FACTORS, MEASURES AND OPTIONS INFLUENCING POST-DISASTER RECOVERY FROM HIWEATHER EVENTS: A CASE STUDY OF TWO AUCKLAND COMMUNITIES

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Abstract

Recovery is an experience that follows a disaster; however, this experience must be planned for, utilising practical factors, measures and options to address the challenges communities face in disaster recovery. This thesis examines key factors influencing recovery and resilience following the August 30-31, 2021, HIWeather (high-impact weather) event, which primarily resulted in flooding. Kumeū-Huapai and Henderson Valley in Auckland were selected as the case study communities using the Strategic Targeting Methodology (STM). The thesis focuses on factors influencing recovery, measures and options to address affected communities. The thesis integrates local knowledge and geospatial technologies to support decision-making, and investigates how communication, preparedness, social capital, governance, infrastructure, and access to resources shape post-disaster recovery. The research employed a mixed method multiple-case study approach, including scoping interviews (with recovery stakeholders and community members), high-level literature review, surveys, field reconnaissance, workshops, and public engagement sessions to explore factors influencing recovery and challenges faced following the August 2021 two-day flood event. A key contribution of this work was the design and development of the Community-centric Recovery Umbrella Approach (CcRUA). The CcRUA is a proactive, flexible, yet inclusive approach or framework designed to facilitate effective recovery and resilience at the local level. It fosters communication and collaboration with recovery authorities, keeping the community at the heart of recovery planning. Findings show that poor communication between communities and recovery authorities hindered recovery efforts, resulting in delayed recovery outcomes. The lack of clarity in communicating roles and responsibilities among recovery stakeholders led to confusion, resulting in frustrated residents. Despite these challenges, both communities demonstrated social capital, one more than the other, and a willingness to engage in recovery planning, highlighting the importance of fostering a partnership between community members and recovery authorities. The study explores the efficiency of using geospatial technologies and local knowledge to improve hazard mapping accuracy through community-led validation of flood boundaries to support decision-making. Furthermore, this research highlights the need for two-way communication, capacity-building initiatives, and clear definitions of recovery stakeholders' (communities and recovery authorities) roles and responsibilities to enhance recovery efforts. Through these key factors, the needs of the community became apparent: clear, adequate, and timely communication; community involvement; a Community Recovery Plan; mitigation measures; effective warnings; alert systems; and building strong partnerships with recovery authorities to co-create recovery plans, strategies, and outcomes. The CcRUA aligns well with international, national, and regional policies such as the Sendai Framework 2015-2030, the National Disaster Resilience Strategy (NDRS), the Civil Defence Emergency Management Act 2022, and the Auckland Recovery Framework, operationalising their goals by integrating local knowledge through this approach. Although the findings are mainly case-specific, the CcRUA is a proactive micro-level approach that offers a scalable, adaptable model other communities can emulate. By addressing communication gaps, strengthening partnerships and collaboration, and prioritising resilience, this thesis can contribute to policy by offering an operational approach and actionable insights that bridge the gap between top-down and bottom-up recovery planning to build resilient communities.

Keywords: post-disaster recovery, recovery planning, recovery options, recovery challenges, recovery measures, community perspectives, resilience, geospatial technologies, communication, social capital, governance, collaboration, partnership, recovery decision-support, community hazard mapping, Community-centric Recovery Umbrella Approach (CcRUA).

Acknowledgments

Whereas some doctoral studies have started smoothly, I transitioned from Jamaica to New Zealand, leaving my former life behind to a life with new opportunities, challenges, a husband, a new pandemic, and a pregnancy while I started my PhD. For me, recovery is truly a lived experience.

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I would like to thank the National Science Challenge/Resilience to Nature's Challenge (RNC), for funding this Ph.D., as it was through this scholarship that I could sustain my studies. For this reason, I am very grateful for the opportunity that I have been given to complete this programme. Without this opportunity, this Ph.D. would not have been possible.

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I love you all and thank you for being there for me during this journey.

Ethical Approval

Ethical approval for this study was obtained from the Massey University Human Ethics Committee (Ethics Notification Number: 4000023804, August 23, 2021).
(See Appendix 11.14)

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LIST OF ABBREVIATIONS

Abbreviations	Meaning
ACDEM	Auckland Civil Defence Emergency Management
AEM	Auckland Emergency Management
CcRUA	Community-centric Recovery Umbrella Approach
CDEM	Civil Defence Emergency Management
CDEMA	Civil Defence Emergency Management Act
CEMG	Community Emergency Management Group
CIMS	Coordinated Incident Management System
CRP	Community Recovery Plan
DGL	Director's Guideline
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EQC	Earthquake Commission
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Science Limited
HIDECS	Hierarchical Decomposition System
HIWeather	High-impact weather
HV	Henderson Valley
HVRA	Henderson Valley Residents Association
ICBDM	Integrated Community-Based Disaster Management
IFRC	International Federation of Red Cross and Red Crescent Societies
KH	Kumeū-Huapai
NCDP	National Center for Disaster Preparedness
NDRS	National Disaster Resilience Strategy

NEMA	National Emergency Management Agency
NIST	National Institute of Standards and Technology
NIWA	National Institute of Water & Atmospheric Research Ltd
ODPEM	Office of Disaster Preparedness and Emergency Management
PDRP	Pre-Disaster Recovery Planning
PNGOs	Partner Non-Government Organisations
STM	Strategic Target Methodology
UNDP	United Nations Development Programme
UNISDRR	United Nations International Strategy for Disaster Risk Reduction

Doctoral Thesis by Publication – Massey University's Guidelines

According to (Massey University, 2019) in a Doctoral thesis with Publications, the doctoral student authors or co-authors multiple articles on their research during their doctoral programme. These articles are then collated and linked together to constitute the doctoral thesis. Each article will be structured in a way that is appropriate for the field and specific publication, often typically comprising an abstract, introduction with literature context, conceptual development or methods, results, analyses, discussion, and conclusions. This may lead to some repetition in a thesis of this nature, which is not in this context seen as a flaw. It is important to recognise that a thesis with publications is not composed exclusively of publications (see structure below). A doctoral thesis with publications must still demonstrate sufficient breadth and depth of knowledge in the discipline but does so using an appropriate number of discrete published articles as chapters (see below).

The Structure of a Thesis with Publication include:

An Introduction chapter: followed by the literature review (which may or may not be published), then a methodology chapter, but it is not required; and then the chapters which may or may not have been published already (in prep/review/press/published). The last chapter is the discussion or synthesis where the whole thesis and research must be discussed, and the novel contribution covered.

• Chapters may require additional introductions and conclusions to ensure clarity of relationship with broader thesis.

Thesis structure will vary depending on the number of research papers to be included. A thesis with publications may consist of a combination of published and non-published chapters. The thesis may therefore include papers that:

• Are in the (final) process of being prepared for publication in a peer-reviewed journal (in prep.).

• Have been submitted for publication in a peer-reviewed journal but not yet accepted (in review, including in revision after reviewers' comments).

• Have been accepted for publication in a peer-reviewed journal but not yet published (in press).

• That are published in a peer-review journal, edited book chapter, or equivalent.

• That are in exhibitions, site specific installations, film, video, scores (with exegesis).

Some chapters may include work that is not publishable but nevertheless contributes to the subject body of knowledge and is thus admissible for doctoral research. A doctoral thesis with publications may therefore partly or (nearly) entirely comprise research papers.

Notwithstanding, the thesis must have an overall introductory chapter that outlines the topic, justifies the research, identifies research objectives, and outlines the thesis structure, indicating those chapters written as papers for peer-reviewed publication.

Before the start of each chapter which represents a research paper or publication, the candidate must complete and include a DRC 16 'Statement of Contribution – Doctorate with Publications/Manuscripts'.

The DRC 16 outlines the student contribution, authorship, intended target journal and the status of the publication.

The research paper/manuscript should be presented in the same form as they were presented, or intend to be presented, for the target journal, with exception that the referencing and text formatting should be standardised throughout the thesis and must be in the body of the chapter.

The candidate should outline the links between the chapters/research papers. A chapter comprising an article will necessarily include an opening paragraph linking with the preceding chapter and/or a closing paragraph linking to the next chapter, in which the overall fit of the article is set clearly within the body of research that is the doctoral thesis.

The candidate must ensure that all methods used in the body of research for the thesis are clearly described in the thesis. These are usually contained within the method sections of the corresponding papers. However, appendices should also be used to outline or expand upon methods that may have been abbreviated for publication. Any data and discussion that was also abbreviated to conform to the strictures of the publication process, including information published as supplementary material should also be included in appendices to the thesis. If appropriate, it is also acceptable to have unpublished chapters that may focus on a methodology, or set of results, but also the methodology chapter (or parts thereof) may be published. Unpublished chapters are entirely admissible in a thesis with publications. The thesis introduction should clarify what chapters are published and they should be referenced accordingly.

The thesis should conclude with a final chapter providing a synthesis of the work presented in the body of the thesis. It is important that discrete published chapters are brought together in this coherent synthesis to demonstrate the overall contribution to knowledge provided by the body of research within the thesis. Final overall conclusions revisiting the research objectives draw the thesis to a close at the end of the synthesis, or as a short, discrete chapter according to preference and disciplinary practice.

Formatting of the final thesis may be a challenge as the thesis should be a whole, presented in the same font and format, so figures and tables must be renumbered and references consistently formatted.

The thesis with publications must still work as an integrated whole, address a significant research question or questions, and present a clearly identified original contribution to the knowledge of the subject with which it deals

1 CHAPTER: Introduction

1.1 Background Context

High-impact weather events are increasing in frequency and severity, posing growing risks for communities worldwide, including in Aotearoa New Zealand. (Doyle, 2022; Scolobig, *et al.*, 2022; United Nations Office for Disaster Risk Reduction, 2020a). Flooding has emerged as a dominant hazard in Auckland, affecting infrastructure, livelihoods, and most commonly - community wellbeing. While emergency response capabilities have improved (Department of the Prime Minister and Cabinet (DPMC), 2024) Post-disaster recovery planning remains underdeveloped, uneven, fragmented, and often disconnected from the lived realities of affected communities (Kondo, 2018; Rumbach, 2016; Trüdinger, 2024; Vallance, 2015).

This thesis investigates post-disaster recovery planning following the August 2021 HIWeather flooding in two Auckland communities: Kumeū-Huapai and Henderson Valley (see Figure 1.1) and presents case studies. These communities experienced significant riverine and inland flooding, yet their recovery trajectories differed significantly. Using a mixed methods case study approach, this research examines how recovery unfolds from the community perspective and how community knowledge, geospatial tools, communication, and partnerships can be integrated into more effective recovery planning.

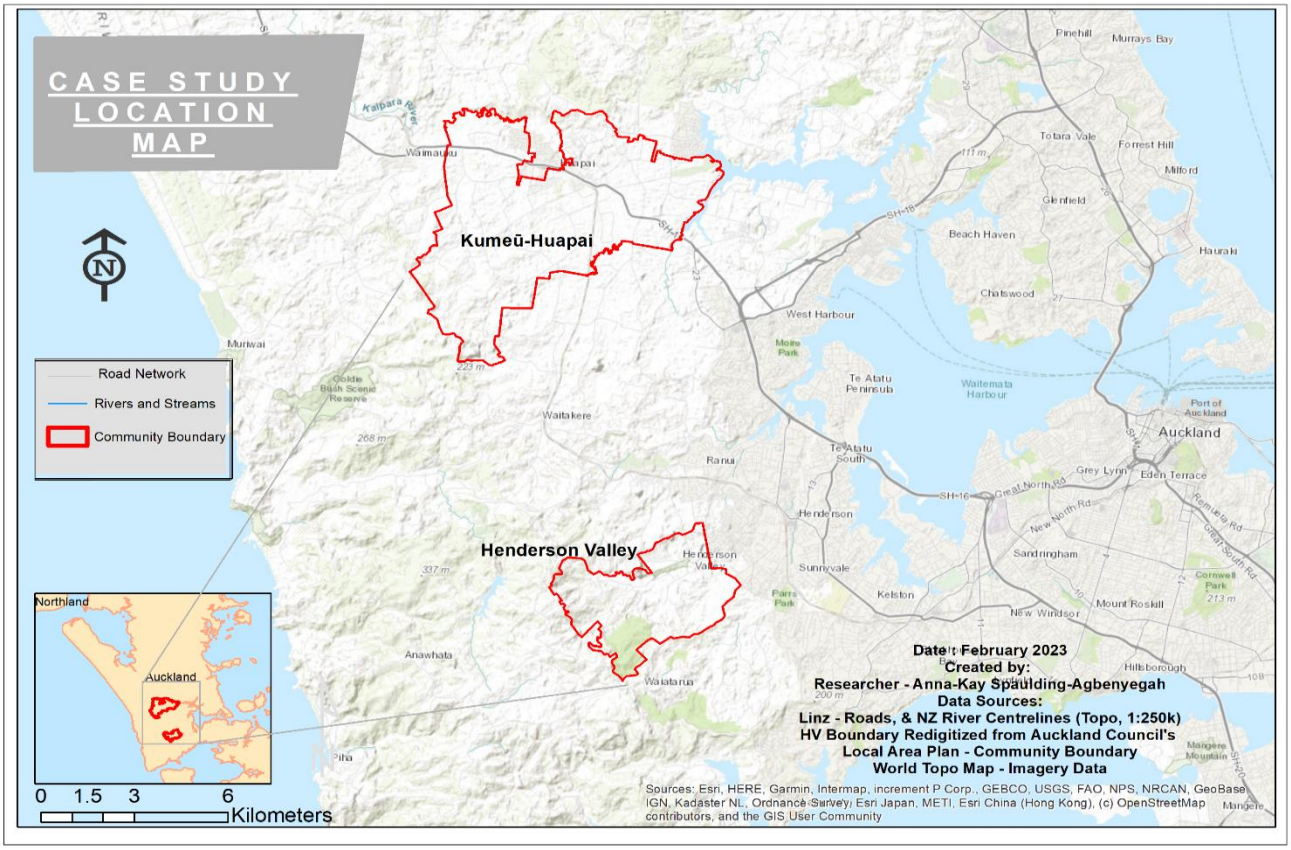

Figure 1.1: Case Study Location Map, Auckland, New Zealand. Source: The Researcher, 2023.

The core aspect of this research is the proposition that recovery planning is not merely a technical or institutional exercise, but a socially embedded, place-based process that requires meaningful engagement between communities and recovery authorities. In practice, emergency management aims to adopt a "Whole-of-Society approach." (Auckland Civil Defence and Emergency Management, 2016; Auckland Council, 2024; Civil Defence Emergency Management Group, 2019; Department of the Prime Minister and Cabinet (DPMC), 2024; Relief Web, 2015; Trüdinger, 2024), keeping recovery at the heart of the community. For the most part, this has proven to be a complex vision rather than a reality. This study, however, positions communities not as a passive recipient of recovery, but as co-producers of recovery knowledge and action, being actualised into recovery planning.

This thesis presents research findings aimed at creating, designing, and developing a Community-centric Recovery Umbrella Approach (CcRUA). This approach integrates community participation, data-driven recovery planning, effective communication, strong partnerships, and engagement with recovery authorities to improve outcomes and enable communities to shape their recovery journeys actively.

1.1.1 Why Does this Research Matter?

Post-disaster recovery planning determines whether communities merely return to vulnerability or emerge stronger and more resilient. However, globally and in New Zealand, recovery efforts often struggle with delayed decision-making, misaligned priorities, and weak community engagement. Official hazard maps and recovery plans may fail to reflect local realities, while communication breakdowns and unclear responsibilities undermine trust and effectiveness.

This research matters because it directly addresses these weaknesses. By integrating community-led geospatial hazard validation, two-way communication, and collaborative recovery planning, this thesis moves beyond the required calls for consultation and instead engages with communities through participation, providing a practical, operational pathway for improving recovery outcomes. By placing communities at the centre of the recovery process, this research acknowledges that local knowledge, participation and partnership, social capital, and two-way communication are indispensable for sustainable recovery outcomes. This research highlights recovery planning from the community's perspective. This ultimately reflects 'keeping the community at the heart of recovery.' (Trüdinger, 2024). The research bridges the gap in understanding "how-to" to empower communities, operationalises the recovery approach, and effectively integrates local and technical knowledge. The research demonstrates how community knowledge can enhance the accuracy of hazard and exposure data, using geospatial technologies to improve resource targeting for recovery planning and to support more legitimate and trusted recovery processes.

Existing approaches often fail to fully engage communities, largely because of vague definitions of consultation and what it entails. Usually, there is a lack of in-depth, critical research on participation (Tuhkanen, 2023), which is needed to address their unique needs and to provide practical, actionable guidance for community recovery planning (Trüdinger, 2024). It can take several weeks for people and the community to be included in formal emergency management response and recovery processes (Campbell, *et al.*, 2021). This research demonstrates an operational pathway for improving recovery.

Furthermore, as disasters are becoming more frequent and severe due to climate change and other global challenges, it is increasingly important to develop adaptable, inclusive, and recovery strategies tailored to the specific needs of affected communities.

In a context of accelerating climate-related hazards, these insights are not optional; they are critical to building sustainable community resilience. This thesis has the potential to influence policy, improve recovery practices, build resilience, and protect lives, assets, and livelihoods through its proposed CcRUA framework.

1.2 Critical Literature

Building resilience in a community requires community-led recovery efforts that are holistic, inclusive, and committed to long-term approaches to decrease recovery time after an event (Panton et al., 2009; Vallance, 2011, 2015; Campbell *et al.*, 2021; Bush International Consulting, 2023, 2024). The foundation for successful and sustainable recovery starts with early recovery planning; that is, long-term development must be planned for future disasters, even before the disaster event occurs (United Nations Development Programme (UNDP), 2011; Vallance, 2011; Programme., 2012; Rumbach, Makarewicz and Németh, 2016; Fekete *et al.*, 2017; Ashford *et al.*, 2020; Trüdinger, 2024). Although lacking, post-disaster recovery processes are being directed towards an integrated risk reduction and risk management that supports community resilience (Bush International Consulting, 2024; International Recovery Platform, 2005; Pine, 2014; United Nations Office for Disaster Risk Reduction, 2020a). Therefore, to address post-disaster recovery (Bush International Consulting, 2024; United Nations Development Programme (UNDP), 2011), The literature encourages integration and existing relationships between the four components of the disaster management cycle prevention, mitigation, preparedness, responses, and recovery that are dynamic and interrelated.

The disaster recovery literature underscores the complexity and multi-agency nature of the recovery process (Salmon *et al.*, 2011; Mcnaughton *et al*., 2015; Elkady *et al.*, 2024). It emphasises the critical role of community participation and engagement between communities and authorities (Vallance, 2011, 2015; Aldrich, 2012; Vallance, and Carlton, 2014). Pre-disaster recovery planning and capacity building are essential for enabling effective post-disaster recovery. Yet, a significant gap remains in practical, context-specific guidance to tailor approaches to diverse communities affected by disasters (Vallance, 2015; Campbell *et al.,* 2021; Bush International Consulting, 2023, 2024). Furthermore, communication, collaboration, and coordination are identified as crucial aspects of recovery (Vallance, 2011, 2015; Campbell *et al.*, 2021; Trüdinger, 2024). At the community level, the thesis found that there is limited understanding of how to effectively integrate local knowledge into scientific environments, balance bottom-up and top-down planning, and ensure that community participation moves beyond tokenism (consult and inform) to meaningful empowerment in decision-making and implementation (Vallance, 2015).

Social capital (bonding, bridging and linking) (Aldrich, 2012), community networks and local leadership are recognised as vital for successful recovery post-disaster (Vallance, 2011). However, gaps persist in understanding how to leverage and strengthen these factors. Additionally, sustaining community engagement over the long-term recovery phase and building resilience rather than merely returning to pre-disaster conditions are underexplored in the literature.

Although frameworks exist at the international, national, and regional (Civil Defence Emergency Management Group, 2019; David Morley, 2014; Federal Emergency Management Agency, 2011; Ministry of Civil Defence and Emergency Management, 2019; National Emergency Management Agency, 2023a; United Nations International Strategy for Disaster Risk Reduction, 2015), operationalising recovery principles into practical, actionable steps remains a challenge. To address these gaps, this research aims to develop and design a Community-centric Recovery Umbrella Approach (CcRUA) that provides actionable guidance, integrates local and technical knowledge, and empowers communities to lead recovery efforts while fostering long-term resilience.

1.2.1 The Knowledge Gap

Post-disaster recovery scholarship consistently recognises that recovery is a complex, multi-actor, and socially mediated process (Federal Emergency Management Agency, 2011; Chandrasekhar, Zhang, and Xiao, 2014; Mannakkara and Wilkinson, 2014; McNaughton *et al.*, 2015; Mannakkara, Wilkinson, and Potangaroa, 2019), which necessitates collaboration between communities and recovery authorities. Although the literature highlights the importance of community participation, communication, and the integration of local knowledge into the science of disaster recovery (Aldrich, 2012; United Nations Development Programme (UNDP), 2011; Vallance, 2011), there are noticeable gaps which remain evident.

First, although community participation is widely promoted, much of the literature focuses on normative principles rather than on how community knowledge is operationalised in recovery planning in different ways (Jerolleman, 2019; Trüdinger, 2024; Vallance, 2011). Communities are often consulted instead of genuinely engaging, where relationships are built. As a result challenges in establishing clear communication and partnerships *(*Campbell et *al., 2021;* Elkady *et al.,* 2024) arise, but are rarely empowered to shape recovery planning and recovery priorities, particularly in technical domains such as damage assessment, exposure identification, and infrastructure reinstatement. Even though the literature highlights the importance of community engagement and participation to foster resilience (Ahmed, 2008; Ireton and Ahmed, 2011; Vallance, 2011; Nguyen and Salvesen, 2014; Donovan, 2015; Kwok *et al*., 2018) there appears to be a lack of research providing actionable, context-specific guidance for community-led recovery planning processes.

Second, while geospatial technologies are extensively used to map hazards and damage, they are typically applied in top-down ways that do not reflect lived experiences on the ground. This can lead to misidentification of exposed assets and recovery needs, limiting the usefulness of spatial data for recovery planning. Few studies examine how participatory or community-validated spatial data can function as decision-support for recovery planning.

Third, there is a limited comparative analysis of how different communities perceive and experience recovery. Recovery frameworks often assume relatively uniform conditions, yet communities vary significantly in social capital, governance relationships, and access to resources, which influence recovery trajectories.

All-in-all, these gaps indicate a need for research that integrates community perspectives, spatial decision-support, and comparative analysis to better inform recovery planning.

1.3 Problem Statement

After a HIWeather event, post-disaster recovery remains complex, particularly for communities affected by flooding. Even with existing formal recovery frameworks and hazard information systems, many communities continue to experience uncertainty, delayed decision-making, and limited involvement in shaping their recovery priorities and what that looks like. This highlights a gap between institutional recovery processes and the lived experiences and needs of affected communities.

One key challenge is that recovery planning is often based on hazard and exposure information that has not been validated by communities. When local knowledge is not incorporated, official flood footprints and exposure assessments may misrepresent which populations, buildings, and infrastructure were affected. This can lead to misdirected resources, disputed recovery priorities, and a lack of trust in recovery authorities. Therefore, there is a need to examine how community-led geospatial mapping can be used to support the identification of exposed assets and strengthen the evidence base for recovery planning.

