Pēpeha

Pēpeha is first and foremost a reflection of thoughts and *'sayings of the ancestors'* (Mead & Grove, 2001, p. 9) comprising various other descriptive means such as '*charms, witticisms, figures of speech, boasts'* (Williams, 1971, as cited in Mead & Grove, 2001, p. 9) that were spoken by our ancestors. These pēpeha were heavily bound to the oratory nature of our language and speech on the marae ātea.

A modern take on pēpeha is a standardised method of communicating to others our tribal links. More commonly it is attached to individual hapū and iwi and includes a reflection of our whakapapa and describes the grounding and the prominent landmarks that portray to others the source of our being. For example, the pēpeha below is central to Ngāti Tūwharetoa. It depicts the researcher's grounding within this world, noting the physical features and resources that reveal the connection between herself and her tūpuna, her whakapapa and the thousands of Ngāti Tūwharetoa uri that speak these same lines on introduction.

Ko Tongariro te Maunga	Tongariro is the mountain
Ko Taupō-nui-a-Tia te Moana	Taupō-nui-a-Tia is the lake

Ko Ngāti Tūwharetoa te iwi	Ngāti Tūwharetoa is the tribe
Ko Te Heuheu tonu te tangata	Te Heuheu is the chief

Pēpeha are often used to describe an individual's place in the world acknowledging the mountains, water bodies, whenua, tūpuna or landmarks (Barrett, 2013) that anchor iwi to a specific area. The geographical features, such as mountains, uphold the mana of an iwi and are often referred to as ancestors, as a landscape formation with an attached kōrero that defines its history from the perspective of the tangata whenua.

3.2.5 Ahi-kā-roa and Mana

Ka wera hoki i te ahi, e mana ana anō
While fire burns the mana is effective
(Meredith, 2012, para. 7).

Ahi-kā-roa, commonly referred to as the burning fires of occupation, is attached to an iwi, hapū, and whānau who have resided within an area throughout the generations and their whakapapa. Ahi-kā-roa is an integral part of understanding the relationship tangata whenua have with their land, not in terms of ownership, but of tenure and occupation. The security of ahi-kā-roa aided in the retention of land throughout the generations, thus ensuring that the tangata whenua hold the mana over the land effectively. This method however was ineffective against the arrival of the colonising body who disregarded any rights, concepts, beliefs of iwi with ahi-kā-roa in their successful attempt to secure land for the Crown.

Mana is a term commonly associated with 'prestige', 'authority' and 'power' but traditionally, the concept has more depth and meaning as with most Māori concepts. Marsden (1992) notes that '*authority is derived from the gods'* (p. 118).

Mana is therefore a gift placed upon a person who then becomes the channel for mana, but never the source (Walker, 1992).

In retrospect, these two concepts are generally intertwined; Ahi-kā-roa is linked to the occupation of an area, however occupation of an area does not constitute mana over an area; whakapapa therefore reinforces the status of a group of people that holds ahi-kā-roa, not merely occupation. Many natural geographical features are named after prominent ancestors of iwi with ahi-kā-roa and mana whenua. Landscape features noted within pēpeha are spoken by those with mana over an area and have maintained their ahi-kā-roa over a long period; maunga can also add to the mana of an iwi.

Te Kāhui Maunga, the mountains within the central plateau region of the North Island, New Zealand, are integral to the ahi-kā-roa of the iwi and hapū of the maunga. Horonuku Te Heuheu Tukino IV (a Ngāti Tūwharetoa chief of the 1800s) reinforced the ahi-kā-roa held by his iwi as described by Cowan, "*Behold my ahi-ka, my mountain Tongariro. There burns my fire, kindled by my ancestor Ngatoro-i-rangi. It was he who lit that fire and it has burned there ever since! That is my fire of occupation!"* (1927, p. 29). Volcanic activity can therefore be viewed as another physical embodiment of ahi-kā-roa. For other iwi associated with Te Kāhui Maunga, such as Ngāti Rangi, the volcanic fires of Ruapehu are called 'Te Ahi Kā o Paerangi', the eternal fires of Paerangi (Rainforth et al., 2012).

This provides an example of the interrelationship between mana whenua and ahi-kā-roa and an illustration of the physical and spiritual representation of these concepts to Māori.

3.2.6 Maunga

Mountains are of particular prominence to iwi, specifically those that each individual iwi and hapū link to through whakapapa. As indicated earlier, pēpeha conveys the

links between an individual to the geographical features within their rohe, and in most cases begins with a maunga. Their importance is often related to what they symbolise for Māori; whether it be as an ancestor, protector, a place where tūpuna are put to rest, or a boundary marker (Walker, 2008).

Maunga are often revered and beloved by their people. The countless stories throughout Aotearoa reveal the nature of these maunga, frequently speaking of their movements and volcanic activities. For example, the eruption of Mt. Tarawera in 1886 impacted largely on the village of Te Wairoa with 108 known casualties as a result of the eruption; the majority of these deaths were Māori. The main impact resulting from the Tarawera eruption was the loss of land for the tangata whenua (Lowe, 2008) which would have had compounding effects on their ahi-kā-roa over their ancestral lands.

Te Kāhui Maunga, the maunga within the central volcanic plateau, are central to iwi and hapū from this area. These maunga, Ruapehu, Ngauruhoe, Tongariro, Pīhanga and Taranaki, are all volcanic entities prized within iwi narratives. Narratives within the central north island iwi Ngāti Tūwharetoa tell of the arrival of ahi tipua (fire demons named 'Te Pupū' and 'Te Hoata') to Aotearoa. Ngātoro-i-rangi *(*a famed tohunga[12] of the Te Arawa waka[13] who claimed the inner lands of Te Ika a Maui, the North Island for Ngāti Tūwharetoa), climbed Tongariro*,* and was on the brink of death from the elements and called to his sisters in Hawaiiki, Kuiwai and Haungaroa to send fire to warm him;

E Para, E! Titoko o te ao marama
Tukua au ki tawhangawhanga nui no Rangi, no Papa
Hei aio!
Tu ake te makariri, haramai te werawera
Hika ra taku ahi ki a Kautetetu

[12] A person of authority schooled in the traditional whare wānanga whom had feet in both the physical world and the spiritual realm.
[13] Reference to a canoe of the great Waka Migration from which many Bay of Plenty iwi descend.

Hika ra taku ahi ki a Te Pupu

Hika ra taku ahi te a Te Hoata

Ki a Te Moremore o te rangi e!

The tipua[14], Te Pupū and Te Hoata, brought forth with them the ahi tamou[15], contained within three kete (baskets). Te Hoata and Te Pupū thus travelled to Aotearoa on a subterranean journey surfacing first at Whakaari, and finally on the slopes of Tongariro at Ketetahi[16] Springs. Their journey from Whakaari to Tongariro left signs on the landscape; classified as ngāwhā[17], puia[18] and waiariki[19] (Te Hau o Tāwhaki, 2011; Hochstetter, 1959; H. Hakopa, personal communication, August 5, 2014) thus bringing forth volcanic and geothermal activity to the land.

Maunga and their significance to iwi are largely embedded within traditional knowledge or Mātauranga Māori. This knowledge includes numerous narratives in which the mountains are often portrayed as living beings; beings led by natural emotions of love and anger.

The legend of the volcanoes of the central plateau is an example of one of these narratives. It begins with Ruapehu, the ancestral maunga of Ngāti Rangi. It is said that he was a gift from the heavens, from Ranginui. Māui Tikitiki-a-Tāranga[20], on one of his many quests, went fishing in the southern waters a great distance from Hawaiiki[21] with his brothers. And with the jawbone of his great grandmother Muriranga-whenua, he fashioned a hook that fished up Te Ika a Māui, the great fish of Maui, which today is known as the North Island of Aotearoa.

[14] Spiritual beings
[15] Sacred fire
[16] Ketetahi Springs is named after the final kete of the three.
[17] Hot spring
[18] Geyser
[19] Thermal hot pool
[20] Māui Tikitiki-a-Tāranga the reknowned demi-god of the Māori myth and legend.
[21] The ancestral homeland of Māori

The sea churned with the might of the fish as it thrashed around and Māui returned to the homeland of Hawaiiki to seek assistance through karakia[22]. In his absence, his fear-ridden brothers sought help from a higher being, Ranginui, our primal father.

Ranginui replied to them '*The mana of Te Ika-a-Māui can only be subdued by a greater mana. I give you this in Ruapehu'.* With this he placed Ruapehu in the centre of the fish to quell its might and thus Matua te Mana was formed.

As time drew on, Ranginui noted the loneliness of Ruapehu and placed two tear drops at his feet. One of these was Te Awanui-ā-Rua, the beginning of the Whanganui River. These were not enough to fill the void in his heart. As he pleaded with Ranginui for company, the primal father sent through four companions; Tongariro, the guardian of the tear drops; Taranaki, the keeper of the tapu of the maunga; Ngauruhoe, the servant to the mountain clan; and finally the beautiful maiden Pīhanga. As time passed, battle ensued between two volcanic entities (Taranaki and Tongariro); this perhaps was used to describe the volcanic activity of this area (Ngāti Rangi Trust, 2013).

Volcanic activity potentially is a critical part of the narratives indicating cultural interpretation of events experienced by the local population. Exposure to volcanic activity is indicated in an incorporation of and perspective on the nature of these events through delivering specific kōrero relating to an event and/or experience. These narratives are repositories of mātauranga Māori and serve to enlighten the experiences of volcanic activity and interpret and understand the geographical landscape. Lowe (2008) explores the impacts of volcanism on early Māori society and mentions that the awareness of volcanic activity was particularly strong among early Māori and mitigation measures by way of tapu and rāhui were placed in areas at risk from future eruptions (Lowe et al., 2002).

[22] Prayer or incantation

3.2.7 Marae

Pēpeha as explained earlier outlines the links iwi and hapū have with their geographical places. A description of a sub-tribe-based pēpeha mentions other physical links to the landscape such as waka, marae and hapū:

Ko Te Arawa te waka	Te Arawa is the waka
Ko Tongariro te maunga	Tongariro is the maunga
Ko Taupō-nui-a-tia te moana	Taupō-nui-a-tia is the moana
Ko Tapeka te marae	Tapeka is the marae
Ko Ngāti Tūwharetoa te iwi	Ngāti Tūwharetoa is the iwi
Ko Ngāti Turumakina te hapū	Ngāti Turumakina is the hapū

This pēpeha is a further description of the researcher's links to one of her tribal areas. The overall Ngāti Tūwharetoa pēpeha described in Section 3.2.4 describes the iwi links, and the hapū pēpeha above provides a more personal representation of a person that further identifies them within the wider iwi grouping.

Marae are a place of refuge and is considered safe largely due to the whanaungatanga element that is present when the gathering of whānau is undertaken. Walker (1992) defines marae as the focal point for cultural and communal activities for Māori. Over time the use and transition of marae have grown since pre 1928[23]. Iwi and hapū settlements, pā or kainga as many were called, were the centre of activity for the people and the marae ātea, or the court yard, was the assembly ground (Firth, 1959, as cited in Walker, 1992, p. 17) that denoted significance more as the focal point and the place for ceremony. Unlike the marae of today, where the wharepuni is now at the core, early navigators did not record the establishment of large elaborate carved buildings that we associate so keenly with marae of today. The evolution of marae has responded to the many changes and needs of iwi throughout the post-colonisation period. Marae has altered in its

[23] Apriana Ngata, Minister of Maori Affairs established carving school at Rotorua in 1928 and the following year 6,000 people attend the opening of the meeting house of Turangawaewae (Walker, 1992).

symbolism over time from a physical point of resistance to colonial dominance, to a focal point for cultural revival and the growth of urban multi-iwi marae (Walker, 1992).

Marae is the physical and spiritual stronghold for iwi and hapū. Lowe (2008) describes marae as a designated place of refuge in response to natural disasters for early Māori. Its importance to iwi is profound in the sense that it provides iwi with a place, with ancestral links, immersed in traditions, kawa and tikanga. It is the tūrangawaewae, a place to stand, for iwi. Walker (1992) describes marae as an institution steeped with history and culture. Marae also is one of the physical components that is representative of whakapapa connections within hapū and also of mātauranga Māori through the whakapapa kōrero of the whare tipuna (Te Puni Kōkiri, 2009). Tapsell (2002, p. 141) goes further to describe marae as a 'physically bounded three-dimensional space' that brings together our primal ancestors (Ranginui and Papatūānuku), ira tangata or the human based element and the ira atua, or tūpuna. It is a place that invites all aspects of iwi culture, being guided by te reo Māori, whakapapa, mātauranga Māori and tradition and tikanga. Marae represents the physical relationship between concurrent time periods and generations of ngā rā o mua[24] and the present through providing a space whereby these two aspects coexist.

The wharepuni (meeting house) is a physical representation of Māori concepts significant to iwi. It knits together the aspects of Tapsell's (2002) three-dimensional space through incorporating the primal parents as the roof and floor of the whare, as well as concepts central to their separation. The wharepuni is typically the focal point of contemporary marae, and the marae ātea, the courtyard was traditionally the focal point for hui, gatherings and celebrations (Walker, 1992).

[24] A term often used to describe history, similar to 'long ago'.

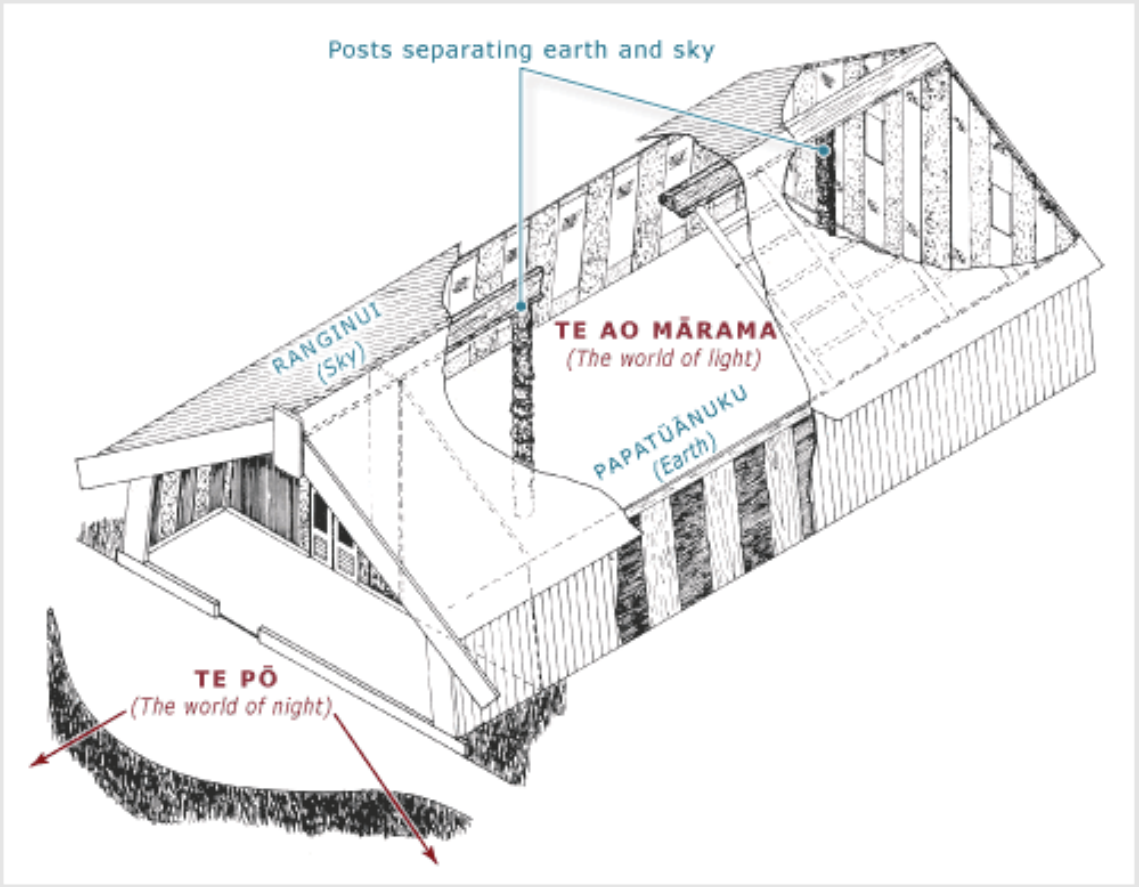


Figure 9. Visual representation of the relationship that exists between wharepuni and atua.

(Keane, 2013).

The structure of a wharepuni is also viewed as the embodiment of an ancestor; a protector of the people from the elements and in times of need. The building mimics the physical aspects of a person with the backbone and ribcage as the apex of the roof and the rafters, and the head and arms as the entrance or front of the wharepuni. Within the body of the ancestor, noted as the interior of the whare, is a library of sorts, with each pou or pillar being an illustration of whakapapa and mātauranga Māori.

A marae is a place for iwi and hapū to commune, to wānanga, to debate, to celebrate and to grieve. The pivotal element in relation to this research is the importance of marae to iwi and hapū during a crisis. It is a place where whānau as a

whole can congregate, to grieve in unison and to gain support from the past and present.

3.2.8 Mātauranga Māori

Mātauranga Māori is a precious knowledge system that has evolved with the various journeys and experiences of iwi throughout Aotearoa and is unique to them. Mātauranga Māori can be described as *"knowledge … created by Māori humans according to a set of key ideas and by the employment of certain methodologies to explain the Māori experience of the world"* (Royal, 1998, p. 2). Hence, it can be defined as an accumulation of a vast amount of knowledge that extends over the history of Māori. Durie (2012) describes mātauranga Māori as evolutionary in the sense that experiences of today further add to its knowledge base. This body of knowledge is not static despite drawing from historical experience and tikanga to guide its users, but provides a foundation for those building on it and casting their new experiences and perceptions into the kete that is mātauranga Māori. Therefore, mātauranga Māori acts as a conduit between the traditional and contemporary knowledge systems and beliefs, weaving together the past and the present.

Mātauranga Māori stretches beyond space and time, beyond the shores of Aotearoa, where its roots exist within Hawaiiki and wider Polynesia. Throughout the passage of time mātauranga Māori has adapted to changes in lifestyle, a new land, to colonisation and the knowledge and experiences gained during this century. This body of traditional knowledge has remained resilient despite experiencing dramatic adjustments during colonisation even to the extent that its survival was jeapordised.

3.2.9 Māori Concepts in Parliamentary Acts

Several Māori concepts are included within local and national policy frameworks. Policy is often guided by a standardised version of Māori value concepts and common terms that identify important aspects central to Māori culture (see Table 10 over the page).

The intimate relationship that exists with iwi and the natural world molds the guiding tikanga that feeds into all other aspects of life, such as by providing a framework that professionals in health care, environmental management and emergency management can take into account. This incorporation can result in a further understanding of the difference of perspectives and cultural traits that exist between Māori and local government agencies nationwide (Harmsworth & Raynor, 2005).

Act	Term	Translation
Resource Management Act 1991	Tikanga Māori	Māori customary values and practices
	Kaitiakitanga	Exercise of guardianship
	Maataitai	Food resources from the sea
	Mahinga Maataitai	Resource gathering area
	Tangata Whenua	Iwi/hapū with mana whenua status over an area
	Taonga Raranga	Prized weaving plants
	Tauranga Waka	Canoe landing site
Te Ture Whenua Maori Land Act 1993	Ahi kā	Fires of occupation
	Kaitiaki	Guardian
	Tikanga Māori	Customary values and practices
	Tipuna	Ancestor
	Whanaunga	Person related by blood
	Whāngai	Person adopted in accordance with tikanga Māori

Table 10. A selection of the first Māori values and terms that were included in statutory acts.

(Resource Management Act, 1991; Te Ture Whenua Maori Land Act, 1993; Mead & Mead, 2003, p. 5).

Table 10 displays the first few Acts that contained standardised Māori terms. In more recent years, further Māori value concepts and terms have been included in a variety Acts including, but not limited to, Protected Objects Act 1975 (2006

amendments to include Māori term among others), and the Affiliate Te Arawa Iwi and Hapū Claims Settlement Act (2008).

3.3 Case Study - Ngāti Rangi

Ko Ruapehu te maunga
Ko Ngā Turi-o-Murimotu te taumata tapu
Ko Whangaehu te awa
Ko Ngāti Rangi te iwi
Ko Paerangi te tupuna

Ngāti Rangi, tangata whenua of the southern slopes of Ruapehu, trace their lineage back to Paerangi-i-te-Whare-Toka, their eponymous ancestor according to oral tradition. Their occupation of the southern reaches of Te Kāhui Maunga spans back over millennia, to before the arrival of the general migration of waka to Aotearoa. They have maintained their ahi-kā-roa since this time. Ngāti Rangi have an estimated 8,000 uri and at least 10% live within the Ngāti Rangi rohe (Ngāti Rangi Trust, 2013).

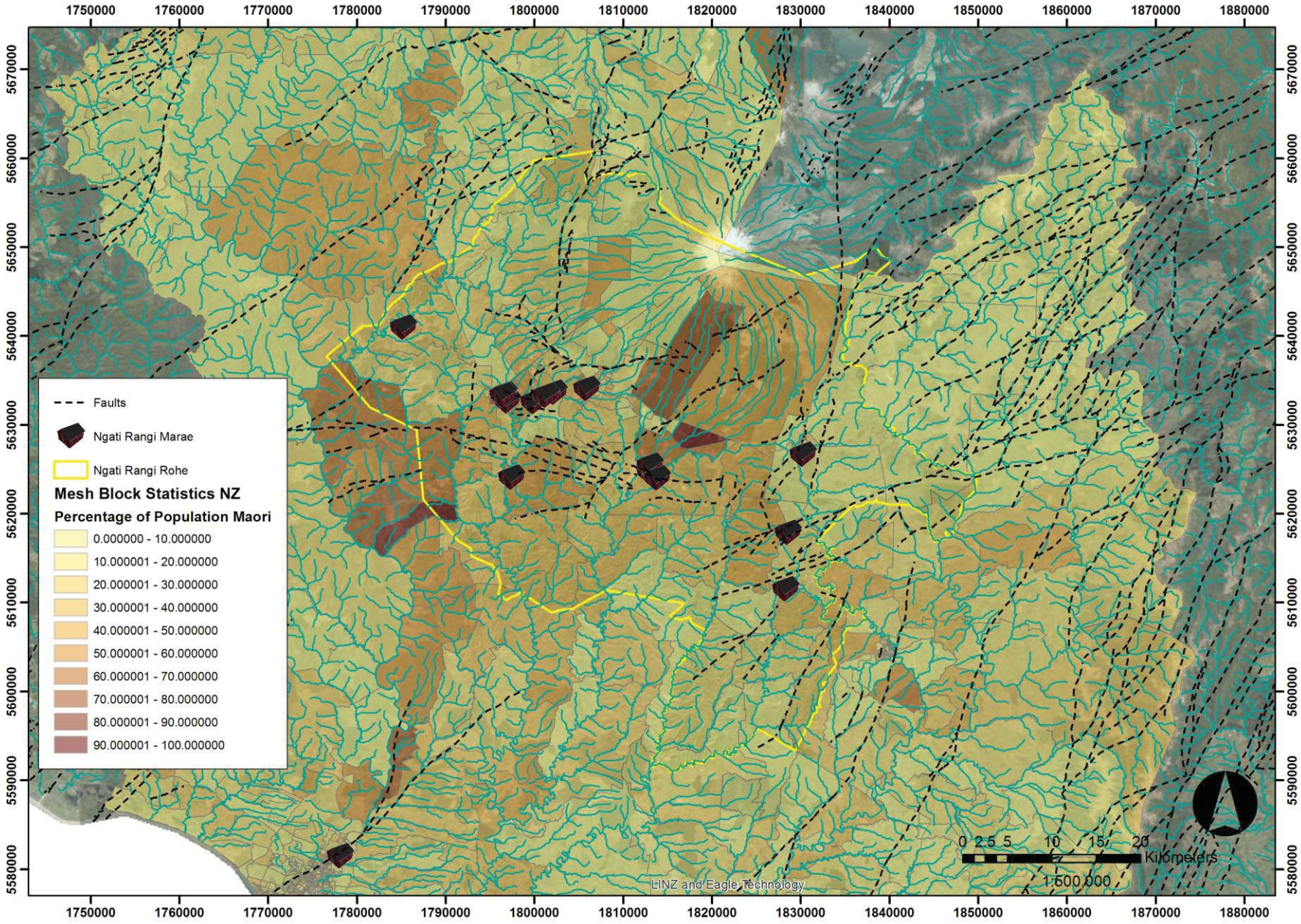


Figure 9. Mesh Block Statistics NZ: Perceptage of Māori population residing within the Ngāti Rangi Rohe

Ruapehu is fundamental to the identity and origin of the Ngāti Rangi iwi. Ruapehu is personified as a living being and is revered and beloved by his people. He is often referred to as 'Koro' (grandfather). Names in te ao Māori are often representative of history and/or significance within myths and legends; Ruapehu is also known by a number of names that are outlined below in Table 11 and are representative of his stature within te ao Māori and more specifically with Ngāti Rangi. These names denote the significance of Ruapehu and the cultural and historical references by which these names came in being.