At the same time, recovery outcomes are shaped not only by technical information but also by social and institutional factors. This includes communication, governance, access to support, and social capital (for example, community cohesion). However, limited empirical research has examined how communities perceive factors that influence their recovery and how these factors shape recovery trajectories across different contexts. Without this understanding, recovery planning risks overlooking the relational and organisational conditions that enable or constrain recovery.

Furthermore, communities vary in how they experience and navigate recovery. Recovery planning is certainly not a one-size-fits-all concept. Differences in social networks, engagement with authorities, access to resources, and exposure to hazards mean that recovery processes are not uniform. Yet comparative insights into how different community groups perceive recovery challenges and priorities remain underdeveloped.

Altogether, these gaps highlight the need for a research approach that integrates community perspectives, community-validated exposure data, and comparative analysis to inform more collaborative, context-responsive recovery planning. Addressing these issues is essential to developing recovery processes that are not only technically informed but also socially legitimate and capable of supporting long-term community resilience.

1.4 Research Aim

This research aims to strengthen the understanding of post-disaster recovery from a community perspective and to generate practical guidance for collaborative recovery planning that builds long-term resilience.

1.4.1 Research Questions

1. What factors influence post-disaster recovery from the community's perspective?
2. How does a community-led geospatial method support the identification of exposed community assets for recovery planning?
3. What are the similarities and differences between community groups in perceiving factors influencing disaster recovery?

4. What measures are needed to address the concerns and challenges faced by various communities in disaster recovery?

1.4.2 Research Objectives

1. To identify the factors that have influenced disaster recovery planning in the communities that were affected by recent disasters in Auckland.
2. To investigate the usefulness of community-led mapping of hazards to identify exposed assets in supporting recovery planning.
3. To develop a set of recommendations for collaborative recovery planning that sustainably builds resilience.

In this thesis, I often use the terms 'effective' and 'efficiency' in this thesis. It is important to maintain clarity and avoid ambiguity. Therefore, it is necessary to define these terms. According to the (Oxford English Dictionary, 2024a)The word ‘effective,’ as an adjective and noun, speaks to ‘that is attended with results or has an effect.’ In other words, it occurs when something successfully produces a desired result, emphasising the achievement of an outcome. In contrast, the (Oxford English Dictionary, 2024b) defines ‘efficiency’ as a noun; it is the power to accomplish, or success in accomplishing something, for the purpose intended, using the least amount of time, effort, and resources. Efficiency emphasises the process and use of resources, while effectiveness focuses on producing the desired results.

1.5 Methodological Overview

This research adopted a sequential exploratory, mixed methods, multiple-case study design to investigate post-disaster recovery and recovery planning in flood-affected Auckland communities, namely Kumeū-Huapai and Henderson Valley. The methodological approach was designed to capture recovery from the community’s perspective and the lived experiences of affected communities. Furthermore, it was structured to address the study’s four research questions by integrating local knowledge and community-derived evidence through hazard mapping to support decision-making in post-disaster recovery.

The two case study communities affected by the August 2021 high-impact weather event were selected based on a Strategic Target Methodology (see Chapter 3, 3.2) involving various reasons, including their vulnerability to HIWeather events, social, geographic, and institutional contexts, and, by and large, their availability and willingness to engage in the research. This multiple-case study design enabled both in-depth analysis and cross-case community comparison. To address the research questions, I have systematically and clearly outlined these below:

Research Question 1 (factors influencing recovery from the community’s perspective), data were collected through community surveys, interviews, street stall engagement, and workshops, allowing residents to articulate their experiences of recovery, communication, governance and support.

Research Question 2 (the role of community-led geospatial methods), participatory flood footprint validation was undertaken. Community knowledge was used to refine official flood maps and to generate improved recollections of exposed populations, buildings and road networks. These spatial

outputs were used as decision-support evidence to examine how participatory geospatial methods supported recovery planning.

Research Question 3 (similarities and differences between the two communities), the case study findings were analysed comparatively. Thematic and quantitative comparisons were used to identify both shared and divergent recovery experiences, perceptions, and challenges across communities.

Research Question 4 (measures needed to improve recovery) and insights from community data and spatial analysis were synthesised to develop evidence-based recommendations for collaborative recovery planning, including communication, partnerships, preparedness, and mitigation strategies.

Data were analysed using a general inductive and thematic approach, using a mixed methods approach: qualitative, quantitative, and spatial datasets used for recovery decision-support. This enabled robust identification of key recovery factors, cross-case patterns, and planning-relevant insights. A detailed account of the research design, analytical procedures, and ethical considerations were provided in Chapter 3 (Methodology).

1.6 Original Contribution

This research makes an original contribution to post-disaster recovery scholarship through the development of the Community-centric Recovery Umbrella Approach (CcRUA) (see Chapter 8). The CcRUA provides a practical and operational framework that positions communities at the centre of recovery planning while coordinating actions between communities and recovery authorities.

Unlike existing recovery frameworks that primarily conceptualise community participation at a high level, the CcRUA translates community engagement into actionable recovery planning processes, including (see Chapter 8, Figure 8.1). The CcRUA provides operational guidance by coordinating between communities and recovery authorities. This allows communities to be the centre of the recovery process. The study found several key elements critical for effective recovery – including community participation in validating flood data and hazard mapping; two-way communication and engagement between communities and recovery authorities; partnership and collaboration in recovery planning; capacity building with communities; and community cohesion that can lead to tangible outputs such as the development of community-specific recovery plan. These critical elements emerged from this study and gave rise to a cohesive model, the CcRUA.

1.6.1 How Does my Work Relate to the Literature and What Sets it Apart?

This research contributes significantly to the evolving discourse on disaster recovery by placing communities at the heart of recovery, evidently reflected through the CcRUA. While existing literature highlights the importance of community involvement, this research addresses a critical gap by providing practical, operational guidance for coordinating efforts between communities and recovery authorities, ensuring a more efficient recovery process (that is, involving effective communication and partnership between stakeholders).

In other words, CcRUA provides a “how-to” practical and operational approach. It offers actionable steps for implementing recovery plans and strategies that bridge the gap between communities and recovery authorities. This approach outlines that recovery efforts are theoretical and grounded in clear, executable processes. This is done by detailing how to coordinate effectively, foster

partnerships, enhance two-way communication, and engage in community-specific recovery planning. The CcRUA empowers stakeholders with strategies for efficient and inclusive recovery operations. This "how-to" approach is a critical feature that distinguishes this research as practical and empirically grounded in disaster recovery.

The integration of essential elements distinguishes CcRUA. Unlike typical top-down approaches, the CcRUA is a bottom-up approach that advocates for a balanced, iterative, and collaborative process that evolves with ongoing community input, enhancing inclusivity and sustainability. Additionally, the research highlights the importance of data validation by involving communities in hazard mapping and flood data verification. This ensures that recovery efforts are accurate and locally relevant. The research also highlights the importance of capacity building and empowering communities to lead recovery journeys. This thesis combines a comprehensive approach/model for addressing short-term to medium-term post-disaster needs and provides a foundation for long-term resilience. To that end, encapsulated in this holistic and actionable approach, my work is distinguished by a groundbreaking contribution to sustainable post-disaster recovery.

1.6.2 Contributions of this Research

This research makes empirical, methodological, and practical contributions to the field of post-disaster recovery and recovery planning, to high-impact weather events that lead to flooding in New Zealand.

1.6.2.1 Empirical Contribution

First, this research contributes new empirical evidence on post-disaster recovery from the perspective of the community. I examined recovery experiences in two flood-affected Auckland communities. The study identifies key social, institutional, and relational factors that influence recovery, including communication, governance arrangements, access to resources, community cohesion, and preparedness. The comparative analysis of Kumeū-Huapai and Henderson Valley extends into existing recovery literature by demonstrating the way in which these factors are perceived differently across communities, highlighting that recovery is not a uniform process but one shaped by local context.

1.6.2.2 Methodological Contribution

Second, the research makes a methodological contribution by demonstrating the value of community-led geospatial mapping as a decision-support tool for recovery planning. Rather than treating geospatial technologies as purely technical instruments, this study shows how participatory validation of flood extent can improve the identification of exposed populations, buildings, and infrastructure. By integrating local knowledge with spatial data, the research illustrates how geospatial methods can support more accurate, socially informed, and legitimate recovery planning decisions.

In addition, the study advances methodological practice by integrating qualitative data (from the community's perspective), quantitative survey findings, and spatial exposure analysis within a mixed methods case study framework. This, in and of itself, is an integrated approach that provides a replicable model for examining recovery in complex hazard contexts.

1.6.2.3 Practical and Policy Contribution

Third, this research offers practical contributions to recovery authorities, local government, and community organisations by translating empirical findings into actionable recommendations for

collaborative recovery planning. The study proposes measures to improve communication, clarify roles and responsibilities, strengthen partnerships between communities and recovery authorities, and support preparedness and mitigation efforts. These recommendations are directly informed by community-identified challenges and are designed to support a more inclusive and effective recovery process.

The research introduces the Community-centric Recovery Umbrella Approach (CcRUA) as a conceptual and practical framework to guide collaborative recovery planning. The framework synthesises community perspectives, institutional responsibilities, and decision-support information to support building resilience in the long term.

Finally, this study contributes to disaster recovery scholarship by reinforcing the understanding of recovery as a socially mediated and institutionally shaped process. By allowing community voices to dominantly guide the local needs for recovery planning and situating technical tools within broader governance and communication contexts. The research responds to calls for more practical, holistic and participatory approaches to recovery planning in an era of increasing climate-related hazards.

1.7 Road Map of the Thesis Structure

Chapter 1: Introduction

This chapter introduces the thesis and establishes the context for examining post-disaster recovery following high-impact weather events, with a focus on flooding in Auckland communities. It outlines the background to the research, articulates the problem statement, and further explains why the research matters, the chapter identified the critical knowledge gaps in recovery planning, presents the research aim, research questions, and objectives and provides an overview of the methodological approach. It also outlines the research's original contributions and concludes with a roadmap for the thesis.

Chapter 2: Literature Review

This chapter critically reviews the literature on disaster recovery and resilience across international, national, regional and local contexts. It examines key concepts and themes relevant to recovery, including governance and institutional arrangements, communication, community participation, social capital and collaborative recovery planning. The chapter also explores the role of information and decision-support tools, including participatory mapping, in recovery processes. Through thematic synthesis and critical analysis, this chapter identifies gaps in existing research, particularly the limited operationalisation of community perspectives and decision-support mechanisms in recovery planning, and as such, justifies the focus and design of this study.

Chapter 3: Methodology

This chapter outlines a sequential exploratory, mixed methods, multiple-case study research design and methodological framework underpinning the study. It details the mixed methods, community-centred case study approach adopted to address the research questions. The chapter describes case study selection, data collection methods (including surveys, interviews, workshops, street stalls, and other community engagement activities), analytical approaches, and ethical considerations. It also discusses rigor, validity, and limitations, providing transparency and justification for methodological choices made.

Chapter 4: Using Community-led Geospatial Method as a Decision-Support tool in Post-Disaster Recovery Planning

This chapter presents the geospatial component of the research, framed explicitly as a decision-support tool for recovery planning. The chapter examines how community-led validation of flood extents improved the identification of exposed populations, buildings and infrastructure in Kumeū-Huapai and Henderson Valley following the August 2021 high-impact weather event. By comparing validated flood footprints with official maps, the chapter demonstrates how integrating local knowledge with geospatial analysis enhances the accuracy and usefulness of exposure assessments for recovery planning and risk management for decision making. This section was submitted as a book chapter for review by Springer Nature.

Chapter 5: A Case Study of Kumeū-Huapai, Auckland, New Zealand

This chapter explores post-disaster recovery in the peri-urban community of Kumeū-Huapai following the August 2021 flood. Drawing on survey data, interviews, workshops, and community engagement activities (including street stalls), the chapter identifies key factors influencing recovery from the community's perspective. These include communication challenges, governance and institutional support, preparedness, mitigation measures, and partnerships with recovery authorities. The chapter also highlights priorities for the community to improve its recovery outcomes, including alert systems, recovery planning, and strengthened collaboration with authorities.

Chapter 6: A Case Study of Henderson Valley, Auckland, New Zealand

This chapter examines recovery experiences in Henderson Valley, a semi-rural community with close-knit neighbourly relationships. This chapter focused particularly on communication, engagement, and infrastructure recovery. The findings highlight challenges related to unclear roles and responsibilities, limited awareness of recovery plans, and delayed infrastructure restoration. The Chapter also identifies opportunities for improving recovery, including strengthened social networks, clearer communication pathways, and more proactive engagement between communities and recovery authorities. Together, chapters 5 and 6 provide rich, context-specific insights into recovery processes across two distinct communities.

Chapter 7: Cross-case Comparison of Factors Influencing Recovery in Kumeū-Huapai and Henderson Valley

This chapter presents a comparative analysis of Kumeū-Huapai and Henderson Valley, addressing similarities and differences in how recovery is perceived and experienced across communities. Using a cross-case analytical framework, the chapter compares factors influencing recovery observing key themes, including communication, governance, access to resources, community cohesion, and preparedness. This perspective directly addresses Research Question 3, about similarities and differences across communities in how they perceive factors influencing recovery and highlights how local context shapes recovery trajectories.

Chapter 8: Discussion and Analysis

This chapter synthesises the findings from the empirical chapters and interprets them in relation to the existing literature and research questions. It discusses how findings confirm, extend, and or challenge

current understandings of post-disaster recovery and resilience scholarship. The chapter also critically examines the Community-centric Recovery Umbrella Approach (CcRUA) and situates it within the broader disaster recovery discourse. The discussion highlights the research's originality and its implications for collaborative recovery planning, policy, and practice.

Chapter 9: Conclusion and Recommendations

The final chapter concludes the thesis by summarising the key findings and recommending practical options for post-disaster recovery planning and reflecting on how the research objectives were achieved. It outlines the empirical, methodological, and practical contributions of the study, discusses limitations, and identifies directions for future research. The chapter also explores the challenges faced during the COVID-19 pandemic, its contribution to the field, limitations, and recommendations for future study. The chapter concludes with recommendations supported by the collected data, aimed at fostering collaborative, community-centred recovery planning and building long-term resilience to high-impact weather events.

2 CHAPTER: Literature Review

2.1 The Complex Nature of Recovery

Post-disaster recovery has become an increasingly complex and persistent challenge for communities worldwide (Mcnaughton, *et al.*, 2015). This is as a result of weather-related hazards accounting for a growing proportion of disaster impacts (Pine, 2014; United Nations Office for Disaster Risk Reduction, 2020b). In recent decades, the frequency and intensity of high-impact weather (HIWeather) events – particularly cyclones resulting in floods have increased, driven in part by climate change and accelerated by urbanisation (UNISDR, 2015; Vinnell, 2021). These events disrupt not only physical infrastructure but also social systems, livelihoods, and local economies, often resulting in prolonged, complex, and uneven recovery. Evidence from global disaster assessments indicates that while reduction efforts have improved in some contexts, exposure of populations and assets continues to rise, resulting in escalating disaster-related losses at community scales (UNISDR, 2015; UNDRR, 2020b).

Post-disaster recovery following HIWeather events is increasingly recognised as a complex, non-linear process that extends well beyond immediate response and reconstruction (Smith & Wegner, 2007; Campbell et al., 2021). Recovery outcomes are shaped by interacting social, economic, institutional, and environmental factors, which vary significantly across local contexts. Although disasters may not always trigger national-level economic crises, they often produce severe and lasting consequences for local communities, small businesses, and critical infrastructure (National Research Council, 2006; NIST, 2016). These localised impacts highlight the limitations of recovery approaches that rely primarily on centralised technical assessments and standardised planning tools, particularly when they fail to reflect lived experiences and place-specific conditions.

A common assumption about climate change is that it will affect storm conditions (Britton, 2010), thereby increasing disaster risk. With increased disaster risk, there is a growing recognition that effective recovery planning must move beyond top-down models to incorporate local knowledge, community participation, and context-sensitive decision-making (UNISDR, 2015; Vallance, 2015; Vallance, 2011). Community-informed approaches are increasingly viewed as essential for identifying what is exposed, understanding differential recovery needs, and prioritising interventions that are socially and practically implementable (Akbar, 2018; Aldrich, 2012; Vallance, S and Carlton, 2014). This shift underscores the need for recovery planning frameworks that integrate community perspectives with analytical tools (Oubennaceur, *et al.*, 2019; Kumar, 2008; Trüdinger, 2024), such as geospatial technologies, to support more accurate, inclusive, and adaptive recovery decision-making in the face of escalating HIWeather risks.

2.2 Auckland Hazard Context: HIWeather Events are Increasing

Given the global increase in the frequency and intensity of natural disasters, it is crucial to examine the specific regional context in which these trends unfold at the local scale. Auckland, New Zealand, provides a salient case in which HIWeather events epitomise the localised consequences of global climatic change. Defining 'HIWeather' raises fundamental questions about what exactly this term really stands for. The term 'HIWeather' means 'high-impact weather' (World Meteorological Organisation, 2021). High-impact weather events refer to weather events that have the potential to cause significant impacts on lives, infrastructure, and socioeconomic systems (WMO, 2021). These events encompass a

wide range of meteorological hazards, including flooding, drought, severe wind, thunderstorms, hailstorms, heatwaves, blizzards, tornadoes, and cyclones (Vinnell, 2021), often resulting in widespread disruption, property damage and fatalities (McGovern, 2017). WMO (2021) further noted that the term has led to significant advances in scientific understanding and weather prediction in recent years.

HIWeather events are increasingly recognised as an integral component of the climate system, operating across multiple spatial and temporal scales Ray *et al.*, (2015) . what distinguish these events is not only their meteorological intensity, but their capacity to trigger cascading and compound impacts that disrupt transport, communication networks, livelihoods and community function. In New Zealand, severe weather events occur almost annually (Vinnell, 2021), often causing moderate to damage; however, when extreme events occur, their impacts can be devastating. Cyclone Gabrielle in 2023 exemplifies this, resulting in widespread infrastructure damage, displacement of more than 10,000 people, and multiple fatalities. The impacts of HIWeather extend beyond immediate physical damage. Disaster losses include indirect and secondary effects, such as disruptions to goods and services, business closures and unemployment, and declines in economic productivity (National Research Council, 2006). Recovery from such events is therefore complex and prolonged, involving multiple acts and long-term planning processes that extend well beyond emergency response. Research highlights the critical role of both formal institutions – such as government agencies and non-governmental organisations and informal community groups, including resident associations and local networks, in strengthening recovery capacity through collaboration and participation (Jerolleman, 2013; Vallance, 2011). When these actors cooperate, communities are better positioned to navigate recovery and contribute to sustainable development outcomes (Cretney, 2016; Jerolleman, 2013).

Daunting, but worth mentioning, multi-hazards transition into high-impact weather events. This occurs when one onset hazard, like a cyclone, triggers other hazard events, like inland and coastal flooding, that eventually overwhelm an entire community or affect an area simultaneously, causing a "ripple effect'' of impacts leading to major damages. (National Research Council, 2006) shows that a distinction can be made between direct and secondary impacts and indirect losses resulting from disasters.

HIWeather events are frequently characterised by multi-hazard dynamics. This occurs where a primary hazard, such as a cyclone, triggers secondary hazards, including inland and coastal flooding. These cascading impacts can overwhelm communities and complicate recovery processes, generating ripple effects across social, economic, and environmental systems (National Research Council, 2006). While scientific advances in weather prediction have improved understanding of these events, challenges remain in accurately modelling localised impacts and translating technical information into actionable recovery planning (Ray et *al.,* 2015). This uncertainty is further compounded by climate change, which is projected to intensify both the frequency and severity of extreme weather events, particularly in rapid urbanising regions (Kemkes, 2019; WMO, 2021). Auckland's rapid population growth and urban expansion heighten its exposure to HIWeather hazards. As New Zealand's most populous region (Table 2.1) (Stats NZ, 2023), Auckland has experienced repeated flooding and severe weather events over recent decades, including major events in 2014, 2016, and 2017. 2018 and 2023 (NIWA), 2018). These events have caused extensive damage to homes, businesses, and critical infrastructure, emphasising the need for effective recovery planning in a region where population density, asset concentration, and hazard exposure intersect. Given Auckland's projected growth and increasing urbanisation, recovery planning

must address not only immediate impacts but also the cumulative effects of repeated hazard events on communities (Stats NZ, 2018b; Trüdinger, 2024).

Table 2.1 Auckland is the Most Populated Region in New Zealand.

	Urban City	Population	Area (km2)	Population Density (people/km2)
1	Auckland	1,656,486	1086	1525.3
2	Christchurch city	391,383	608	643.7
3	Wellington city	202,689	444	456.5
4	Hamilton city	174,741	877	199.2
5	Tauranga city	152,844	178	858.7
6	Napier-Hastings city	150,660	375	401.8
7	Dunedin city	128,901	255	505.5

Source: Extracted from (Stats NZ, 2023).

2.2.1 The Vulnerable State of Auckland to HIWeather Events

Auckland's vulnerability to HIWeather events is shaped by its unique geography and environmental characteristics. Located on an isthmus, the region encompasses a diverse mix of urban and rural landscapes within a dynamic coastal environment. Its setting includes estuarine systems (Wright et *al.,* 2009), high-density urban development, exposed east and west coastlines, and low-lying catchments, all of which increase susceptibility to hydro-meteorological hazards (Auckland Council, 2013).

The region is exposed to a range of natural hazards, which are both frequent and infrequent (Auckland Council, 2021). Frequent hazards include flooding, coastal erosion, freshwater erosion, and land instability, while less frequent but high-consequence hazards include cyclones, droughts, earthquakes, volcanic activity, and tsunamis (Auckland Council, 2021a). Among these hydro-meteorological hazards, flooding poses the greatest and most widespread risk to communities. As climate change intensifies, the likelihood of rainfall patterns and storm severity, compound hazards, and repeated flooding events is expected to increase, amplifying impacts on vulnerable populations and critical infrastructure (Wright et *al.*, 2009).

The consequences of HIWeather events are severe, including loss of life, property damage, infrastructure disruption, and long-term socioeconomic impacts. It is noteworthy to mention that if there is little to no preparedness for HIWeather events, then lives, property, infrastructure, and, by and large, the environment will face significant catastrophe. Auckland's exposure, coupled with its dynamic landscape and rapid urban growth, underscores the importance of recovery approaches that are grassroot oriented, adaptive, and informed by community knowledge. Understanding how communities visualise, experience, interpret, and respond to these hazards is critical to developing effective recovery strategies (Vallance, and Carlton, 2014; Vallance, 2015).

2.3 Exposing the Gaps in Recovery Scholarship

2.3.1 Top-Down Recovery - Not a Good Fit

It is commonly argued that recovery cannot succeed if the aims, priorities, and processes do not have community support (Kwok, et al., 2019; Murphy, 2007; Vallance, 2011). Too often, leadership is seen as a top-down process with commands emanating from the top (Lester, 2019) . This approach lacks collaborative relationships to sustain an ongoing and effective disaster response system (Lester, 2019; Vallance, S and Carlton, 2014; Vallance, 2011). For a change to take place, one must move from top-down approach in emergency management to a more collaborative one. There must be a fundamental and transformational shift towards communication and collaboration. In other words, there must be a shift from institutional to personal familiarity, involving collaboration that builds real relationships and trust. In fact, it is often stated, "A disaster is not a good time to be exchanging business cards."

A distinct limitation in existing frameworks is the disconnect between top-down and bottom-up approaches (Vallance, and Carlton, 2014; Kwok *et al*., 2018; Ashford *et al.*, 2020). While the Sendai Framework for Disaster Risk Reduction emphasises the importance of community participation, operationalising this principle at the micro-level is often non—existent and unrealised (United Nations International Strategy for Disaster Risk Reduction, 2015). Recovery plans, approaches, and or strategies often fail to incorporate a balance of local knowledge and scientific expertise, resulting in misaligned priorities (Bush International Consulting, 2023). This thesis bridges that gap by recommending a novel Community-centric Recovery Umbrella Approach (CcRUA) (see Chapter 8). The CcRUA is a scalable framework that aligns the recovery authorities' goals with the needs of the communities. By design, the framework emphasises partnership and collaboration by operationalising global, national, and regional recovery principles into practical, actionable steps. This ensures that recovery is both locally relevant and scientifically sound.

2.3.2 Gaps in the Post-Disaster Recovery

As many years have gone by, it is often recurrent and clear to see the persistent gaps that exist in disaster recovery planning scholarship (Donovan, 2015; Kondo, 2018; Mannakkara, Sandeeka., Wilkinson, Suzanne., and Potangaroa, 2019). Despite increasing disasters, growing body of literature, it continues to illuminate inefficiencies in recovery planning, which include limited community participation, communication failures between recovery authorities and communities, as well as weak decision-making processes that involve communities from even before the recovery phase begins (Doyle, 2022; Fekete, 2017; Khan, *et al.*, 2017; Vallance, 2015).

Firstly, even though community involvement is widely advocated, it has, in fact, become a buzzword; participation is often tokenistic, with communities positioned as beneficiaries rather than co-creators of their own recovery strategy. This ultimately results in top-down plans that do not necessarily reflect the community's needs.

Secondly, while GIS is a main tool used in community hazard mapping, it still remains underutilised as a participatory decision-support tool, with limited empirical evidence on community-led geospatial methods supporting recovery planning (Parajuli, *et al.,* 2020; Rollason, *et al.*, 2018).

Thirdly, communication is getting better with information being provided in documents that sits on shelves and on websites, rather than being translated to the communities – communication failures particularly lack a sustained two-way dialogue, which continued to undermine trust and coordination during recovery (Doyle *et al*., 2014; Campbell *et al*., 2021).

Finally, there seems to be a trend with existing recovery and resilience frameworks that remain weakly operationalised, (that is, it proves difficult to practically implement them at the community level), with limited evidence translating resilience principles into practical recovery actions (Campbell, *et al.*, 2021; Fekete *et al.*, 2017).

2.4 Understanding Recovery and Resilience

2.4.1 Recovery

To understand how communities can recover and build resilience post-disaster HIWeather events, it is important that recovery and resilience are clearly defined.

Recovery can be defined as "harmonised efforts and processes to affect the immediate, medium, and long-term holistic regeneration of a community following a disaster" (Southland Emergency Civil Defence Group (SECDG), 2014). Recovery is a developmental and remedial process encompassing the following activities: a. minimising the consequences of the disaster, b. regeneration of the emotional, social, and physical well-being of individuals and communities, c. taking opportunities to adapt to and meet the future needs of the physical environmental, economic, and psychosocial environments, d. plummeting future exposure to hazards and their associated risks (SECDG, 2014).

Recovery should be tailor-made to suit each community (Mannakkara, 2012), as communities are complex systems that are not only defined by geographical boundaries but various people, despite their location, can identify with and contribute to that community (Martiskainen, 2017). Early definitions of recovery emphasised that recovery was predictable, made up of identifiable parts occurring in a sequential manner; choices and decisions were value-driven, and outcomes (i.e., paths to recovery) emphasised a return to normalcy. Smith and Wenger (2007) mentioned that this definition is an oversimplification of what recovery truly is and fails to recognise that recovery is not uniformly achieved by all members of society, nor does it always follow a clearly defined path. According to (Smith, and Wenger, 2007) recovery is messy, uncertain and complex topic.

ReCap (Campbell et *al*., 2021) defines recovery as people and communities leading a life worth living, even if it differs from life before the disaster. ReCap understands recovery as a complex, non-linear, multi-layered process that occurs as people and communities work to resolve the impacts of a disaster. ReCap further asserts that recovery is intertwined with disaster reduction, readiness, and response and can provide an opportunity to improve pre-disaster circumstances and, for some, increase resilience.

Recovery planning is best dealt with before the disaster in the pre-planning stage of preparedness. (Mannakkara, 2012) mention that post-disaster practices can be made more efficient by collating community data in the pre-disaster stage. Nguyen and Salvesen (2014) alluded that disaster recovery planning can be defined as the pre-disaster planning for post-disaster rebuilding and restoring of communities (e.g., social, economic, physical, and natural environments). This may be either a return

to pre-disaster status or an improved state (Smith and Wenger 2006). According to the Resilient Auckland Group Plan (Auckland Civil Defence and Emergency Management (ACDEM), 2016), recovery is planned for before emergencies. It begins when disaster strikes by working in parallel with response activities. They mentioned that every event needs a method to recover, and so the main priority of the Auckland Council - Auckland Emergency Management (AEM), more specifically the Controller and the Recovery Manager is to work together to plan an integrated approach to address recovery using the Auckland's Recovery Framework for action as a guide (ACDEM, 2016 pp.140-164).

In the planning period post-disaster, many government and non-government agencies are involved; many are newly created or expanded in response to the disaster. For example, post-disaster 2010 -2011 Canterbury Earthquake, the Canterbury Earthquake Recovery Authority (CERA) was formed as a government department on 29th March 2011, and its full powers were brought into force on 19th April 2011 by the Canterbury Earthquake Recovery Act (Office of the Auditor-General, 2017). CERA was formed to address and meet the needs of recovery (i.e., to lead and coordinate the government's response and recovery efforts) (Rivera-Muñoz, 2020). However, (Rivera-Muñoz, 2020) mentioned that the encroachment of local government by the central government was evident in the Canterbury Earthquake Response and Recovery Act 2010. This process was described as a top-down approach to recovery, which was later replaced by new central government development plans such as the Recovery Strategy for Greater Christchurch.

With the disestablishment of the CERA and the enactment of the Greater Christchurch Regeneration Act 2016, the government thought of handing over the power of the next recovery phases to local authorities. Rivera-Muñoz and Howden-Chapman's study revealed that the enactment of this recovery legislation has had a huge impact on the recovery process; this affected empowering the central government to issue orders-in-council to facilitate recovery and remove "red tape" and legislative impediments. (Rivera-Muñoz, 2020) surmised that this is a sign of a participatory approach, which has implications for recovery policy decisions and a much more engaged process of recovery that the people of Christchurch were looking for.

A participatory approach to recovery is important to build resilience in communities and cannot only be achieved by working with community locals alone (Arnold et *al.*, 2014). This approach is community-driven and encourages communities to be connected; that is, communicate with national and subnational agencies, higher-level policy, technical assistance, and information for effective adaptation and DRM support.

Disaster recovery differs from planning and development under normal conditions (Berke and Campanella, 2006; Inam 2005; Olshansky and Chang 2009). It can be best characterised as a "compression of urban development activities in time and in a limited space" (Olshansky, Hopkins, and Johnson 2012, p. 173), which means that planning and development happen at a much faster pace and at a much higher level of intensity during disaster recovery. It is important to note that swift action often comes at the cost of effectiveness and equity (Chandrasekhar, Zhang, and Xiao 2014).

Recovery is constantly moving and changing (Mcnaughton et al., 2015). Vallance (2015) suggests that recovery is an ongoing learning and partnership-building process, requiring sustained engagement between communities and authorities. Although complex (Mcnaughton et al., 2015), planning for disaster recovery involves thorough deliberation with multiple agencies and stakeholders

to address post-disaster recovery challenges. Successful recovery can be achieved by listening to different people's perspectives of recovery and collaborating with many stakeholders involved in the process to see the big picture and many truths of post-disaster recovery (McNaughton *et al.,* 2015). In taking a participatory, comprehensive, and inclusive approach for all people and organisations, there should be some amount of preparedness (Ministry of Civil Defence and Emergency Management, 2019; Trüdinger, 2024; Vallance, 2015). Preparedness in the form of ensuring that decisions about desired outcomes and the diversity of local needs are incorporated and that invaluable local resources and knowledge at the grassroots level are captured to restore the functions of the community.

It is assumed that after unpredictable impacts of high weather events, the road to recovery is a long one (Mcnaughton et al., 2015). It is also commonly observed that some communities are hit harder and take longer to recover. This was the case for Gulfport, Mississippi where Hurricane Katrina in late August 2005 (Rafferty, 2020) claimed more than 1,800 lives and is recorded as the costliest natural disaster in United States history. The data that exits regarding Katrina proves to be the most costly natural disaster to strike the US, which roughly cost between $80 billion to $120 billion (Jack, Brian, Justin, 2016). Levees were breached, houses completely flooded, and business places destroyed, leaving people homeless and in disarray. Since the impact of the storm in New Orleans and throughout the Gulf, neighbourhood recovery planning involving community organisations, residents, and city administration (Chandrasekhar, 2014) work has continued rebuilding communities to be sustainable and more resilient in the face of future disasters (Chandra, 2015).

For this study, the researcher will focus on post-disaster recovery of the built and social environment, particularly buildings, road infrastructure, and population. For a community to become resilient, it requires that the built environment maintain acceptable levels of functionality during and post-disaster (National Institute of Standards and Technology, 2016). Additionally, recovery times should be based on the role and importance of each infrastructure system within the community, and the extent of disruption that can be tolerated. It can also be noted that not all facilities need to be restored within the same timeframe (NIST,2016). According to (Campbell *et al.*, 2021) the social environment can be expanded into four capitals – Social, cultural, political, and human – to enable a deeper understanding of these important recovery angles.

2.4.2 Resilience

The term 'resilience' originates from the Latin word 'resiliere', which means to "bounce back (Koren, Kilar, and Rus 2017, p. 3). The United Nations defines the concept of resilience as the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, and recover from the effects of a hazard in a timely and effective manner through the preservation and restoration of its essential basic structures and functions (Groeve, Poljanšek, and Vernaccini 2015).

Klein, Nicholls, and Thomalla (2003) defined resilience as a desirable property of natural and human systems in the face of potential stresses in their investigation of weather-related hazards as an example of natural disasters in coastal megacities. According to Klein *et al*. (2003), it is recommended to be used in a "restricted sense: to present specific system characteristics that discuss (1) the ability of the system to absorb disturbance and still function acceptably, and (2) the system's self-organisation capability".

Several researchers have developed conceptual frameworks to measure community resilience from various perspectives. Community resilience refers to the ability of a localised (geographically defined area) to respond, cope, and adapt to change through communicational actions (Cretney, 2016). According to (Norris *et al.,* 2008), resilience can be understood as a set of network adaptive capacities: economic development, resource equity, social capital, and information and communication. Similarly, Cutter et al. (2008) proposed the DROP framework and model — Disaster Resilience of Place — to conceptualise disaster resilience at the community level. The DROP model demonstrates how resilience capacities (coping, adaptive, and absorptive) influence the degree of recovery and resilience of the community. It also includes six indicators, ecological, social, economic, institutional, infrastructure, and community competence, to quantify a community's overall resilience.

Balaei, *et al*., (2020) posits that resilience can be defined based on two principal elements: the residual functionality of the system in the aftermath of a disaster (i.e. robustness) and the system's swiftness in bouncing back to a normal level of functionality (i.e. recovery rapidity). National Center for Disaster Preparedness (NCDP) (2020) mentions that community resilience is the ability to adapt to, withstand, or rapidly recover from a disaster or catastrophic event. NCDP (2020) further suggests research and experience have attested that communities with greater capacity – as defined by their access to human, social, political, and economic capital – and greater capabilities in developing, acquiring, or exchanging these resources are more likely to be resilient in the face of a disaster.

With these definitions in mind, we see that resilience does not only focus on what happens after the disaster but operates through the lens of preparedness. Patterson, *et al. (*2010) highlight that resilience is critical to disaster preparedness. Disaster preparedness means conceptualising the entire disaster planning and management spectrum. Patterson and colleagues stressed the importance of using the Integrated Community-Based Disaster Management (ICBDM) model (involving communities in the process) to build capacity to prepare for, act during, and recover after a disaster. This practice of disaster preparedness, coupled with risk perception planning, helps us to appropriately see how communities' strengths and capabilities can be integrated into these processes.

According to Koren, Kilar and Rus (2017), Figure 2.1 illustrates the urban system as a complex mix of interdependent components and dynamic interactions between them that enable it to function effectively. The resilience of an urban system indicates the ability of a system to resist, absorb, accommodate, and recover from the effects of a hazard in a timely and effective manner. In a community that is said to be resilient, their recovery experience is likely to be an effective one that overcomes challenges and increases their ability to handle future events (Cretney, 2016; Norris, 2001).

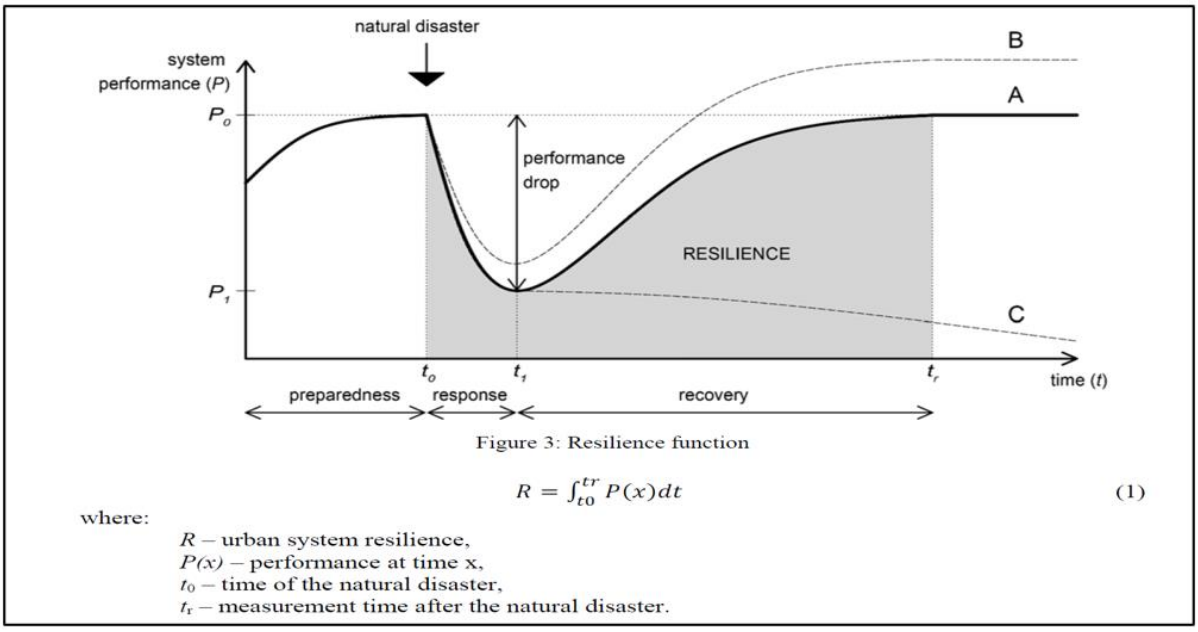

Figure 3: Resilience function

$$R = \int_{t0}^{tr} P(x)dt \quad (1)$$

where:

R – urban system resilience,
$P(x)$ – performance at time x,
t_0 – time of the natural disaster,
t_r – measurement time after the natural disaster.

Figure 2.1 Urban Resilience System – Resilience Function. Source: Extracted from (Koren et al., 2017).

2.4.3 Building Resilience

Understanding how a community can recover from HIWeather events post-disaster involves building community resilience before the event. This involves a Community-driven Development (CDD) approach by engaging communities and their perspectives (Mcnaughton, *et al.*, 2015), and organisations to help communities manage risks and implement local-level strategies that can effectively be part of long-term investment for building resilience (Arnold et al., 2014).

Building resilience goes beyond re-erecting a building and replacing damaged infrastructure post-disaster. Building resilience happens over time, and it moves more toward a process. According to (Patterson et al., 2010) the process of resilience is facilitated by the presence of protective factors at the individual, family, and community levels. These factors serve to mitigate the impacts of disasters and strengthen community capacity to handle existing and future events. It can take decades for communities to become fully resilient in all developmental aspects (social, environmental, physical, economic). Since 2017, some recovery and resilience authorities do not seem to have a clear overview of the state of community resilience to disasters in Auckland (Centre for Disaster Resilience, Recovery and Reconstruction 2017). It is important to note that a large and complex number of factors contribute to a community's overall resilience (CDRRR 2017). Resilience is hard to measure for a region, as it involves many factors; social (cultural, political, human), built, natural, psycho-social, and economic (Campbell et al., 2021). It is holistic and should be inclusive to encourage build back better (BBB) principles that are sound, can withstand future shocks or stresses without causing great devastation whilst addressing not just the economy but other issues of the local community (Manna kara and Wilkinson 2012), mentions that the term BBB entails using reconstruction not only to rebuild damaged structures and infrastructure but also encourage a holistic approach towards improving physical, psycho-social, and economic conditions of affected communities to improve overall resilience.

In Auckland, post-disaster recovery efforts to date have shown support for not just economic recovery, but social, natural, and the built environment, with strategies such as re-development and 'asset

improvement' projects. One asset improvement project worthy of mention is the holistic recovery community project, such as the Northcote Development project at Greenslade community in Northcote. According to (Our Auckland, 2020), stage-one of the works includes lowering the existing playfield and the replacement of underground stormwater pipes, by improving the stormwater network to reduce the frequency and severity of flooding in and around the town centre. Additionally, stage two of the work includes upgrading the urban wetland known as the Greenslade Reserve.

Building resilience in communities where buildings and infrastructures are exposed to extreme HIWeather triggered hazards is achievable but involves a structured approach (Elkady, et al., 2024). This includes collective community participation, stakeholder involvement, and collaboration, with an agile and conscious population with financial stability would react better to disaster situations than vulnerable populations with limited resources (Koren et. al., 2017). To achieve recovery within an acceptable timeframe and to build resilience across all spheres of the community involve community participation, agency, and knowledge (Campbell *et al.,* 2021). Urban communities are dynamic systems requiring strong community organisations to recover efficiently. So, resilience literature suggests community participation builds resilience, then recovery frameworks and or plans are two-folded in its benefits; i.e. helping communities recover and building resilience.

2.5 The International Context: Planning for Recovery

It is important to understand that having a plan for recovering post-disaster makes recovery more efficient (Federal Emergency Management Agency, 2016) and, therefore, reduces the long tail that often characterises it (Mcnaughton, *et al.,* 2015). Having a plan or framework for recovery is that blueprint.

A framework is a reusable design, and it must be general enough to be helpful but precise enough to be applied to a situation (Chen, and Xu, no date). This further alludes to the fact that a framework is abstract, but frameworks should be easy to understand and customise. In the context of post-disaster recovery, a framework is a set of guidelines to inform stakeholders involved in preparing for and managing recovery (Civil Defence Emergency Management Group, 2019).

A recovery framework is useful, particularly during the period before the disaster event (United Nations Development Programme (UNDP), 2011), since the idea is to anticipate the 'actions, results, policies, laws, etc., which, once the event happens, steers the post-disaster interventions toward recovery that are focused on people and their communities without creating new risks.

The Sendai Framework for Disaster Risk Reduction 2015 – 2030 was adopted at the Third United Nations World Conference on Disaster Risk Reduction, which represented one of many unique opportunities for countries: to adopt a concise, focused and action oriented post 2015 framework for DRR (United Nations International Strategy for Disaster Risk Reduction, 2015). Priorities for Action looks at the need for focused actions across sectors by States at the local, national, regional and global levels in the following areas (United Nations International Strategy for Disaster Risk Reduction, 2015, p. 14);

"Priority 1: Understanding disaster risk.
Priority 2: Strengthening disaster risk governance to manage disaster risk.
Priority 3: Investing in disaster risk reduction for resilience.
Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better"

in recovery, rehabilitation and reconstruction".

In approaching DRR, this International Framework is a blueprint for how nations can manage risks. The Framework challenges countries to understand better their risks and how to strengthen DRR arrangements at the local, national, and regional levels (United Nations International Strategy for Disaster Risk Reduction, 2015). New Zealand endorses the Sendai Framework priorities in their approach to DRR (Ministry of Civil Defence and Emergency Management, 2019), and by and large, recovery and resilience. The framework brings together a strong message of integration, collaboration, and a whole-of-society approach.

Although the Sendai Framework is endorsed in New Zealand, how exactly is this applied in Auckland at the local level? The Sendai Framework is fed into the National Disaster Resilience Strategy (NDRS) used to guide resilience (Ministry of Civil Defence and Emergency Management, 2019) in New Zealand. These are often embedded in community engagement reports and local Board engagement strategies (Auckland Council, 2021b). For example, in the Albert-Eden Local Board in Auckland, there is an Engagement Strategy for 2019-2022 that seeks to strengthen the relationship and engagement between the Auckland Council and the local community. With focus areas on bridging the gap between Council and communities, working on common goals, closing the loop, and meeting face-to-face (Auckland Council, 2022). In getting communities involved in building resilience, having a plan could help locals benefit from being engaged in the mitigation process and achieving better community preparedness through education and collaboration (WSP, 2022). This is one way that both community and Council can benefit from good quality information on historical flood events.

Pre-disaster and post-disaster preparedness planning are interrelated (International Recovery Platform, 2005; Kondo, 2018; Pine, 2014). According to (Pine and Gupta, 2014, p 292) the National Disaster Recovery Framework in the United States of America, through its encouragement of pre and post-disaster recovery planning and capacity-building efforts, provides another opportunity to inject hazard mitigation and closely related adaptation measures into the recovery and reconstruction process (Smith, 2014).

Following a natural disaster, stakeholder participation can enhance the planning process for post-disaster recovery (Chandrasekhar, 2014). Although having a recovery plan and framework to activate pre- and post-disaster is logical, the broad question of recovery extends beyond mere "disaster management" (Vale, and Campenella, 2005). Value-laden questions regarding equity in recovery remain unresolved: who sets the priorities for the recovering communities? How are the needs of residents valued amid disrupted lives? Who decides which voices carry the dominant narratives that interrupt what transpires? (Vale, and Campenella, 2005) What roles do authorities, national disaster-assistance policies, and relief organisations have in setting guidelines for reconstruction and recovery? How can recovery authorities overcome the lingering stigma inflicted by their city's victimization? Finally, what opportunities exist for visionary long-term recovery planning that incorporates stakeholder participation and engagement with local communities?

2.5.1 The New Zealand Context

In New Zealand, the Civil Defence Emergency Management (CDEM) Act (2002/2016) is the primary legislation governing Disaster management (Ministry of Civil Defence and Emergency Management, 2019; National Emergency Management Agency, 2023a; United Nations Office for Disaster Risk Reduction, 2020a). Global agreements such as the Sendai Framework 2015-2030 and Sustainable Development Goals (SDGs) have outlined how nations should approach and manage disasters. These frameworks are a key influence in developing this National Disaster Resilience Strategy (NDRS) Strategy (Ministry of Civil Defence and Emergency Management, 2019). The National Disaster Resilience Strategy (NDRS) is the national framework that sets three main priorities to improve New Zealand's resilience to disasters. These priorities include: 1. Managing risks, 2. Effective response to and recovery from emergencies, 3. Enabling, empowering, and supporting community resilience (Ministry of Civil Defence and Emergency Management, 2019).