Matua te Mana	Reference to Ruapehu being the first maunga created by our atua (Ranginui), and Ruapehu holding the mana of the Te Ika a Maui.
Paretetaitonga	Paretetaitonga means 'that which wards off the southern winds'. This name was given by Maui-Tikitiki-a-Taranga. A principal peak on Ruapehu also holds this name.
Te Whare Toka o Paerangi	In short this means Paerangi's house of stone.
Ruapehu	The most common name for the maunga that refers to its explosive nature; pehu (explosive) rua (crater).

Table 11. The Ngāti Rangi names for Ruapehu

(Ngāti Rangi Trust, 2013).

The deeply spiritual connections Ngāti Rangi have with their ancestral maunga are reinforced not only during the recitation of their pēpeha, but through maintaining their ahi-kā-roa, which is reinforced by the 15 marae located within the Ngāti Rangi

rohe. Their spiritual connections are strengthened and maintained as Ngāti Rangi continue to follow and embrace the spiritual pathway set before them by their tūpuna, and continue their cultural practices. Ngāti Rangi, in the preservation of their ahi-kā-roa, have continued their residence in this area, to be near their tūpuna. The importance of Ruapehu to Ngāti Rangi cannot be overstated: their tūpuna rest with Matua te Mana in Te Wai-ā-moe[25], he is Te Whare Toka o Paerangi, their house of stone, and Pare-i-te-tai-tonga, their protection against the strength of Tawhirimatea. From Ruapehu spring the headwaters of major rivers in the area that feed mouri (mauri) onto the landscape, ngāhere (forest), and the people. The nature of his activity constantly replenishes the surrounding lands, feeding into the fertility of the landscape and through this providing a constant source of mouri and mana to Ngāti Rangi.

Figure 10. Te Wai-ā-moe, Mt. Ruapehu: Taken during a recent visit to the Crater Lake, Janurary 2015.

[25] Last resting place for Ngāti Rangi chiefs, also known as the Crater Lake on Mt. Ruapehu

3.4 Ngāti Rangi and their communication of 'Hazards'

Mātauranga Māori is a crucial element in chronicling perspectives, experiences and knowledge of specific events in iwi history within Aotearoa. Information on volcanic hazards exist within the mātauranga-ā-iwi[26] principally through waiata and karakia. As a repository of cultural knowledge and information over the generations of Ngāti Rangi existence, these examples provide the opportunity for review of volcanic events that occurred within recent history. The Ngāti Rangi Ski Academy (Kāhui Maunga Ski Academy) provides one basis for interaction of tangata whenua with their ancestral maunga, perhaps by cultivating a sense of kaitiakitanga and conservation (Te Reo Kōruarua, 2014) as well as ensuring this important cultural knowledge is shared at the pre and primary school level.

This intergenerational knowledge sharing also imparts their cultural perspective and perceptions on volcanic 'hazards'. The Ngāti Rangi perspective on the use of the term hazard when discussing volcanic activity is formally articulated within their Ngāti Rangi Taiao Management Plan (Gabrielsen, 2014). Ngāti Rangi rejects the use of the term hazard when describing the consequence of volcanic activity (Gabrielsen, 2014; Pinal et al., 2013; Rainforth et al., 2012; Wilson, 2007). This position is communicated throughout the generations and therefore and is widely accepted throughout the iwi. This viewpoint is based on the acceptance of Matua te Mana and in a wider context Rūaumoko, as natural entities and processes that should not be restrained, diverted or withheld. A Ngāti Rangi pao, a very concise song usually sung for entertainment (Māori Dictionary, 2014), describes Ruapehu in his eruptive state.

O rongo Ruapehu
Turaki auahi
Puahiri Whakarunga
Ki whai tua ee[27]

[26] Knowledge specific to an individual iwi
[27] Pao gifted to this research by C. Wilson (Te Māreikura Māramatanga, Ngāti Rangi, circa 1945)

‘Puahiri whakarunga’ is a descriptive word for an eruption; ‘turaki auahi’ could also signify the visual experience of witnessing a plume of ash – ‘auahi’ meaning smoke and ‘turaki’ to throw down. ‘Rongo’ could also represent reputation; the reputation or fame of Ruapehu. This pao provides an indication of the perception and understanding of Ruapehu as a volcanic entity from a Ngāti Rangi viewpoint.

The appreciation Ngāti Rangi has for Ruapehu as a volcanic entity could explain the designation of tapu areas in relation to the mountain. Practical measures were put in place to signify the dangers and risks of specific areas, such as Te One Tapu. Tapu is a belief, a notion that educates one to respect the natural world as ‘Māori things involve the whole of nature’ (Pewhairangi, 1992, p. 10). This understanding, contained within their mātauranga Māori, is indicative of traditional interpretations of volcanic activity and the safety of the people of the area.

In the recent past, Ngāti Rangi has taken advantage of the active nature of Ruapehu as a means to communicate specific kōrero and historical knowledge concerning volcanic activity across generations. Despite the lull between episodes of volcanic activity there is a continuation of internal iwi knowledge sharing which extends throughout these periods of quiescence. There are a variety of ways Ngāti Rangi share knowledge and historical experiences regarding the maunga as an entire being, not always specific to volcanic activity; through wānanga, rā wairua (Ra maramatanga – annual event dedicated to the spiritual experiences of Ngāti Rangi), and Kāhui Maunga Ski Academy, as some examples, and delivered via tikanga, iwi stories, karakia and waiata. The exchange of knowledge is also crucial to the understanding of cultural and scientific language on a bi/multi-cultural level.

For countless generations Ngāti Rangi have inhabited the southern flanks of Ruapehu. They have born witness to his volcanic activity since human settlement in Aotearoa. There are early written accounts of lahars within the Whangaehu River, one such by Reverend Richard Taylor (1861, as cited in Hodgson, 1993) who reported uncharacteristic flooding within the Whangaehu River. Ngāti Rangi has within their oral narratives records of events, by way of mōteatea, ngeri, karakia, and other

forms of waiata. For example, the waiata below is from Ngāti Rangi and was written with reference to the eruption of 1945:

Moimoi Tahuārangi *te pikinga i Tuhirangi*
Ka whakamau te hiwi ki Murimotu ee
Kei tuahiwi taku rori haerenga ki roto Ōhāpopo
Takoto whāroa ngā mānia ki Karioi ee
Kia tū wātea taku titiro Raetihi Pā ki Ruapehu
Te whakaingo mai he tau pakipaki
Papaki rawa i taku uma
He puke nohoanga nō te keukeu roa
He roa te tāringa kia whakaaria mai ngā tohu tukutuku
Tukutahi te puehu turaki whakatua
Ka whakahoki mai *hei tāpora mō te nohoanga ia koutou mā eei*

The guardians cry as they ascend Tuhirangi
And then continue on to Murimotu
Over yonder is the path to Ōhāpopo
Where the plains of Karioi open up
So that I can clearly view Ruapehu
Oh the majesty as I wait for a clear period of weather
And his majesty also reminds
That he originated from the great surges of the ocean
I stand waiting for activity
Behold! An eruption of ash.
Do not fear, this ash will cloak and replenish the land and help us live as one[28]*.*

This waiata is another example of traditional knowledge; waiata is a medium where large tracks of information are stored and repeated throughout the generations.

[28] Ngāti Rangi waiata gifted to this research from C. Wilson, Ngāti Rangi. Bold in place as received from C. Wilson (Te Māreikura Māramatanga, Ngāti Rangi, Circa 1945).

Through the translation provided by Ngāti Rangi, the waiata relays a number of factors describing the iwi and their relationship with Ruapehu, and their reaction to volcanic activity. This has the potential to reveal the nature of the relationship Ngāti Rangi have with their ancestral maunga and the associated volcanic processes or hazards. Tobin and Montz (1997) illustrate natural hazards as the possibility of interaction between natural events and humans. Therefore, based on this description, a natural hazard is described as such based on its potential to impact on people and property.

The use of the term 'hazards' to describe a volcanic eruption and its resulting impact on surrounding populations by scientists and emergency managers in New Zealand and internationally is a subject of contention for Ngāti Rangi. Their relationship with Ruapehu expresses their acceptance and understanding of him as a powerful being of nature and awareness of their place within nature and te ao Māori. This recognition and understanding of Ruapehu ultimately means the Ngāti Rangi people accept him as an active volcanic entity and celebrate and welcome his volcanic processes. Ruapehu is Matua te Mana, the guardian of mana that uses volcanic activity to share part of his mana with the people, and to replenish and revitalise the land and Ngāti Rangi. The importance of Rūaimoko (the female entity of Rūaumoko), the unborn child of Ranginui and Papatūānuku, to Ngāti Rangi is paramount also. Rūaimoko exists within the womb of the eternal mother Papatūānuku, but is also linked strongly with Matua te Mana.

Ngāti Rangi have resided at the southern side of Ruapehu from time immemorial. Their exposure to volcanic activity throughout the generations has meant that they have adjusted their livelihoods to live safely with a volcano. Subsequently, their traditional kainga and pā (traditional homes and fortified villages) are located in areas considered safe by the people. Ngāti Rangi are the human voice of their maunga, and they speak for him when needed but will watch and listen for the tohu that will indicate to them their level of safety. Any alterations for precautionary measures against the potential impacts resulting from volcanic activity and eruptions have the ability to distort their connection to their maunga. Therefore, Ngāti Rangi

are adamant in their stance to protect Ruapehu against any human alteration. It goes against their tikanga to demean the mana of Matua te Mana by altering his geomorphological nature, even if this means protecting the lives and property of people. People chose to settle in areas along flood plains and along lahar channels perhaps without prior knowledge and understanding of volcanic processes. People chose to position themselves on the landscape and therefore make the maunga and its natural processes hazardous. However, from the perspective of Ngāti Rangi moving a mountain to protect their home is unacceptable, homes should be moved to protect the mountain. Finally, their belief is Ruapehu is their tūpuna, their koroheke[29] and as such, he is the key to their cultural identity, and history and the link to the realm of ngā atua through whakapapa. Matua te Mana provides strength to the iwi, who are strong in the belief that Ruapehu has the right to be able to erupt, shake, and express his emotions without restraint from humans.

3.4.1 1945 Eruption

The eruption of 1945 had substantial impacts on the daily lives of those living at the foot of the mountain, largely revolving around ash and its resulting impacts; skin, eye and throat issues, crop failure, issues with stock feed, shearing blades dulling during shearing season, impacts on driving visibility and corrosive impacts on vehicles and machinery (Johnston, 1997). A prominent Ngāti Rangi kuia recollected the eruption clearly '*we were covered in ash'* (R. Mareikura, personal communication, October 1, 2014). Johnston (1997) sourced 13 separate references of ash fall within Ohākune in 1945 from July through to September with the final date of ash fall occurring over a three-day period. The tribal account of this event is captured within a waiata 'Moimoi Tahuārangi' which pays homage to the prestige of the mountain and the celebration of eruptive events (C. Wilson, personal communication, September 23, 2013). During this time, the relationship between the tribe and their mountain was not really recognised, and cultural use of the mountain was nil due to his state of tapu.

[29] Ngāti Rangi term for koroua, or male elder.

3.4.2 1953 Tangiwai Disaster

The Tangiwai railway disaster of 1953 is long held within the memory of Ngāti Rangi and is potentially one of the most memorable lahars due to the present koroheke and kuia generation being alive during this time. It can be presumed that many whānau hold stories about this night, as many were scheduled to travel on the train, others had their dance interrupted by news of the event. Many families also contributed to the clean-up of the awa post disaster and, for some time, Ngāti Rangi did not visit the Whangaehu River for their cultural and spiritual purposes. It can be said that a cultural rāhui over the area was implemented by the iwi until a time when it was deemed culturally appropriate. The communication of this event was predominantly by word of mouth. As a result of this event, the New Zealand Railways Department installed a lahar warning device upstream of the Tangiwai Bridge in order to detect any future rise in acidic waters in the river system which could signal an alarm to halt railway traffic until inspection (Neall, 1976).

3.4.3 1995/1996 Eruption Episode

The 1995/1996 volcanic activity would have initiated internal discussions around historical iwi kōrero relating to volcanic activity. This period was integral for iwi revisiting local knowledge and perhaps gaining an understanding of the science of volcanic activity. This again would have fortified the iwi and their relationship with their ancestral mountain. Notwithstanding this, the activity still stimulated practical questions regarding the safety of the iwi (K. Wood, personal communication, May 8, 2014) such as that of marae, homes and infrastructure from volcanic flows (leading up to the 2007 lahar). Many key Ngāti Rangi people carried the position of faith in their ancestral maunga that he would look after the iwi, which resounded throughout the iwi. This also contributes to the trust in the experience of Ngāti Rangi tupuna in the placement of marae in the rohe.

3.4.4 Consultation and involvement pre: 2007 Lahar

The flow of communication between the Crown and Ngāti Rangi became an integral part of consultation following the 1995/1996 eruptions due to the risk of an imminent Crater Lake dam break, which occurred 18 March 2007. The consultation between Ngāti Rangi and the government (by way of the Department of Conservation, Minister of Conservation Sandra Lee and Civil Defence) was viewed as successful. The success was due to the sharing of knowledge, communication and decision-making by Ngāti Rangi. The stance Ngāti Rangi took on engineering solutions that were proposed was that they were deemed unacceptable on a cultural and spiritual level as well as practically.

The position Ngāti Rangi held, and still hold, when discussions turned to a proposed engineering solution at the Crater Lake was that no intervention will be undertaken on the maunga. An alternative was chosen, with the creation of a bund on Te One Tapu in consultation with neighboring iwi and the Crown. Emergency management preparation was central to the lead up to the 2007 lahar. Local company Winstone Pulp International (WPI) Karioi Forestry and the timber mill participated in planning for the event as the Whangaehu River meanders through the forestry and both of their industrial sites (Karioi and the Timber mill) are located within a 1-2km vicinity to the Whangaehu River and the Tangiwai Bridge.

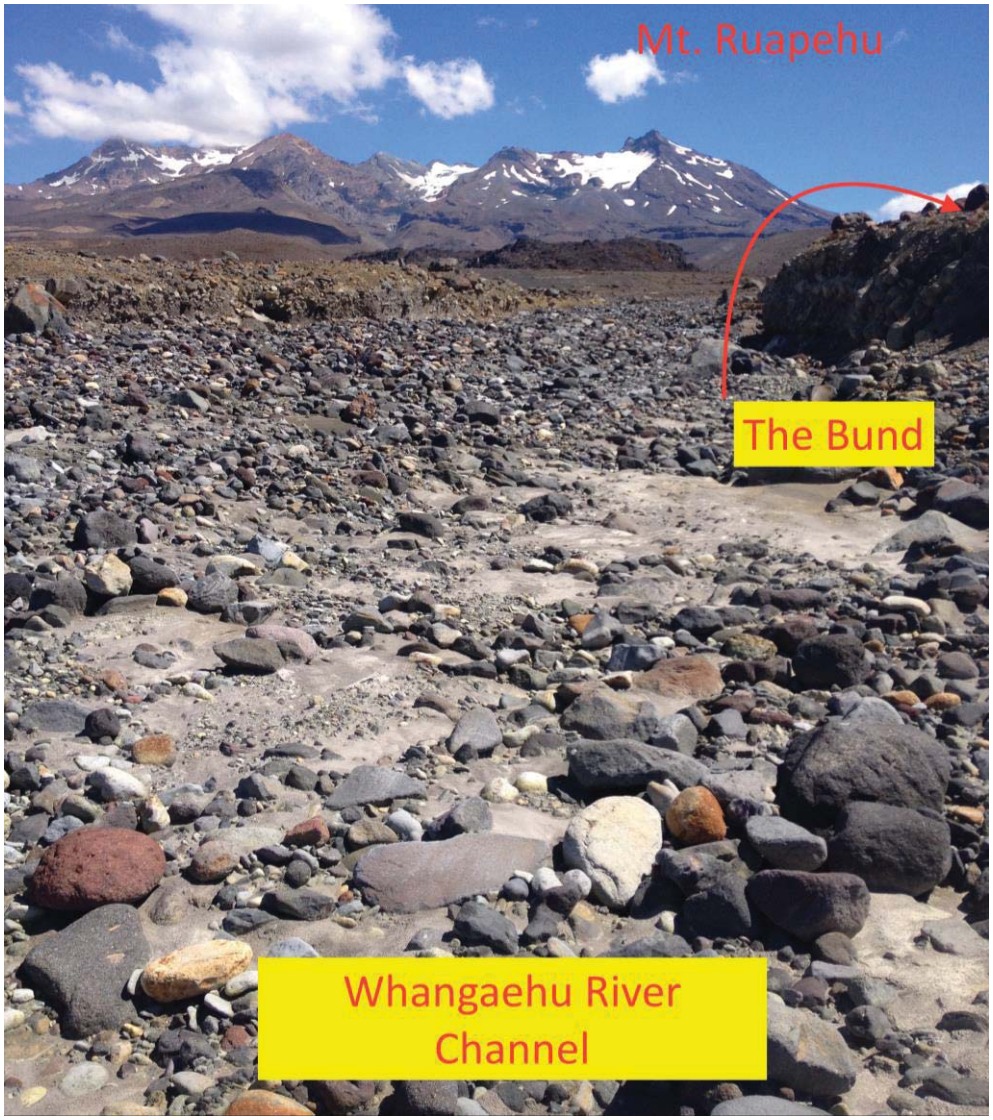


Figure 11. Te One Tapu: From the eastern side of Ruapehu flows the Whangaehu River, a tupuna awa of Ngāti Rangi. Located on the top left is evidence of the Bund built up prior to the 2007 lahar.

The community at Karioi were involved as part of preparatory measures to ensure the safety of the community as the lahar made its way past the Tirorangi Marae bridge. Two community meetings were held for the Karioi residents largely to discuss traffic safety measures and the movement of stock. Pagers were the main means of communicating instructions, timeframes and keeping track of the lahar flow. The main concern for the residents was the safety of the bridge as its ruin would have resounding economic and social impacts. The local community was empowered through the process of consultation and heavy involvement in the response to the lahar (D. Te Riaki, personal communication, July 24, 2014).

3.4.5 Current Communication.

'Koro Ruapehu is constantly changing. Sometimes he's sleeping, sometimes he's active – sometimes he erupts'

(Ngāti Rangi Trust, 2014a).

The Ngāti Rangi Trust website provides users with direct links via the Internet to a variety of current volcanic surveillance and monitoring activities of Ruapehu which are:

- Links to GeoNet for current volcanic alert levels;
- Link to Horizon's maunga camera;
- and The Ngāti Rangi installed Te Wai-ā-moe (Crater Lake, Ruapehu) camera, which feeds directly to the Trust.

(Ngāti Rangi Trust, 2014b).

High-level communication occurs at the top level, among research and monitoring institutes such as GNS Science and Massey University, local authorities such as Horizons Regional Council and Waikato Regional Council and Crown entities such as Department of Conservation, Ministry of Civil Defence and Emergency Management as well as the iwi authority, Ngāti Rangi Trust. Through these forums, current monitoring of culturally significant sites has been initiated by the iwi and supported by these organisations. Monitoring of Te Wai-ā-moe, Whangaehu River and potentially Lake Rotokura is planned in the near future. The dissemination of information from these high-level personnel is where the communication is essential.

3.5 Summary

The concepts discussed intend to aid in the understanding of iwi. This chapter has examined the core relationships and foundations that ground iwi to a specific location and highlighted the importance of marae, maunga and all the intertwined

concepts that bridge not only these two key landmarks and history, but are also key to representing iwi and their relationship to the whenua through ahi-kā-roa. Maunga are central to the identity of iwi and contribute to their mana and ahi-kā-roa. Ngāti Rangi have long been exposed to volcanic activity and their mātauranga Māori highlights their interactions with their local environment. Their coexistence with the maunga and their interaction throughout history demonstrates a variety of concepts particularly within the mainstream Māori worldview and the key concepts central to Ngāti Rangi. Ruapehu as a volcanic entity is embedded within the Ngāti Rangi culture; however, understanding the risks posed to the local communities in the vicinity of Ruapehu is key to building their resilience.

Chapter 4: Ko Ruapehu te maunga

4.1 Introduction

This chapter describes the volcanic processes or 'hazards' of the region deriving from Mt. Ruapehu. These volcanic processes are the primary volcanic hazards that can impact the local and national populations. An analysis of specific hazard types are explored in this chapter, in addition to the means by which New Zealand addresses their impacts.

4.2 Volcanic Hazards and Eruption Styles of Mt Ruapehu

Ruapehu is New Zealand's largest andesite stratovolcano and stands at 2797 m (Lecointre et al., 2004). Ruapehu has three summit craters that have all been active over the last 10,000 years including the current Crater Lake, which is situated over the active South Crater (GeoNet, 2013). As a stratovolcano, Ruapehu is susceptible to triggering a number of hazardous events. Evidence of these volcanic hazards is recorded in the landscape and represented by the surrounding volcaniclastic ring plain, which is made up of fragmented rocks, the result of historical lahars, debris avalanches and some fluvial and glacial deposits (GeoNet, 2013).

4.2.1 Lahar

The term lahar derives from the Indonesian language in reference to a type of flow containing a mixture of water, rock debris, sand and silt (Smith & Fritz, 1989; Department of Conservation, 2006a; Neall et al., 2010). Lahars and other associated volcanic activity have shaped the surrounding landscape, which is largely a tussock environment with gravel and stone fields (Department of Conservation, 2006a; Neall et al., 2010). Lahars on Ruapehu often occur due to a number of circumstances: as a result of an eruption or other contributing factors such as a rim collapse, glacier burst, heavy rain (Keys, 2006) or as a result of an eruption causing the surrounding ice and snow to melt and flow (Major & Newhall, 1989). Water is an essential element to lahars (Neall et al., 2010), and in this case water is stored in the Crater

Lake and further water sourced from the surrounding snow and ice; heavy rains can also trigger lahars on Ruapehu. There are two types of lahars; firstly a debris flow which is largely made up of more than 80% of sediment of a variety of clast sizes and is a turbulent flow, and secondly a hyperconcentrated flow (60-80% sediment) which contains less sediment (size of sand grains or smaller) and flows as a laminar sheet (Department of Conservation, 2006a).

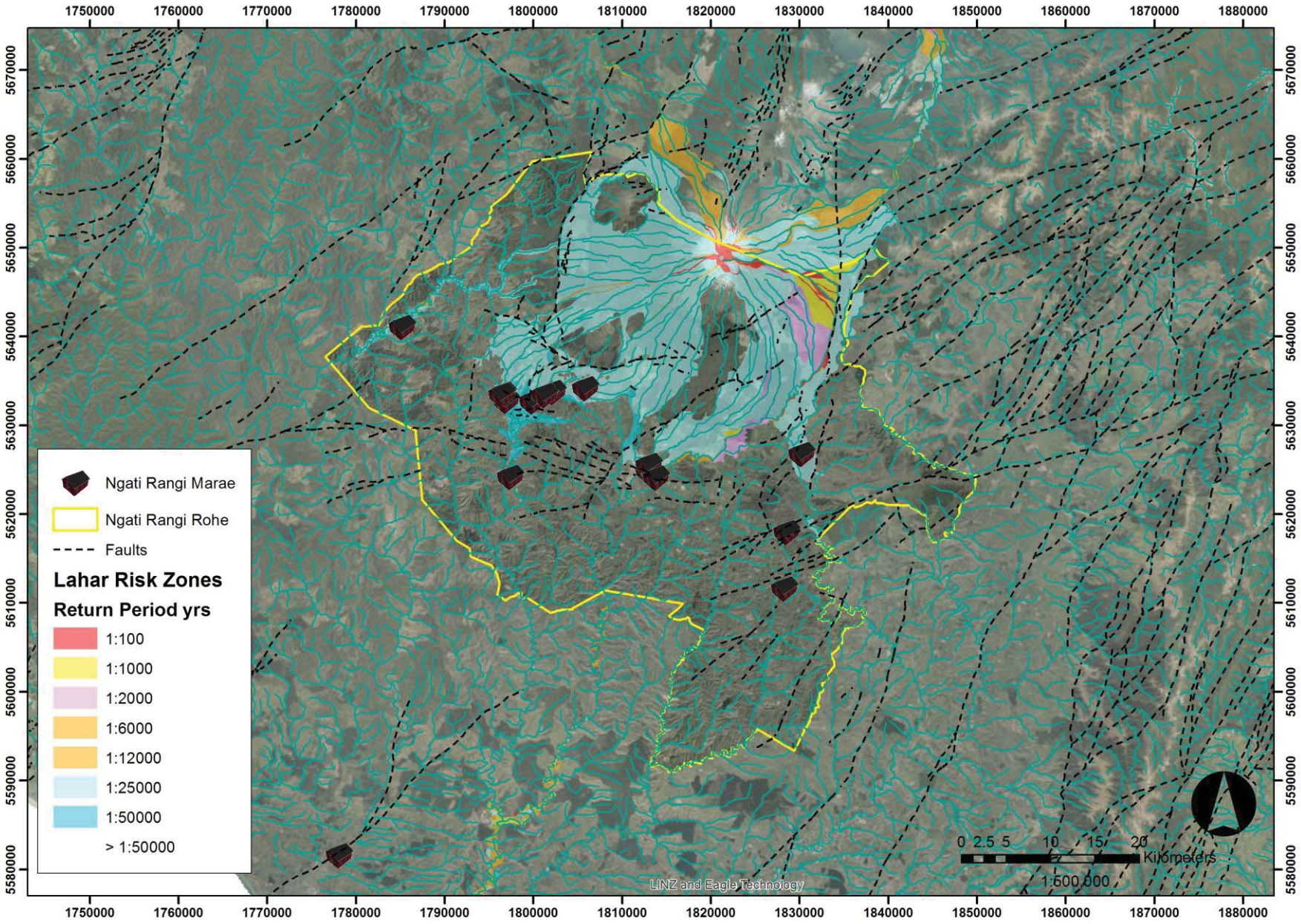


Figure 12. Ngāti Rangi rohe map: Ngāti Rangi marae placement in relation to mapped lahar risk zones (displayed in colour based on returned periods).

Lahars are usually confined to gorges and stream channels and often scour and erode the channels further. They are characterised as dense and fast and can therefore carry large objects such as rocks, and remnants of buildings (Neall et al., 2010). Since 1945 there have been approximately 13 lahar incidents on Ruapehu, although not all of these have been associated with an eruption. The Tangiwai disaster in 1953, for example, occurred as a result of a dam-break. During the 1995-96 eruptions, deposits of tephra built up around the crater rim by 6-9m, which posed the risk of a dam break that eventually occurred in 2007.

4.2.2 Lava Domes and Lava Flows

While not a hazard that occurs as regularly as lahars on Ruapehu, lava domes and flows still pose a threat to civilization. They occurred at Ruapehu in 1945 and potentially in 1861 (Neall et al., 2010). Lava domes are essentially mounds of viscous magma that extrude from a vent, and often initiate a series of other volcanic events, for example, if contact is made with the Crater Lake. A typical size of a lava dome can be between a radius of 100 m to at least 1-3 km (Neall et al., 2010), and due to its viscosity, it remains congealed in a heap around the vent (Bates and Jackson, 1980 as cited in Fink, 1987). Lava flows, uncommon in recent history, occurred predominantly during the Holocene period. Typically lava flows, like other volcanic flows, are defined by the topographic setting, favouring valleys. The risks posed by lava flows on Ruapehu can be the secondary hazards created due to ice and snow and instability of steep slopes (Neall et al., 2010).

4.2.3 Pyroclastic Flows

Pyroclastic flows are high speed currents of hot volcanic material and gas that are often very devastating (Druitt, 1998). These are rare on Ruapehu but have occurred in the Mangaturuturu and Whangaehu catchments, and flow deposits also exist in the Mangatoetoenui and Whakapapa catchments (Neall et al., 2010). Pyroclastic flows are largely controlled by the topography of the mountains, favouring valleys and are controlled by gravity (Druitt, 1998). Pyroclastic flows can occur when ejected

volcanic debris collapses sending hot material in a 'fluidising gas cloud' (GNS Science, 2010) reaching temperatures of up to several hundred degrees and speeds of up to 200km/h (Neall et al, 2010; GNS Science, 2010); these factors contribute to their hazardous nature. The main impacts on the environment and on human civilisation in the locality of a volcano are the impacts from heat and poisonous gases, which can result in burial, asphyxiation, serious burns and irritations.

4.2.4 Volcanic Debris Avalanche

Volcanic debris avalanches are typically large-scale landslides that occur when an unstable portion of a volcano collapses and gains traction through the force of gravity down a slope. These avalanches can be generated by a number of factors: the intrusion of magma, large magnitude tectonic earthquakes or very heavy rainfall. Several large volcanic debris avalanches have originated from the slopes of Ruapehu, with many flowing further than the surrounding ring plain (Tost et al., 2012). Similar to other volcanic flows, debris avalanches favour the contours of valleys and depressions in the landscape. They are hazardous due to the fact that failure can occur without warning and sends large volumes of material downhill at speeds of up to 320 km/h (Dufresne, 2009).

Mt. St. Helens provides an example of a debris avalanche, the largest recorded in history (USGS, 2013). This debris avalanche occurred on 18 May 1980 resulting in a total of 2.5 km^3 of material travelled 27 km outwards (Neall et al., 2010).

4.2.5 Ash fall/Tephra

All aerially ejected material forced into the air as a result of an eruption, hot gases or lava fountains (USGS, 2009) is given the term tephra (Froggatt & Lowe, 1990). Tephra is categorised by size and thus divided into three groupings: ash (>2 mm diameter), lapilli (2-64 mm diameter) and bombs (<64 mm diameter) (Neall et al, 2010; Lowe & Hunt, 2001). Tephra and its inundation are determined by the force produced by the eruption, in combination with the velocity and direction of wind

(Neall et al., 2010*)*. Due to these factors tephra has a large area of impact with the potential to cause widespread damage (Blong, 1984).

During the 1995 eruptions from Ruapehu, and more specifically on October 11th and 14th of that year, tephra expelled from the volcano had volume of approximately 30 X 10^6 m^3 within an area of 31,000 m^2. The following year, on 17-18 June 1996, another tephra-based eruption covered an area of up to 16,000 km^2 with approximately 6 X 10^6 m^3 of tephra expelled from Ruapehu (Cronin et al., 1998).

The impacts from tephra are potentially higher in comparison to other volcanic hazards due to the secondary impacts on the human population, local/national economy and property. These impacts may include reduced visibility, respiratory issues, roof collapse, crop damage, effects on infrastructure such as roads and airport runways (ash mixed with water causes less traction on these areas due to increased slipperiness), impacts on machinery, vehicles and airplanes (USGS, 2009). Secondary impacts from tephra can include significant and often fatal effects on livestock from consumption of excessive fluoride concentrations on pastures. During the 1995-1996 series of eruptions, approximately 2000 grazing stock deaths occurred as a result of chronic fluorosis in the Ruapehu region (Cronin et al., 2003; USGS, n.d) and starvation (Cronin et al., 1998).

To expand on this, impacts on stock as a result of tephra depend on the following factors:

- tephra consistency
- the volume deposited
- level of poisonous aerosols contained/attached to the tephra
- amount, if any, of rainfall following deposit of tephra
- current health and needs of livestock
- the age of livestock
- length of pasture; and
- stocking rate.

(Neild et al., 1998).

4.2.6 Volcanic Gases and Acid Rain

Volcanic gases emitted during an eruption are made up mostly of water, or rather steam and carbon dioxide. Smaller quantities of other gases, such as sulphur and hydrogen, are also emitted (Bates & Begg, 1997; Froggatt, 2010). During the 1995-96 eruptions at Ruapehu, large quantities of sulphur dioxide (SO_2) of up to 15,000 tonnes/day were expelled from the volcano (Neall et al., 2010). This ejected gas, and also hydrogen chloride and hydrogen fluoride, liquefies and mixes with water *'in the eruption plume to form aerosols which rain out over the landscape with ash*' (Neall et al*.,* 2010).

4.3 New Zealand Civil Defence and Emergency Management

This brief section describes further the New Zealand Civil Defence and Emergency Management procedures and the main strategy that guides the emergency management practices within New Zealand.

The exposure of New Zealand to a varying number of natural hazards and their associated risks reinforces the importance of research within the natural hazards sector. The Natural Hazards Platform – Interim Research Strategy has highlighted the need for research into natural hazards and signified its importance (Natural Hazards Platform, 2009). Together with the National Civil Defence Emergency Management (CDEM) Strategy (Ministry of Civil Defence & Emergency Management, 2008), the research strategy also supports the need for effective risk management strategies.

The National CDEM Strategy as described earlier in Chapter 1 has four main goals: 1) increasing community awareness of hazards through enhancing community understanding, preparedness and participation within civil defence; 2) reducing the likely risks posed by natural hazards; 3) enhancing the capability of communities locally and nationally to manage emergencies; and 4) augmenting the capability of

communities to recover from emergencies (Ministry of Civil Defence & Emergency Management, 2008). The approach used to actively achieve these goals coincides with the implementation of the 4Rs. The 4Rs (reduction, readiness, response and recovery) form the basis of the Civil Defence framework within New Zealand. Reduction is focused on the identification, analysis and minimisation of the risks posed to people and property. Readiness is largely focused on the development of strategies that can be used within an emergency or crisis phase. It can include several strategies for individuals and community-wide and-led response plans. The chief aim for the response phase includes two parts: A) awareness of a potential event, and B) an event occurring without warning. This response phase outlines the actions that individuals, communities and response services need to undertake before, during and post-emergency. The recovery phase is focused on immediate, medium-term, and long-term recovery after an event has transpired (Ministry of Civil Defence & Emergency Management, 2008).

To achieve the goal of community awareness of localised hazards through the 4Rs, it is noted that civil defence and emergency management requires a more meaningful understanding of the psychological, social, institutional and political processes that influence individuals and communities in how they consider risks from natural hazards. Finnis et al. (2004) have outlined that it is essential to focus on the perceptions of risk within the decision-making process, as this is also integral to community preparedness. In addition to this, Coetzee (2004) outlines the National Contingency Plan for Volcanic Eruption and clarifies the roles and responsibilities of stakeholders in the management of risk with three phases (1) pre-eruption phase, (2) eruption phase, and (3) post-eruption phase which links in closely with the 4Rs.

Understanding the risks posed from a volcanic entity can provide adequate data for the local population to work towards enhancing resilience. The CDEM Strategy in conjunction with the 4Rs essentially aim at strengthening and empowering communities through education and building up their capabilities to recover from emergencies.

4.3.1 Mitigation Measures

As a means to mitigate the impacts from volcanic eruptions, in particular from lahars, the following steps were undertaken post the 1995-96 series of eruptions:

- installation of early warning systems;
- establishment of emergency response systems;
- creation of a bund to prevent an overflow into the Tongariro River head waters;
- constant monitoring of the Crater Lake;
- raising and strengthening of the State Highway 49 bridge over the Whangaehu River; and
- various traffic control measures were put in place

(Keys, 2006).

4.3.2 Economy

In the southern reaches of Ruapehu there are several populated settlements; namely Raetihi, Ohākune and Waiouru. From the 2013 Census Data, the Ruapehu District has a population of 11,844 with 4,752 occupied dwellings and 2,409 unoccupied (Statistics New Zealand, 2013). A tourism drive for the Ruapehu region is at the forefront of local government marketing strategies to assist in the economic development of the district. Projected economic growth rates largely from tourism are predicted to support 677 new jobs from 2007 – 2026, resulting in a projected GDP increase of $397 million from $460m in 2007 to $857m in 2026 (Ruapehu District Council, 2010).

There is also a local Ruapehu intiative, The Ruapehu Whānau Transformation (Ruapehu Whānau Transformation Plan, 2014), which is a project aimed at providing a fundamental service in the retention of people within the community. This initiative relates specifically to employment, education, housing, health and social aspects within the region. It highlights the drive to build capacity within the local communities and the retention of Ngāti Rangi and other members of the community in the area further reinforcing ahi-kā-roa. This initiative empowers the community

with the opportunity to seek knowledge, to develop the skill base for employment whilst justifying the aspiration to maintain localised residence therefore strengthening the local population.

4.3.3 Economic Impacts from Volcanic Activity

Volcanic events have adverse effects on the community, the environment and the community. In light of the projected growth rates of the local population of the Ruapehu region through to 2026, there is still the risk of impacts on the local economy from volcanic activity. According to Johnston (1997), the agricultural community in Ohākune suffered substantial impacts on crops as a result of significant ash falls in the region from the 1945 Ruapehu eruption. In conjunction with crop damage, other impacts as a result of this eruption caused unpalatable pastures for local stock, reducing their access to food. Private homes were impacted through contaminated water tanks where downpipes were not disconnected. Other parts of the central North Island also felt the brunt of ash fall. For example, the Whanganui River experienced significant sediment build-up from ash and increased water turbidity from erosion, which impacted local water supply and fish populations in Taumarunui (Johnston, 1997). Other eruptions throughout the recent history have also affected the local economy. Cronin et al. (1998) describe the livestock in other North Island areas being affected by fluorosis and famine due to contamination of feed. Consequently, >2,000 stock died due to fluoride poisoning following the 1995 eruptions of Ruapehu (Cronin et al., 2003).

Further physical impacts resulting from the 1995-96 eruptions' ash fall affected all facets of society within the Central North Island, which is highlighted within Table 12 over the page.

Area of impact	Impact from ash fall
Horticulture	Mainly in residential gardens plants and vegetables were burned by ash resulting in poor growth and plant death.
Animals	Both livestock and household pets were affected by ash through ingestion from contaminated pasture, and also on their feet and coats.
Buildings/Structures	Build-up of ash on roofing, within gutters in some instances causing corrosion issues.
Machinery	Issues resulting from ash fall affecting motors and machinery, and air conditioning systems issues from ash.
Roads	Visibility issues from ash on roads (disturbance from driving). Ash on the road mixed with rain caused surface problems.
Water Supply	Residential water tanks affected by ash falling into guttering and thus entering into water supply.
Electricity	Erosion of system due to corrosiveness of ash causing power cuts and power line failure.
Storm water drainage	Potential to block drains and/or impact on sewage system.
Telecommunications	Potential impact on lines with ash fall and disruption to call clarity.
Air Traffic	Disruption of air traffic through delays and detours.
People	Impact on activities pertaining to outside recreation; boating, hunting and fishing and also the tourism sector.

Table 12. Physical impacts resulting from ash fall during the 1995/96 Ruapehu eruption episode.

(Becker et al., 2001)

The Atihau Whanganui Incorporation are an iwi based incorporation made up of a collection of Māori owned land that lies predominantly within the Ngāti Rangi rohe. The likelihood of impacts stimulated the initiation of their volcanic hazards emergency plan (C. Skyes, personal communication, July 7, 2014) to adequately prepare for a disaster and reduce the likelihood of economic impacts from volcanic activity, namely ash.

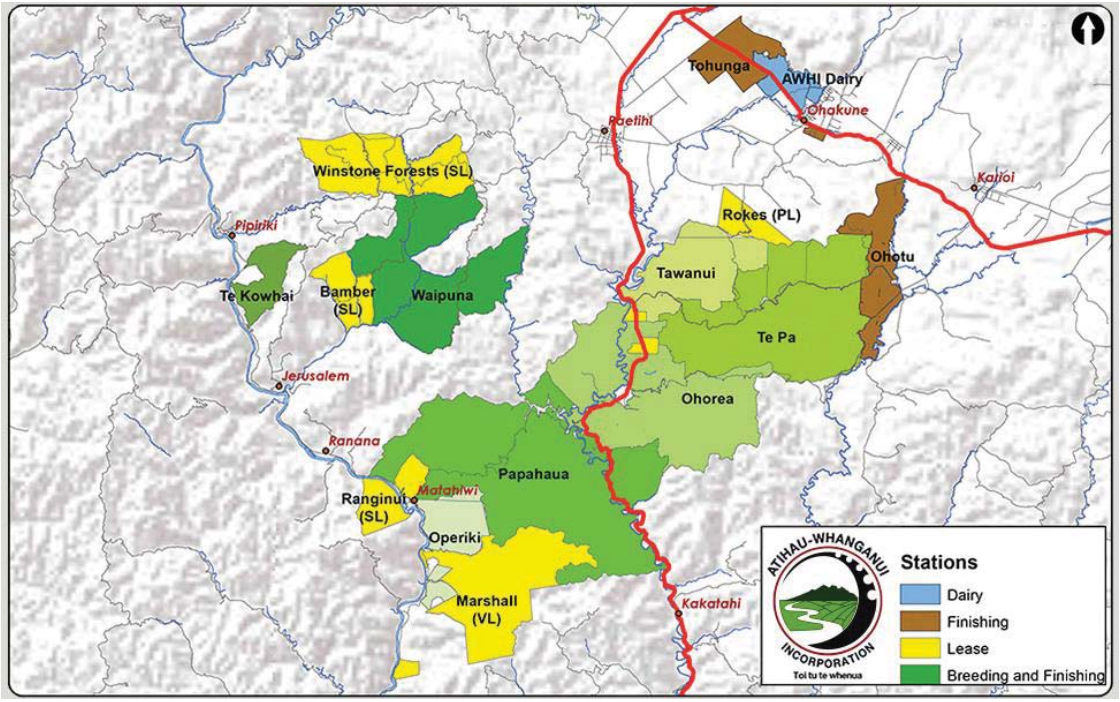


Figure 13. Atihau Whanganui Incorporation Land-use within the Ruapehu and Whanganui regions, New Zealand.

(Atihau Whanganui Incorporation, 2014).

The Ngāti Rangi Taiao Management Plan also takes into consideration future development within their rohe and the need to designate areas appropriate for development and areas that need to be avoided, specifically in known lahar paths (Gabrielsen, 2014).

4.4 Summary

This chapter has introduced volcanic processes that derive from Ruapehu, describing the typical hazards that result from each of these processes. Typically, the majority of localised warning systems focus on the potential for lahar activity as the most regular hazard originating from Ruapehu. It is key that wide-scale comprehension of these processes are understood by the local and wider community. It is clear that economic impacts as a result of tephra fall-out have the potential to devaste local horticulture and agriculture ventures.

Chapter 5: Methodology

5.1 Introduciton

This section describes the approach, methods and analysis of data for this research. This research itself converges several disciplines and therefore requires a distinct method to aquire and analyse data. A mixture of kaupapa Māori research, and qualitative and quantitative research techniques were applied. The research undertaken for this thesis included a literature reivew, analysis of marae survey data, marae assessments, conversations with Ngāti Rangi uri and an assessment of volcanic based data.

5.1.1 Research Constraints

Ngāti Rangi are heavily involved in internal and external iwi matters. Maintaining and building ahi-kā-roa is central to their vision as they work to entice their people home. The main constraint to this research was the availability of people, or lack of, and the risk of causing further 'hui fatigue' that consumed many of the key players within the iwi dynamics. This reduced the likelihood of meeting with key Ngāti Rangi people and pushed the data collection timeframe further out to accommodate their schedules.

Another major constraint to the research was locating individual marae for the specific marae site assessments. All of the fully functioning marae were easily located, but it proved difficult locating several of the multi-purpose facility marae as no specific addresses were given by the Trust. Consequently, some site assessments were unable to be completed.

Also Ngāti Rangi were the case study of this research, and their circumstances in relation to volcanic flows may only apply to a few other iwi and hapū within New Zealand, particularly those living near their ancestral mountain, which happen to be

volcanic entities. Therefore these findings are likely to apply to these communities, and perhaps can be adjusted to capture information on alternative volcanic hazards.