At the National level, the Director's Guideline (DGL) document for recovery has a living framework formed, called the National Recovery Framework (Civil Defence Emergency Management Group, 2019). This supersedes the Recovery Management Director's Guidelines for CDEM Groups (DGL 4/05) and the Focus on Recovery: A Holistic Framework for Recovery in New Zealand Information for the CDEM Sector (IS 5/05). According to (Civil Defence Emergency Management Group, 2019) this framework describes the strategic and operational responsibilities at the local, CDEM Group and National Levels to manage, coordinate, and deliver recovery activities (see Figure. 2.2). The recovery framework should be applied for emergencies where the National Emergency Management Agency (NEMA) or CDEM Groups / local authorities are: the lead agency or, supporting another lead agency (Civil Defence Emergency Management Group, 2019). The key responsibilities across the framework include monitoring, advising, coordinating, reporting, and delivering activities to support the community.

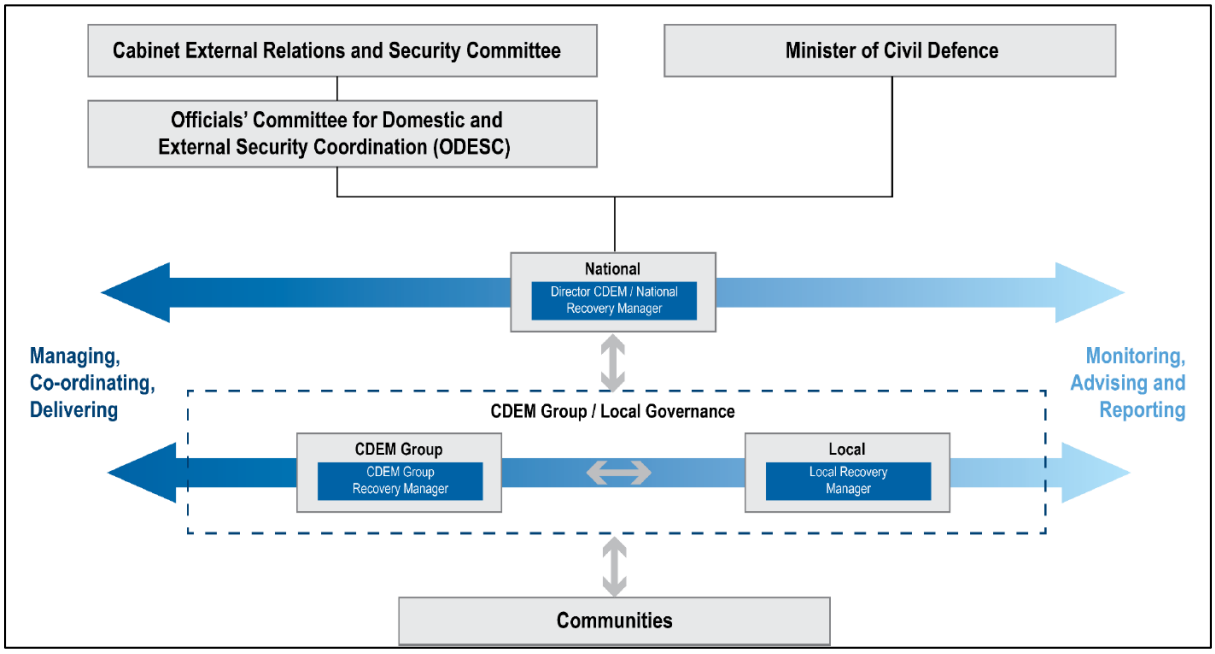

Figure 2.2 The National Recovery Framework. Source: Extracted from (Civil Defence Emergency Management Group, 2019).

At the regional level, the Auckland Council follows the Framework for Action, which looks at Reduction, Readiness, Response, Recovery, and Resilience (Auckland Civil Defence and Emergency Management, 2016). The Recovery Framework for Action[1] sets out the current state, all action points, delivery lead, delivery support, and timeframe. Here, recovery planning addresses the following - 1. increasing knowledge of the Sendai Framework principles and ensuring that consideration is given to DRR when planning for recovery; 2. Improving coordination, as recovery is often uncoordinated across agencies, which can hamper recovery; 3. Strengthening the CDEM Group's recovery framework to align with national recovery arrangements.

Within a recovery framework, a key focus of the community recovery process is led by the community that needs to recover; that is, the community is at the centre (Federal Emergency Management Agency, 2011; Arnold et al., 2014). "Typical approaches to community consultation look at the consequences and the opportunities but do not necessarily consider the constraints and the implications of a dynamically changing environment." (Brooks and Curnin, 2021, p. 121). Communities may be more receptive when their plans and contributions are part of a recovery framework developed through engagement and collective participation; they are more willing to engage and adapt to frameworks that can be practically applied and implemented in their community.

Although a community framework might not be the 'be-all' solution to recovery in creating a resilient community, it is a tool that can be used as a guide to an efficient recovery process. This does not mean complete passivity, (Liu, and Huang, 2014) agrees that post-disaster situations are fluid in nature, so it is unlikely that adequate responses can all be pre-planned. However, much will depend on the ability to respond flexibly and effectively. Lui and Huang (2014) explain that, at times, improvisation becomes necessary to anticipate and react to changing post-disaster situations.

2.6 Recurrent Themes in the Recovery Scholarship

2.6.1 Communication

Communication plays a critical role throughout the phases of a natural hazard reduction (mitigation), readiness (preparedness), response, and recovery) (Doyle, 2022; Pine, 2014). It is important to set the stage to portray what we mean by communication. The reason is that the word varies across contexts (Doyle, 2022). This leads us to ask the question, what is communication? The Oxford Dictionary defines communication as a noun: "The transmission or exchange of information, knowledge, or ideas, by means of speech, writing, mechanical or electronic media etc" (Oxford English Dictionary, n.d.). The keywords from this definition are 'transmission' and 'exchange' of information, signifying that there must be a two-way flow of information. According to (Tang, 2015), two-way communication completes a communication cycle. Information is shared in a bidirectional way. The sender creates and sends a message to the recipient, who reads and interprets it and provides feedback in response. On the other hand, Tang and colleagues posit that in one-way communication, feedback is lacking, usually characterised by a top-down information flow and shared on a website that is not open to debate and discussion.

Given the definition of communication, this research focuses specifically on communication between residents and recovery authorities. Echoed in the evolution of science communication (Doyle,

[1] The Auckland Emergency Management (AEM) acts as the delivery leading body to implement this Recovery Framework for actions (ACDEM, 2016, p166, Table 14).

2022) is the landscape of communication. It is important to note that communication has shifted from mainly ‘one-way communication’ of disseminating information toward a more participatory mode, often called ‘two-way communication.’ (Doyle, 2022).

Communication is key to any community's recovery post-disaster. Throughout any disaster, a community needs to know what is happening, what needs to be done, who they should contact for assistance, and how they may be affected (Civil Defence: Northland Emergency Management Group, 2023; Toomey, 2014). Communicating should occur throughout the pre-, and post-disaster recovery process to maintain robust and accessible communications among all stakeholders involved and all other partners to ensure ongoing dialogue and information sharing (International Recovery Platform, 2005). According to (Elkady, Sahar., Mehryar, Sara., Hernantes, Josune., and Labaka, 2024)One factor influencing interaction among stakeholders in disaster management is improving the communication of risks and mitigation measures with citizens, raising awareness of risks, both before and post-disaster.

This calls for having a recovery plan. In the work of (Neeraj, 2021) to plan for post-disaster recovery; having an effective recovery plan is a holistic approach that is crucial after an event. This reduces vulnerability and increases the resilience of communities to recover well. Neeraj, Mannakkara, and Wilkinson (2021) postulate that this holistic approach is needed to enhance the ability of a community to anticipate, avoid, or recover from a shock and to adapt successfully to make a community better and more secure in the future.

To specify what may be done in a post-disaster recovery setting, pre-disaster recovery planning (PDRP) is needed (International Recovery Platform, 2005). These types of plans are based on informed scenarios rather than actual conditions. Recovery plans can be created by anticipating potential hazards and identifying pre-existing vulnerabilities. This can paint a picture of post-disaster conditions by successfully developing goals, strategies, and actions. The planning process should be cyclical, scalable, and participatory. The state of Florida in the United States of America has enacted a law that hazard-prone coastal communities should develop a Post-disaster Redevelopment Plan. According to (International Recovery Platform, 2005) several local governments, such as Hillsborough County and Panama City, Florida, have piloted the planning process, each devising its own organisational structure.

In general, communication between public officials and disaster-affected communities is crucial in recovery planning (Rumbach, 2016). Public participation in recovery planning helps to improve governance by communicating local preferences to decision-makers, building trust in planning processes, improving the quality and implementation of these plans (Rumbach, 2016). With effective communication, trust is built (Chandrasekhar, 2014; Doyle, 2022; Khan., Mishra., Kuna-hui., and Doyle, 2017). This increases the accountability of the recovery authorities, with the locals.

Without effective communication, recovery efforts occur in isolation, resulting in missed opportunities to maximise outcomes. In communicating recovery information, one requires a recovery coordinator (Bush International Consulting, 2023). According to (International Recovery Platform, 2005) A coordinator manages and oversees recovery services and ensures a strategic approach to coordinating regional and local assistance and policies. Secondly, a coordinator is responsible for coordinating assistance to support community recovery planning (International Recovery Platform, 2005). In communicating and coordinating recovery planning, many challenges exist, which require the needs of the affected community to be at the centre of the recovery planning (Ministry of Civil Defence

and Emergency Management, 2019). This means keeping the community at the heart of recovery planning (Trüdinger, 2024), which, for example, translates into having areas for emergency management planning and operation centres in the form of community hubs that should be opened as community-led centres (Civil Defence: Northland Emergency Management Group, 2023). This is simply a network of response groups led by local people around the area and supported by authorities.

2.6.2 Participatory Mapping

Buildings and infrastructure systems within a community are built to be sustainable, not to be eroded by hazards but supported by developing a community recovery and resilience plan (National Institute of Standards and Technology (NIST), 2016). NIST (2016) further alluded that this plan must be comprehensive, collaborative, and participatory (involve the affected or exposed community). For more innovative and efficient recovery, a guide must primarily focus on planning for community recovery. This will ultimately complete resilience planning and inform preparedness steps. When a community prioritises recovery planning of its assets at risk, it develops a step-by-step planning process that helps communities understand issues concerning community-level damage (NIST, 2016). Addressing this damage requires two-way communication between the local community and authorities to apply both bottom-up and a top-down approach (Cadag, 2012) which is often difficult to achieve.

If we can identify exposed assets with the use of GIS tools – involving authorities, planners, and decision-makers, with the help of communities, then we can apply a participatory approach (Bullen, 2024; Cadag, 2012). This will reduce discrepancies between conventional maps and local knowledge outputs. This approach tends to identify high-risk areas in need of mitigation, preparedness, resilience, and recovery plan of action to reduce damage from the flood risk in the local community (Glas *et al.,* 2017). The accuracy of validating elements at risk starts with engaging the local community by having them play a participatory role in the awareness of flood risk management (FRM) and being involved in mapping incident areas (Bullen, 2024). Bullen and Miles assert that FRM authorities are often restricted to a top-down approach, which limits flexibility for collaborative and integrated FRM implementation.

Furthermore, (Bullen, 2024) assert that integrating local knowledge with technological flood models can be critical to future FRM approaches if the proposed solutions are to be considered sustainable, with strong uptake by the local community. In (Cadag, 2012) work, they used different forms of participatory mapping on six communities in the Philippines, which have been used for DRR: ground mapping, stone mapping, 2D scaled mapping, GPS mapping, and web-based and interoperable GIS mapping. For this study, we used topographic maps (2D scaled mapping) (community members drew incidents on the map), GPS, and web-based GIS mapping, which does not require training and any local resources and may be easily manipulated by the community.

In planning for effective recovery, using reliable geospatial data to locate critical infrastructure like roads, buildings, or other elements exposed and at risk is of utmost importance (Glas *et al.*, 2017; Gerge *et al.*, 2022). It leverages GIS technologies to locate and extract elements at risk, such as buildings, roads, crops, cars, etc. (Glas *et al.*, 2017) within hazardous areas. These are also called assets exposed. Gerges and colleagues proposed that a GIS-based web framework can effectively quantify existing GIS layers, such as road segments, flood hazard areas, transit roads, and other critical assets. For example, in the work of (Gerges *et al.*, 2022) they used ArcGIS within a web-based framework to show the ESRI map (ESRI world topographic layer) and ArcGIS technologies to select the desired locations to evaluate the

exposure of assets. They applied an Exposure Capacity-based Transportation Resilience Index (EC-TRI) on the transportation infrastructure of six communities within New Jersey to showcase the practicality of EC-TRI and to illustrate the evaluation methodology. They used a baseline scenario (i.e., based on a FEMA flood hazard). Then, a user delineates an area on the map (or select communities), and the framework extracts the desired attribute values by computing the intersection between the selected area and each GIS layer selected. Once the elements at risk are examined, the exposure (relative to current and future hazards) can be determined.

2.6.3 Governance

Governance is a critical yet complex aspect of recovery for decision-makers and community leaders (International Recovery Platform, 2009) . This is important because governance sets the stage to provide authority and a clear platform for communication, recovery planning process, and framework (Kondo, 2018). It ensures that all major stakeholders involved adopt a comprehensive and strategic planning framework. Kondo (2018) alludes to a citywide recovery plan developed just before the earthquake hit Kobe, Japan. This recovery plan proved effective, but it had some drawbacks, such as being impractical, having little citizen participation, and possibly becoming an urban safety plan.

Governance ensures that stakeholders' are represented from the outset with clear expectations, knowing their roles and responsibilities to reduce confusion (International Recovery Platform, 2005; Toomey, 2014). Toomey (2014) supports the view that recovery agency governance needs to be flexible and tailored to changing post-disaster recovery environments. Plan, policies, and regulations should be fit for purpose, flexible enough to adapt to a changing environment to enable resilient development in various circumstances (Ministry of Civil Defence and Emergency Management, 2019). The plan should be a living document.

Legislations are highly critical in recovery and reconstruction (Rotimi, 2009). Rotimi and colleagues alluded to the notion that implementing legislation or revising legislation in construction before a disaster event can facilitate reconstruction and recovery in New Zealand. Their work mentioned that having a clear understanding of emergency activities provided by certain recovery authorities, like Lifeline Utilities, regarding their duties and obligations, especially toward local and regional councils, needs to be clearly expressed in legislation. There is no specific power to direct certain emergency activities (Rotimi et al., 2009) and no overall command structure, which results in chaotic and patchy co-ordination in recovery (Bush International Consulting, 2024).

In some instances, local governments may not possess the authority to design and implement plans (International Recovery Platform, 2005). Therefore, in such cases, planning should be prioritised at the appropriate policy level, where decisions can be actualised. Of course, it must be underscored that local representatives are encouraged to be included in the participation, planning, and decision-making process (International Recovery Platform, 2005; Campbell et al., 2024). In New Zealand, recovery plans are coordinated and established at the National level. At the regional level, the Recovery Manager plans, manages, directs, and coordinates activities throughout recovery. The Regional recovery manager facilitates communication between agencies undertaking recovery activities. At the local level, the local recovery manager facilitates communication between community leaders, groups, and organisations (National Emergency Management Agency, 2023a).

Major challenges arise when there is poor governance (Gjerde, 2018). (International Recovery Platform, 2009) highlights several governance issues in recovery, some evident in the research findings. 1. Non-existent legislation hinders the building of effective legislative and institutional frameworks. When legislation does not exist, recovery progress toward enforcing laws and regulations is slow and fragmented. 2. Civil society is often not engaged in risk management-related issues but is more focused on daily chronic risks (Kondo, 2018). 3. More attention needs to be given to civil society participation. Often, recovery authorities do not have a direct relationship with citizens. Therefore, civil society participation requires more thinking in terms of what it means and how to engage communities meaningfully – often, it is more lip service than reality (International Recovery Platform, 2009; Vallance, 2011).

2.6.4 Community Participation

There are several challenges facing recovery processes, one of which includes the central role of participation (Tuhkanen, 2023) in Build Back Better. Recovery is a complex process in and of itself, let alone focus on learnings related to participation post-disaster. Further research on the scope of resident participation within this space presents a research gap (Tuhkanen, 2023).

Building resilience requires participation, engagement, and partnerships, which will improve stakeholder interaction (Bush International Consulting, 2023, 2024; Elkady, Sahar., Mehryar, Sara., Hernantes, Josune., and Labaka, 2024; Vallance, 2011, 2015). The National Disaster Resilience Strategy (Ministry of Civil Defence and Emergency Management, 2019) mentions that one main guiding principle for building a resilient New Zealand is that government nurtures positive relationships and partnerships. This can be achieved by engagement, communication, and shared experiences. Additionally, this can be addressed by acting inclusively, including incorporating and recognising Treaty of Waitangi principles, collaboration, and collective action (Ministry of Civil Defence and Emergency Management, 2019).

In New Zealand, the government is mandated to work with Māori and other groups from external entities to achieve local goals (Campbell *et al.*, 2021). The ReCap document alluded to the idea that these priorities engage with Māori and communities to meet needs. However, it can take several days for Māori and the local community to be included in the formal emergency management response and recovery process. To address the gaps between the Council and local communities, the Auckland Council engaged in a community engagement study. This study was done to hear from local communities throughout Auckland about how to better engage with locals to be included in the decision-making process to build a more resilient nation (Auckland Council, 2021b). Their engagement approach was informed by key internal Council stakeholders who work directly with communities. They formed a Thriving Communities Reference Group and a Māori Advisory Group to guide their approach. They used a mixed method approach – including one-to-one interviews, small focus groups, and large events to reach a diverse range of community groups and leaders. Discussion questions were used to prompt wide-ranging conversations about finding good practices and identifying areas on which the Council could improve or build on. Additional questions asked in Māori engagement were – how can the Council work together with Manaaki migrants and newcomers to build a more inclusive Tamaki Makaurau? How does Auckland Council help to facilitate this interaction?

There were key findings from the research, to name a few, some messages addressed the following (Auckland Council, 2021b, pp. 11-12) – 1. strengthen community voices by fortifying civic

participation, empowering youth, democratic decision-making and representation. 2. Foster the use of Te Ao Māori, tikanga (protocols), Mātauranga (knowledge) and New Zealand's history. 3.Work to strengthen partnerships with tangata whenua as Treaty partners. 4. Promote community-led approaches that recognises local knowledge and skills of communities and what diverse communities value. 5. Provide more support for community groups to improve understanding, access, and availability for different types of support, grants, and funding for communities provided by the Council and other organisations. 6. Improve relationships, communication, and engagement – that is to focus on building good relationships and improve community engagement, communication tools and practices with communities.

Some participation is 'passive or token' participation, where residents react to a lack of information simply because they are only informed or given fact sheets, not involved, or have not collaborated and empowered. , Vallance (2015) surmises that participation should move from just informing to consulting, involving, and collaborating to 'active' empowerment (Figure. 2.3) (Vallance, 2015, p. 3). The figure below shows the level of participation that moves from informing to empowering within the context of how the public understands science (Doyle, 2022; Vallance, 2015). There is a difference between two-way conversations versus a one-way method of communicating risks and hazard information to the public. Both methods give different results. Communication for natural hazards and disasters has moved from enhancing the design and delivery of a one-way product to understanding the complexities and influences on the landscape within which communication occurs, and decisions are made via participatory design (Doyle, 2022). We see from (Figure. 2.3) a shift in communicating risk to the public from disseminating risk messages toward two-way, participatory communication.

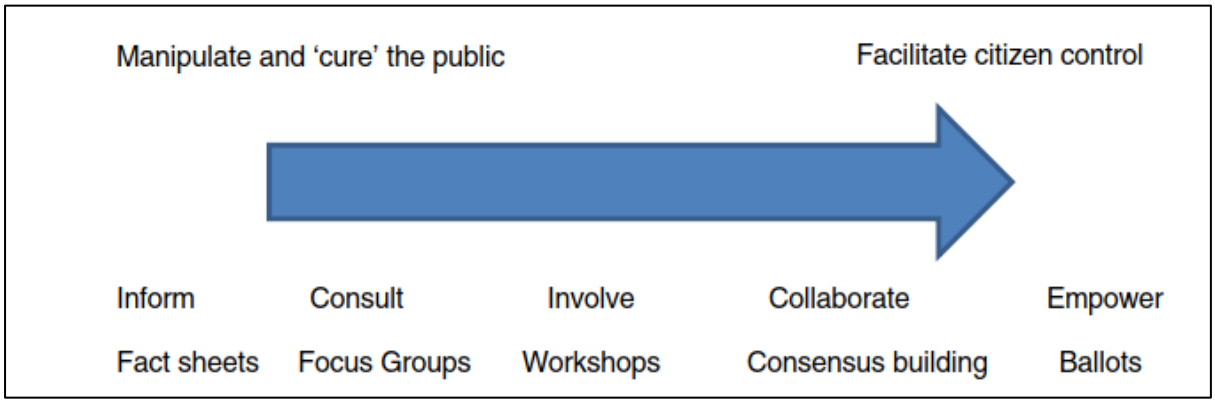

Figure 2.3 Typology of Participation and Empowerment. Source Extracted from (Vallance, 2015).

It is important to note that different types of participation, involvement, and communication influence how communities are affected post-disaster. Doyle and Becker, (2022) noted that in Columbia, for example, there was a lack of effective risk communication before the 1985 volcanic disaster, as the population had no prior experience with volcanic risks. Despite efforts by the scientific community, such as hazard maps and information campaigns, the response was limited, with approximately 8,000 people evacuating, and it remains unclear if this was due to the campaigns. After the disaster, Columbia implemented community-based risk communication strategies. A key example is the 2007 development risk scenario maps for Nevado Del Huila volcano, in collaboration with indigenous communities and government agencies. This participatory-collaborative approach resulted in reduced causalities during the 2008 lahar to just ten deaths which shows the progress in risk communication practices.

In Gulfport, Mississippi, for example, community engagement boosted preparedness after the hurricane through activities like strengthening neighbourhood ties, visiting elderly residents, and improving communication to address public safety concerns. Effective communication, crucial for both traditional hazards and crises like COVID-19, results in a strong response and recovery (Doyle, 2022; World Health Organisation, 2019). Post-disaster Katrina, residents were encouraged to create disaster plans and develop toolkits to coordinate neighbourhood strategies. The community's collaborative, cross-sector approach (traditional, epidemiological, and biological hazards) to rebuilding is a model for other communities to emulate.