5.1.2 Observation

'Observation' in this sense is used to describe the researcher's involvement with Ngāti Rangi since August 2012 (as a contractor for the Ngāti Rangi Trust). The researcher's primary role at the Trust is to provide cultural-based feedback and perspective to government organisations on activities that occur within the Ngāti Rangi rohe. This role means that an indepth understanding of Ngāti Rangi as an iwi, their traditions, stories, tikanga was obtained and kept by the researcher for this specific purpose. This in turn provides a depth of understanding on Ngāti Rangi, thus formulating baseline perspectives for this research.

5.1.3 Ethics Approval

Prior to any data collection, a full Massey University Human Ethics Approval was submitted to and granted by the Massey University Human Ethics Committee. Minor changes were requested by the board post-submission and once these were amended, and approval had been given, data collection took place.

5.2 Approach

5.2.1 Quantitative and Qualitative Research Approaches

A mixed research approach was undertaken for this study through binding a mixture of qualitative and quantitative research. This approach combined western science and a Māori worldview, and aimed to incorporate traditional iwi knowledge into volcanic hazard research.

The qualitative aspect of this research was used largely to seek the human perspective. The aim was to identify perspectives from the ground, from people that lived in the area, and from people with a relationship to the land, and to the volcano.

Iwi in general have large repositories of knowledge coded in local waiata and karakia and held by those in particular deemed worthy of holding on to such knowledge. Historical knowledge of volcanic episodes should be confined within iwi history and kōrero. This assumption was made purely based on the fact that Ngāti Rangi have long lived within the lands of their ancestors, for over a thousand years, and therefore will have experienced and recorded in some way, volcanic events.

Gaining a better understanding of historical occurrences and responses is beneficial for current research on volcanic hazards and for emergency management. A qualitative approach was able to unearth to some degree the current gap in the knowledge base regarding iwi and volcanic hazards, and understanding what aspects contribute to iwi resilience to natural hazards. This approach was also required as a means for some freedom of movement in the type of method utilised to better support the dynamic nature of iwi and the preference with which iwi choose to be consulted.

These two approaches provided contrasting analysis of baseline data, as well as primary data, which proved valuable in their assessments. The availability of baseline data in the form of a historical lahar distribution map, could be analysed through Geographical Information Systems (GIS) data sets alongside currently available statistical, environmental and geological data and assessments from marae. Utilising a combination of these two research approaches allowed the researcher to adequately blend these distinct data sets through providing the human element of experience, history and merging with the science.

5.2.2 Kaupapa Māori Research Approach

In conjunction with the qualitative and quantitative approaches outlined previously, aspects of the Kaupapa Māori Research approach were also utilised in order to work alongside Ngāti Rangi for this project. There are debates about Kaupapa Māori, its approach to research (Mane, 2009), but these are not central to this research.

There are a number of principles that guide researchers, whether they be Māori or not, in undertaking research with iwi, mātauranga Māori and the intellectual property belonging to iwi. These are described further in Table 13 over the page.

Principles of Kaupapa Māori as Research

Whakapapa	Provides perspective on the relationships, communities, natural landscape and the universe of Māori in relation to their place in the world and their view of the world.
Te Reo	Indicates again interactions with the world through the use of te reo Māori[30].
Tikanga Māori	Allows researchers to understand how to traverse throughout te ao Māori safely whilst making the necessary judgements and decisions.
Tino Rangatiratanga	Its relevance to the research process is autonomy; giving Māori the power to structure the research process and take ownership of it. This also includes sovereignty, control, self-determination and independence; all asserting Māori control throughout research.
Whānau	Central to kaupapa Māori in the sense that whānau or whanaungatanga are elements embedded within Māori culture, and indicate their physical and spiritual relationship with the natural world.
Taonga Tuku Iho	Legitimises Te Reo Māori, tikanga and mātauranga Māori through validating their status within a Kaupapa Māori paradigm.
Ako Māori	Is an acknowledgement of the way Māori teach and learn and practices unique to Māori.
Kia piki ake i ngā raruraru o te kainga	Aimed at positive nature of research and benefits to iwi with the aim of removing the negative stereotypes and pressures felt by the Māori communities.
Kaupapa	Is wider than just the topic of the research, but goes further to outline the community and their visions and aspirations.
Te Tiriti o Waitangi	This outlines the relationship that exists between Māori and the Crown and the roles and responsibilities this entails.
Ata	This relates to building relationships and understanding boundaries whilst promoting a safe environment for both parties.

Table 13. Key principles that are central to undertaking Kaupapa Māori research

(Pihama, 2001; Pohatu 2005; Smith, 1997).

[30] Māori Language

The principles in Table 13 highlight the fundamental elements that are central to Māori and their role within research, both as researchers and as participants. Walker et al. (2006) further add specific principles on Māori worldview, and social justice. These concepts all provide a means by which researchers can better develop the appropriate understanding of what is considered culturally appropriate when initially designing the research and its parameters, questions, and data collection through to results and ownership of knowledge.

Kaupapa Māori research was central to this study because a) the researcher is Māori and b) the case study proposed was based on iwi and their interactions with their environment. This meant that the tino rangatiratanga[31] of iwi throughout the research process was paramount. Mātauranga Māori[32] and more specifically Mātauranga-a-iwi[33] and/or kōrero-a-iwi[34], are knowledge types fiercely protected by iwi, hapū and whānau. As such, not all seekers of knowledge are privy to this type of information. Consequently, special processes that protect the iwi and their knowledge base are crucial to research in general, purely to avoid the exploitation of iwi, and their knowledge base and intellectual property. This process allows the iwi to be the decision makers, to provide what information they want, to decide how it is used and to what extent, and for this process to be guided by tikanga (customs).

There were a number of issues highlighted during the ethics application process concerning research with and on Māori, and the employment of the researcher with the Ngāti Rangi Trust. Through maintaining the principles of Kaupapa Māori research and coming from an upbringing within Te Ao Māori ensured that this process was adhered to. The concern with employment by the Ngāti Rangi Trust was discussed and it was clarified that the separate roles that the researcher has will remain separate to ensure no overlap in the work and research streams.

[31] Described in Table 13.
[32] Traditional knowledge systems of iwi Māori described further in Chapter 3.
[33] Traditional knowledge systems specific to a particular iwi.
[34] Stories specific to a particular iwi.

5.3 Data Collection

The data collection phase of the project was initiated when the researcher presented the proposal at one Te Kāhui o Paerangi (a rūnanga hui for Ngāti Rangi) in October 2013. This was undertaken initially to verify if this research had the support of the iwi. The support was given and some key members of the iwi offered to assist this research through providing input based on their experiences. The selection of participants in this research was based on their requests to be involved. Other key participants were selected based on their knowledge of Ngāti Rangi, their mātauranga-ā-iwi, and their standing within the iwi.

Therefore, data collection involved two separate streams (1) marae surveys and (2) interviews. Initially wānanga were tabled as the means to transfer knowledge between Ngāti Rangi and the researcher and vice versa.

5.3.1 Marae Surveys

Previous data surrounding Ngāti Rangi marae had already been collated and presented to Ngāti Rangi by their iwi authority, Ngāti Rangi Trust, in 2013 and therefore was used as the foundation for this specific marae based research. The Ngāti Rangi Trust Marae Surveys were largely centered on the capacity of the individuals, whānau and hapū of that marae, therefore highlighting the human element of the marae structure. However, they also provided insight into the number of facilities each marae had available and the numbers they could cater for. These details provided real practical figures for this research when looking at utilising marae as civil defence shelters.

In conjunction with this, individual site assessments were undertaken by the researcher in early March 2014 that further assessed each marae more specifically for their structural and location based resilience to a volcanic event.

The lead-up to these site assessments involved making contact with the Ngāti Rangi Trust through email and kanohi-ki-te-kanohi (face-to-face) discussions for contact details of each marae and their representative/s. A hardcopy of marae addresses and representatives was given to the researcher in conjunction with an A4 rohe map, which provided visual marae placement to an extent. Letters subsequently were sent out to each marae representative informing them of the intent to undertake a physical, non-intrusive survey of their marae. One of the issues identified through this process was that many of the marae representative addresses provided were out-of-date resulting in returned letters and no alternative means of contact. Some marae had no representatives and therefore no contact details were provided. The Chairperson for one marae (with no representatives) was contacted instead to ensure that their marae remained notified. Lastly, some marae lacked full addresses and only road names were given.

Despite Ngāti Rangi having 15 marae recorded (16 if the National Army Marae in Waiouru were included as it lies within their tribal boundary), not all of these marae were considered for this research. Eight marae are considered by the iwi as being fully functional, three are semi functional, two are aspirational and one of the fully functional marae is located within Whanganui. It was decided that for the purpose of this research, in seeking whether marae could be investigated to determine iwi resilience, that those marae with full facilities (and within the Ngāti Rangi rohe) and those with multipurpose facilities would be targeted. Three of the targeted multipurpose marae could not be located from the map provided by Ngāti Rangi Trust and thus were unidentifiable by the researcher whilst undertaking the site assessment.

The marae site visits were aimed at identifying the following:

- Water tanks: size and number;
- Power: source (above or underground);

- Heating type: wood burner; gas; electricity;
- Access routes: number of routes, areas at risk;
- Style of roof: Flat or slanted;
- Proximity to rivers and streams; and
- The site in relation to historic lahar hazards.

5.3.2 Discussions with Iwi

The human element of data collection initially proposed was through wānanga with Ngāti Rangi with the aim of knowledge sharing and to promote discussion. However, the larger scale wānanga did not eventuate so it was decided to hold smaller, cluster-based wānanga with each paepae (meaning four separate wānanga due to the four paepae clusters of the iwi). The marae representatives for each cluster group were contacted with a request to hold smaller cluster-based wānanga. Only the Whangaehu Paepae responded to this request.

As a result of this, a hui took place at Ngā Mōkai marae in Karioi with the researcher, her two supervisors and two representatives of the Whangaehu Paepae. This hui was approximately two hours long. These discussions focused predominantly on the experiences and involvement of these members with volcanic processes and on the resiliency of Ngāti Rangi. The discussions were guided by a series of questions (see Appendix 3 and 4) but were not limited to these questions specifically.

Overall the discussion process occurred with six Ngāti Rangi individuals (which included the two representatives from the Whangaehu paepae). These consisted of talks via phone and email, one held at marae, one held at the Ngāti Rangi Trust office, others just passing discussions when able, and one at the home of the interviewee. The main content discussed consisted of the following:

- Experiences in emergency management;

- Involvement in consultation and the iwi driven stance leading up to 2007 lahar;
- Experiences and perspectives on volcanic activity;
- Resilience of Ngāti Rangi;
- Marae placement; and
- The relationship between Ngāti Rangi and their ancestral maunga.

5.4 Analysis

5.4.1 Geographical information systems (GIS)

Geographic Information Systems (GIS) were a crucial part of this research. It allowed a relationship between Ngāti Rangi marae and historical flow data on Ruapehu to form. The initial use of GIS for this research involved the digitization of Ngāti Rangi marae.

Currently available tools, such as QGIS (QGIS, 2014) - a free downloadable application from the internet that can analyse spatial data and create new data through a polygon, line and points - and Arc View (ESRI Inc., 2014), a desktop application that functions similarly to QGIS, were used to create a series of marae-based maps. Publicly available data from various government agencies were used in conjunction with volcanic hazard data held by Massey University. Each marae that was assessed was digitised using QGIS, and a new shapefile was created consisting of the total marae assessed. Thus ArcGIS was used to illustrate the Digital Elevation Models (DEM) for each of the marae and finally representing the relationship between the Ngāti Rangi marae and volcanic hazards. To aid in the identification of the Ngāti Rangi marae, Ngāti Rangi Trust provided their GIS material relating to their marae in the form of a shapefile. The final maps for each marae, the marae in relation to the Ngāti Rangi rohe boundary, and the Statistics NZ mesh blocks were then converted into JPEG files.

5.4.2 Resilience Framework

The data collected via the marae surveys and discussions with key Ngāti Rangi individuals were utilised to formulate baseline indicators on Ngāti Rangi resilience and develop a framework for measuring the resilience of Ngāti Rangi to volcanic processes.

5.5 Summary

These approaches, processes and data analysis provided a means that has ensured that all aspects of the disciplines involved in this research were adequately represented.

Chapter 6: Results

6.1 Introduction

The results are confined to two stream types: (1) discussions with iwi and (2) marae-based results. The findings will be displayed in line with these two streams initially with the iwi discussions. Aspects of these discussions have been categorised and displayed into sections outlined below in 6.2.

This chapter will conclude with the marae-based results. The marae-based results focus predominantly on the blending of existing scientific research with data collection from the marae assessments. These results will also take into account the data from the Ngāti Rangi marae surveys of 2013. These will be displayed GIS by way of maps for each marae assessed.

6.2 Results of Iwi Discussions

Several discussions were undertaken with Ngāti Rangi uri that could offer perspective on the following:

- Marae
- Emergency management
- Involvement in response plans
- Capacity building
- Responses; perspectives on natural hazards
- Information sharing
- Historical kōrero
- Significance of Ruapehu to Ngāti Rangi
- Ahi-kā-roa and resilience

Other references were sourced from three key areas, which are outlined below, to further support the kōrero extracted from the interviews:

- Ngāti Rangi Taiao Management Plan 2014;
- Waitangi Tribunal report Wai 1130;
- Presentation by Ngāti Rangi iwi researcher Hana Rainforth at the 7th Cities on Volcanoes conference; and
- Marae – TVNZ broadcast of Te Kura Kaupapa Māori o Ngāti Rangi and their Kāhui Maunga Ski Academy. The Kāhui Maunga Ski Academy is funded by Ruapehu Alpine Lifts and regularly uses the ski field during the winter months of the year.

6.2.1 Marae

Marae can be viewed as a physical representation of ahi-kā-roa (D. Te Riaki, personal communication, July 24, 2014); marae are connected to whānau, hapū and iwi through whakapapa and reinforced again by ahi-kā-roa. Those interviewed described the importance of marae to members of the iwi, as a place of refuge and also the strategic placement of marae both historically and more recently:

> *Historical marae were within Karioi, Raketapauma and Manganuioteao and all the area between were used for food gathering* (C. Wilson, personal communication, November 26, 2014).

> *Placed on sacred sites to protect those areas* (C. Wilson, personal communication, November 26, 2014).

> *Marae were placed in strategic places where access to resources was large. They also aligned themselves to spiritual pathways throughout the areas, and were mostly placed with direct view of the maunga* (C. Wilson, personal communication, November 26, 2014).

> *A few centuries of experience probably helped our people understand where you … build a kainga in relation to the river. So there were those concerns amongst our people, whether there was enough safety* (K. Wood, personal communication, May 8, 2014).

> *Many other marae were later established once … areas became populated to reestablish the links to these areas* (C. Wilson, personal communication, November 26, 2014).

The importance of marae to whānau in an eruption was described by one participant, who recalled that:

> *A number of our families had said that if there was an eruption, a more significant eruption that would be the place that they would gravitate too* (K. Wood, personal communication, May 8, 2014).

6.2.2 Emergency management – Consultation and Involvement

Several Ngāti Rangi uri were involved in response plans developed to address the imminent Crater Lake dam break lahar of March 2007. In the lead up to this event there was significant communication and consultation between Ngāti Rangi and the Department of Conservation as the overseeing authority within the Tongariro National Park. Discussions centered principally on methods to deal with a lahar:

> *Korero to leave things alone sort of set the scene for not interfering on Koro but still putting in place…infrastructural protection off Koro and off the mountain…to move those things away from the mountain…the ERLAWS [Eastern Ruapehu Lahar Alarm Warning System] lahar management system being installed, the gates on the road, the raising of the Tangiwai Bridge, they were key steps and even the Bund that was built out on Te One Tapu* (K. Wood, personal communication, May 8, 2014).

> *We want to make sure the infrastructure that's established is durable for the future and not just a one off, go up the mountain and dig a trench and let it go, it doesn't fix it for the next lahar that will take place* (K. Wood, personal communication, May 8, 2014).

> *Let him let off steam, let him do what he needs to do. But we won't run away from it* (R. Mareikura, personal communication, October 1, 2014).

Ngāti Rangi Trust are also reinforcing lessons learnt from the 95/96-2007 consultation period through cementing their involvement in research, monitoring and the management of their ancestral maunga. An environmental management plan 'Ngāti Rangi Taiao Management Plan' (Gabrielsen, 2014) was developed to address key issues and activities that impacted on Ngāti Rangi and their natural resources. Ngāti Rangi have developed policies and rules to address volcanic monitoring, and an approach to emergency management, which is outlined in their Taiao Management Plan:

> *Monitoring and management of natural events in connection with Rūaumoko will involve Ngāti Rangi* (Gabrielsen, 2014, p. 39).

For example, Massey University and Ngāti Rangi are undertaking the project 'He haerenga mōrearea – A hazardous journey; Exploring Mātauranga Māori for assess volcanic hazards and improving monitoring approaches and iwi/hapū planning' (Pinal, Davies & Berryman, 2013) together. Both groups value the sharing of knowledge throughout the generations and bringing together opportunities to learn about volcanic processes with a central focus on blending together mātauranga Māori and science in regards to volcanic activity.

It is also vital to display fundamental Ngāti Rangi policy and rules that fortify their stance on intervention for emergency management purposes. For instance, in their Taiao Management Plan Ngāti Rangi assert that:

> *Ruapehu maunga will not undergo any physical works, or have any structure installed as part of any emergency management strategy, to divert or withhold the flow of a lahar* (Ngāti Rangi Taiao Management Plan, 2014, p. 39).

In that plan, Ngāti Rangi promote an improved understanding of how Ruapehu is integral to them and articulate the reasoning behind their stance against intervention on the mountain in relation to emergency management:

> *Matua te Mana is our ancestral maunga and the source of our identity. Koro Ruapehu is the anchor for us to our whenua, and he exists as the stronghold for our people* (Gabrielsen, 2014, p. 40)

One Ngāti Rangi participant explained that:

> *Our relation to the mountain gets deeper and deeper… its like our life source.* (R. Mareikura, personal communication, October 1, 2014).

The Waitangi Tribunal (2013) has also emphasized the importance of Ruapehu and other volcanic entities, often labelled 'Te Kāhui Maunga', to the existence of Ngāti Rangi.

Lahars are celebrated by Ngāti Rangi and are an important aspect of replenishing the area with mana and mouri. Lahars act as a process that brings balance back to the environment:

> *Our families have been living with lahars, through all those periods and no one has talked negatively about them even those, in terms of the Tangiwai disaster that were involved in that whole process and that people lost their lives in the process, and it was a tragedy at the time but it never seemed to be held as that's a fearful problem that we need to be fearful of, and is constantly in our minds* (K. Wood, personal communication, May 8, 2014).

> *It was a natural process after a period of time, things that were in the river, things would come back into balance and restore themselves, so I think that's how our people saw it and that's what I see now, the river is just its dynamic self, and lahar are just a part of the landscape of this generation also* (K. Wood, personal communication, May 8, 2014).

> *A lahar is Koro sharing his mana with us.* (Wilson, 2014 as cited in Gabrielsen, 2014, p. 39).

> *Ngāti Rangi have always viewed lahars as an integral part of the makeup of their tūpuna maunga and therefore themselves* (Wilson, 2007).

The personification of Ruapehu is often utilised by iwi to describe their ancestral maunga in a manner that allows the volcanic activity to be viewed from the perspective of tangata whenua:

> *Its best that Ruapehu lets off a bit of sweat and steam every now and then.* (R. Mareikura, personal communication, October 1, 2014)

This notion is further reinforced by Ngāti Rangi who regard the waters that flow from Te-Wai-ā-moe via the Whangaehu River to be the 'sweat gland of Ruapehu' (Waitangi Tribunal, 2013)

6.2.3 Intergenerational Learning and knowledge sharing

Information about responses to volcanic activity was articulated to the younger generation through the reactions from the older generation. This perspective is also held by the present generation:

> *In the 1940s when the mountain blew up there was black ash everywhere, the mountain was blowing up then. Nobody seemed to be concerned and so us as kids weren't concerned cause our parents weren't concerned* (R. Mareikura, peronsal communication, October 1, 2014).

The local communities trust the judgement of Ngāti Rangi and often follow the example of the iwi during an eruption. This imparts the iwi perspective on the wider community and on the younger generation:

> *When we stay, others stay; when we leave, others leave* (Rainforth et al., 2012).

> *When the old man Carol*[35] *moves…then we'll move. But while he's still there we'll be safe.* (R. Mareikura, personal communication, October 1, 2014)

There are connections between the generations that arise especially when a new phase of heightened activity occurs. It brings forth the memories of past eruptions and allows for intergenerational learning to take place with the youth of the iwi. It is key within Ngāti Rangi that information is shared and knowledge handed to the next generation to ensure that kōrero about Ruapehu is carried on.

> *Our principal role as tangata tiaki over our taiao was a responsibility handed to us by our tupuna, and therefore a responsibility we hand on to our tamariki and mokopuna.* (Dryden, as cited in Gabrielsen, 2014, p. 6).

> *The children are learning it now, and their parents are acknowledging it through karanga, through waiata – the mountain* (R. Mareikura, personal communication, October 1, 2014).

> *When you're used to living with that you develop an affinity with it…the sort of thing…to try and pass on to our mokopuna that Koro is a living entity that we have lived with* (K. Wood, personal communication, May 8, 2014).

> *They are also reconnecting with the teachings of their tribe who have lived in this area for centuries.* (Marae – TVNZ, 2012)

Rainforth et al. (2012) describe Ruapehu as the 'source of ourselves' and emphasise his importance in the following poem:

> *He is Te Whare Toka o Paerangi*
> *He is the shining scale that led us across dark waters*
> *He is our shelter from harsh winds*
> *He is the last rest of our chiefs*

[35] In conversation with R. Mareikura she described Old Man Carol as 'Old Mareikura' an elder of Ngāti Rangi

He is our life, our identity.

These words further depict the resounding prominence of Ruapehu in all corners of the Ngāti Rangi culture and identity.

Reflections of historical and recent events are described below by prominent pāhake (elder) Raana Mareikura who recounted her experiences with volcanic activity and other natural events that have occurred in her lifetime:

> *Sometimes you can smell the sulfur coming down the river, and it comes down here too [reference to the Mangawhero River] I remember the old people saying they could smell sulphur…not very often it has come down this way but I remember it coming* (R. Mareikura, personal communication, October 1, 2014).

> *The last big flood…was here in the 40s, and the water came right up to here*[36] *…it took away the bridge. I remember we didn't have a car bridge for years* (R. Mareikura, personal communication, October 1, 2014).

> *When we eventually got it … it was quite bad, everywhere was quite black. Every where [there was] ash. The first one [eruption of 1945] we were on rain supply…we used water out of the river* (R. Mareikura, personal communication, October 1, 2014).

6.2.4 Resilience/Ahi-kā-roa

A key link identified by Ngāti Rangi interviewees was the connection between marae, resilience and the ahi-kā-roa that binds not only these elements, but many more Māori concepts defined earlier in Chapter 2.

[36] Discussion regarding the recent flooding in the region as the Mangawhero River burst its banks (Karauria, 2013) in October 2013. 'Right up here' refers to her kainga located behind Maungārongo Marae, Ohākune.