Vallance (2015) explored the case study of the Post-disaster Canterbury Earthquake in February 2011. Here, the CBD of Christchurch was devastated, with 80% of its inner-city buildings affected, and 8000 homes in Red Zones were demolished. With buildings deemed structurally unsafe, other aspects of life have also been significantly affected, with numerous school closures and the loss of important buildings such as churches, community halls, recreation centres, shopping malls, corner shops, restaurants, and other businesses. These changes have profoundly altered individual and collective behaviour patterns, further disrupting residents' sense of security and well-being. It is within such context – characterised by a common sense of anxiety and grief, displacement, extensive land damage and demolition, top-down decision-making, uncertainties with authorities' responsibilities and tension between recovery agencies and locals—that public participation in recovery occurred.

2.7 Existing Gaps in the Literature

As a result of the increase in the frequency and intensity of global disasters, significant attention is given to addressing gaps in post-disaster recovery (Donovan, 2015; Kondo, 2018; Mannakkara, Wilkinson, Suzanne and Potangaroa, 2019). Despite growing scholarship on post-disaster recovery, the literature identifies persistent challenges, including inefficiencies in recovery planning; limited community participation in recovery activities, poor communication between stakeholders and the community, and weak decision making processes during recovery (Vallance, 2015; Fekete *et al.*, 2017; Khan *et al.*, 2017; Doyle and Becker, 2022; Bush International Consulting, 2023; Trüdinger, 2024).

This thesis addresses gaps in the recovery scholarship by advancing community-centred recovery approaches emphasising the need for community voices, participatory decision-making, collaboration, and the use of geospatial technologies. I have organised and identified gaps under four key themes that structure this research.

2.7.1 Marginalised Community Voices

The disaster recovery scholarship consistently highlights the value of community involvement in recovery planning. However, in practice, participation is usually limited to tokenistic consultation rather than meaningful discussions, deliberation or continuous engagement between communities and recovery stakeholders (Vallance, 2015). The literature highlights that communities in pre- and post-disaster recovery environments are seen as beneficiaries rather than co-creators of recovery strategies(Chandrasekhar, Zhang and Xiao, 2014; Vallance, 2015; Fekete et al., 2017; Kwok et al., 2019; Ashford et al., 2020), which leads to plans failing to address local needs.

The marginalisation of community voice contributes to recovery top-down plans that inadequately reflect; local needs, recovery priorities, and or lived experience. Although international

frameworks and resilience scholarship increasingly call for inclusive and participatory recovery approaches, (Aldrich, 2012; United Nations Development Programme (UNDP), 2011; Vallance, 2015)There still remains a gap in empirical research demonstrating how community knowledge can be systematically integrated into recovery decision-making.

The thesis addresses this gap by examining recovery from the community's perspective, as well as investigates how local knowledge and participatory approaches (Aldrich, 2012; United Nations Development Programme (UNDP), 2011; Vallance, 2015), can contribute to identifying exposed assets and to informing recovery planning, thus repositioning communities as active agents in the recovery process.

2.7.2 GIS Technologies Underused as Participatory Decision-Support

Hazard mapping is an important component of Disaster Risk Reduction (DRR) and disaster recovery planning research (Alves, 2021; Kumar, 2008). Moreover, traditional approaches to hazard mapping rely on top-down, technically driven assessments that often fail to capture local realities experienced by the affected communities (Parajuli *et al*., 2020; Vinnell *et al.*, 2021; Ibrahim, Kuuire and Kepe, 2024).

The literature provides insight that combining geospatial technologies with local knowledge through participatory and bottom-up approaches can immensely improve accuracy and relevance of hazard data (Rollason et al., 2018; Parajuli et al., 2020; Alves, Djordjević and Javadi, 2021). Communities hold valuable insight into historical hazard patterns, for example, they know what took place when, and where, as they are usually the first to arrive and last to leave (Vallance, S and Carlton, 2014). Communities are usually aware of flood extents and exposed assets, which can enhance the reliability of validating them (Lunetta, Ross, and Lyon, 2004; Rollason *et al.*, 2018; Joy *et al*., 2019; Parajuli *et al*., 2020).

While there is growing interest in citizen science, and community validation of hazards using geospatial technologies (Glas *et al.*, 2017; Rollason *et al.*, 2018; Parajuli *et al.*, 2020; Vinnell *et al.*, 2021; Bubeck et al., 2023; Ibrahim, Kuuire and Kepe, 2024), GIS remains underutilised as a participatory decision-support tool within recovery planning. The literature lacks sufficient empirical evidence on how community-led geospatial methods directly support recovery decision-making.

The thesis addresses this gap by examining how participatory GIS approaches can support the identification of exposed communities and assets for making decisions when planning for recovery.

2.7.3 Communication Failures

Communication is a common theme in the recovery scholarship and is widely recognised as critical to effective recovery outcomes (Doyle *et al.*, 2014; Vallance, 2015; Otto et al., 2017; Parajuli *et al.*, 2020; Doyle and Becker, 2022). Despite this recognition, communication failures remain a significant barrier to sustain effective recovery.

The literature identified recurring challenges such as unclear messaging, information received during an event instead of prior warning, and the absence of sustained two-way dialogue between communities and recovery authorities (Vallance, 2011; Doyle *et al.*, 2014; Campbell *et al.,* 2022). These failures often hinder recovery efforts, cause delays in the recovery process, leading to confusion among stakeholders about their roles and responsibilities, and frustration among affected communities.

Even though communication is frequently discussed, there is limited empirical research examining how communication dynamics build trust, participation, and recovery outcomes. There is limited literature on practical guidance on structuring communication processes that enable continuous feedback and collaboration throughout recovery.

This research addresses these gaps by examining the dynamics of information exchange during the recovery process by highlighting how two-way communication builds trust, empowers communities, clarifies responsibilities, and supports inclusive recovery planning.

2.7.4 Weak Operationalisation of Recovery and Resilience Frameworks

Building long-term resilience is critical to post-disaster recovery (Vallance, 2011; Fekete et al., 2017; Campbell et al., 2021). Oftentimes, recovery efforts focus on returning to a pre-disaster condition rather than creating systems that reduce vulnerabilities to future hazards and preparing communities for future hazards (Kita, 2017; Mannakkara, 2014; United Nations Office for Disaster Risk Reduction UNISDR, 2017).

Although recovery frameworks emphasise resilience-building measures, such as building capacity, strengthening social networks, enhancing social capital initiatives, and improving infrastructure, the literature reveals a weak operationalisation of these frameworks at the community level. There is little empirical evidence demonstrating how resilience principles are translated into pragmatic recovery actions, particularly in diverse community contexts.

This research addresses the gap by identifying factors influencing recovery and long-term resilience from the community's perspective, examining how social cohesion, leadership, and education and training can be embedded into recovery strategies to support effective and efficient recovery.

2.8 Options for Recovery

2.8.1 Building Relationships through Partnerships and Engagement

For recovery to be successful, there is a need for local community groups that are dedicated to offering their time, efforts, and resources and building relationships with external stakeholders and networks (Cretney, 2016). For example, the Bangladesh recovery programme used a community engagement-social cohesion approach, which does not build activities on an isolated but rather more on an integrated basis. This empowers communities to share their recovery ideas and activities with decision-makers while engaging them to assist and provide guidance (Donovan, 2015; Ireton, 2011). Getting involved after a disaster can empower disaster-affected communities (Vallance, 2011), allowing communities to take ownership of community recovery plans and projects (Donovan, 2015). This was asserted in the example of the Grand Forks and East Grand Forks.

Donovan (2015) referred to a practical example of the West Bank region. This region was inhabited by two resilient communities that used placemaking (a community project to enhance and improve their shared communal space) to build "a community of implementation" of local people and stakeholders to achieve a successful project. He shared that each workshop had a two-way communication process. What does that look like? No decision was made without the community's support. In other words, responses were invited at each session, and anonymous feedback forms and

other parallel mechanisms made it easy for community members to participate. In this way, stakeholders demonstrated that they listened, and that the community had control.

2.8.2 Social Capital in Post-Disaster Environments

In the field of disaster recovery, social capital is an underexamined factor that promotes recovery post-disaster (Aldrich, 2012). Social Capital comprises resources embedded in one's social networks (Lin, 2008). Aldrich (2012) argues that stronger social capital builds new norms about compliance and participation among network members and provides information and knowledge to individuals in a group – creating trustworthiness. For example, studies by post-Katrina (2005) have shown strong connections between civic engagement and involvement in associations, clubs, trusts, and societies. Similar factors such as civic involvement, rich social capital, and active citizenship helped survivors of the Kobe earthquake (2004) to recover from the tragedy (Tatsuki, 2008). Aldrich also notes that high levels of social capital serve as a core engine for recovery. He explains that communities with strong social capital experience faster recoveries than those with little social capital. Moreover, social capital serves as an informal insurance post-disaster that plays a role in post-disaster resilience (Aldrich, 2012). That is, communities with greater levels of social capital tend to overcome obstacles and become more resilient, as in the Kobe earthquake (2004) and Hurricane Katrina (2005).

2.8.3 Empowering Communities through Building Capacity and Capability

Community participation, agency, and knowledge are greatly valuable in disaster resilience and recovery (Vallance, 2015; Campbell, *et al.*, 2021). Recovery outcomes are successful when community capacity and local decision-making are complemented rather than overpowered by external groups and authorities. Similar to the Myanmar capacity-building project that increased awareness in its corresponding communities, involving the local community through DRR education, training, and involvement in decision-making accelerated recovery and enhance resilience *(Patterson et al.,* 2010; Campbell *et al.*, 2021).

In Zamiba's Emergency Drought Recovery Project (2002 – 2005) for instance, a community project combined an immediate response to the public works component with medium- to long-term capacity-building efforts for communities in the country to cope with natural disaster events (Arnold *et al.,* 2014). This approach employed community-based preparedness and recovery planning. It strengthened the government's early warning system, drought management arrangements, and a cohesive longer-term safety net framework at the central and district government levels.

3 CHAPTER: The Methodology

This study employs a sequential exploratory, mixed methods, multiple-case study research design. I will explain the reason in detail for selecting these methods below.

3.1 Justification for the Research Design

3.1.1 Why Sequential Exploratory Design?

This study adopted a sequential exploratory mixed methods design. This started with qualitative phase, which comprised of scoping interviews, community engagement sessions, and participatory GIS validation. This was done to explore recovery experiences and identify emergent themes. Based on the research needs, objectives, and questions, I implemented a research design to collect data sequentially and engage communities between November 2021 and December 2022. Ngulube (2015) explicitly identifies that this sequential exploratory mixed method is a valid approach. This method was used to understand communities' recovery experiences while maintaining that communities are the focus of recovery (see Figure 3.1). Figure 3.1 depicts the sequence in which the community-centric engagement method captured data for this research.

(Ngulube, 2015) alluded that in his study, an exploratory mixed methods approach was employed, with qualitative data1collected first, followed by a quantitative phase in a sequential manner. For my research, I started with scoping interviews with community members to understand what took place post-disaster recovery, how they were affected, and how they adapted in the face of disaster. This allowed me to form themes from these interviews – qualitative data, that would inform the kind of questions I asked in the survey – the quantitative data.

In my research, sequential exploratory design involved qualitative data collection coming first (including exploration, theme development, and concept building), then followed by the quantitative phase (testing, validation, and generalisation). This design was used when little is known about the phenomenon, as one phase informs the next phase, as it is critical to ensure that the survey instrument is grounded in lived experiences (Britton, 2010; United Nations Development Programme (UNDP), 2011).

For this research, the data collection methods were used in this sequential order (See Figure 3.1):

1. Strategic Targeting Methodology (Interviews and conversations with recovery authorities and online research to ascertain the most suitable communities to study)
2. Case Study Communities selected (from recovery authorities' guidance and desktop research),
3. Literature review themes explored, and gaps emerged
4. Conducted community stakeholders' interviews in case study areas
5. Scoping interview answers were transcribed using NVivo and manually edited.
    a. I transcribed all ten interviews, printed them out on paper, displayed them on a board, and highlighted themes
    b. Survey questions were developed from interview themes identified
    c. Survey was tested, then published on the community's social media pages, in the environs of the community, and at community engagement events
6. Field reconnaissance (I used the snowball technique to locate community champions to accompany me through each community and to be the link between myself and the community)

was conducted in each case study location on different days. By engaging with the community, I was invited to community meetings where I met various members willing to participate in the surveys. I booked days with each community champion to get familiarised with the community and where were the areas that were most impacted by the 2021 flood event. Disaster areas were hand drawn and verified on a physical map that I produced in ArcGIS using the impacted areas that the Auckland Council had initially captured.

7. Street stall sessions in supermarkets in each community on different days (Community mapping and validation exercise took place).
8. Community engagement workshop (community mapping and validation exercise took place here as well).

These qualitative insights informed the development of a structured survey instrument, which was subsequently administered to examine patterns across community groups. Sequential exploratory mixed methods designs are appropriate where complex social phenomena require conceptual clarification prior to measurement (Ngulube, 2015). In other words, this means exploring the theory in order and in depth, then measuring it by asking structured open questions or creating a survey. Data is not collected at the same time; it is done one after the other. Such methodological pluralism enhances validity, deepens interpretation, and enables the use of diverse data to examine the same issues across data sources, supporting more robust conclusions in post-disaster recovery research.

3.1.2 Why Mixed Methods?

A mixed methods approach was selected to capture post-disaster recovery, because it is a complex phenomenon *(Brooks, 2021; Gjerde, 2018; McNaughton, et al.,* 2015), which has several moving parts, and perspectives about inclusion and community participation. Therefore, using this method is appropriate as it captures what recovery looked like for each community studied.

According to (Hurtado, 2022) the transformative paradigm explicitly supports the use of mixed methods when addressing complex social phenomena shaped by multiple lived experiences. Hurtado explains that research within the transformative paradigm recognises that "multiple realities must be captured within a context where some are valued, and others are either devalued or made invisible". In this post-disaster recovery context, communities' experiences are not uniform; they are shaped by factors such as socioeconomic conditions, historical exposure to risk, institutional responses, and power dynamics. To appreciate their experiences, a single method is insufficient to capture the contextual and structural complexity surrounding the recovery phenomenon.

Furthermore, although no single method is uniquely tied to the transformative paradigm (Hurtado, 2022, p. 20), Hurtado emphasises that "the inclusion of qualitative methods is seen as critical.", and that mixed methods are well-suited because they allow the researcher to capture multiple levels of contextual complexity. In this study, qualitative scoping interviews allowed the identification of lived recovery experiences and marginalised perspectives, while survey data, that is, quantitative data, provided insights on broader patterns noted across the two case study communities. Participatory GIS validation further incorporated spatial and structural dimensions of exposure, acknowledging historical and institutional factors that shape the realities of recovery.

Employing the mixed method approach is critical to this research, as it allows different sources of data to function like a prism (Hurtado, 2022), which revealed multi-dimensionalities and angles of

approach rather than only triangulation. Similarly, (Ngulube, 2015; Romm, N. R. A. and Ngulube, 2015) noted that mixed method research goes beyond the boundaries of triangulation, which utilises several research techniques in the same research design. Thus, mixed method research combines the strengths of qualitative and quantitative methodologies to produce a comprehensive, broad-based research.

For this reason, I chose to adopt a mixed method research design for this study, as mixed methods are epistemologically consistent with a transformative orientation that values community knowledge, acknowledged realities, and aims to produce actionable insights for sound recovery planning.

The research approach encompasses mixed methods data collection techniques, including qualitative and quantitative data. This includes interviews (with residents and recovery authorities) and survey data, which were derived from scoping interviews and the literature.

case studies and scoping interviews with technocrats and experts in the disaster management field and residents from the case study communities. Additional data collection techniques included – informal discussions during fieldwork, fieldwork; field and desktop hazard mapping, observations, workshops, interviews, surveys, and street stall sessions (see Figure 1.2). Other research methods concerned with data collection techniques, such as document reviews (Journal articles, books, online research, and newspaper articles), were employed.

3.1.3 Why Multiple-Case Study Approach?

Post-disaster recovery is context-specific, shaped by varied recovery dynamics including, but not limited to local governance structures, socioeconomic conditions, hazard exposure, community capacity, and institutional response (Aldrich, 2012; Panton, *et al.*, 2009; Vallance, 2015; Mannakkara and Wilkinson, 2014; UNDP, 2011). Recovery outcomes are different across various communities (Cretney, 2016; Eisenhardt, 1989; Vallance, 2015) depending on levels of social capital, community leadership, how connected communities are to external authorities, institutional coordination, and prior vulnerability, reinforcing the need for contextually grounded analysis.

Therefore, a case study approach is appropriate for this study because it enables an in-depth, place-based examination of recovery dynamics within a community's real-life setting (Eisenhardt, K. M. and Graebner, 2007; Eisenhardt, 1989). Unlike large-scale statistical studies that prioritise generalisation, case study research allows for detailed exploration of lived experiences, institutional relationships, and localised recovery processes. This is crucial in disaster research, in that, recovery outcomes are influenced not only by hazards magnitude but also by contextual factors such as community cohesion, leadership, infrastructure vulnerability and exposure to risk.

For this study, a multi-case study design was adopted to enable comparison between Kumeū-Huapai and Henderson Valley, by examining similarities and differences in how communities perceive and experience recovery. This specifically addresses research question three. Studying more than one community, (in this case, I studied two communities in detail), strengthens analytical generalisation by allowing cross-case comparison rather than reliance on one setting. This comparative logic enhances the robustness of the findings and supports a deeper understanding of what influences recovery. Thus, this case study strategy aligns with the study's objective of examining recovery from the community's perspective and identifying locally grounded measures to improve recovery planning.

3.2 Justification for Case Study Selections

Initially, the following areas in Auckland were selected as potential case study locations for this study: Kumeū-Huapai, Henderson Valley, and New Lynn. The Strategic Target Methodology (STM) was used to identify vulnerable communities to HIWeather events.

Two case study communities were selected as the final study locations for this study: Kumeū-Huapai and Henderson Valley. These locations were selected based on a criteria matrix (see table 3.1) because stakeholders were consulted with and advised that previous studies had been conducted in New Lynn and that residents had data saturation and so would be reluctant to participate in the study. When I attempted to navigate the New Lynn community, I found it very difficult to identify a community champion who could help me become familiar with the community, its environs, and its people. Also, working with two communities proved to be more feasible for this study in that the researcher had a limited time frame to conduct data collection. So, I had to decide whether to study three communities at the surface level, risking the time and resources of the research. Or select two communities and conduct an in-depth study that would allow sufficient time and resources to cover the data-collection over the research period.

Table 3.1: Criteria of Indicators Considered for Selecting Case Study Communities to HIWeather Events in Auckland.

Category	Indicator
1. Socioeconomics	○ **Contribution to GDP** ○ **Mixed community activities (business, horticulture, tourism, residential, vineyards, paddocks)**
2. Infrastructure	○ **Road Network – road network to access the community** ○ **Power – sections of the population on the power grid and usually affected by weather events**
3. Hazard Exposure	○ **Communities exposed to the August 2021 flood event** ○ **Communities that experienced more than five flood incidences over the last century** ○ **Frequent flood incidents that are 1 in 100 years RP and greater** ○ **Landslides from flood events, flood-induced landslide in last 10 years**
4. Historic Hazard Events	○ **Data from NIWA Hazards catalogue** ○ **News articles & online research**
5. Vulnerability	○ **Communities near rivers** ○ **No existing community recovery plan**

Source: STM Adopted by IFRC and ODPEM, Refined by the Researcher.

The case study strategy enables in-depth contextual analysis of recovery processes within real life settings. This allowed the researcher to understand and observe how communities experienced recovery by uncovering detailed knowledge of the community's perspective about the factors that hinder and promote recovery post-disaster.

This methodological approach was thoroughly thought through. The approach was action-oriented, where selecting communities within Auckland was based on a set of criteria that has been used in the field of disaster risk management and have been tested as a valid tool in which communities were selected for study, namely in the Caribbean region(International Federation of Red Cross and Red Crescent Societies, 2014; The Office of Disaster Preparedness and Emergency Management, 2012; United Nations Development Programme (UNDP), 2011). (see Table 3.1 - Criteria table for choosing communities). The criteria chosen to select the communities in Auckland were decided by a series of preliminary consultations with experts in the emergency management field (United Nations Development Programme (UNDP), 2011), based on the nature and sensitives of Auckland communities, and ultimately determined by the research scope.

Considerations listed in Table 3.2 were considered to include communities that were vulnerable to floods, have contributed to GDP, business, and tourism and had a relaxed residential environment (Auckland Council, 2010; Islam, 2022; Stats NZ, 2018b). These criteria include the following factors: socioeconomic, infrastructure, hazard exposure, historic hazard events, and vulnerability. In the initial stage of the study, stakeholders referred the researcher to other research project leads who have worked on or were working on similar projects in this space. In addition, the methodology helps to explain to stakeholders, including community members, the reasons for selecting their community as opposed to another.

When identifying and prioritising communities for selection, preliminary meetings were held with technical stakeholders from the recovery-related relevant organisations to determine suitable indicators that would apply to the community selection process. An inventory of existing indicators was assessed to determine the most suitable community for this study. Five categories were identified for measurement as shown in Table 3.1. The communities were selected based on the STM criteria and finalised based on locations within the study scope and on community gatekeepers who were willing and able to assist the researcher in connecting with the community. According to (Elkady *et al.,* 2024), prioritising and locating leaders are critical for effective recovery, as strong leaders can mobilise resources, foster collaboration, and guide communities in emergencies.

3.2.1 Adopting Strategic Targeting Methodology (STM)

STM, is used to identify communities that may be suitable options for case study selection. The researcher developed a set of criteria from the STM employed by (International Federation of Red Cross and Red Crescent Societies, 2014; The Office of Disaster Preparedness and Emergency Management, 2012), and refined by the researcher (see Table 3.1).

To determine the study communities, the researcher consulted with supervisors to discuss potential case study areas in Auckland, New Zealand. The researcher was subsequently directed to contact key disaster emergency management, recovery, and resilience stakeholders and recovery authorities to ascertain best-suited potential case study areas exposed to recent HIWeather events. During the pandemic, the researcher organised online interviews and meetings with several stakeholders from Auckland Emergency Management (AEM), National Emergency Management Agency (NEMA), Scion Research Group, and academic experts to determine the most vulnerable communities. To identify the best possible site to study, hazard layers including rivers, hazard overlays, and past hazard events in communities were overlaid in ArcGIS over Auckland communities to determine the most vulnerable

areas to flooding. . Since post-disaster recovery is multi-dimensional and involves many institutions, (UNDP, 2011 p, 21) notes that "the process must involve stakeholders from national, regional, and local levels, as well as those from the international cooperation sector." This process led to discussions regarding identifying the research scope and finalising specific case criteria.

(Ngulube, 2015) mentioned that qualitative designs or approaches include case studies, where knowledge is situated and can be obtained from a particular location. The case study approach is an increasingly popular and relevant research strategy (Eisenhardt, and Graebner, 2007), that is suitable for unique settings. Eisenhardt (1989) supports the view that the case study research approach assists in providing a detailed description of the phenomenon, testing theory, or generating theory. From this perspective, the findings of a qualitative case study may bridge the gap between inductive and deductive research. (VanWynsberghe, and Khan, 2007) highlights the notion that a case study is relevant to all research traditions because it is trans paradigmatic and transdisciplinary.

3.2.2 Relevance of Case Study Selection

These communities matter theoretically as they both have experienced and were affected by the August 2021 HIWeather flood events. Additionally, both communities exhibit recurring flood exposure and lack formalised community recovery plans. Both case study communities are flood-prone, even though they can be found in two different environments: peri-urban and rural flood-prone contexts.

3.2.3 Comparability between Cases

These communities were not selected out of convenience. They were selected based on the criteria used in the STM table (see Table 3.1) and recommendations from recovery authorities. They can both be compared with each other to show similarities and differences. It makes sense comparing them because they have similar hazard exposure to floods and or landslides. They have different socioeconomic profiles, with different levels of institutional engagement and variation in community structure.

3.2.4 Limits of Transferability

It is prudent to acknowledge the limits of transferability of the findings from these communities. It does not mean that all flood-prone communities will behave the same, nor does it mean that it can be applied everywhere. It means that if another community looks like these selected communities, the findings might reasonably apply there as well.

While this study does not seek statistical generalisation, the multiple-case study design supports analytical generalisation to contexts with similar characteristics (Eisenhardt, 1989). Kumeū-Huapai and Henderson Valley represent peri-urban, and rural flood-prone communities exposed to recurrent HIWeather events and characterised by mixed socioeconomic activities and evolving recovery governance structures. The provision of detailed contextual description enables the assessment of the applicability of findings to other communities facing comparable hazard exposure and institutional dynamics. To this end, transferability may be limited in contexts with significantly different hazard profiles, urban density, governance arrangements or pre-existing recovery frameworks. These boundaries are acknowledged to maintain methodological transparency.

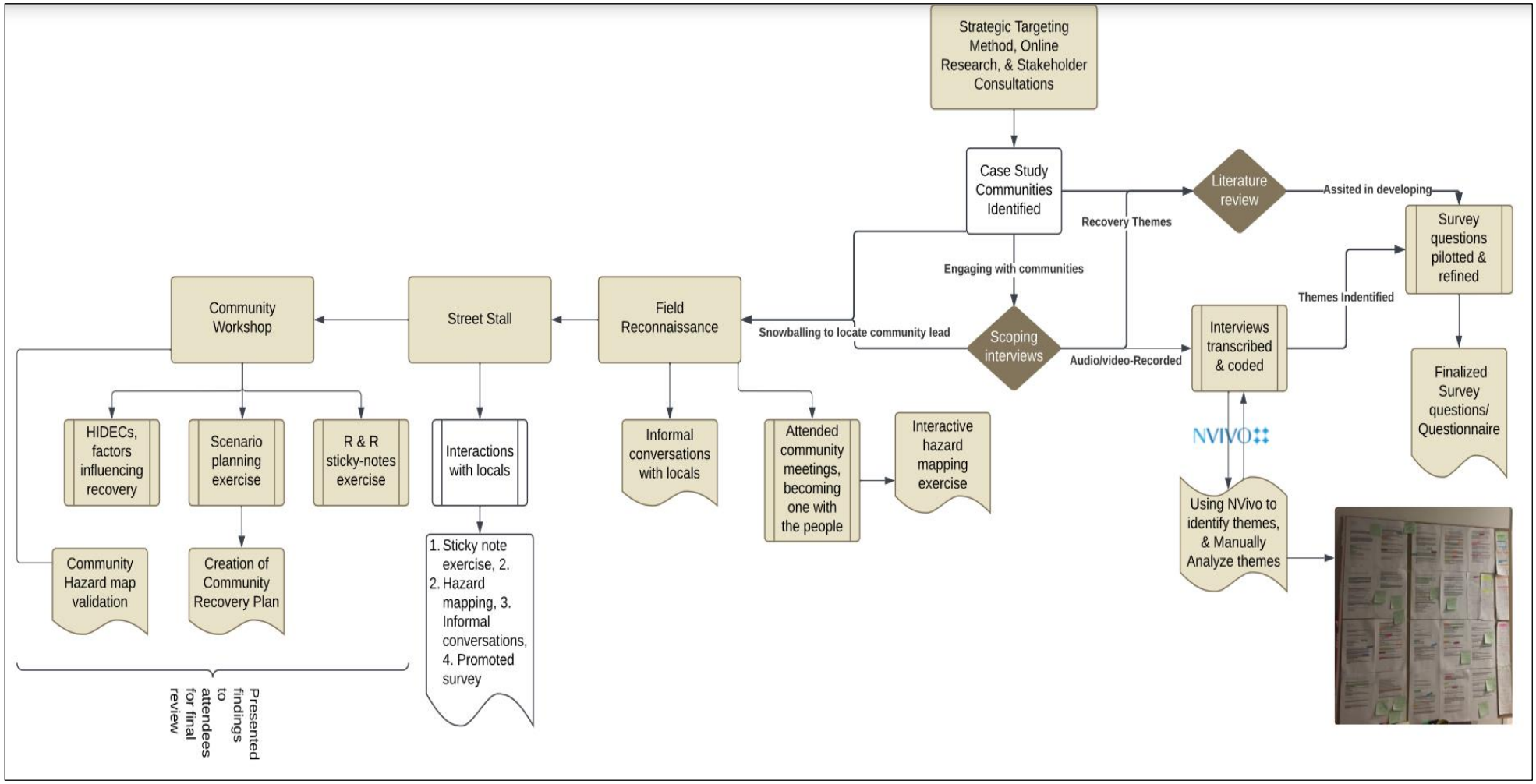

Figure 3.1: Post-Disaster Recovery Community-centric Engagement Methodology. Source: The Researcher, 2024.

3.3 Research Data Collection Methods and Instruments

This study mainly used primary and secondary sources to gather recovery data. Interviews, surveys, and community engagement sessions (workshop and street stall events) form the primary source of data collection, and previous literature on recovery and resilience constituted the secondary source of data (Odiase, Wilkinson, and Neef, 2020). These methods and techniques included document analysis, structured and semi-structured interviews, online Zoom and Teams meetings with local community members.

Upon finalising the case study communities using the criteria listed (see Table 3.1), the data collection and engagement process focused on residents' recovery knowledge, experience, needs, and challenges. The literature review and scoping interviews informed the design and development of the community survey. As shown in Figure 3.1, the scoping interviews were transcribed using NVivo software and manually analysed to identify themes forthcoming from all ten scoping interviews with community residents. These themes found were further researched in the literature and assisted in developing the survey questions. This survey included comprehensive literature findings on the research theme of post-disaster recovery from high-impact weather events derived from internet sources, journal articles, and similar resources on recovery and resilience. The study employed a validated descriptive online survey to conduct questionnaires/surveys (Ngulube, 2015; Romm, and Ngulube, 2015; Brewer *et al.*, 2019)).

3.3.1 Interviews

One-to-one interviews are typically conducted face-to-face; the researcher considered conducting such interviews via an electronic method in a particular circumstance (Saunders, 2009). For this study, most interviews were conducted via Zoom. This was due to the challenge of an ongoing pandemic and COVID restrictions from 2020 to 2022. Saunders et al. (2009) maintain that even where access is not an issue, conducting interviews by telephone, in this case via Zoom, may still offer advantages associated with speed of data collection, convenience of data recording, and lower cost. In other words, this approach may be seen as more convenient.

For one-on-one interviews, the number of participants depends on the subject matter and its complexity (Saunders *et al*., 2009). Inevitably, the more complex the subject matter, the smaller the number of interviewees. Participants are normally chosen using non-probability sampling, often with a specific purpose in mind, or in this case, would have experienced a flood event because the researcher feels one can learn a great deal from these individuals. Krueger and Casey (2000:25) refer to such participants as being 'information rich'. For each case study, 5 interviews were done for the Kumeū-Huapai, and 5 for Henderson Valley. More interviewees could have been attended per area; however, this was not achieved due to lack of availability, unwillingness to part-take in the study, and or lack of response from potential participants.

After questions had been originally drafted for the one-to-one interview, additional questions followed when the researcher started to transcribe the data manually and was aided by NVivo software. This led to the addition of follow-up questions to the interviews, and parties were recontacted by telephone to answer them. Saunders et al. (2009) agree that it was appropriate to conduct a short, follow-up telephone interview to clarify the meaning of some data and have the respondents answer follow-up

questions that were not considered during the initial interview session with a participant with whom the researcher has been able to establish integrity and to demonstrate competence.

3.3.2 Online Survey

The themes that emerged from the scoping interviews, online research, and literature review informed the survey questions. Qualtrics was the preferred tool for designing and developing the online survey based on its accuracy and data security features. Qualtrics was also the tool used to collect and analyse the data. The collected data was downloaded from Qualtrics at the end of data collection, and quality was checked for inaccuracies and variances. Most charts were generated from Qualtrics, and further analysis was done in Microsoft Excel.

Martiskainen, (2017) agrees that before survey distribution, community sensitisation, comprehensive workshops, seminar sessions with agencies and technocrats, as it is important to conduct an in-depth analysis of community case studies to assess the grassroots perspective on sustainable community recovery. This approach was implemented for this study. The purpose of the survey questions is to inquire about the level of planning that has been done to prepare for post-disaster recovery, to ascertain the factors that influences recovery, and to build community resilience, making the community at the heart of the study (Civil Defence Emergency Management Groups, 2019), and creating a sense of ownership.

The online survey assessed: a. knowledge - the understanding of hazards (specifically HIWeather events) faced in the community, b. the awareness of disaster preparedness and recovery plans, c. preparation - community recovery scenario planning, d. planning – community recovery plan post-disaster. The survey was designed and developed using the Qualtrics software application. These were distributed online via each case study community's Facebook page with an embedded survey link attached to each post. Posts were made twice monthly from August to December 2022. The survey QR code was printed on flyers, handed out to residents at community meetings, street stall events, workshop sessions, in the town centres, on commercial properties and offices in each community. Survey flyers were left in local shops, and commercial places at each case study sites.

3.3.3 Field Reconnaissance

The field reconnaissance also allowed the researcher to build relationships and trust with the community that participated in the data collection. These relationships were honed through follow-up attendance at community meetings and field reconnaissance/community walk-throughs, connecting with residents via their community Facebook page, Telephone and Zoom check-ins to validate interpreted data gathered from residents. Trust was built through onsite field observations of affected properties, walk-through of debris sites, and conversations with affected residents (see Appendix 11.9 - fieldwork photographs 1-4). During the initial scoping interviews, community leads for both case study areas were willing to assist the researcher in advertising and promoting community surveys and community engagement events, such as community street stalls and workshops.

3.3.4 Street Stalls

The street stall community engagement method asked three open-ended questions to community members, with an opportunity to validate community hazard maps. Although the mixed method approaches were aimed at producing desired outputs in line with the research questions, there was room for a "goal-free" inductive approach (Thomas, 2006; United Nations Development Programme (UNDP), 2011). It was important to employ a participatory approach to stimulate dialog between the researcher and the local community to ultimately build relationships, allow the residents to participate in data collection experience (United Nations Development Programme (UNDP), 2011; Vallance, 2015; Joy et al., 2019; Srinurak and Sukwai, 2023) engage with residents to understand their recovery experience and discover the factors that influence recovery from high-impact weather events they experienced.

3.3.5 Community Workshops

Workshop facilitation aimed to define the elements and issues of recovery, recovery processes experienced and develop a community recovery plan. Persons involved were engaged community members, while the others were affiliated with local government. The rationale for this forum was to foster community ownership of the recovery plan.

For this research, both qualitative and quantitative research approaches were employed. A qualitative opportunistic approach (Vallance, 2015) was employed for some aspects of this research. This was mainly based on the researcher's involvement and experiences (I sat, walked, observed, and interviewed residents) 'wading around in the mud,' as suggested by Vallance.

The research conducted workshop activities (see Appendix 11.10 – workshop activities) where one clear objective was to identify factors that influenced the community's recovery post-disaster HIWeather event, directly addressing Research Question one. Here, the Hierarchical Decomposition System (HIDECS) (Alexander, 1962) methodology was employed to ascertain what factors influenced post-disaster recovery. It was used a mapping exercise to understand the depth of factors influencing recovery in both case study communities. See Appendix 11.6 and 11.7 for HIDECS mapping results. In this study, HIDECS was applied as a qualitative analytical framework to organise and interpret factors influencing post-disaster recovery. However, quantitative survey results were incorporated to support the identification, prioritisation and comparison of factors influencing recovery across the two case study communities. (Romm, and Ngulube, 2015) suggested that both qualitative and quantitative methods - explanatory, exploratory, convergent, embedded, and multiphase designs, are some common research designs that mixed methods researchers often use.

The overall results of employing these methods, approaches and techniques have contributed to the design and development of the Community-centric Recovery Umbrella Approach (CcRUA). This model was developed to address post-disaster recovery needs following a high-impact weather event in communities. This model acts like an approach that can provide operational guidance in coordination between the community and recovery authorities.

3.3.5.1 Hierarchical Decomposition System (HIDECS) Analytical Approach

To support the comparative analysis of factors influencing post-disaster recovery, this study used the HIDECS as an analytical framework. HIDECS is a structured decision-support approach that enables complex systems to be decomposed into hierarchical factors and sub-factors, allowing relationships

between variables to be systematically examined. In this research, HIDECS was applied to organise and analyse the factors influencing recovery identified through structured workshop exercises, with participants independently undertaking the mapping of factors that influenced their recovery.

This approach was useful; for examining how different recovery factors interact within community settings, and for identifying the relative importance of these factors, organised in themes: communication, preparedness, social capital, governance infrastructure and resource access. HIDECS was applied during the workshop and comparative analysis stages of the research, where community-derived factors were grouped, categorised in themes, assessed to support cross-case comparison between Kumeū–Huapai and Henderson Valley. The detailed application of HIDECS and its outputs are presented in Chapter 7, where it supports the identification of recovery priorities and development of recommendations for recovery planning.

3.4 Research Methods Aligned to Answer Research Questions

The study and the methods adopted in the research are designed to answer the research questions. For this research, I aligned the research methods with the research questions to illustrate the sequential exploratory mixed methods data collection process. The order of each activity was used to capture data from each case study community. Table 3.2 below explicitly shows the methodological coherence or order, moving from one phase to the next. It then deliberately explains the purpose of each phase, removing ambiguity about the design logic.

Table 3.2: Sequence of Research Methods - Mapped to Research Questions.

Sequential Phase	Method / Activity (as implemented in this study)	Data Type	Purpose	Research Question(s) (RQs) Addressed
Phase 1	Strategic Targeting Methodology (STM) – interviews and conversations with recovery authorities; online research	Qualitative	Identify vulnerable communities exposed to HIWeather events; define study scope	Sets the contextual scene for all Research Questions (RQs), supports study framing, and informs case selection
Phase 2	Case study community selection (guided by recovery authorities and desktop research)	Qualitative	Select appropriate case study communities using STM criteria	RQ3, and overall, supports the contextual foundation for all RQs
Phase 3	Literature review themes explored, and gaps identified	Qualitative (secondary data)	Identify conceptual gaps and inform the scoping interview focus	RQ1, RQ4
Phase 4	Community stakeholder interviews were conducted in case study areas	Qualitative	Explore lived recovery experiences and factors influencing recovery	RQ1, RQ3
Phase 5	Scoping interview transcription and analysis using NVivo and manual coding	Qualitative	Identify emergent themes from interview data	RQ1, RQ3

	a) Transcripts printed, displayed, and manually coded	Qualitative	Deep familiarisation with data and theme refinement	RQ1, RQ3
	b) Survey questions developed from interview themes	Quantitative instrument design	Translate qualitative themes into measurable survey items	RQ1, RQ3, RQ4
	c) Survey tested and published via community social media, flyers, and engagement events	Quantitative	Capture broader community perspectives	RQ1, RQ3, RQ4
Phase 6	Field reconnaissance (snowballing to identify community champions; community walk-throughs)	Qualitative / Observational	Build trust; understand spatial and social context; identify affected and exposed sites	RQ1, RQ2
Phase 7	Street stall sessions (held at each community's supermarkets), including community mapping and validation exercises	Qualitative / Spatial	Validate hazard maps; capture informal community input	RQ2
Phase 8	Community engagement workshops (HIDECS mapping and validation exercises)	Qualitative / Participatory / Spatial	Build trust, facilitate collective reflection, and validate exposure and recovery priorities	RQ1, RQ2, RQ4

Source: The Researcher, 2026.

3.4.1 Harmonised Methodological Phases

In General, this thesis employs a mixed methods approach to holistically address the research questions (see Table 3.2). Figure 3.1 displays the methodological design, which shows how each phase informs and complements the other, from scoping interviews to the development of surveys. From field reconnaissance, including participatory mapping, street stall community engagement sessions, and community workshops. The approach integrates an exploratory sequential, mixed methods (qualitative, quantitative), participatory techniques, and case study approach to provide a multidimensional perspective. The literature shows that mixed methods research is well-suited for complex phenomena like post-disaster recovery, enabling triangulation, that is, combining different data sources to enhance reliability and validity (Bryman, 2006; Bazeley, 2009; Romm, and Ngulube, 2015).

It is important to show how methodological phases are integrated to strengthen research findings (Bryman, 2006; Ngulube, 2015). The methodological phases in this study, scoping interviews, surveys, field reconnaissance (participatory mapping), geospatial analysis, street stalls, and community workshops, were intentionally designed to support each other. Each phase informed subsequent stages of the research, creating a process that ensured robust findings. For example, findings from the scoping interviews informed and shaped the development and design of the online community survey. Also, the survey findings validated some of the discussions explored in the workshop sessions. Additionally, community members validated geospatial flood maps during the workshop, ensuring the hazard maps captured accurate and lived experiences of affected community members.

Here, results were triangulated across phases to integrate the approaches. This linkage ultimately informs and strengthens each approach. This reduces methodological gaps and enhances the overall rigor of the research. According to (Bazeley, 2009), effective integration in mixed methods research produces findings that are "greater than the sum of the parts," a core component of this study's design.

The key findings from these phases (Scoping interviews, surveys, community engagement sessions, and geospatial participatory mapping) pointed to the same conclusion: that effective recovery requires clear communication, collaborative partnerships, and active community participation. Integrating quantitative and qualitative methods reveals consistent patterns showing how community-led approaches can enhance accuracy and trust in recovery planning. By harmonising these phases, the research not only bridges gaps in the field but also provides actionable frameworks for future disaster recovery work.

3.5 Rigor: Reliability, Validity, Trustworthiness

This study undoubtedly adopted various strategies to ensure methodological rigour, drawing on established criteria for mixed methods as well as case study research, and triangulating multiple data source to understand the recovery phenomenon. Triangulation is one of the ways of enhancing rigor and trustworthiness in qualitative studies, and validity and reliability of quantitative studies (Ngulube, 2015). Rigour was addressed through credibility, dependability, confirmability, and transferability, alongside considerations of reliability and validity in the quantitative components of this study (Bazeley, 2009; Bryman, 2006; Ngulube, 2015).

Credibility was enhanced through triangulation across multiple data sources, including scoping interviews, survey responses, participatory GIS validation, field reconnaissance, street stall engagement sessions, community workshops, and document analysis. The recovery process was examined through multiple lenses reduced reliance on a single data source and strengthened confidence in the findings.

Dependability was supported by a clearly documented sequential exploratory research design, in which each methodological phase informed subsequent stages. The research approach is consistent across cases, because it uses a structured data collection process and rationale approach to conduct the case selection

Confirmability was addressed by maintaining stored documentation, both printed and soft copies of interview transcripts, NVivo coding outputs, survey instruments, and geospatial datasets. Findings were grounded in participant data rather than in researcher assumptions, supported by the integration of qualitative, quantitative, and spatial evidence.

Reliability and validity were addressed through the development of survey questions (quantitative component) informed by both the literature review and the scoping interview themes. This ensured that the content was valid by aligning survey items with empirically identified recovery factors.

3.5.1 Community Self-Report Bias and Mitigation

This study seeks to understand recovery from the community's perspective. Therefore, the data collected relied partly on self-reported data from community members. Thereby, the potential for self-report bias must be acknowledged. Participants' responses may have been influenced by limitations, emotional

stress and responses to past and or recent disaster experiences, or dissatisfaction with recovery authorities.

To mitigate the possible risks, self-reported data were triangulated with findings from participatory mapping, collectively validated, field reconnaissance observations (walk-through by the researcher), document analysis and geospatial validation from the myriads of activities, methods and techniques used to collect data. This means that these self-reported responses were cross-checked against other independent sources of evidence. For example, if respondents reported flood extents to a certain extent, these claims were visually validated in workshops.

3.5.2 Sampling Limitations and Mitigations

The survey was the most widely used data-collection tool in both communities. To collect survey data from the case study localities, a percentage of at least 40% of the total population would be an excellent response rate (Brewer et al., 2019). However, based on each community's population size and available community members who participated, took interest, and were willing to participate in data collection, they were well below 40% of the population for each community. I aimed to collect at least 10% sample size for each community.

A calculation was done to estimate the actual sample size per location (Survey Monkey, 2024). The Kumeū-Huapai community's total population at the time of data collection was approximately 3,432 people, according to the 2018 census. For Henderson Valley, the total population was approximately 1,440 people (Stats NZ, 2018b). A total of 108 responses were collected from August 2022 to December 2022: 46 completed responses from those who lived and worked in Kumeū-Huapai and 46 completed responses from those who lived and worked in Henderson Valley Community. For the Kumeū-Huapai community, with a confidence level of 90%, the margin of error was calculated to be 12.2%. In the case of Henderson Valley, the community with the same confidence level had a margin of error of 12%.

The remaining 16 responses were from respondents who are affiliated with the community. This means they handle business, enjoy recreation, and visit friends and family in the community. These responses were incomplete, and the respondents opted out of the survey, leaving some questions unanswered. It must be noted that these responses were not analysed nor used for this study

This low sample size may have resulted from political contention in the Kumeū-Huapai community, as residents were generally displeased with the Council's response. Residents mentioned that there were long delays in completing their floodway, the allowances for new developments in flood plain areas of the community, and slow response and action toward the community post-disaster August 2021 flood event. The disadvantage of being a rural community may have played a part in the low response rate for the Henderson Valley community. Also, the low response rate may be because of reluctance to complete a 30-question survey. Another factor may include that few people were actively on the community's Facebook page, which limited the survey's reach. Also, not many people were willing to complete an online survey. In some cases, the researcher had to assist residents in filling out the online survey by sitting face-to-face with residents to ask questions and then filling them in individually. Interestingly, all respondents who live and work in both communities and completed the survey were between the ages of 30-64, accounting for 73.81% of respondents. The respondents aged 30-64 comprise most of the workforce and may not have had enough time to complete the online survey, resulting in a low sample size.

To mitigate this, the street stall and workshop sessions were other instruments used to capture views and increase the sample size in each community. In Kumeū-Huapai, 30 participants participated in the street stall questions, while in Henderson Valley, 26 responded to the questions posted by the researcher. Residents interacted with recovery conversations and provided feedback based on the questions listed on the charts (see Appendix 11.8 and 11.9, Street Stall photographs). Once this was done, a workshop was held to allow the engagement and involvement of the community. Henderson Valley had a more significant participant number, totalling 12 people, while the Kumeū-Huapai community saw only six attendees. This led to each community's recovery plans being developed by the people for the people.

3.6 Ethics and Confidentiality

Human Ethics considerations were crucial to the data collection process. The data collection component of the PhD was evaluated by peer review, has been approved and deemed as low risk. (See Appendix 11.14) for the Ethic Approval report. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. Considering this, the ethical conduct is an integral part of this research due to its engagement with disaster-affected communities and the collection of personal experiences and realities of their recovery process. All participants were informed of the purpose of the research, the voluntary nature of their participation, and their right to withdraw at any stage of the data collection process without any consequence.