> *I think resilience comes down to adaptability and to work with very little to create a lot. Again, depending on the marae situation the less modern services that are available to the marae are probably the more resilient and adaptable* (K. Wood, personal communication, May 8, 2014).

A statement by Ngāti Rangi bridges these two concepts of resilience and ahi-kā-roa together:

> *Kia mura ai te ora o Ngāti Rangi ki tua o te 1,000 tau*
> *Ngāti Rangi vibrantly existing in 1,000 years.*
> (Ngāti Rangi Trust, 2012).

Adaptability is a key element also that allows movement within the culture to maintain its resilience in the face of adversity.

> *The tribes adapted its cultural practices to keep up with progress here*[37] *but not everyone's happy about it. It's about a lot of consultation, a lot of wānanga* (Marae – TVNZ, 2012).

> *The school's*[38] *ski academy and the tribes cultural practices are becoming an integral part of the ski field, including opening and closing the season with karakia, prayer* (Marae – TVNZ, 2012).

> *That is part of our underlying backbone of our resilience. As long as they're still there and available*[39] *they have stood the test of time, as communal families, hapū, marae – as long as there is still families around to support it and nurture that, they will still literally stand and be there* (K. Wood, personal communication, May 8, 2014).

[37] The reference to 'here' is in relation to the Tūroa Ski Field on the southern side of Ruapehu.
[38] Te Kura Kaupapa Māori o Ngāti Rangi.
[39] Refering to marae.

> *Resilience in the Ngāti Rangi dialect, there isn't one but we can use Mataara[40], Manawaroa[41]/Manawanui[42]* (C. Wilson, personal communication, November 26, 2014).

> *We are still ahi-kā, after all of this activity. We are here. We still live here. We still live next to the Whangaehu. Tirorangi [marae] is functioning next to the Whangaehu [River], Ngā Mōkai [marae] there, so we are still functioning.* (D. Te Riaki, personal communication, July 24, 2014).

> *For us as Ngāti Rangi we are alive and well throughout all of that risk* (D. Te Riaki, personal communication, July 24, 2014).

Ahi-kā-roa is representative of unbroken occupation over an area; therefore, Ngāti Rangi is ahi-kā-roa. What is also representative of unbroken occupation and ahi-kā-roa is the ability to be active kaitiaki over their lands and its resources. This is thoroughly represented within the Ngāti Rangi Taiao Management Plan 2014.

> *"In order for Ngāti Rangi to be a flourishing tribal nation throughout and beyond the next millennium, the connections that exist with the natural world need to be strengthened. We can do this by: reconnecting with our whānau, hapū and wider iwi groupings; revitilising our connections with the natural world through talking with and listening to our waterways, ngāhere, whenua and maunga, and playing an active role in the protection of the taiao".* (Gabrielsen, 2014).

[40] Vigilance (Māori Dictionary App, 2015).
[41] Endurance/Resilience (Māori Dictionary App, 2015).
[42] Unwavering/persistant (Māori Dictionary App, 2015).

6.3 Marae Audit

This section presents the results of the Ngāti Rangi Marae Surveys and the individual Marae Assessments carried out by the researcher, as well as data from publicly available GIS components that are displayed in a map format.

The results are organised to show the following: the facilities available to each marae in relation to their individual capabilities; and thus the data presented in the maps (see Figures 1-2) indicate the relationship between identified hazard types (volcanic flows: flows, tephra fall: fall, lava flows, and debris avalanches: landslides), the hazard recurrence rate, and marae themselves. Marae are the focus for this section because they have been identified by Ngāti Rangi as one of the principal factors of their resilience. Marae are at the centre-point of iwi activities, such as tangihanga[43], hui, wānanga and celebrations; they represent the fundamental element of community relationships and networks.

6.3.1 Ngāti Rangi Marae Surveys

15 marae were identified within the Ngāti Rangi rohe and varied considerably in their use and the resources available at each location. All of these marae were categorised into four cluster groups based on their location in relation to the surrounding river catchment, namely:

- Hautapu
- Whangaehu
- Mangawhero
- Makōtuku/Manganui (see Figure 11 over the page for the four cluster groups)[44].

[43] Funeral

[44] As mentioned, each of the 15 marae are grouped into the four cluster groups described earlier. This figure contains the entire structure of the Ngāti Rangi rūnanga which also includes another paepae (or a fifth cluster group) 'Te Pae Tuara' dedicated to the pāhake (elders) representatives from the three principal hapū of Ngāti Rangi.

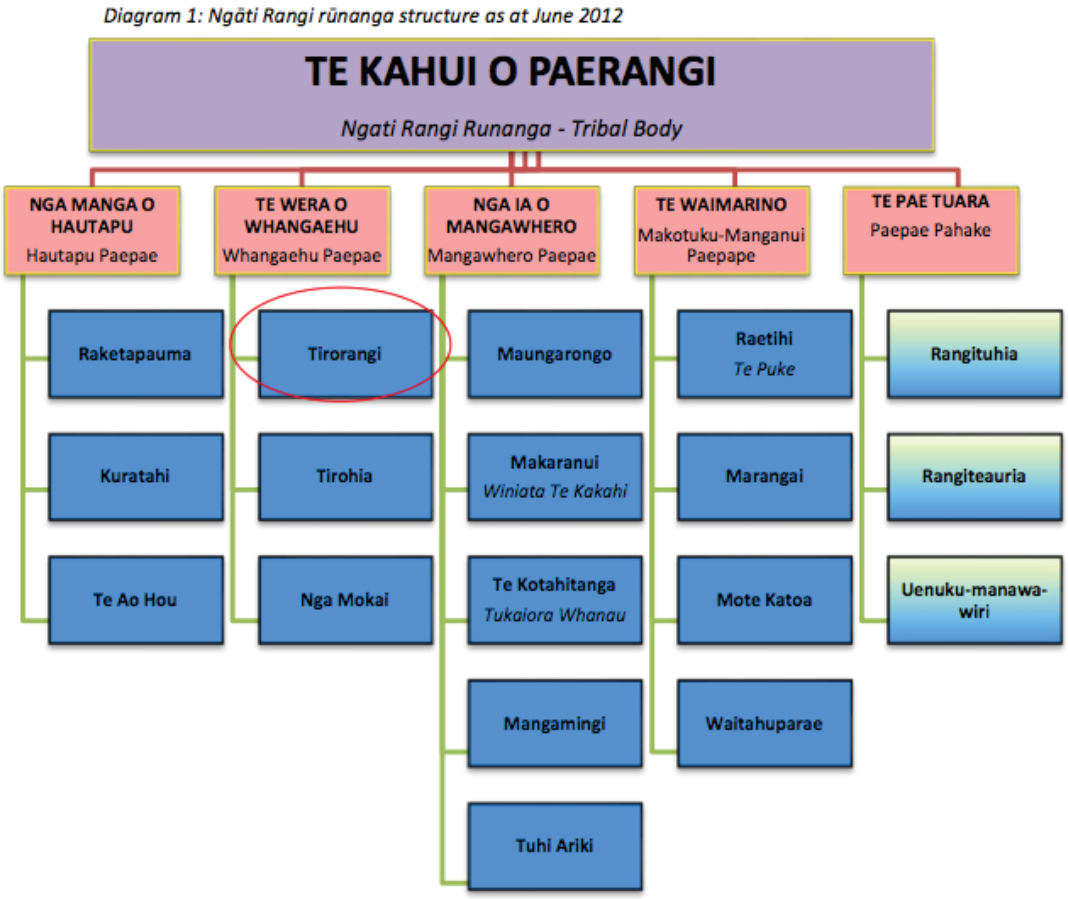


Figure 14. Te Kāhui o Paerangi is the Ngāti Rangi Rūnanga. Its structure is based on marae representation and is catchment based.

(Tirorangi Marae Survey, Ngāti Rangi Trust, 2013).

In 2013, the Ngāti Rangi Trust surveyed the Ngāti Rangi marae. The purpose of the survey was to individually assess and identify the needs and capacity of each marae. Ngāti Rangi marae are thus organised into 3 separate categories: (1) fully functional, where marae have all facilities available and can cater for a large group of people; (2) Semi functional: these marae can be described mainly as 'multipurpose' with some facilities available, which are displayed in Table 14 over the page. Semi-functional marae are used mainly by whānau members to whom there is a direct whakapapa link; (3) Aspirational marae: these marae have no physical structures and are land blocks where historical marae were once located. 13 of the 15 marae participated in these surveys, which generated an overall internal marae based document for whānau and hapū. The two marae that did not participate in the Ngāti Rangi Marae Surveys were Tirohia and Marangai. Table 14 provides a overview of the facilities at

each marae with information concerning, if available within the surveys, when each marae was built and how many individuals each marae can hold. Mote Katoa Marae does not have a wharepuni but other buildings are available for sleeping. These buildings can hold up to 100 people, but as noted in the individual marae survey there is not enough bedding (mattresses, pillows and sheets) available. Raketapauma and Raetihi can both hold up to 150 individuals in their wharepuni. Mangamingi can hold 30 individuals in their wharepuni and 90 individuals in their Wharekai.

(Adapted from Ngāti Rangi Marae Survey, 2013).[45]

Marae	*Wharepuni*	*Wharekai*	*Wharepaku*	*Max pers in Wharepuni*	*Max pers in Wharekai*	*Built*
Raketapauma	Y	Y	Y	120-150	120	2001
Kuratahi	Y	Y	Y	100	90-100	*
Te Ao Hou**	Y	Y	Y	100	150	1978
Tirorangi	Y	Y	Y	50	100	1953
Ngā Mōkai	Y	Y	Y	40	60	1925
Tirohia**	*	*	*	*	*	*
Maungārongo	Y	Y	Y	130	110	*
Mākaranui**	MPF	MPF	MPF	*	*	*
Te Kotahitanga**	MPF	MPF	MPF	*	*	*
Mangamingi	Y	Y	Y	30	90	1800s
Tuhi Ariki	MPF	MPF	MPF	*	*	*
Raetihi	Y	Y	Y	150	200	1980s
Marangai**	*	*	*	*	*	*
Mote Katoa	N	Y	Y	100	150	*
Waitahupārae	MPF	MPF	MPF	*	*	*
	MPF	Multi Purpose Facility				
	*****	Didn't provide information for Survey				
	******	No field assessment undertaken				

Table 14. Description the facilities present at each Ngāti Rangi Marae

6.3.2 Marae Site Assessments

Site visits to each marae were undertaken. These visits occurred in early March 2014 over a series of two days. These assessments aimed to ascertain the following:

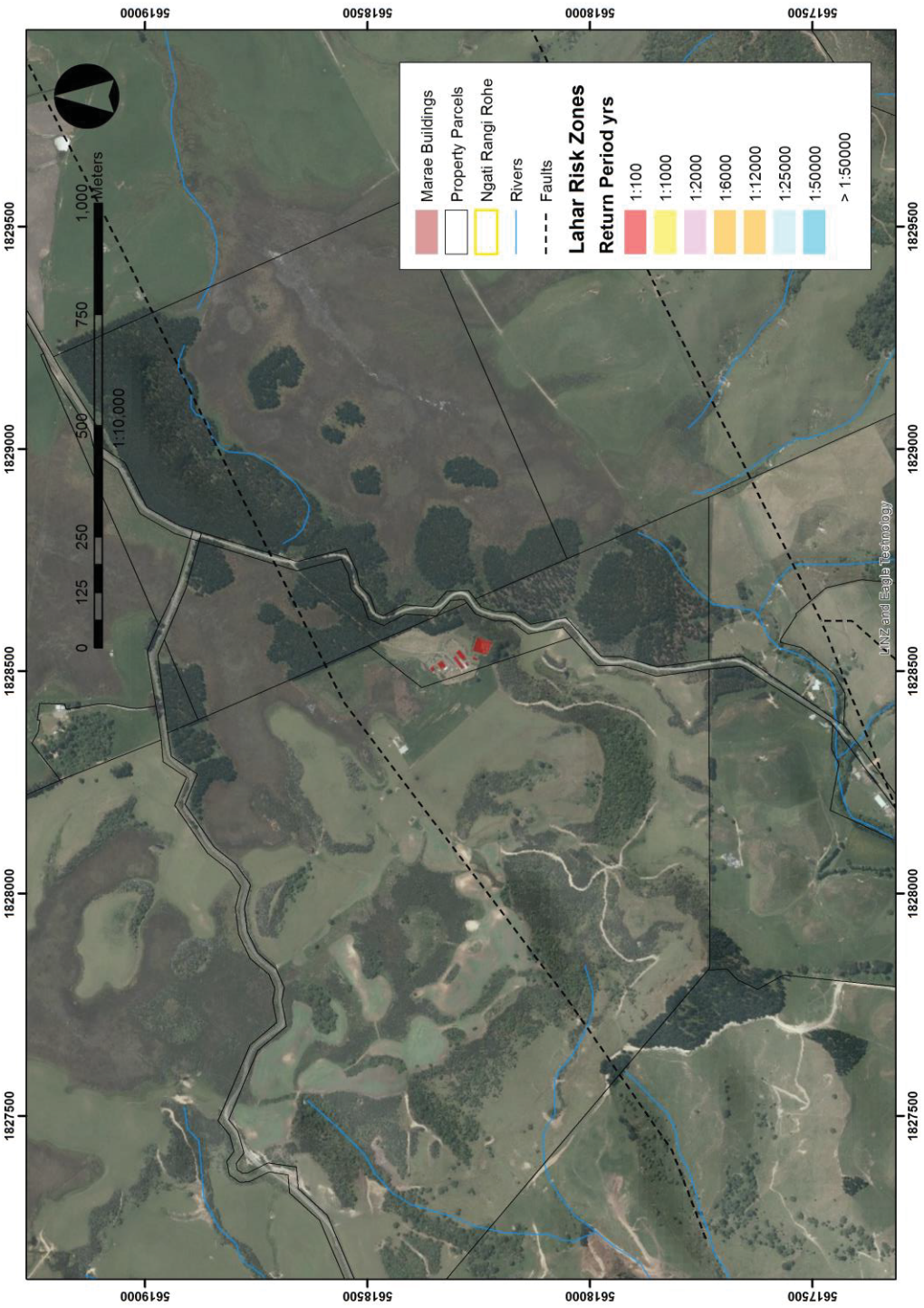
[45] Translation for the unfamiliar māori words contained within this Table are outlined below so not to distore the layout of the Table:
Wharenui – Meeting house, Wharekai – Dining Hall, and Wharepaku – ablutions.

- Marae access routes
- Proximity of marae to local waterways
- Surrounding environment
- Type of water supply
- Power supply
- Marae heating options
- Type of roofing structure; and
- Historical volcanic activity in the area.

The results from these site assessments are presented below in a series of maps and tables. Each map displays the target marae in the middle and digitized as red. Contained within each of these maps is the legend describing the following features:

- Marae buildings
- Property parcels
- Rivers; and
- Fault lines

These maps also outline the lahar risk zones, which show historical lahar deposits and their return periods. Marae with no visible structure were not assessed, nor were marae for which the iwi had not supplied a clear address. Each map also includes a small description that outlines the results and describes the hazard occurrences of the area throughout the history.



Raketapauma Marae Results

Raketapauma marae is situated near State Highway (SH) 1 between Waiouru and Taihape and is nestled amongst farmland, wetlands and pine plantations. Other access points to Raketapauma are via Waiāruhe Road, which also adjoins with Kuratahi marae. The wharepuni has an extremely high roof, the wharekai to a lesser degree. Two large tanks are located metres from the wharekai and potentially fed through an underground system attached to the roofs. Gas is fitted to the wharenui for heating, and the wharekai for cooking. There are two extra buildings located on the marae grounds with two water tanks attached to them. Marae facilities are fed power through an underground connection and the facilities are located near the Naval Communications Station, Irirangi (RNZN Communicators Association, 2010) in addition to an airstrip near by.

Hazard Recurrence Rate

Flow	*Fall*	*Lava Flow*	*Landslide*
Nil	**?**	**?**	**?**

Other Considerations

Three fault lines located near the marae as indicated in Figure 16.

Figure 15. Map of Raketapauma Marae in relation to volcanic flows

Kuratahi Marae Results

Kuratahi marae is located on Ruanui Road approximately 15-20 minutes drive from SH 1 just north of Taihape. There are three other access points via Turakina Valley Road from SH 3, Stout Road off SH 49 near Tangiwai and also Waiāruhe Road. Ridges, valleys and flat areas dominate the surrounding landscape with pastoral farming the main land use activity. A local Ngāti Rangi whānau live in the vicinity of the marae, and marae facilities are well maintained and upgraded when required. Five large concrete tanks are attached to the wharekai roofs and it is highly probable that these are the main source of water for the marae. Surrounding vegetation such as established trees and large hedges shelter marae buildings with farm machinery located on site. Heat pumps and fire places are used to provide heating to the wharenui and potentially used to heat water. Overhead power lines supply power to the marae. All roof tops are slanted except one.

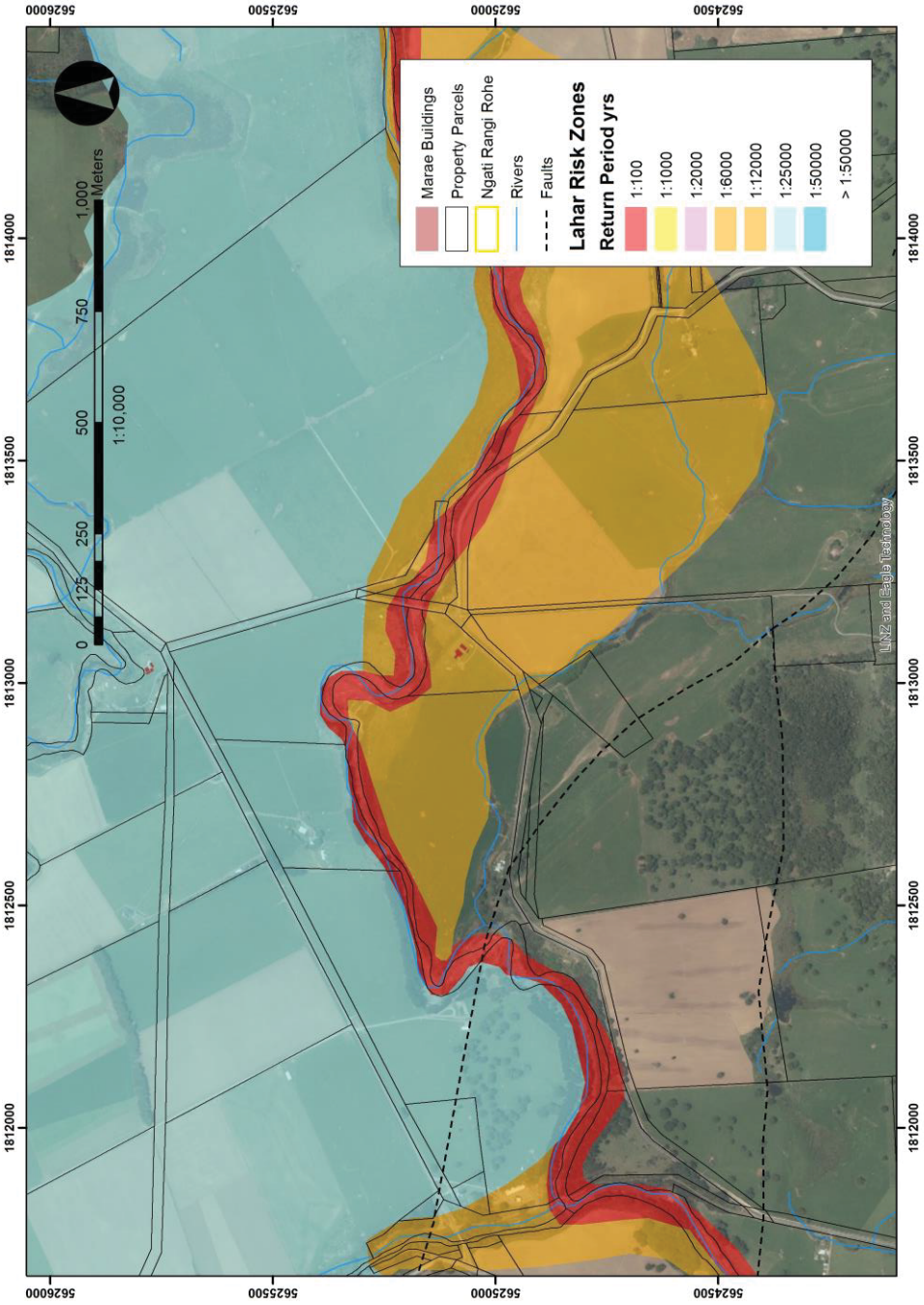
Hazard Recurrence Rate

Flow	***Fall***	***Lava Flows***	***Landslide***
Nil	**?**	**?**	**?**

Other considerations

Historic volcanic debris avalanche occurred in the Hautapu Catchment as a result of cone failure of Ruapehu (Tost et al., 2012). Ruanui Road is prone to slips along several areas with exposed rock derived from road cuttings.

Figure 16. Map of Kuratahi Marae in relation to volcanic flows.



Tirorangi Marae Results

Tirorangi is a rural marae surrounded by pastoral farm land. It is located on an elevated terrace above the Whangaehu River, on Whangaehu Valley Road. Access points to the marae are via SH 49 and SH 4. There are two river crossings between SH 49 and the marae with the final one over the Whangaehu River. Figure 18 indicates significant lahar deposits of varying ages with the most recent shown in red, being the main conduit for lahars both historically and at present. Tirorangi is a fully operational marae; a wood burner is used to heat the wharekai. Wood burners potentially heat water cylinders outside. On site are four large water tanks located at the rear of the marae and gas bottles are used for cooking purposes and are attached to the wharekai.

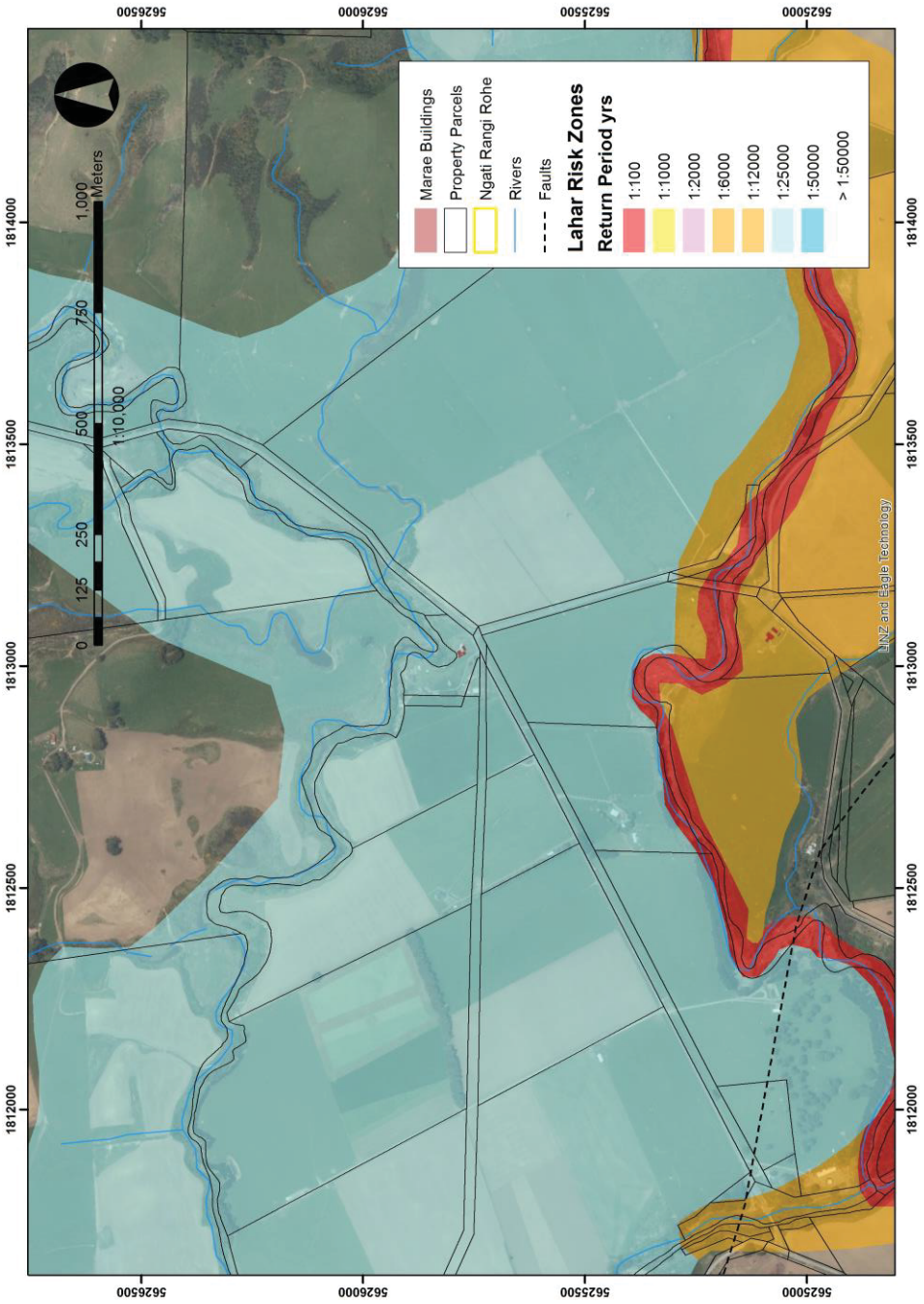
Hazard Recurrence Rate

Flow	***Fall***	***Lava Flows***	***Landslides***
1: 6000	**?**	**?**	**?**
1: 12000			

Other considerations

The marae borders the Whangaehu River, which has a lahar return period of 1: 100 years. Large historical lahar deposits with a return period of 1: 25000 dominate the area. Two fault lines are located south of the marae. The access route from SH 49 (Whangaehu River Bridge) is constantly at risk from lahar.

Figure 17. Map of Tirorangi Marae in relation to volcanic flows.



Ngā Mōkai Marae Results

Located in the Whangaehu Catchment, Ngā Mōkai sits in an elevated position above the Tokiāhuru Stream and is nestled at a junction of Whangaehu Valley Road and Oruakukuru Road, which links with SH 4. From SH 49 there is one river crossing over a small one-laned-bridge. The buildings located on the marae grounds are quite small in comparison to other Ngāti Rangi marae but there is a whare karakia (chapel) on site. The wharenui is small and was recently refurbished in early 2000; it has a slanted roof whereas the wharekai has a flat roof. There is one water tank located on the property but the researcher is unsure if this is used or not.

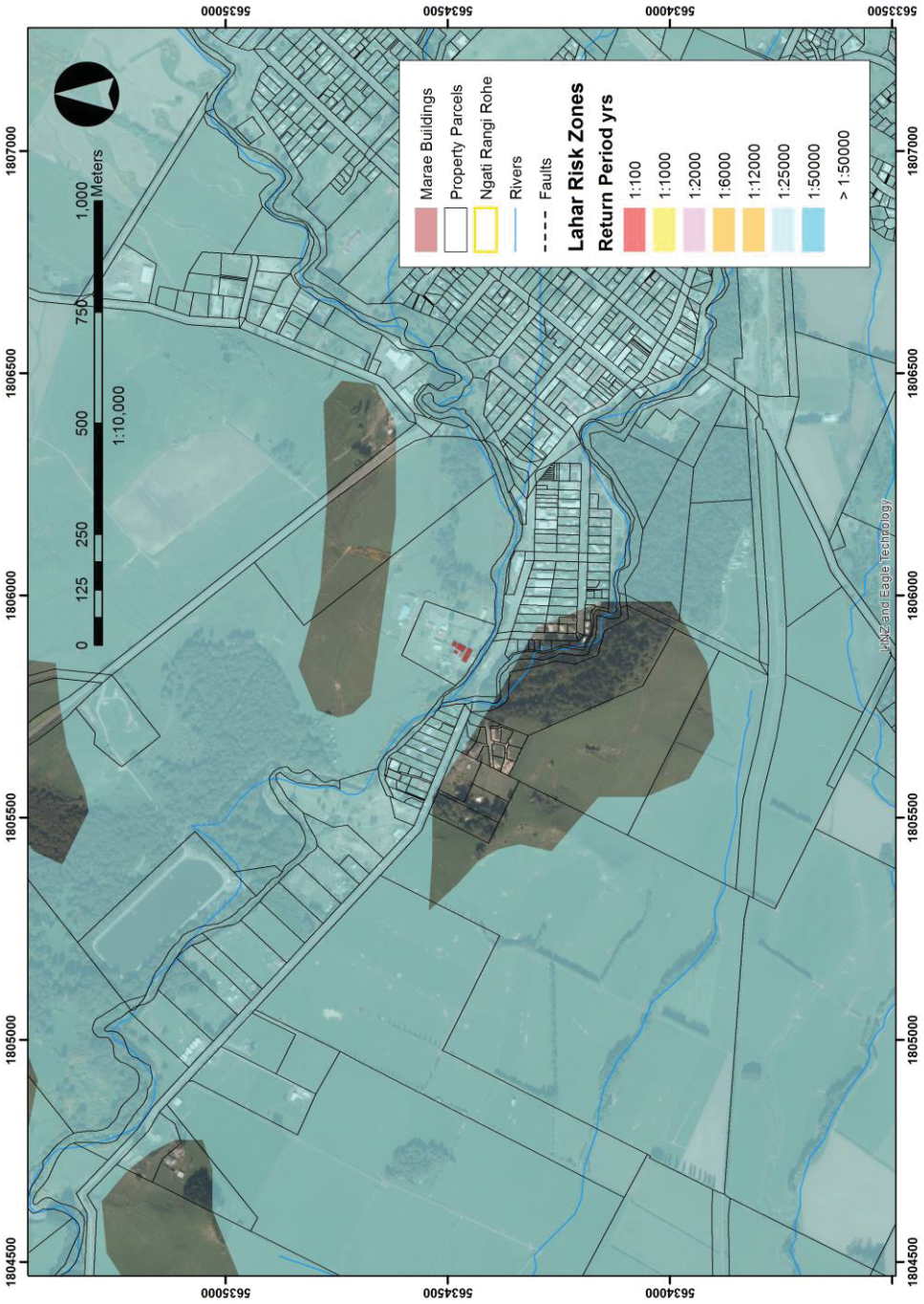
Hazard Recurrence Rate

Flow	*Fall*	*Lava Flows*	*Landslide*
1: 25000	**?**	**?**	**?**

Other Considerations

Nil.

Figure 18. Map of Ngā Mōkai Marae in relation to volcanic flows.



Maungārongo Marae Results

Maungārongo is located at the edge of the Ohākune township. The extended grounds of the marae also contain Manu Kōrero te Kōhanga Reo, Te Kura Kaupapa Māori ō Ngāti Rangi, the Ngāti Rangi Community Health Centre, and housing for Ngāti Rangi pāhake (elder generation). Maungārongo is limited to two access points which both have bridge crossings over the Mangawhero River. The water in the ablution block is heated predominantly by gas. Heaters provide warth for the wharepuni. The rear of the wharekai has gas bottles attached and an extra cooking facility adjacent to the Mangawhero River. Maungārongo marae does not have any rain capture system on any of the buildings. Roofs on all buildings are slanted and power is supplied to the marae through underground cables.

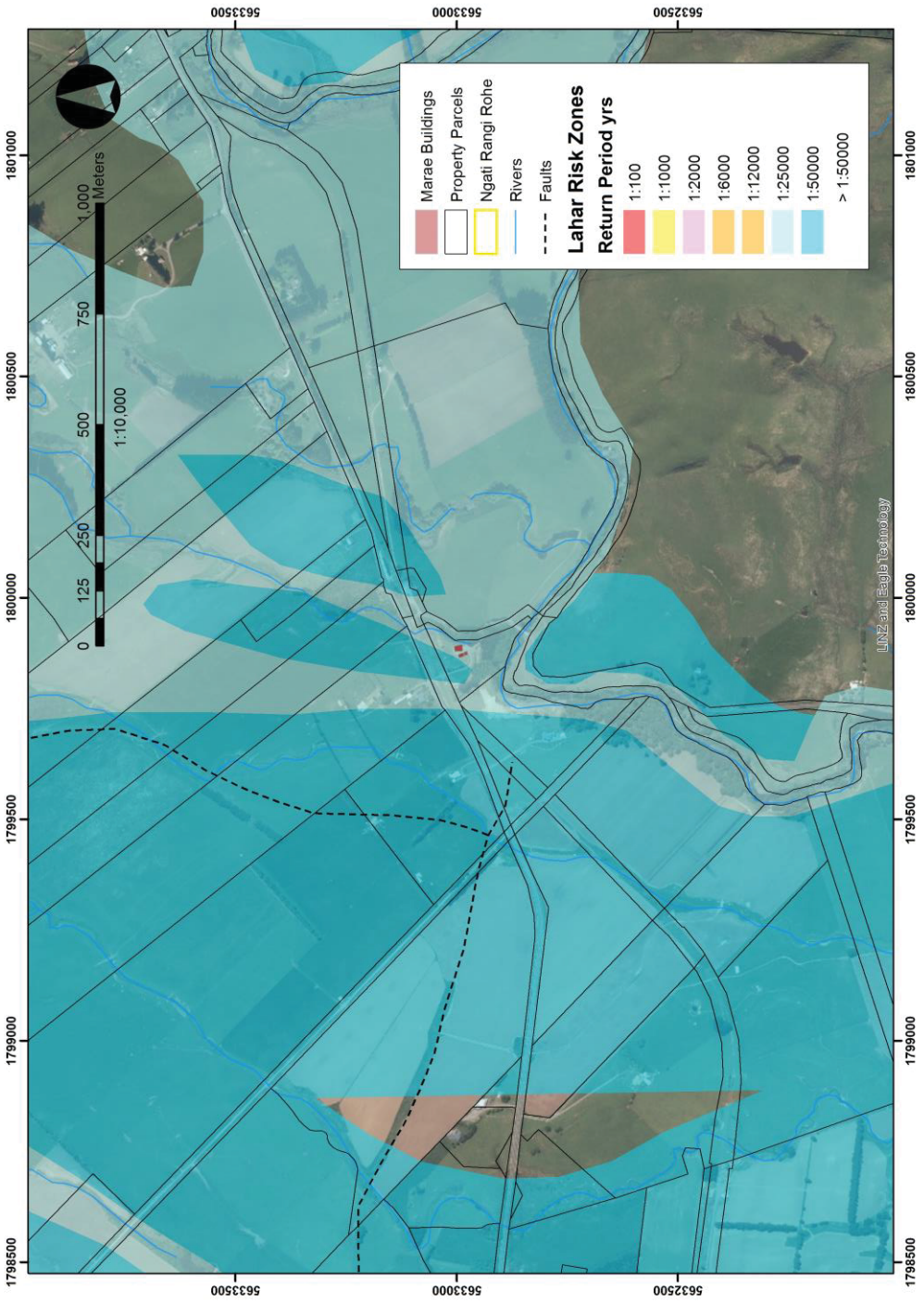
Hazard Recurrence Rate

Flow	***Fall***	***Lava Flows***	***Landslide***
1: 25000	**?**	**?**	**?**

Other Considerations

Flooding of the Mangawhero River has the potential to impede access to the marae grounds. The Mangawhero River is also a known lahar channel and the Ohākune craters, approximately 21 Ka, are located up to two kilometres north of the marae.

Figure 19. Map of Maungārongo Marae in relation to volcanic flows.



Mangamingi Marae Results

Located near the junction of the Ohākune Raetihi Road and Pahiki Road, Mangamingi sits on old lahar deposits on a terrace above the Mangawhero River. The wharenui is one of the oldest Ngāti Rangi marae and is very small in comparison, only holding up to 30 people. The wharekai on the other hand is considerably larger. Like most other marae in the rohe, Mangamingi is rural with pastoral farmland surrounding the grounds and is located between Ohākune and Raetihi. Gas is fitted to the ablution block for water heating, but the heating source for the wharepuni is unknown by the researcher. Underground power provides electricity to the facilities.

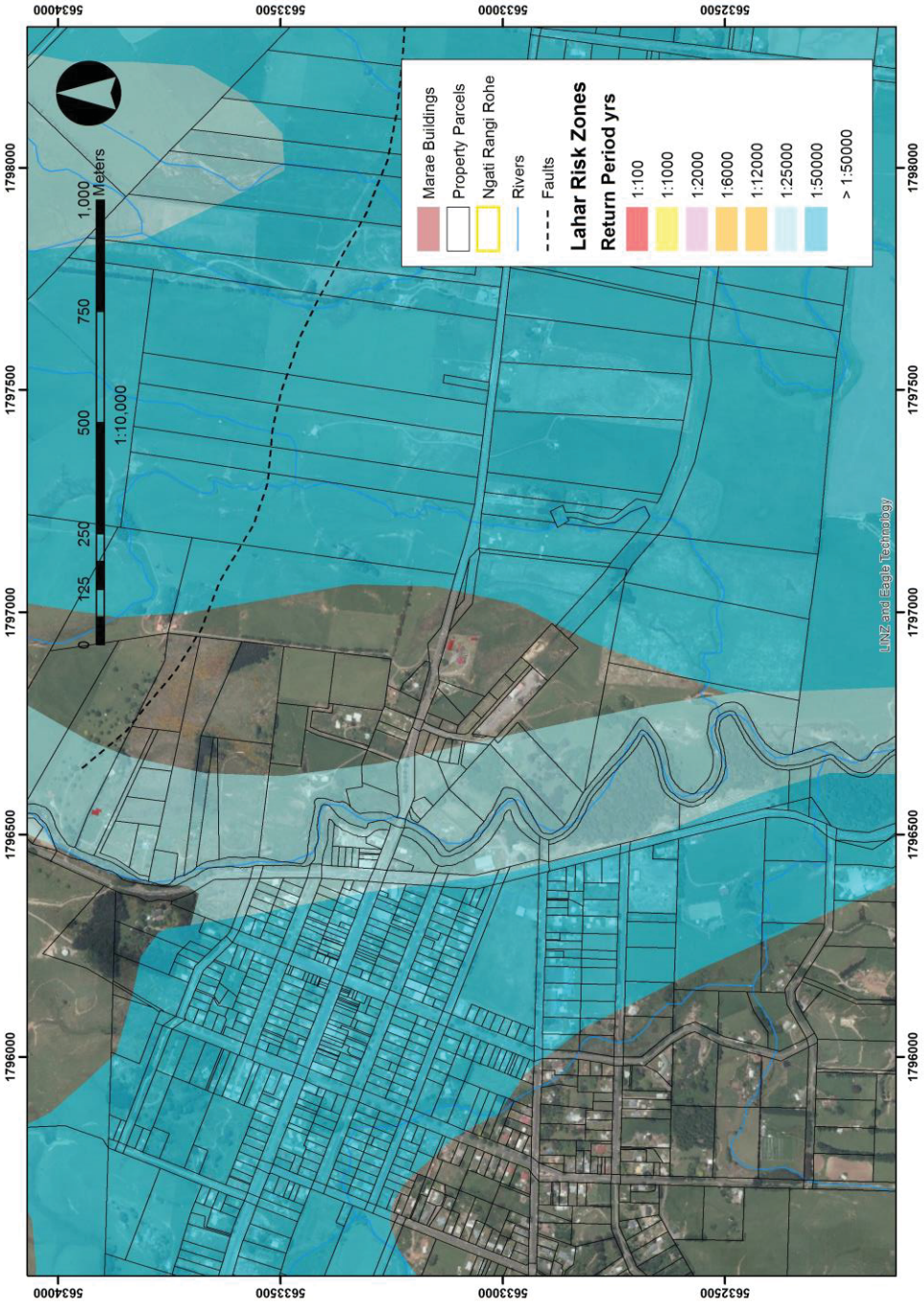
Hazard Recurrence Rate

Flow	***Fall***	***Lava Flow***	***Landslide***
1: 25000	**?**	**?**	**?**
1: 50000			

Other Considerations

There are two fault lines located to the west of the marae.

Figure 20. Mangamingi Marae in relation to volcanic flows.



Raetihi Pā Results

Raetihi Pā is located at the edge of the Raetihi township within 500m of the Makōtuku River elevated above the road. High roofs dominate the buildings and the marae is on town supply for at the moment; no water capture tanks are used. There are personnel permanently based at the marae during normal working hours. Fire is used to heat the water and electricity powers all the facilities; the wharenui has an underground connection whereas all other buildings are linked via overhead power lines. There is a whare karakia located behind the marae. Access to the marae is through the Ohākune Raetihi Road.

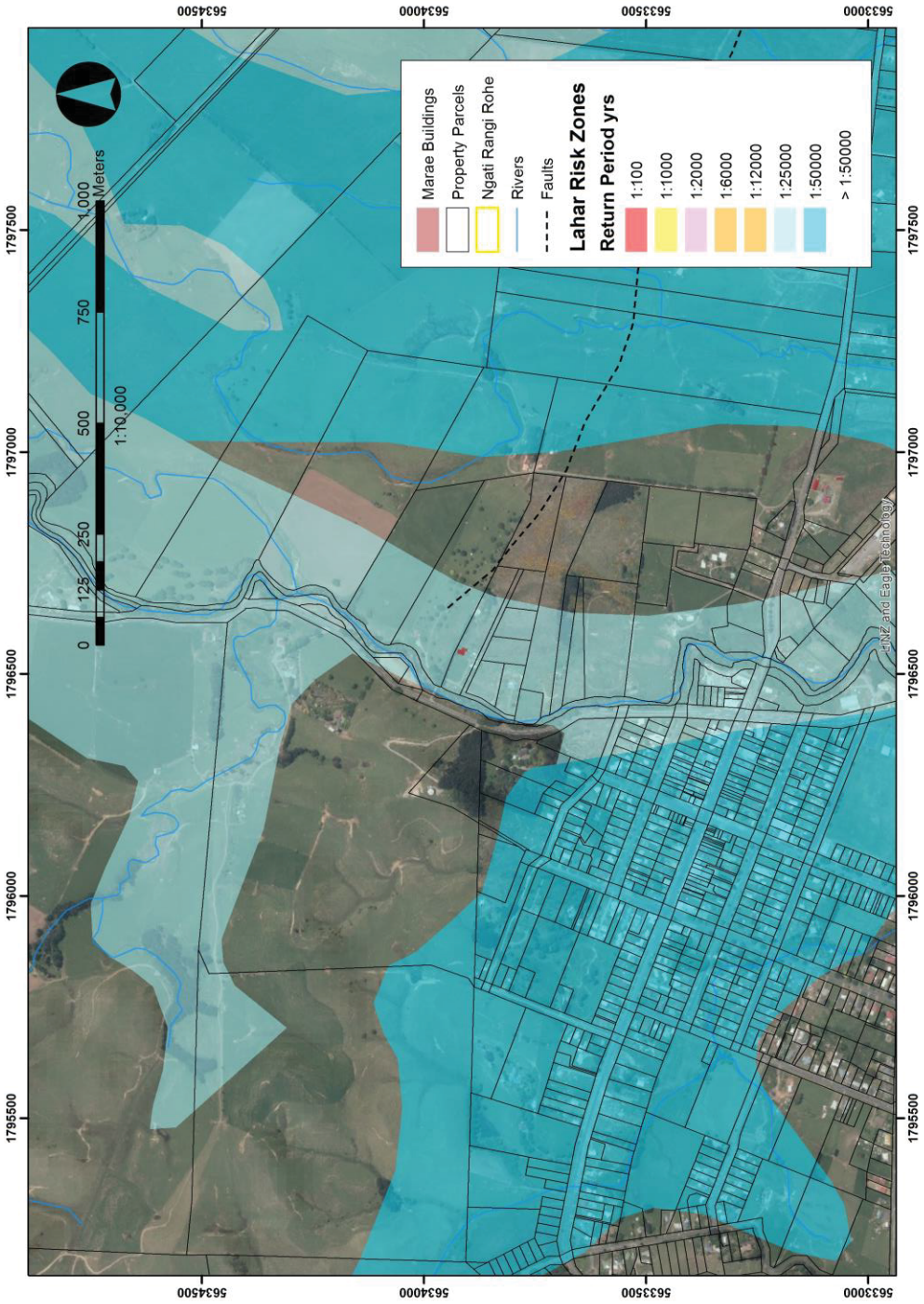
Hazard Recurrence Rate

Flow	*Fall*	*Lava Flow*	*Landslide*
Nil	**?**	**?**	**?**

Other Considerations

The map also indicates the magnitude of lahar deposits within the area. A fault line runs east-west to the north of the marae.

Figure 21. Raetihi Pā in relation to volcanic flows.



Mote Katoa

Mote Katoa is a multi-purpose marae situated north of the Raetihi township off SH 4. Access to Mote Katoa crosses the Makōtuku River and is potentially the only point of access. As a multi-purpose facility, not all resources are available for use at this marae. There were no indications of heat pumps or chimneys for heating and one tank was viewed at the rear of the ablutions block. There is an airstrip located north of the marae along SH 4.