Prior to community engagement activities, consents were obtained from participants. Confidentiality and anonymity were maintained throughout the research process by removing identifying information from transcripts, survey datasets, maps, and reporting. Pseudonyms were used where required, and no individual participant or household was identifiable in chapter outputs. Transcript interview records were stored using pseudonyms and stored on an external drive that cannot be accessed by anyone except the researcher.

3.6.1 Detailed Community Engagement Procedures

Community engagement's foundation is first built on trust. I shared who I am and the purpose for conducting the research. I shared my interest in how communities have been affected by recent disasters and my aim to assist through research by collecting relevant data to guide recovery efforts. I assured the participants that the data being sought is intended to improve and build on the body of knowledge in post-disaster recovery, influencing how recovery authorities engage communities with similar recovery experiences.

The community engagement process was designed to foster strong relationships, minimise the burden on participants, and build trust. Initial engagement involved informal conversations, followed by scoping interviews, an online meeting, or an in-person meeting at their homes. Here, I was referred to other community members who could help share their recovery experiences and stories. Community champions, or gatekeepers, usually facilitated introductions to other community members or community groups who would be helpful in the research. This snowballing approach was culturally appropriate, as it served as an entry into each community and helped the researcher understand the local context before formal data collection.

Community engagement activities included community meetings with various community groups, street stall sessions, and workshops. Street stall sessions were conducted in public spaces. For the communities that were selected, these sessions were held in supermarkets to encourage informal participation and reduce barriers to engagement. Community workshops provided structured opportunities for collective discussion on recovery processes and its complex phenomenon, participatory mapping, and validation or recovery experiences and the creation of what their recovery plan would look like. Separate meetings were held with stakeholders and community members to avoid power imbalances and encourage open dialogue.

3.6.2 Data Handling and Cultural Considerations

Data collected throughout the study were securely stored on password-protected devices, external hard drives, and institutional services accessible to the researcher. Interview recordings, transcripts, survey data, and GIS datasets were handled in accordance with ethical approval requirements. Incomplete survey responses were excluded from the research analysis to respect participant consent and data integrity.

Cultural considerations were addressed by adopting a respectful, community-centred research approach. By this, I mean allowing the community participant to contribute their thoughts and data being collected, by keeping their needs, and the community's needs at the centre of recovery. The researcher remained attentive to local sensitivities, avoided extractive research practices, and ensured that participation did not exacerbate stress for communities already affected by the recent disasters. Findings were communicated transparently, and where appropriate, shared with community representatives to support reciprocity and accountability.

3.7 Data Management

3.7.1 Data Analysis

Document analysis played a crucial role in this research by providing foundational insights and contextual background data that complement primary data collection methods. The document analysis data feeds into the development of surveys and interviews and sets the stage for workshop discussion points. Notably, themes deriving from initial scoping interviews were researched and analysed as part of the academic literature used. The analysis included a thematic review of academic literature, government policies, recovery plans, and official hazard maps. This systematic approach allows for themes worth exploring in the research to identify gaps in recovery practices (Thomas, 2006), inconsistencies in hazard data, and relevant community recovery and resilience themes.

A thematic literature review synthesised findings from previous studies on post-disaster recovery. This particularly addressed literature on participatory mapping, geospatial technologies, communication, and community participation in post-disaster recovery. (Bazeley, 2009) notes that while systematic document analysis enriches mixed method approaches by providing critical background data, it enhances the unity of findings across phases. Official documents such as government policies and hazard maps were analysed using thematic coding to identify recurring patterns. The research findings from this approach informed the design and development of the survey and workshop activities (Ngulube, 2015; Romm, and Ngulube, 2015).

The study used ArcGIS 10.8 to analyse and depict a story about community exposure from a spatial perspective from HIWeather events. This tool was used in hazard mapping, asset exposure identification, and the creation of field site location maps. The tool was also used to detect and map the changes after an event and record and allow for the planning process of recovery (Environmental Systems Research Institute, 2021). Microsoft Excel was used to analyse quantitative data. Additionally, the General Inductive Approach was the preferred mode for analysing themed data gathered from workshops, seminars, and interview discussions; Thomas (notes that this method used a "systematic procedure that analysed qualitative data guided by specific evaluation objectives." This method suits the nature of the research, as capturing unplanned effects is crucial to the study's findings. Furthermore, the understanding of inductive analysis is in line with Strauss, and Corbin's (1998) description: The researcher begins with an area of study and allows the theory to emerge from the data" (p. 12).

3.7.2 Data Triangulation

Here, it is important to define triangulation. Bryman (2006) defines triangulation as the use of multiple methods or sources of data to cross-check the validity of findings in the study of social phenomena. It minimises inconsistencies in the findings by ensuring corroboration across multiple perspectives.

This thesis employed data triangulation across the various methodological phases. Triangulation also allows researchers to thoroughly manage aspects of a phenomenon and increase the amount of research data collected (Ngulube, 2015; Sarantakos, 2013). Data triangulation was employed to enhance the validity and reliability of the findings (Ngulube, 2015). For this thesis, triangulation was employed by linking the findings from document analysis, survey responses, geospatial analysis, community engagement sessions, and workshop discussions.

This approach enabled corroborating community-reported recovery experiences with spatial data and institutional documentation, reducing reliance on a single data source. Results from different sources are used to ensure robustness in the conclusions drawn (Bryman, 2006; Ngulube, 2015). For example, document analysis identified discrepancies in the official hazard maps. It was validated by feedback from affected community members during the workshop, street stall engagement sessions, field reconnaissance, and geospatial data analysis. Subsequently, the convergence of evidence across findings from the mixed methods and multi-case study approaches strengthened the credibility of the findings and supported a more comprehensive understanding of post-disaster recovery processes.

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STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

Student name:	ANNA-KAY SPAULDING-AGBENYEGAH
Name and title of main supervisor:	PROFESSOR REGAN POTANGAROA
In which chapter is the manuscript/published work?	CHAPTER 4

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Student: Planned,written, formatted and edited the chapter as seen fit.
Prof. Regan Potangaroa: reviewed chapter with no major concerns.
Prof Suzanne Wilkinson: reviewed chapter with no major concerns.
Dr. Julia Becker & Dr. Vivienne Ivory: editorial suggestions made. Offered recommendations for methodological effectiveness, especially how they compare to other methodologies used.
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4 CHAPTER: Using Community-Led Geospatial Method as a Decision-Support Tool in Post-Disaster Recovery Planning

Abstract

In New Zealand, Auckland communities are vulnerable to severe High-Impact Weather (HIWeather) events, which, over the last century, have already caused devastating impacts. With projected population growth comes increased exposure to people and their environment. In this chapter, I particularly focus on answering Research Question 2: identifying exposed assets (buildings, population, and road network) to plan for recovery. This helps us understand the assets exposed, prioritise and provide information for developing community recovery plans to promote sustainable communities and successful recoveries. However, this data must be validated by communities and recovery authorities to make sound decisions. This chapter investigates the exposure of and impact on the Kumeū-Huapai and Henderson Valley communities from a HIWeather event on 30-31 August 2021. Several weather incidents over the past few years have impacted these communities, caused severe inland and riverine flooding and damaged their infrastructure. The original maps used by recovery authorities to assess the extent of potential flood damage were outdated. Geospatial methods and analysis were used as a decision-support tool, along with community validation, to assess the exposure status of assets following the August 2021 event. The research aligns with Sustainable Development Goal 13, which encourages communities to take action to combat the impacts of climate change on their neighbourhoods. This chapter demonstrates how community-led validation of flood hazards footprints highlights the exposure of buildings, population, and road networks. This ultimately affects recovery prioritisation, resource allocation, and recovery planning decisions. The case study communities integrate exposure analysis with community validation through community engagement meetings, field reconnaissance, street stalls, and workshops. The outputs provide locally grounded, evidence-based inputs that can be used by recovery authorities and communities to identify assets exposed and plan for recovery actions under increasing climate-driven disasters.

Keywords: High-Impact Weather (HIWeather) events, geospatial methods, community assets, exposure analysis, elements-at-risk, community resilience, recovery planning, flood hazard footprint

4.1 Introduction and General Overview

Expanding the built environment in hazard-prone areas increases the number of assets exposed to the effects of climate change. Understanding built environment asset exposure to prevalent hazards is important to ascertain what is exposed and how the exposure can be mitigated (National Institute of Standards and Technology, 2016). Exposure concerns the local population, as they find their assets and themselves vulnerable (Oubennaceur *et al.*, 2019). Climate change has been affecting different regions of the world, including New Zealand, in different ways. New Zealand has faced more frequent storms and extreme events, including heat waves, droughts, fires, landslides, storm surges, and floods (Chappell, 2014; National Institute of Water and Atmospheric Research (NIWA), 2024; Trüdinger, 2024; UNISDR, 2011; UNISDR, 2008). Over the past decade, New Zealand has ranked among the warmest on record, with above-normal rainfall (>149% of annual normal) for parts of Auckland, resulting in 2021 being the warmest year on record, characterised by a number of extreme rainfall events (NIWA, 2024).

This chapter focuses on severe HIWeather events that cause flooding. In particular, the chapter examines the August 2021 West Auckland floods that affected Kumeū-Huapai and Henderson Valley communities. ArcGIS is used to analyse the exposure of key community assets, including buildings, population, and roads, to the flood event. The analysis integrates geospatial exposure mapping with a community-led validation process to identify discrepancies between originally mapped extents and those mapped by residents based on the impacts their community experienced. Through this approach, the chapter demonstrates how locally validated geospatial data can improve understanding of exposed assets and support more informed recovery and resilience planning decisions.

This chapter ultimately positions geospatial analysis as a decision-support mechanism for post-disaster recovery planning rather than as a technical GIS exercise. By combining exposure mapping with community-led validation, the chapter demonstrates how locally verified flood footprints improve the accuracy of identifying exposed buildings, population, and road networks. These validated outputs can support recovery decision-making, including prioritising affected areas, efficiently allocating recovery resources and informing community recovery planning.

4.1.1 How Vulnerable are Auckland Communities?

New Zealand faces increasing exposure to climate-related hazards, including severe storms, floods, landslides, and coastal inundation (Ministry of Civil Defence and Emergency Management, 2019; NIWA, 2024). The Auckland region, with its subtropical climate and complex river catchments (Wright *et al.*, 2009), is particularly vulnerable to intense rainfall events and flooding associated with HIWeather events. The World Meteorological Organisation defines HIWeather as a weather phenomenon that results in significant societal impacts, including damage to infrastructure, property and disruption of essential services (World Meteorological Organisation, 2021). Similarly, HIWeather events has been used in this chapter as an extreme weather event that caused significant loss of assets in the built environment, damage to property, and a major disruption to power, communication, and transportation (Ray *et al*., 2015).

Since the August 2021 Auckland floods, more HIWeather events have led to floods and landslips. Recent extreme weather events highlight the growing vulnerability of New Zealand communities. The January 2023 Auckland floods and Cyclone Gabrielle in February 2023 caused widespread damage

displacement, and infrastructure disruption across Aotearoa, about half of the country's population was affected, with approximately 10,000 people forced to evacuate from their homes, and at least six people died (McCabe, 2023). Research indicates that populated New Zealand catchments have a substantial probability of experiencing one or more of 1:150-year Average Return Intervals (ARI) in any given year NIWA, n.d.). Climate change is expected to intensify rainfall events as warmer atmospheric conditions increase moisture capacity, leading to greater flood risk for communities, infrastructure, and the built environment (Miguel, 2022).

In this context, understanding the exposure of community assets to flood hazards is critical for effective disaster recovery planning. This chapter examines the exposure of buildings, population and road networks in Kumeū-Huapai and Henderson Valley communities following the August 2021 HIWeather flood event and demonstrates how community-led geospatial validation can improve the accuracy of exposure assessments used to support recovery planning.

4.1.2 Study Areas

The case study locations are situated in West Auckland, Kumeū-Huapai, and Henderson Valley communities (Figure. 4.1). The case study locations' land-use is mainly comprised of peri-urban in Kumeū-Huapai, and semi-rural in Henderson Valley with lifestyle blocks, layouts of pastoral farming, large paddocks, plantation forest and some horticulture (Auckland Council, 2010; WSP, 2022). Both communities are located behind the Waitākere Ranges, with varied river catchments that include several tributaries. For Kumeū-Huapai, the Kumeū-Kaipara River catchment makes up the second largest river system within the Auckland Region, with the river channel running for approximately 65 km from Waitākere Ranges to the Kaipara Harbour near Helensville (Islam, 2022). For Henderson Valley, a considerable number of tributaries originate from the Waitākere Ranges, with its catchment having over 5 tributaries with the main Opanuku stream in its upper catchment (Auckland Council, 2010).

The case study locations near the river catchments have been exposed to floods. The most recent flood events occurred on 30 - 31st August 2021, 27 - 31st January 2023, and 13 - 14th February 2023. This chapter will only focus on the impact of the August 2021 flood event. The August 2021 flood event resulted in significant damage to mostly residential, agricultural, commercial, and light industrial areas (Miguel, 2022; WSP, 2022), with widespread asset damage. Residents reported flood heights in Kumeū-Huapai up to approximately 5 m and in Henderson Valley as high as 3 m. Most of the damage observed in these areas was due to the river bursting its banks from a series of blocked channel flow paths from landslides, leading to blocked stormwater drainage systems and road infrastructure. The flooding was exacerbated by overgrown and unmaintained river channels and other manmade influences affecting all assets within the flood extent.

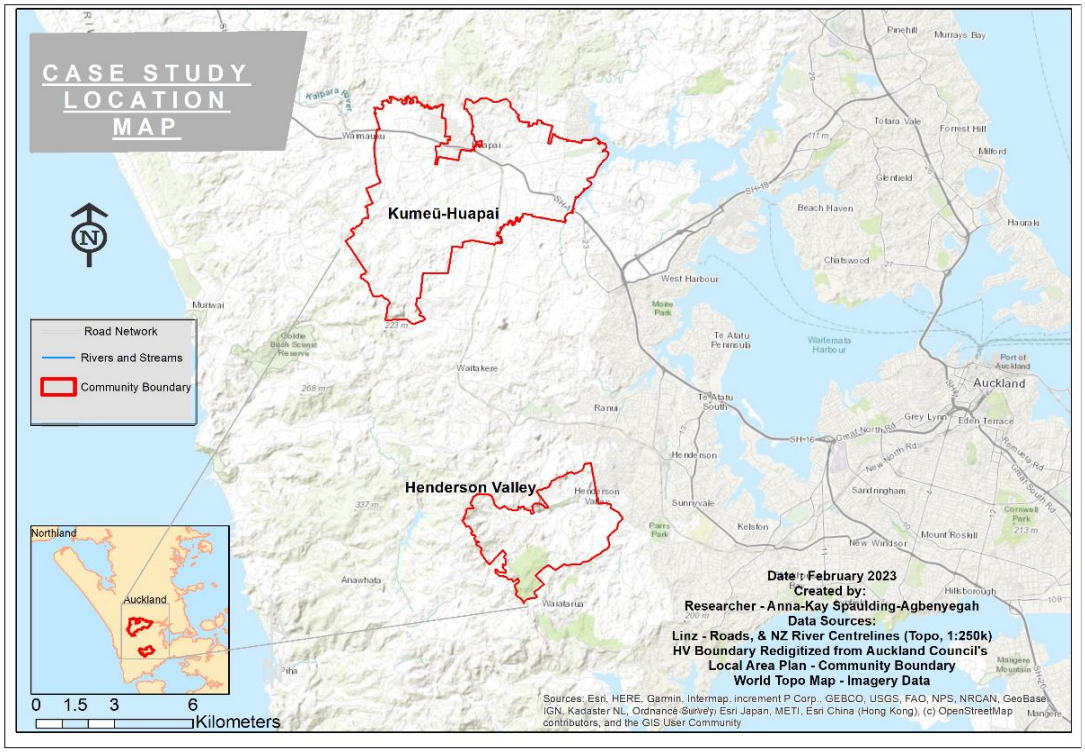

Figure 4.1 Case Study Communities (*Highlighted in Red Boundaries*) in the Auckland Region. Source: The Researcher, 2023.

4.1.3 The High-Impact Weather Event

On 30-31 August 2021, an extreme weather event from a low-pressure system resulted in a downpour of torrential rainfall associated with a low-level jet rapidly transported moisture toward Auckland from the Pacific Ocean (National Institute of Water and Atmospheric Research (NIWA), 2022). This caused over 12 hours of heavy rainfall and thunderstorm activity, leading to widespread flooding over the north-western parts of the Auckland region. West Auckland communities received 201mm of rain during a 14-hour period, with a daily total of 208mm of rain representing at least 149% of the normal August monthly rainfall at Kumeū between 30-31 August (National Institute of Water and Atmospheric Research (NIWA), 2022). This resulted in a considerable amount of flooding, which resulted from rivers bursting banks with significant debris from landslips upstream. This was accompanied by fallen trees, which caused infrastructure problems. The wind impacted communication in Henderson Valley, causing power loss for several days. The river bursts its banks and inundates roads, residential, commercial, agricultural, and light industrial zones in some areas in Kumeū-Huapai (Islam, 2022) and Henderson Valley (Miguel, 2022) communities. Approximately 400 homes were left without power, and evacuation centres were set up for those households forced to evacuate (National Institute of Water and Atmospheric Research (NIWA), 2022).

4.1.4 Building Resilience and Planning for Recovery Using Geospatial Technologies as a Decision-Support Tool

Geospatial information is critical for an effective and quick response to emergency management, especially flooding (Twumasi, Yaw A., Merem, Edmund C., Namwamba, John B., Okwemba, Ronald., Ayala-silva, Tomas., Abdollahi, 2020). Twumasi *et al.* (2020) further allude in their study that geospatial technologies play an important role in understanding various disasters, their outcomes, the damage they could inflict in an area, and to guide plans for disaster management response. Their study aimed to identify flow-prone areas in Southeast Louisiana using GIS technologies. The study's results were used to guide management and to provide parishes with the tools needed to plan for the predicted increase in flood events and mitigate their effects on the community. GIS also helps to identify exposed areas at risk easily (Al Saud, 2018). The vulnerability, risk, flood-affected zones, and attainable areas could easily be identified and mapped through the GIS tool (Pradhan *et al.*, 2022) . GIS is used as an effective decision-support tool that can be used to identify vulnerable assets and areas that are highly exposed to hazards. GIS enables mitigation and disaster risk reduction solutions (Codling, 2014). Importantly, the decision maker can prioritise where to respond, and the recovery needs of a community with such tool. Furthermore, this tool assists stakeholders in understanding how addressing risks can aid in efficient response and recovery processes to build resilience.

Research shows that using GIS technologies for community-based informal and formal networks catalyse protective, response, and recovery actions such as preparing for disasters and mitigating hazards and risks(Kwok *et al.*, 2018; Kwok *et al.*, 2019). It includes the preparation phase before an event to recover (Kwok *et al.*, 2019), re-building following the devastation, and adapting in an environment that will allow people to transition from the response to the recovery phase (Odiase, 2020).(Neeraj, 2021) describes resilience as the ability of a system to absorb, withstand, cope with, and successfully recover from a disaster event . Although resilience can be conceptualised as not just about returning to the former equilibrium state of vulnerability, but the opportunity provided by the disaster event system renewal and the formation of a new trajectory to meet current challenges (Odiase, 2020). The ability of a community to ensure a successful recovery begins with the ‘recovery planning phase’, which includes pre-disaster preparedness, mitigation, and recovery capacity building (Federal Emergency Management Agency, 2011). This involves the local knowledge of which assets are at risk and knowing flood-prone areas. Review of the literature show that there is a gap in information and knowledge on the use of geospatial technology as a decision-support tool to aid flood management (Glas, *et al.*, 2017; Twumasi, *et al.*, 2020).

4.2 Geospatial Exposure Analysis and Community-Led Validation Approach

This analysis involved two linked components: (1) exposure mapping of elements-at-risk- (buildings, population, and roads) (Kerle, 2016), using an initial flood hazard footprint, and (2) community-led validation to refine the hazard footprint based on lived experience and local observations. Exposure was defined as the spatial intersection between the hazard footprint and community assets (Office of Disaster Preparedness and Emergency Management (ODPEM), 2015; Westen et al., 2013). The purpose of this approach was to produce recovery-relevant, locally grounded estimates of exposed assets. The interaction between the elements-at-risk and hazard footprint defines exposure (Office of Disaster Preparedness and Emergency Management (ODPEM), 2015) (Figure 4.2).

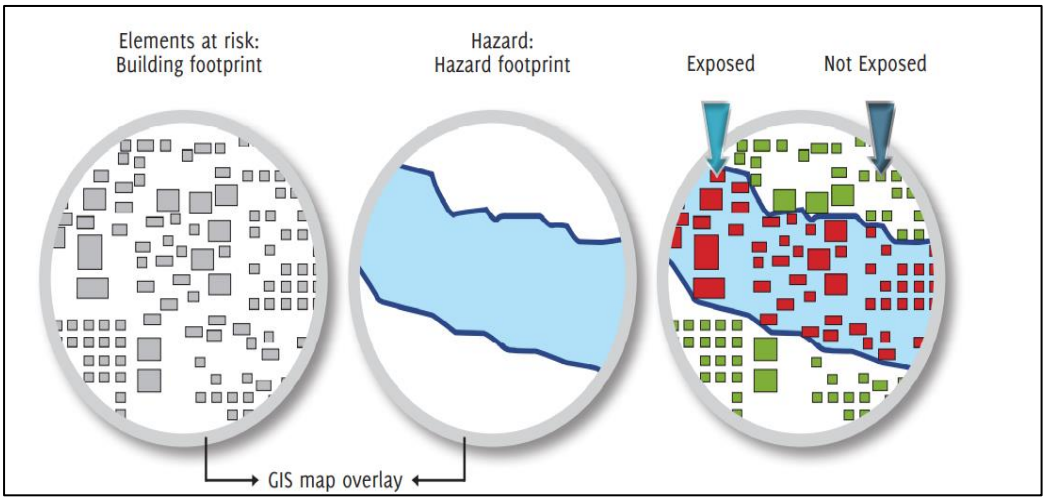

Figure 4.2 GIS Datasets Overlayed unto Flood Hazard to Determine Elements-at-Risk. Source: Reproduced from: (Westen et al., 2013).

4.2.1 Exposure Metrics and Data Sources

It is essential to define terms in this section:

- Flood footprint (hazards footprint): Original (AEM map-derived), and Validated (community-led, refined map)
- Buildings exposed: number of building footprints within the hazard footprint (LINZ building outlines)
- Population exposed: estimated population in residential buildings within the hazard footprint (assumption mentioned below)
- Road exposed: total road length (km) within the hazard footprint (LINZ roads)

Population exposure was estimated by multiplying the number of residential buildings within the hazard footprint by the average household size (Stats New Zealand, 2017). This approach provides an estimate that indicates a suitable form of planning-level decision-support. However, it does not account for multi-dwelling properties, variable household occupancy, or building stories, and therefore should be interpreted as an approximation rather than a census-equivalent measure.