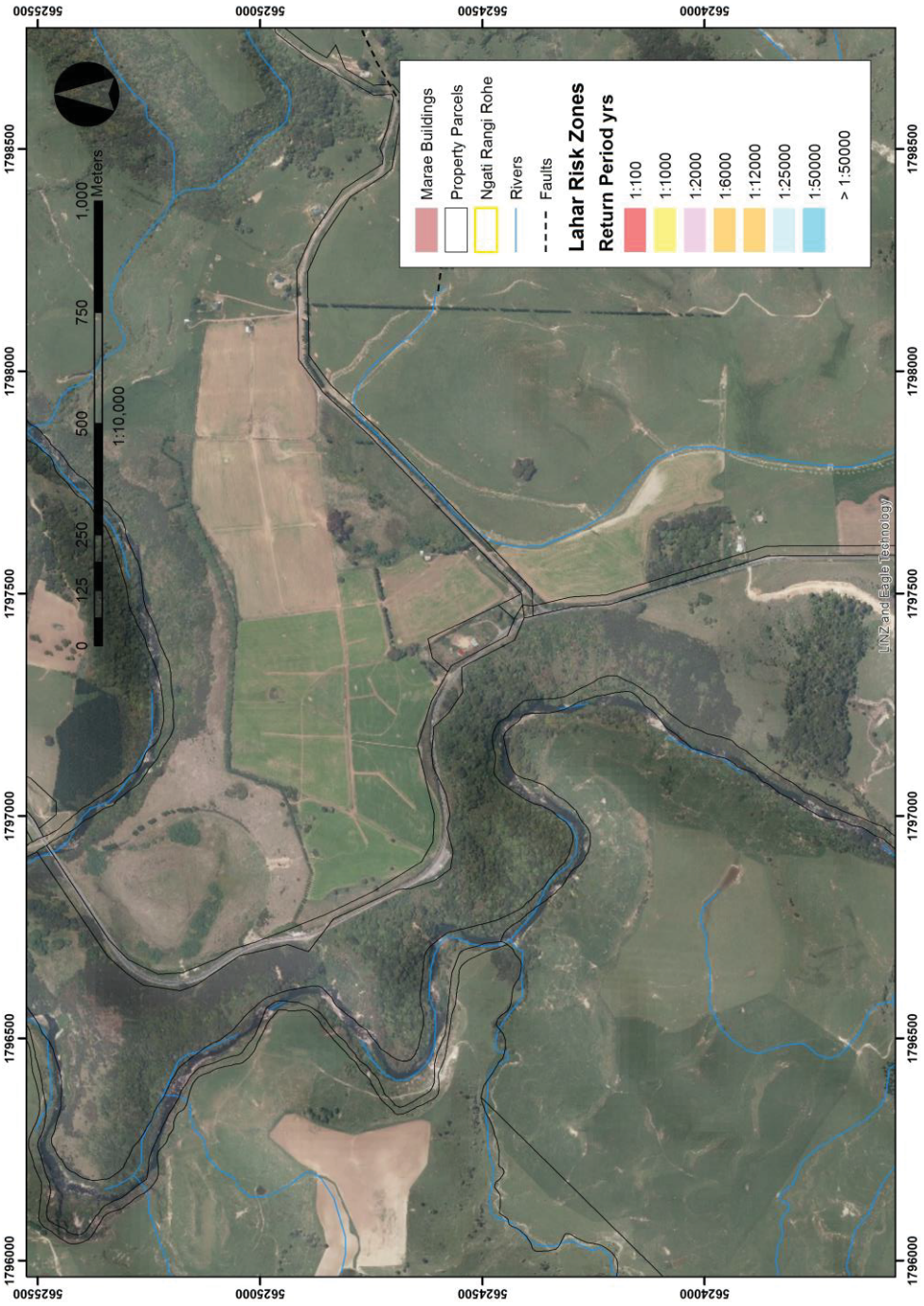
Hazard Recurrence Rate

Flow	***Fall***	***Lava Flow***	***Landslide***
1: 25000	**?**	**?**	**?**

Other Considerations

Makōtuku prone to flooding leaving the river crossing to Mote Katoa compromised. A fault line exists to the east of the marae.

Figure 22. Mote Katoa Marae in relation to volcanic flows.



Tuhi Ariki Marae Results

Tuhi Ariki is another multi-purpose facility located south of Raetihi on SH 4. It occupies a significant elevated position above the river gorge below. There are two separate buildings on site with significant land area unused but no ablution block.

Hazard Recurrence Rate

Flow	*Fall*	*Lava Flow*	*Landslide*
Nil	**?**	**?**	**?**

Other Considerations

Nil.

Figure 23. Tuhi Ariki Marae in relation to volcanic flows.

Waitahupārae

The marae representative for Waitahupārae Marae made contact on receipt of the letter sent out to all marae representatives to clarify that they have no facilities or buildings and are one of Ngāti Rangi's aspirational marae. However, a site assessment still went ahead to view the site in relation to the surrounding landscape. This marae is positioned on a terrace above the gorge of the Manganuioteao River, with farmland and steep hill country within the vicinity of this block. Littered throughout this area is the presence of large quantities of volcanic rocks from a historical debris avalanche and lahar deposits. Access to this area is via a gravel road. Waitahupārae is positioned to the far west of all other Ngāti Rangi marae and is near the western rohe boundary.

Mākaranui

This marae could not be located during the site visit phase of data collection and is not used as part of this research. However it is noted that this marae is used mainly as a whānau campsite with facilities for kai, kitchen and wharepaku/wharekaukau (ablutions, showers). It is currently without a wharepuni. This marae, however, is situated between Maungārongo and Mangamingi and is in close proximity to Te Kotahitanga marae.

Te Kotahitanga

Te Kotahitanga is located south of Mākaranui. This marae was not located during the site assessment phase and therefore not used as part of this research. Te Kotahitanga is a whānau-based marae with some facilities on site.

Marangai

The Ngāti Rangi marae map indicates the location of Marangai as between the Raetihi township and Mote Katoa marae. During the site assessments this marae was not located. Marangai is not currently operational; however, it is noted that a partial building is located on site and is used by whānau members.

Te Ao Hou

Te Ao Hou marae has strong whakapapa links to Ngāti Rangi but is located in Whanganui, outside of their designated rohe. For this reason, this marae is exempt from this research.

Tirohia

This marae is an old homestead located further up Ngā Mōkai Road (heading south east off Whangaehu Valley Road) nestled in an elevated position close to the road. However, due to its lack of current use and facilities it was not assessed as part of this research.

6.4 Summary

The key element highlighted within this chapter was the relationship between the continued existence of marae, and the resilience of Ngāti Rangi. The interviewees noted the prominence of marae specifically to ahi-kā-roa and thus they are a strong contributor to their resilience. Although Ngāti Rangi maintains a large number of marae within their rohe, several of these were not suited for this research primarily due to lack of facilities. Finally, in conjunction with this, the maps presented for each marae assessed also indicate the current risk level posed by volcanic flows to each of these marae, thus providing visual clarity on the potential safety of each location during a volcanic event.

Chapter 7: Discussion

7.1 Introduction

The research has examined a multitude of data from several disciplines with the intention of achieving a framework that allows indigenous communities and their resilience to be measured against natural hazards. This chapter focuses predominantly on two key findings; marae as the centre point of Māori culture along with one key element that ties iwi to land, water and their tūpuna, ahi-kā-roa. Also explored throughout these findings are the different layers that make up the resilience of Ngāti Rangi; these are also found to represent baseline indicators when considering the framework.

7.2 Marae

Marae have been assessed in their ability to support the community as civil defence shelters. Based on the results, six criteria for prioritising the Ngāti Rangi marae as civil defence shelters emerge. These are:

- Facilities to support (fully functional vs. aspirational)
- Risk posed from current volcanic activity
- Historical risk, based on old lahar deposits and tephra fall-out
- Other risks from natural phenomena (that may impact on access routes)
- Communication
- Proximity to main centres (transportation routes).

These variables are explored further in Table 15 where the priority analysis was undertaken. The results from the marae audit analysis stipulate that not all Ngāti Rangi marae have the ability to act as places of shelter during an event that forces people from their homes.

Marae	Classification	Historical Lahar deposits	Risks to access routes e.g. Bridges	Proximity to waterways	Plans and policies	Proximity to highway	Access to communication
Raketapauma	Fully Functional	Nil	Nil		Nil	≥5 mins to SH 1	Cell phone reception
Kuratahi	Fully Functional	Nil	Slips		Fire safety policy	15-20mins to SH 1	Landline Cell phone reception
Tirorangi	Fully Functional	1:100 1:6000 1:12000	Bridge over Whangaehu River	Within 50m of the Whangaehu River	Nill	≥7 mins SH 47	Cell phone reception
Ngā Mōkai	Fully Functional	1:25000	One bridge crossing over the Tokiāhuru River	Within 50m of the Tokiāhuru River	Nill	≥5mins SH47	Cell phone reception Internet access
Maungārongo	Fully Functional	1:25000	Flooding of Mangawhero River. Only 2 access points over this river	<10m to Mangawhero	Several plans and policies	>1km	Landline Cell phone reception
Mangamingi	Fully Functional	1:50000 1:25000	Potential flooding of Ohākune-Raetihi Road	Elevated position above Mangawhero	Nill		Cell phone reception
Tuhi Ariki	Semi Functional	Nil	Nil	Significant elevation	Nill	On SH 4	Nil
Raetihi Pā	Fully Functional	Nil	Potential flooding of Ohākune-Raetihi Road, SH 4 from the Mākotuku River	Elevated position above the Makōtuku River	Nil	>1km SH 4	Landline Cell phone reception Internet access
Mote Katoa	Semi Functional	1:25000	One access route via bridge over Makōtuku River	> 150m from Makōtuku	Several plans and policies	>150km from SH 4	Cell phone reception
Waitahupārae	Aspirational	1:50000 1:25000	Slips	Significantly elevated above the Manganuioteao River	Nil		Nil
Mākaranui	Semi-functional	N/A			Nil		Cell phone reception
Te Kotahitanga	Semi-functional	N/A					Cell phone reception
Marangai	Aspirational	N/A	Unknown	Unknown		Unknown	Cell phone reception
Te Ao Hou	Fully Functional	N/A	Unknown	Unknown		Unknown	Unknown
Tirohia	Semi Functional	N/A	Whangaehu valley Road Bridge				

Table 15. Risk analysis of Ngāti Rangi Marae[46]

[46] Refer to Appendix 5 for marae prioritisation calculation.

The analysis of data captured within Table 15 represent the physical facts derived from observations, from previous academic research and the marae assessment and surveys. The classifications of marae indicate their ability to house civilians during an emergency event. Those fully functional marae had a higher prioritisation than the semi-functional and aspirational marae. This Table also outlines the site-specific return period of volcanic flows that impact several marae. Historical lahar deposits exist widely throughout the rohe but are generally confined to the main catchments where marae are placed, yet three fully functional and one semi-functional Ngāti Rangi marae are not located on lahar deposits. Risks to access routes were also identified. In order to prioritise each marae, all typical risks required identification, specifically with access routes to individual marae. This analysis ensured that all risks to roads, river crossings, proximity to waterways were factored in for a more thorough assessment of risks. The data collection indicated previous flooding issues in the area where specific marae, within the Mangawhero and Makōtuku/Waimarino paepae, are at risk.

The level of telecommunications offered at marae can be viewed as crucial, since a key focus of the emergency shelters is the distribution of information to the wider public. Table 15 outlines individual marae capabilities in relation to communication, such as internet access, landline and cell phone reception. Raetihi Pā is the only marae with all the communication capabilities to ensure that the distribution of information both inbound and outward is effective. The immediacy of marae to local highways such as SH 1, SH 4 and SH 47 delivers clear points of access for emergency services and evacuees largely because these highways are better maintained by infrastructural services than many of the smaller ones.

7.2.1 Marae as Civil Defence Shelters

Raketapauma is considered to be the first priority for Civil Defence shelter within the Ngāti Rangi rohe. There are no recorded historical lahar deposits within a 1km radius of the marae, and the marae is elevated enough to avoid any inundation from localised waterways. The high slanted roof of the wharepuni provides some assurances of reduced impacts from tephra. Raetihi Pā and Kuratahi would be

considered second equal in terms of prioritisation. However, Raetihi Pā and its proximity to Raetihi and Ohākune may have an advantage over Kuratahi. In addition to this, the elevation of each of these marae has meant they have avoided historical lahars originating from Ruapehu. West of Raetihi Pā marae is a telecommunications tower, providing enhanced cell phone and internet access for Raetihi residents.

Mangamingi marae sits at third on the prioritisation list and like many other marae of this catchment, its access routes are at risk from flooding. Although the wharepuni cannot house many people comparatively to other marae, its total land area is quite substantial.

Arguably, Tirorangi sits on the other end of the spectrum of fully functioning marae due to its proximity to the Whangaehu River, the current lahar channel. It resides on a section of land that has not been historically inundated by a 1:100 year lahar flow but has been by larger return period flows. However, its location creates a significant element of risk if future lahar volumes were to increase. The likelihood of inundation from lahars along the Whangaehu River catchment is probable for Tirorangi marae but the most damaging prospect is the impact on the structural integrity of the Whangaehu River bridge, which connects the northern and southern settlements of Karioi. These factors force the prioritisation of Tirorangi marae to the least favourable of the fully functioning marae, due to the potential risk from lahar impacts.

Debatably, the low prioritization of Tirorangi is in direct conflict with its symbolism of ahi-kā-roa to Ngāti Rangi. In the context of their mātauranga Māori, the continued existence of Tirorangi beside an active lahar channel metaphorically signifies the continued resilience of Ngāti Rangi to volcanic hazards. The risks to the Whangaehu catchment are well known, particularly by the iwi and local residents along the Whangaehu River. To date, the majority of recent recorded lahar events have remained within the confines of the Whangaehu River channel near the Tirorangi marae, therefore supporting their cultural kōrero relating to the safety of their marae and its continued existence on the banks of the Whangaehu River. Ngāti Rangi has

existed in this area for 1,000 years. During this time, the location of Tirorangi has not been inundated by a lahar. Karioi was one of the key locations of marae, alongside the Manganuioteao and in the Hautapu quarter at Raketapauma. Their kōrero denotes their relationship with Ruapehu and their stance regarding the safety of Ngāti Rangi as a people, and Tirorangi as special place fortified by their tūpuna.

Marae are pivotal in the resilience of Ngāti Rangi and represent the ahi-kā-roa of the people. Wood (personal communication, May 8, 2014) discusses briefly the essentiality of marae to the people of Ngāti Rangi, stating: *'a number of our families had said that if there was … a more significant eruption, that [marae] would be the place they would gravitate too'.* This further supports the crucial social element that strengthens the whakapapa ties amongst the iwi and presents the fundamental community spirit and network that is essential to overall resilience, with marae at the centre. Māori culture also supports resilience through specific cultural concepts such as manaakitanga, kaitiakitanga and tikanga, which are largely values built around the holistic nature of iwi interaction with the environment. It is within the nature of Ngāti Rangi to support their community and they are guided by manaakitanga. This is integral to the stability of a group of people and represents the strength of Ngāti Rangi as a community.

7.3 Ahi-kā-roa – in essence, resilience

The relationship between ahi-kā-roa and resilience was the most significant finding of this research. In light of this, it is essential not to confuse Ngāti Rangi and their residence in the area as ignorant of the potential and actual risks from volcanic processes. Their perspective and acceptance of Ruapehu as a powerful volcanic entity are instilled within their culture and Ruapehu plays a fundamental role in the birth of Ngāti Rangi within Aotearoa. Wood articulates this further *'families weren't particularly afraid of the whole nature of eruptions … that whole process … it's a very natural process'* (K. Wood, personal communication, May 8, 2014), which again

reinforces the holistic belief system that guides Ngāti Rangi and their interpretation of volcanic activity.

It has been stipulated via several forums that Ngāti Rangi have a stance of no intervention on the maunga that diverts or withholds the flow of a lahar, instead there is a need to *'put in place … infrastructural protection off Koro and off the mountain … move those things away from the mountain... ERLAWS lahar management systems being installed, the gates on the road, the raising of the Tangiwai Bridge, they were key steps [away from intervention on the mountain] and even the bund that was built out on Te One Tapu'* (K. Wood, personal communication, May 8, 2014). Social, political, and economic environments are at risk from volcanic events due to the configuration of society, communication and networks that exists and the reliance of civilisation on infrastructure. Wisner et al. (2004) bring an important point to the surface signifying that the major emphasis on disaster preparation is hazard focused. They specify that more attention should be diverted towards the social frameworks that influence and structure communities, essentially to avoid total reliance on the infrastructure. The vision of Ngāti Rangi as an iwi '*kia mura ai te ora o Ngāti Rangi ki tua o te 1,000 tau*' describes their forethought and aspiration to continue their existence within their tribal area and is translated as 'Ngāti Rangi continues to vibrantly exist in 1,000 years' (Ngāti Rangi Trust, 2012).

Understanding what represents resilience at an iwi level will be highly beneficial for Emergency Management in New Zealand largely due to the multicultural society, but more so to identify the cultural foundations that distinguish resilience of iwi, hapū, whānau from mainstream New Zealand. Factors that contribute to the resilience of Ngāti Rangi are not included in mainstream resilience measures. The resilience of Ngāti Rangi to volcanic processes highlights crucial cultural elements that emphasise the significance of mātauranga Māori and more particularly ahi-kā-roa.

Ahi-kā-roa is a key indicator of resilience and can provide a practical measure of resilience. Ahi-kā-roa can be quantified due to several factors such as: (1) ahi-kā-roa being a living concept built around the residence of iwi within their tribal boundaries and ebbs and flows with the growth of iwi, (2) the activeness of each marae, (3) the continued presence of iwi within local decision-making, and (4) active kaitiakitanga. These become a crucial element that this research has found. It is integral as it represents the need for a more inclusive method of defining and incorporating elements that better represent resilience from an indigenous-based ideology.

The Community Response team of Karioi is a prime example of community involvement, consultation and execution. Ideally this process will need to be repeated, strengthened by new information and research, and supported by new technology.

A western or Eurocentric understanding of resilience of a group of people has dominated across cultures. Typical measures that are seen to contribute to protection against hardship (intelligence, positive parenting, quality education) (Masten, 2001) are not fully representative of culturally based contributors to resilience for Ngāti Rangi. It has been the assumption that these protectionary measures of intelligence, parenting style and the quality of education will be the common thread internationally in resilience research (Theron et al., 2013). However, more traction is being gained in exploring the perceptions of resilience by specific cultures within their 'specific sociocultural context' (Theron et al., 2013, p. 65). This development perhaps opens up a relatively 'new' context for examining cultural resilience. For example, HeavyRunner and Morris (1997) discussed the terminology 'cultural resilience' as a basic description of their traditional cultural practices that foster resilience within their tribal group, which has been occurring throughout the generations.

7.4 Ngāti Rangi and their Ahi-kā-roa

This section describes key features of Ngāti Rangi and their resilience based on the results captured in chapter 6, which includes the layers of Ngāti Rangi resilience and an equation describing the resilience of Ngāti Rangi.

The Whangaehu paepae of Ngāti Rangi distinguished ahi-kā-roa as a strong principle that not only contributes to, but is considered 'the' resilience of Ngāti Rangi. Ahi-kā-roa is defined as occupancy over the land, and is reinforced by whakapapa. Ngāti Rangi marae are physical representations of ahi-kā-roa and each of these marae hold a place within the overall rūnanga structure and contribute (if a representative is active) a presence within the affairs and decision making of the iwi. Understanding the historic importance of marae and their placement provides an appreciation of why kāinga and pa were situated where they were/are.

If ahi-kā-roa is at the centre of Ngāti Rangi resilience, then the basis of ahi-kā-roa is built on several imperative functions and concepts such as:

1. Whakapapa: A basic understanding of whakapapa is genealogy; it paints a picture of where Ngāti Rangi have been, where their roots lie and how they are positioned in the world. It also expands to the connections between whānau, hapū and iwi.
2. Kaitiakitanga: viewed plainly as indigenous environmental management. Ngāti Rangi reside on their ancestral land; they have an understanding of the land, waterways and natural resources at an intimate level. Through active kaitiakitanga, aspects of capacity building can be undertaken through involvement in monitoring and research.
3. Capacity building: The Ruapehu Whānau Transformation as an example of a project aimed at the retention of locals through upskilling.
4. Māori Worldview: Or a Ngāti Rangi worldview, indicating their way of looking at the world that encompasses their understanding of creation and their cultural outlook on life.
5. Mātauranga Māori: The traditional knowledge systems that support a Ngāti Rangi way of life. It is a body of knowledge that is drawn on to interpret the surrounding environment and is constantly added too.
6. Marae: cornerstone of ahi-kā-roa as the physical representation of iwi presence within an area. Key features that accompany this aspect are whanaungatanga, which are the family networks and on a wider front

whakapapa joining people to people, and people to marae[47]. Tikanga provides the foundation and stability for culture and tradition and is also a guiding mechanism for ahi-kā-roa and inevitably resilience.

Layers of resilience
Intergenerational knowledge sharing
Turangawaewae - Marae
Iwi/hapū/whānau connections
Relationship and connection with environment
Self sufficiency
Capacity building within iwi
Kaitiakitanga
Oral Narratives and traditional knowledge systems
Tikanga

Table 16. Ngāti Rangi Layers of Resilience

In addition to the key concepts of ahi-kā-roa, described earlier, the layers of resilience, featured in Table 16, portray the practical ways these layers contribute further to ahi-kā-roa. These layers have also provided a clear platform to solidify key resilience indicators and build on them through further discussions with Ngāti Rangi.

7.4.1 Marae: The stronghold for iwi. The foundation for resilience

Marae are instrumental to Ngāti Rangi resilience as the central point of culture, history and the gathering of people in one area. As determined by the marae audit results in relation to the lahar return period, no marae has been adversely affected in the history of Ngāti Rangi existence in the area. However, their individual proximity to risk

[47] These key concepts were described earlier in Chapter 2.

is highly varied, with Tirorangi being most at risk from lahar inundation. To add further to ahi-kā-roa, Ngāti Rangi marae were initially only situated along three main catchments, being the Whangaehu catchment at Karioi, the Manganuioteao catchment with Waitahupārae, and in the Hautapu catchment with Raketapauma. These marae were situated in strategic places mostly based on access to resources and their alignment to spiritual pathways throughout the rohe, placed on sacred sites in order to protect them and their proximity and view of Ruapehu. The lands between these marae locations were used for food gathering. All other Ngāti Rangi marae were established at a later date, mainly in response to the growth of local towns and settlements within the rohe and to retain a direct link to the land at these sites. Also Ngāti Rangi avoided settlement in specific areas such as Te One Tapu, on the maunga itself and between the maunga and Stratford[48] (within their rohe).

Volcanic eruptions are not associated with any negative connotations and therefore are not largely feared by Ngāti Rangi. Life continues during an eruption, as has been done in the past. This also extends to lahars. Families along the Whangaehu catchment and the wider Ngāti Rangi community have been living with lahars for generations and it is widely accepted as a natural process of the volcano and is beheld as an event that can restore balance to the environment and to the people. The resiliency of Ngāti Rangi is therefore demonstrated in the cultural practices that enhance the resilience of the iwi to overcome adversity. It is also the ingrained processes or lifestyles lived by Ngāti Rangi; this embeddedness is one of the main contributors to their resiliency. To Ngāti Rangi, resiliency is based on the ingrained processes and lifestyles lived by the people and the tikanga that guides all cultural processes. Those whānau that have farming backgrounds understand the requirements that type of lifestyle needs, particularly with stockpiling resources for themselves and the stock, and conserving water particularly for drought; this knowledge and resourcefulness contributes to their resiliency.

[48] Stratford, a small Taranaki settlement located between New Plymoth and Hawera, New Zealand.

7.4.2 Resilience Equation

Therefore if resilience were described in the form of an equation, it needs to take into account all the positive reinforcements that contribute to the resilience of Ngāti Rangi, bearing in mind the exposure and risk posed by volcanic hazards.

$$Resilience = \frac{Ahi\text{-}kā\text{-}roa \ x \ Adaptive\ Capacity}{Event\ occurrence}$$

Most importantly, both ahi-kā-roa and adaptive capacity play different roles in the resilience of the Ngāti Rangi iwi; ahi-kā-roa to some extent encompasses the values and concepts that are inherent within their culture, while adaptive capacity is the flexibility that allows cultural evolution to take place. The term 'event occurrence' was used rather than the usual 'risk', 'volcanic hazard' or even 'threat' purely to indicate exposure to an actual event rather than risk or threat, as these are always present.

The equation presented stipulates the key factors contributing to Ngāti Rangi resilience to volcanic processes. Ahi-kā-roa proved to be the essential factor in supporting the resilience of Ngāti Rangi and the malleability of their culture to withstand change and adapt when and where necessary, which was termed adaptive capacity. The resilience of the iwi will be tested during volcanic events and therefore can be measured against event occurrences and resulting impacts. It could prove difficult to quantify adaptive capacity until after events have occurred when it will be evident how the culture has adapted to change in order to survive.

7.4.3 Measuring Ngāti Rangi resilience – guiding framework

This proposed framework provides other users visual and theoretical guidance on undertaking the measuring of iwi resilience to natural hazards.

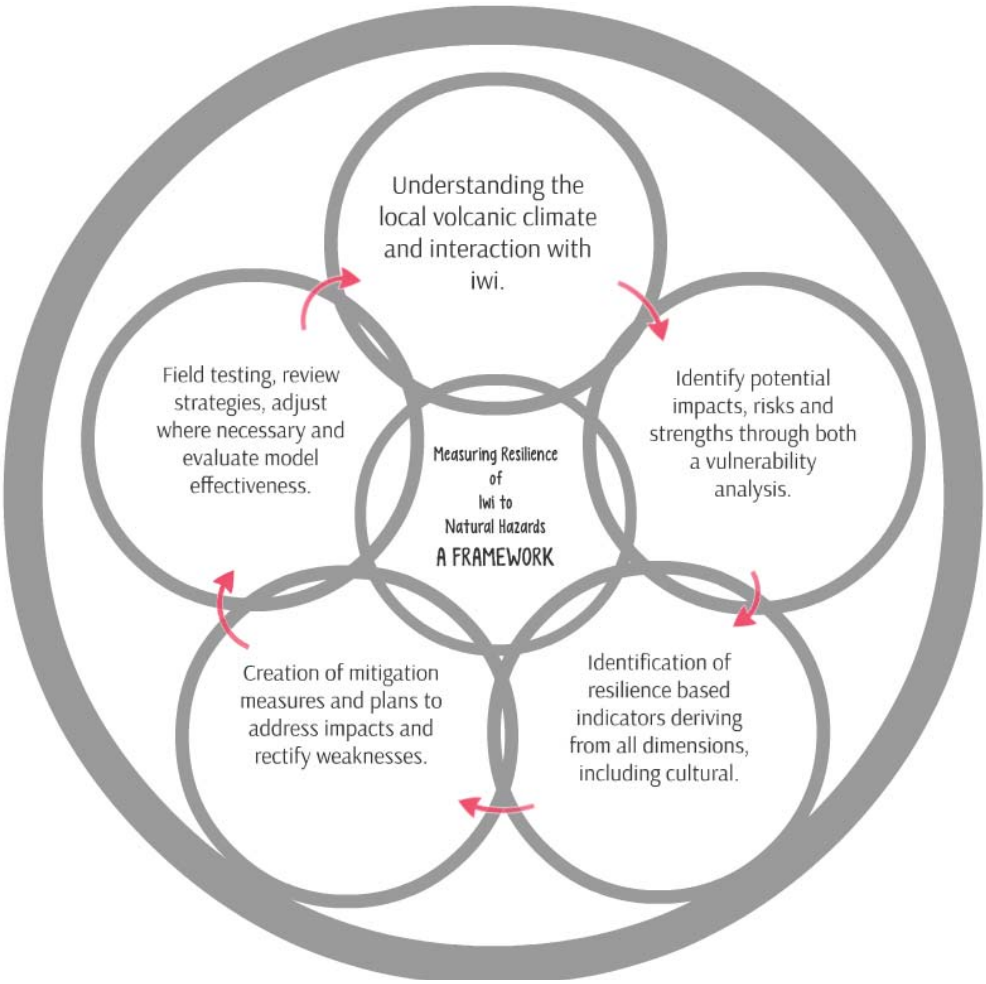


Figure 24. Measuring Iwi Resilience to Natural Hazards: A Framework.

Early in Chapter 1, a number of theoretical models were displayed that would provide a good base, with subtle adjustments to incorporate an additional dimension, which was better inclusive of cultural parameters displayed throughout this study. The DROP framework is site specific, as are iwi, and can therefore present a good mixture of western and indigenous based indicators. The inherent resilience of a community is a crucial element to this model, which is strongly identified within Ngāti Rangi.

7.4.4 Local people – Local Volcanic Climate

This process explores, as this research has, the volcanic climate being assessed in conjunction with the local iwi. This therefore creates the baseline for understanding the level of risk to iwi communities, in addition to their relationship with their mountain and the cultural concepts that exert their dominance within this type of

framework. As with Ngāti Rangi, several cultural concepts within their belief system will strengthen their cultural-based indicators and reinforce their relationship with Ruapehu.

Further appreciation is required of the risk perception of the local people. Ngāti Rangi and their relationship with their ancestral maunga is unique, while the volcanic processes are understood by iwi and these events celebrated, the designation of tapu areas throughout the area signifies the depth of understanding of the volcanic nature of Ruapehu. This has occurred through constant residence in the area and living closely with the environment. The iwi understand the nature of Ruapehu and have an awareness of the historical and recent occurrences within their rohe; due to the consistency of volcanic activity, this awareness, relationship and understanding of this volcanic entity is able to be re-shared among his people.

7.4.5 Vulnerability analysis

While this research did not explore a vulnerability analysis for Ngāti Rangi, the DROP model is designed to present the relationship between vulnerability and resilience. The region comprises several small communities where tourism and primary industry dominate the economic sector. Identifying where vulnerabilities lie may allow for preparatory measures to address, and thus strengthen, shortfalls. Alternatively, marae vulnerabilities in relation to access points, structures, power and water supply, as partially identified through this study, could be further reinforced as a means to reduce the vulnerabilities of the iwi and their livelihoods. Further research to determine actual vulnerability to individual volcanic processes, i.e. tephra and debris avalanche, via a vulnerability analysis could better support this proposed resilience framework.

7.4.6 Identifying Indicators

In relation to the DROP model, Cutter et al. (2010) go further to create specific resilience indicators that can establish the baseline conditions to measure the resilience of communities. Despite this, the challenge remains to initially identify

metrics and assign applicable standards to measure resilience. Cutter et al. (2010) use composite indicators or 'indices' (p. 2) as a vehicle to quantify resilience. These indicators can be described as a simplified measure taken from specific information and can communicate the varying complexities involved (Freudenberg, 2003).

Dimension	Candidate Variables	*Potential adjustments for Ngāti Rangi*
Ecological	Wetlands acreage and loss Erosion Rates % Impervious surface Biodiversity	*Water quality* *Biodiversity* *Pest Control* *Protected areas* *% Riparian planting* *% Farming neighbouring waterways*
Social	Demographics Social Networks Community values-cohesion Faith-based organisations	*Population of Ngāti Rangi residing in rohe* *Community networks* *Demographics* *Education Facilities*
Cultural		***Belief systems*** ***Whanaungatanga*** ***Mātauranga Māori*** ***Marae*** ***Whakapapa*** ***Tikanga*** ***Kaitiakitanga*** ***Ahi-kā-roa***
Economic	Employment Property values Wealth generation Municipal Finance/revenues	*Employment (seasonal and full)* *% Primary Goods Exported* *Ngāti Rangi Assets*
Institutional	Participation in hazard reduction programs Hazard mitigation plans Emergency services Zoning and building standards Emergency response plans Interoperable communications Continuity of operation plans	*Participation and development of emergency management plan* *Emergency Services per capita* *Community participation in response plans* *Communication* *Long-term operation plans*
Infrastructure	Lifelines and critical infrastructure Transportation network Residential housing stock and age Commercial and manufacturing establishments	*Transport and Railway network* *Critical infrastructure* *Power and water supply* *Residential housing stock and age* *Marae*
Community Competence	Local understanding of risk Counseling services Absence of psychopathologies Health and wellness Quality of life	*Intergenerational learning* *Wānanga* *Māori health* *Understanding and acceptance of the nature of volcanic activity* *Previous experience and exposure*

Table 17. Potential Indicators for Quantifying Ngāti Rangi Resilience

(Adapted from Cutter et al., 2008).

Table 17 outlines a number of potential key indicators that can be used as part of the DROP model. It has some subtle adjustments to suit not only Ngāti Rangi, but also the local social, political, economic and infrastructural climate of the rohe. The critical distinction that is required for this resilience framework is the inclusion of a 'cultural' system in addition to the current systems triangle (social systems, natural systems, and built environment shown at the very left of Figure 26 below). Ngāti Rangi indicators can be placed in the other three systems to provide an overall indication of Ngāti Rangi resilience.

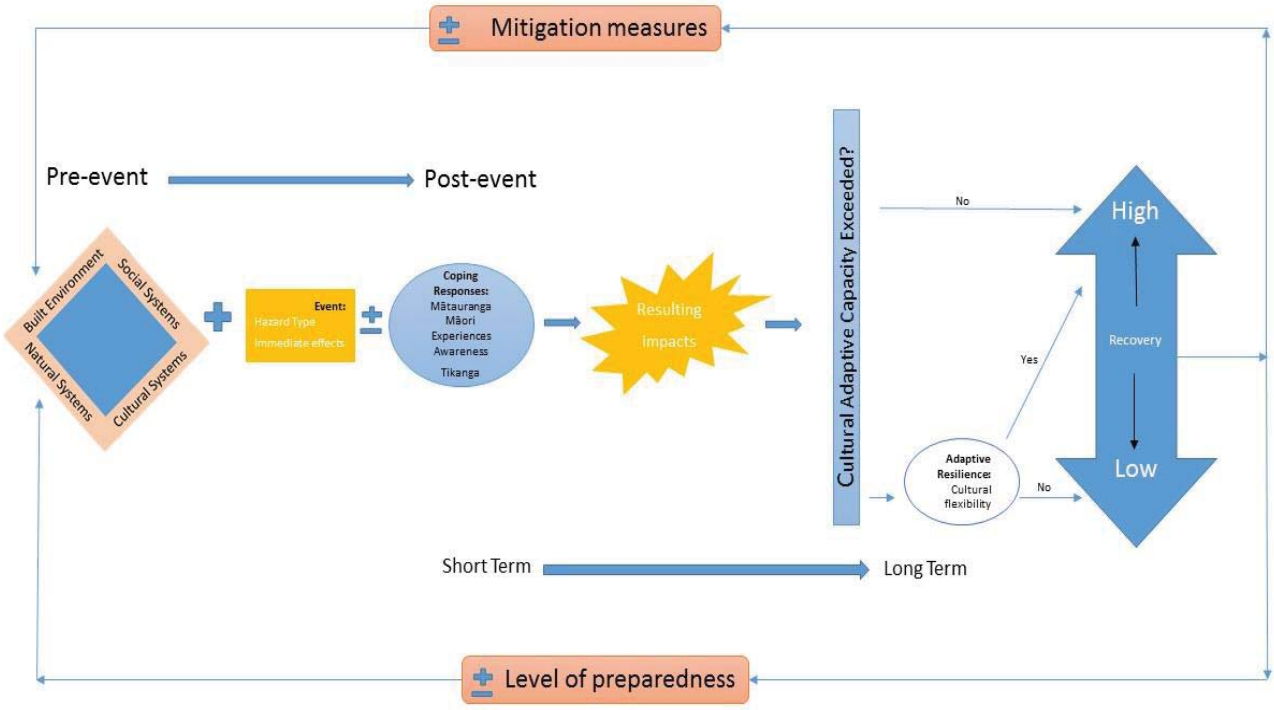


Figure 25. DROPO Model Flowchart: Cultural Adaptation

This will ensure that the cultural inclusion and analysis will take place. In relation to the indicators described in Table 17, these cultural-based indicators target the community level of Ngāti Rangi. The other dimensions offer measurements based on income, health, infrastructure and social services that should be blended with the Ngāti Rangi based information derived from this study. This research proves that the resilience of Ngāti Rangi is heavily supported by cultural beliefs and relationships but as a reflection, further research into the remaining dimensions outlined in Table 17

could investigate if disparities exist in and between these areas and whether these impact on the strong cultural-derived resilience of Ngāti Rangi.

This individual process provides a means of turning a set of variables into composite indices that can then be applied within a model to quantify resilience. The difficulty lies with assigning the weighting and aggregation to the identified variables, specifically those within the cultural dimension, as they are not based on numbers but the strength of relationships. Therefore these weights need to be assigned appropriately to capture the essence of what these proposed variables represent.

7.4.7 Mitigation and Preparatory Measures

The DROP flowchart outlines mitigation and preparedness as essential to the framework and contributing to the overall effectiveness of the DROP. Community involvement in emergency management plans to address potential impacts as a result of the 2007 lahar proved effective. This ensured information was shared and there was awareness of likely impacts. Improvement in individual/family-based preparatory measures should be addressed and identified. Marae acting as civil defence shelters should also adopt some form of mitigation plans and establish internal preparatory measures for the health and safety of the users.

7.4.8 Field testing

The final installment of this framework is to begin certifying the process. Basically a form of field testing needs to be conducted to flesh out issues, inconsistencies and confirm the model is usable. This will then allow the model to be adopted by other communities that are looking to assess their own resilience to natural hazards. That is an essential part of this process to ensure that all parameters and indices provide an accurate measurement of the resilience of iwi to natural hazards.

Chapter 8: Conclusion

This chapter contains the concluding statements that finalise this research.

- Ngāti Rangi resilience is fundamentally cultivated from culture and traditions that have been sourced from residence at the foot of Ruapehu. These cultural traditions can exist in the form of tikanga, and are very present in the livelihood of Ngāti Rangi and subsequently reinforce their resilience. The concept of resilience, not necessarily the term, is very crucial to Ngāti Rangi and the exploration of it alongside Ngāti Rangi has again reinforced that the knowledge they hold through their experiences and cultural practices in relation to volcanic activity provides a certain degree of resiliency.
- Despite resilience being difficult to define and measure, it is clear that the resilience of Ngāti Rangi diverges from what is understood to be mainstream resilience. The Ngāti Rangi indicators identified display strong connections to the traditional knowledge of the iwi and derive largely from their ahi-kā-roa. Consequently, careful consideration must be made in the application and assessment of these indicators within a model to ensure that they are assessed in a culturally appropriate way that is driven by iwi.
- Marae are representative of ahi-kā-roa and therefore the embodiment of resilience. Several Ngāti Rangi marae are more than adequate to act as civil defence shelters based on the findings regarding proximity to volcanic flows, the individual marae resources, access routes and other localised hazards. With an area at risk from volcanic events, having several new civil defence options available to the wider community will provide immense benefit to community members seeking shelter during a volcanic event.
- A large proportion of this research's objective was to examine and identify resilience of iwi to natural hazards. This has meant that a framework was developed to guide the measurement of iwi resilience to natural hazards.

Ruapehu poses a series of hazards to the surrounding communities both locally and nationally. Ngāti Rangi have existed within their ancestral lands for over 1000 years and have the aspiration to continue this over the next 1000 years. Their mātauranga Māori and traditional practices have guided their residence beneath their ancestral maunga, Ruapehu, for generations. The capacity within their culture to adapt has allowed the growth of the iwi to coexist with volcanic activity in the 21st century, adding to their resilience.

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Appendices

Appendix 1. Information Sheet for Marae Cluster Groups 2014

Kia ora e te iwi,

My name is Hollei Whiungarangi Gabrielsen and I am from Moawhango (Ngāti Whitikaupeka/Tamakōpiri) and Ngāti Tūwharetoa and I am a Master of Science student at Massey University. My research aims to measure Māori resilience to natural hazards. To do this research, I would like to work with Ngāti Rangi to measure your resilience to the volcanic events and processes of Mount Ruapehu. As part of the research, I will be developing a scientific-based model to measure this resilience. This model will include iwi indicators of resilience that are specific to Ngāti Rangi.

It will also include an analysis of Ngāti Rangi marae, and potentially land and other assets to determine how well these taonga will be able to provide for the iwi and the wider community during a volcanic event. To do this analysis, I will use Geographical Information Systems (GIS) to map landforms and hazards in relation to local marae and analyse the risks to them.

I initially hoped that a wānanga with the wider iwi were to take place January/February 2014, however, I do not want to overload the already busy Ngāti Rangi whānui. Therefore I propose that meeting with the cluster groups to undertake this aspect of research may be more practical. The purpose of these wānanga will be to promote discussions and gather an understanding of the volcanic world and the Ngāti Rangi world to bring these two elements together and further understand them. At the wānanga, I hope to explore a number of topics with you that promote discussion. These topics include:

- Ngāti Rangi perspectives of volcanic processes;
- What is resilience and what does this look like to Ngāti Rangi?
- How or if marae were used in the past after volcanic events.
- How marae might be used as civil defence posts in the future.

At the wānanga and with your permission, I would like to use two dictaphones to record our kōrero. This kōrero will be used to develop the Ngāti Rangi indicators in the model, and with your consent, will be written up in my thesis, which will be the main output from my research. I may also write journal articles and conference papers.

The korero that is captured from the wānanga will be stored by the Ngāti Rangi Trust on a secure drive and the information gathered will be available for review by the iwi to ensure that I am following your wishes . I will also store the data on my Massey University Computer, which is password coded and protected.

At the completion of the research, the information gathered at the wānanga will remain at the Trust for the iwi to decide what will happen with the recordings. I will present the findings from the research at one of the research feedback hui in 2014. If you have any questions or concerns regarding this research you can contact myself or my supervisors: Dr Jonathan Procter, J.N.Procter@massey.ac.nz and April Bennett, A.L.Bennett@massey.ac.nz.

Nāku iti nei, nā

Hollei

H.Gabrielsen@massey.ac.nz

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern B, Application 13/90. If you have any concerns about the conduct of the research, please contact the Chair, Massey University Human Ethics Committee: Southern B, telephone 06 350 5799 x 80877 email humanethicsouthb@massey.ac.nz

Appendix 2: Marae Visit Letter

Tena koutou Te Kāhui o Paerangi Marae representatives,

I am Hollei Gabrielsen, a Massey University Masters student and I spoke at Te Kāhui o Paerangi on 20th October 2013 and presented my Masters project to you all as marae representatives. My project is aimed at measuring the resilience of Māori communities to natural hazards.

A portion of this research is focused on marae, they act as the stronghold for iwi and hapū and where we return to in times of need, tangihanga, celebration, hui, and to wānanga. Therefore, I intend to look more into the individual marae and assess their ability to act as a Civil Defence Shelter.

I am proposing to visit several, if not all of your marae between 3rd -7th March 2014.

On this visit I intend to look into the following:

- Total land area of marae boundaries
- Water tanks
- Water supply
- Type of power supply
- Location of rivers near marae grounds
- Local geography

I do not intend to access any buildings, however, if you, or another representative of the marae wish to be present, you are more than welcome to join us. Please don't hesitate to contact myself or my supervisor (Jon Procter: J.N.Procter@massey.ac.nz) if you need more clarification or details relating to these proposed marae visits.

Nāku iti nei, nā

Hollei Gabrielsen

h.gabrielsen@massey.ac.nz

Appendix 3: Discussion Guide with K. Wood.

- 2007 experiences and perspectives
- What is resilience and what does this look like to Ngāti Rangi?
- How and if marae were used in the past after volcanic events
- How marae might be used in the future as civil defence posts. How might protocols come into play? Are there exceptions during a disaster event?
- 95/96 experiences and perspectives.
- Any kōrero from 1945?
- Negative impacts from volcanic activity if any (farm owners, workers on the land, ash in waterways, impact on drinking water, market gardeners, how do iwi/shareholders benefit from Atihau farms?)
- Experiences working with or dealing with district, regional council and Department of Conservation in times of unrest and activity.
- In comparison to these two main events – what might you want to change in terms of a response or lead up to an event?
- How was information distributed to the iwi during these times?
- Anything else?

Appendix 4: Discussion Guide with Whangaehu Paepae.

Brief Background:

a. Hand out (slide show document)
b. Work to date
c. GIS mapping overlay
d. Ongoing - model adjustment/development

Recent Events:

a. 2007 Lahar – Karioi Community Response
b. 95/96 eruptions
    - How did you find out about it?
    - First reactions.
    - Going about daily routines – what changed?
    - Impacts?
c. 1945 korero
    - Research on impacts?
    - Local korero?

Ngāti Rangi resilience:

a. What it looks like within Emergency Management?
b. What does it look like for us as Ngāti Rangi?
c. What is Ngāti Rangi resilience?
d. Understanding our inherent resilience?
e. What role do our marae play in resilience?

Future response:

a. What might this look like
b. What would we change from previous events
c. Where do we see ourselves within this framework

Appendix 5: Ngāti Rangi Marae Classification Table

Category	Variable	Weight	TRI	NMK	MGR	MMG	RP	MTK	RPM	KTH	TA
Marae Classification	Fully-Functional	1	1	1	1	1	1		1	1	
	Semi-Functional	2									
	Multi-Purpose Facilities	3						3			3
Distance from SH (km)	2 -5km	1	1	1	1		1	1	1		1
	5 -10 km	2				2					
	10 km + (use actual < symbols)	3								3	
Distance to waterways (m)	150 m +	1					1		1	1	1
	100 – 150 m	2									
	Less than 100 m	3	3	3	3			3			
Deposits	Nil	0					2**		0	0	0
	1:50000	1				1					
	1:25000	2		2	2			2			
	1:100 1:6000 1:12000	3	3								
Risks to access routes	Nil	1				1			1	1	1
	Flooding	2		2	2		2	2			
	Current Lahar	3	3								
Access to communication	3 + Options	1			1		1				
	2 Options	2								2	
	0-1 Option	3	3	3		3		3	3		3
SCORE			14	12	10	9	8	15	7	8	9
Prioritisation			6	5	4	3	2	7*	1	2	3*

* Proximity to waterways is close, however elevation above waterways is significant.
** Close proximity to historic lahar deposits and issues from flooding within the surrounding areas can restrict access from Raetihi township.
* Multi-purpose Facilities may not be appropriate to act as Civil Defence Shelters.

TRG: Tirorangi

NMK: Ngā Mōkai

MGR: Maungārongo

MMG: Mangamingi

RP: Raetihi Pā

MTK: Mote Katoa

RPM: Raketapauma

KTH: Kuratahi

TA: Tuhi Ariki