4.2.2 Data Collection – Community-Engaged Hazard Footprint Mapping and Validation

First, the mapping method was followed by supplementary secondary data sourced from the locations of the flood and landslide hazards from a preliminary hazards map from Auckland Emergency Management (AEM) (Figure 4.3). It must be noted that the shapefiles for this map were not provided by the source to the researcher. The researcher later created the original flood footprint in step three below. This map was made available to the researcher six weeks post-disaster and produced mainly from reports of affected areas in West Auckland communities impacted by the August 2021 flood event. More detailed maps and reports were produced by the Auckland Council/AEM in Mid-year 2022 where flood information was provided by the public through photos and videos (WSP, 2022). For the scope of this chapter, this map shown in (Figure 4.3) was available at the time of the validation process and so it was used to derive the original flood footprint.

Figure 4.3 Small-scale Map of Areas Reported that were Affected by Flooding and Landslides in the West Auckland Region from the August 30-31 High Weather Event. Source: Reproduced from: Auckland Emergency Management Floods Map, Printed on October 15, 2021.

Third, ArcGIS 10.8 was used to georeferenced the original AEM small-scale map of areas in the Auckland region that were flooded by the August 2021 High-Impact Weather event. Once georeferenced and orthorectified, the AEM hazard map was overlayed onto the base topographic map within the areas of interest, and the flooded areas were then re-digitised from the original flood footprint to develop the original flood footprint shapefile. It is important to note that this flood hazard footprint refers to the past August 2021 flood event. Henceforth, the AEM boundary will be mentioned as the 'Original Flood Footprint'.

The fourth step involved validating the flood extent. The researcher used community validation in both case study locations. This was conducted through community-led approaches, including field reconnaissance, community meetings, street stall sessions, and community workshops. This approach aided in identifying the impact boundaries or hazard footprint. Validating the flood footprint involved overlaying the original flood footprint on each community boundary for both case study areas. A physical map was printed so that community members could identify the areas of interest within their community. The community then verified the extent of the flood that took place on 30-31 August 2021 using the original flood footprint as a baseline reference.

4.2.2.1 Community-engaged Mapping and Verification Process

With the aid of geospatial technologies, such as the TouchGIS mapping application, the researcher and community gatekeeper, along with other willing residents, mapped impact areas in the field. The affected communities then verified flood boundaries by pointing to the flooded location where the incident occurred. Community members highlighted the flood extent with a coloured marker on the printed map of their community (see Appendix 11.5). The affected community member also pointed to the height at which water levels rose.

Once the community member identified affected areas, the researcher mapped them on the TouchGIS application and verified with the community member.

TouchGIS was used to digitise field data, map and edit the collected data, then uploaded it to the ArcGIS. The ArcGIS software was used to retrieve the field data and visualise the maps. This was a similar approach used by Parajuli *and colleagues's work* (Parajuli *et al.*, 2020) for mapping hazards with community members in Nepal. Some community members drew on the community map to identify areas inundated or impacted by landslides. Similarly, this was done in two Ghanian communities – Tamale and Waa, using a community engagement mapping process, where residents participated in interactive mapping sessions, where map outputs were interpolated in ArcMap 10.8 (Ibrahim, 2024). Integrating local knowledge with focused mapping of the flood hazards within a community is usually a more accurate approach, where outputs can be shared with local authorities for advocacy and planning purposes to build resilience (Lunetta, Ross, and Lyon, 2004; Glas *et al.*, 2017; Oubennaceur *et al.*, 2019; Parajuli *et al.*, 2020; Ibrahim, Kuuire and Kepe, 2024). This approach usually meets important criteria for efficient and effective land use planning.

The researcher created community hazard maps for both case study areas, with the original flood footprint overlaying the community assets. These were first taken to community meetings, second to community street stall events, and third, workshop sessions for both communities to undergo a verification/validation process. For the Henderson Valley community, a total of 35 people, and for the Kumeū-Huapai community, 30 people from all three community engagement sessions contributed to the validation process of the flood hazard footprint. Residents and workers within the community contributed to the validation process by re-drawing the flood extent on the physical map over the original flood footprint with a marker and or highlighter.

The final step involved finalising the validated flood extent. After each session, the researcher completed the validation process and made the necessary changes to the boundary in the GIS application software to reflect the final community-led validated flood footprint. Contour data was collected and used to create the validated flood footprint. Contour data was collected from Land Information New Zealand LINZ (Land Information New Zealand, 2022b), and used to assist in further validation of the flood extent. This data was used to assess the topography of the land to aid in determining the extent of the flood boundary. Elevation is one of the most critical factors contributing to flood hazards; this is so because water flows from high to low elevations, and therefore, low-lying areas are prone to experience flooding (Gacu *et al.*, 2023). Contour data provides an understanding of the geographic distribution of the study location, which is an essential factor responsible for the occurrence of floods, and helps to map flood-prone areas (Al Saud, 2015). The Spatial Analysis geoprocessing feature was used to clip contours to the extent of the community boundary. This boundary can be referred to as the 'Validated Flood Footprint.'

4.2.3 Data Collection – Community Assets

In this chapter, there were three community assets and or/data sets that may be exposed to hazards that were collected via secondary sources. First, the buildings dataset comprising digitised building outlines were exported from Land Information New Zealand (LINZ) via aerial imagery available on the LINZ Data Service. The building dataset was last updated in June 2021(Land Information New Zealand, 2022a). This dataset shows the most recent set of building outlines in New Zealand. This was then

clipped to the extent of the community boundary to show only the buildings within the area of interest (AOIs).

Population data was identified by using the building dataset as the base data. Since the building dataset did not distinguish residential buildings, the researcher extracted buildings within the residential zones of the community. The number of residential buildings was selected in ArcGIS 10.8 and multiplied by the average household size for each community.

For the Kumeū-Huapai community, population data was derived from calculating the mean (household occupancy size for Auckland communities), which is 2.7 (Stats NZ, 2017), this number is then multiplied by the number of residential buildings exposed. The specific household size was unavailable for Kumeū-Huapai; hence, the average population household size for Auckland was used .

For Henderson Valley community, the same procedure was used , except that the average household size was 3.1 for this community (Stats NZ, 2017). This means that the exposed residential units were multiplied by 3.1 found within both the original and validated flood footprint to arrive at the population exposed. When the population data was overlayed on the hazard data, the population exposed was derived.

The road dataset was exported from LINZ (Land Information New Zealand, 2022c) into ArcGIS 10.8. The road layer involved an additional manual task of slicing the road sections within the flood footprint. Then the sections in kilometres (km) (length of the roads) were impacted.

Exposed assets using the validated flood footprint were cross-referenced with AEM original flood footprint, and the differences were noted in a tabular format (Table 4.1).

Table 4.1 Exposed Elements-at-Risk for each Community by the Flood Hazard Footprint (the Yellow Squares Highlight the Community-Validated *Flood Footprint Findings*).

Elements at risk exposed	Kumeu-Huapai Original Flood Footprint	Kumeu-Huapai Validated Flood Footprint	Henderson Valley Original Flood Footprint	Henderson Valley Validated Flood Footprint
Buildings	1605	889	263	404
Population	3871 persons	1,768 persons	815 persons	1,252 persons
Road	22.4 km	9.8 km	2.9 km	5.8 km

Source: The Researcher, 2023.

4.2.4 Data Validation

The flood hazard was validated through community engagement sessions. In the Kumeū-Huapai community, this flood boundary was amended and validated by the residents and workers of the Kumeū-Huapai community at community meetings, street stall sessions at New World Supermarket in Kumeū, and the Kumeū-Huapai workshop at the Kumeū Arts Gallery. In Henderson Valley, data validation on the community map was done at the resident Association meeting, at a street stall session in the Pak N Save supermarket, and at a workshop session held at the Henderson Primary School. These sessions were conducted from July through to September 2022 for both communities (Figure 4.4). The researcher then

made the necessary changes in ArcGIS to reflect the community's mapped perspectives. This approach is called participatory GIS (Bullen, 2024; Ibrahim, 2024; Joy, Jean., Gyan, Suresh., Univeristy, Vihar., and Kanga, 2019). Joy and colleagues describe the participatory GIS approach whereas the local community generates information on a physical map, and then their data is brought into a GIS software platform, like ArcGIS and re-mapped. When local knowledge information is integrated into GIS, it is called Participatory GIS (Joy *et al*, 2019). This approach has been applied in Ghanian communities in Tamale and Wa (Ibrahim, 2024), Karnali river basin in Western Nepal (Liu *et al.,* 2018), and Corbridge in North East of England (Rollason *et al.*, 2018).

Figure 4.3 Kumeū-Huapai Community Residents Identified and Verified the August 2021 Flood Extent from the Floods that Affected their Community. Source: The Researcher – Captured at the Community's Workshop.

Field reconnaissance was conducted to validate the flood areas that were affected. This was done by identifying the areas of flood and landslide impact that residents identified, and then the areas of impact were compared and validated (Lunetta, 2004) on a physical print community map and mapped via a GPS mobile application called "TouchGIS". Various land use areas were observed and noted during the field reconnaissance; residential buildings and commercial areas were cross validated on the field reconnaissance and noted on the physical map of the community.

To improve the accuracy of the flood footprint extent, this was cross-referenced with drone footage captured in the Kumeū-Huapai community, sourced from a resident. Drone image data was not available for the Henderson Valley community, so their data was mainly validated by the community themselves.

4.2.4.1 Community-led Validation Criteria and Discrepancy Resolution

Community-led validation was done to improve the accuracy of the flood hazard footprint and reduce reliance on unverified mapped outputs. This validation focused on three criteria: (1) spatial accuracy of inundation boundaries, (2) alignment with local knowledge (flood pathways, depths, and observed impacts), and (3) consistency across multiple participants and engagement forums. During community engagement sessions, such as meetings, street stalls, workshops, and field reconnaissance, participants annotated printed maps by re-drawing the flood extent over the original footprint using markers and highlighters.

Where differences occurred between the original footprint and community inputs. Discrepancies were resolved by prioritising convergent evidence across participants and sessions, supported by field reconnaissance observations and secondary verification (example., contour/topography interpretation and available drone footage for Kumeū-Huapai. This process reduces single-source bias and produces a validated footprint intended for recovery planning use.

Potential sources of bias include recall error, uneven participation across communities, and the possibility that highly affected residents were more likely to engage. However, these risks are mitigated through triangulation across various engagement forums, and by cross-checking mapped inputs against topographic constraints and available visual evidence.

4.3 Results

4.3.1 Flood Extent

The validated flood footprints for both sites differed significantly from the original (Figures 4.5 and 4.6). The original flood footprint for the Kumeū-Huapai community was 1152 hectares, shown in light blue, while the area for the validated boundary was 545 hectares, shown in dark blue in (Figure 4.5), decreased by a 54% difference from its original state.

On the other hand, the Henderson Valley Community experienced a slight difference between the original flood footprint and that of the validated flood footprint. The original flood footprint shown in (light blue) (Figure 4.6) was found to have a slightly larger area of 146 hectares than the validated flood footprint of 126 hectares, resulting in a decrease of 16% difference from its original state. Even with a smaller difference in flood coverage in hectares for the validated flood footprint, more assets were exposed to the flood hazard. The reason for this was that community assets were found within its extent.

These differences change the spatial basis for prioritising recovery interventions and demonstrate the planning risks of relying on unvalidated footprint data. This could significantly slow the recovery planning process, allowing efforts to be inefficient and untargeted.

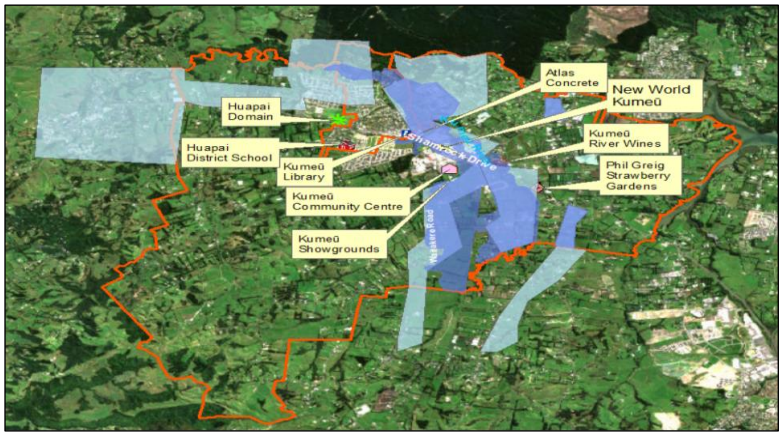

Figure 4.4 Screen Capture of Kumeū-Huapai Original Flood Footprint (Light Blue) versus Validated Flood Footprint (Dark Blue). Source: The Researcher, 2023.

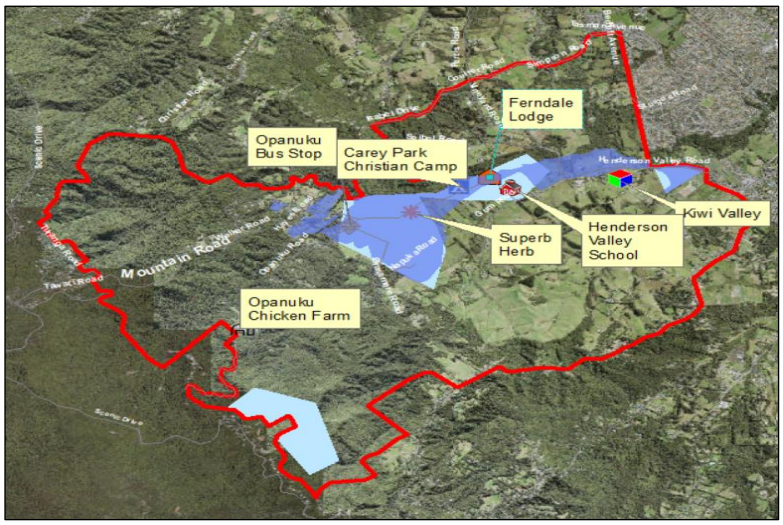

Figure 4.5 Screen Capture of Henderson Valley's Original Flood Footprint (Light Blue) versus Validated Flood Footprint (Dark Blue). Source: The Researcher, 2023.

4.3.2 Buildings Exposed

For the Kumeū-Huapai community, the total buildings were 8,010. Building exposure discrepancies were found when the source layer 'August Flood' event was overlayed under the building footprint. The number of building footprint assets at risk was found to be reduced, from 1605 buildings exposed in the original flood footprint to 889 exposed buildings in the validated flood footprint (Figure 4.7). This saw a decline in exposed buildings by a difference of 716, which marks a reduction of 44.6% for buildings exposed to the validated flood footprint hazard.

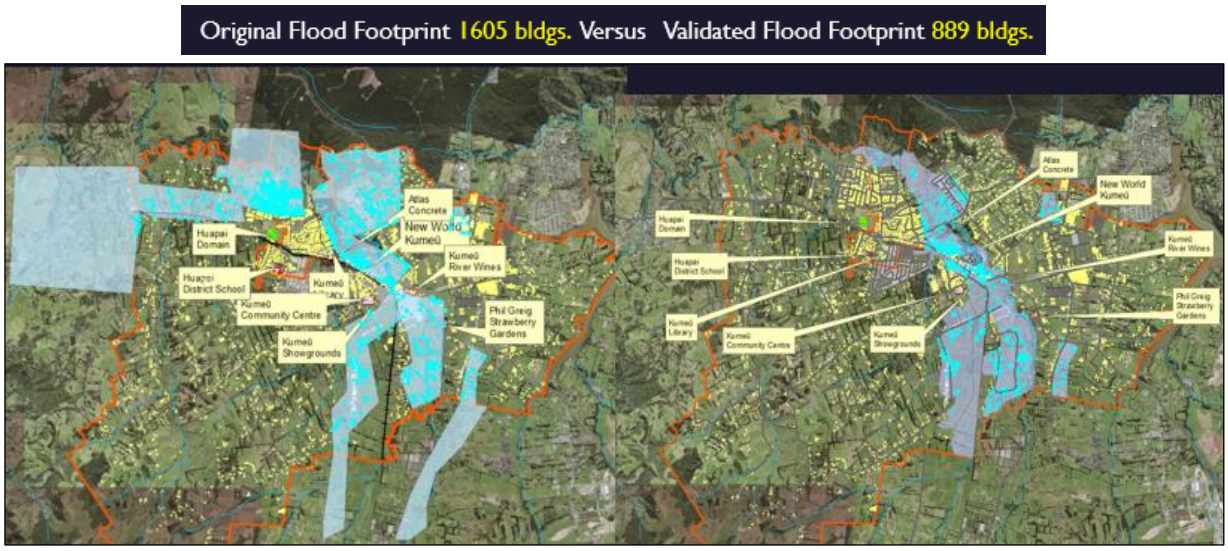

Figure 4.6 Kumeū-Huapai community - Building Assets Exposed to the Original Boundary (Shown on the Left-Hand Side) and Validated Flood Footprint (Shown on the Right-Hand Side) (*The Bright Blue Highlights are the Building Assets Exposed*). Source: The Researcher, 2023.

On the other hand, for the Henderson Valley community, the total building footprint was 1,318. There was an increase in buildings exposed when the validated flood footprint was overlayed under the building footprint dataset. (Figure 4.8) shows that the building footprint increased from 263 buildings when the original flood footprint was overlayed, an increase of 404 buildings exposed in the validated

flood footprint. The data showed that there were 141 more buildings exposed in the validated flood footprint than in the original flood boundary. This saw a 53.6% increase when the validated flood footprint was used to identify the exposed buildings at risk.

Updated building exposure estimates directly influence recovery actions. This influence, for example, targets property affected by the event (property assistance), prioritisation of infrastructure repair, and identification of high-impact zones.

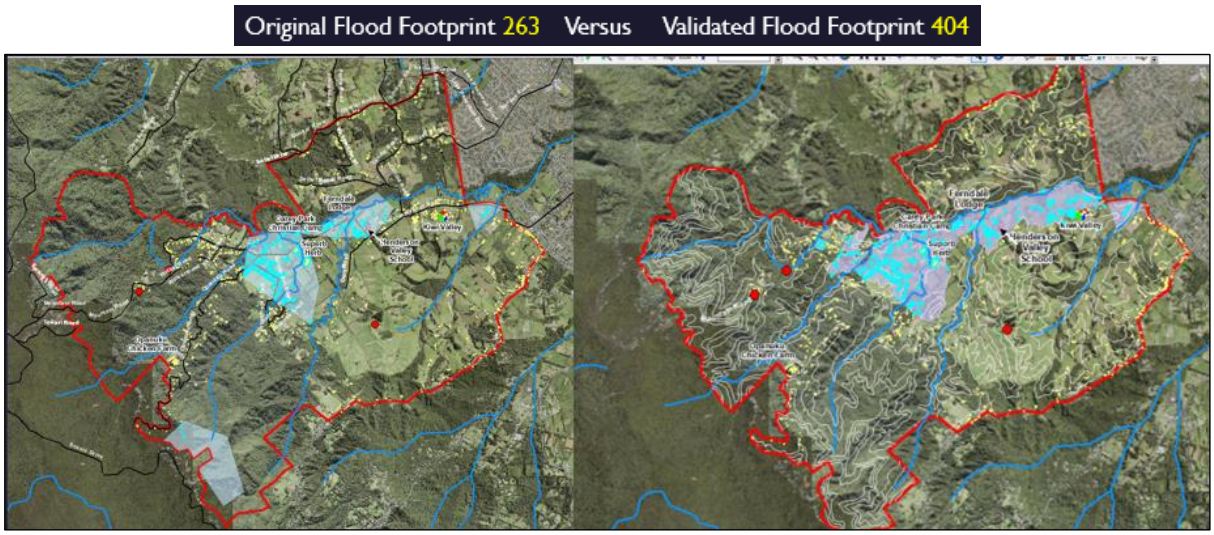

Figure 4.7 Henderson Valley Community - Building Assets Exposed to the Original Boundary and Validated Flood Footprint (*the Bright Blue Highlights are the Building Assets Exposed*). Source: The Researcher, 2023.

4.3.3 Population Exposed

In the Kumeū-Huapai community, it was identified that 655 residential buildings were exposed. The total population exposed was recorded as 1,768 people. The residential buildings exposed in the original flood footprint were 1434. This number was multiplied by 2.7, resulting in 3,872 population exposed using the original boundary. This showed a vast discrepancy in the original boundary versus the validated flood footprint, with a population difference of 2,103 people who were not exposed to the validated flood footprint data.

It was found that with the original flood boundary, there were 815 people exposed, while there were 1,252 people exposed when the validated flood footprint was used to identify the exposed population (Table 4.1). For this case, there was a vast variance in the population exposure when the validated flood footprint was used, with 437 more people exposed.

With validated data, recovery planning becomes more efficient and targeted. Revised population exposure provides an improved planning input for welfare support, targeted communications, and recovery service prioritisation.

4.3.4 Road Network Exposed

In the Kumeū-Huapai community, it was recorded that there were approximately 9.8 km of road network that was affected by the validated August 2021 flood event. With roads cleared within 0-7 days of the event. During periods of blocked and closed roads, alternate routes were used to adapt to the conditions.

A significant road network was affected, with approximately 22.4 km of roads exposed on the original flood footprint (Figure 4.9).

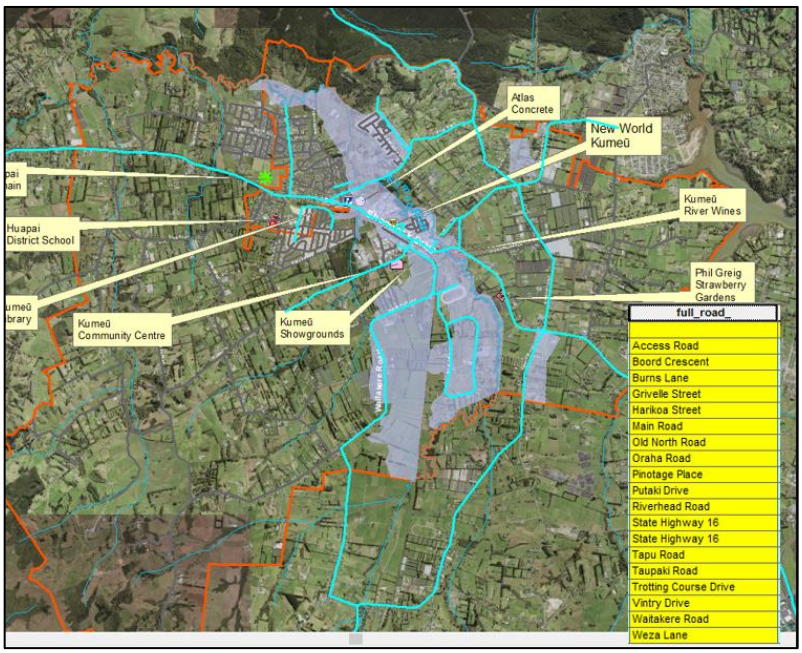

Figure 4.8 Kumeū-Huapai community - The Road Network Exposed when Overlayed with the Validated August Flood Footprint. Source: The Researcher, 2023.

In the Henderson Valley community, 5.8km of exposed road was associated with the validated flood footprint (Fig 4.10). Meanwhile, a 2.9km road network was deemed affected by the original flood boundary. For this community, a section of Mountain Road, called 'Upper Mountain Road,' was closed for approximately eight months post-disaster, as this was blocked by a slip, and the road had incurred damage. An alternate route was used until the road reopened, causing the residents many months of inconvenience and frustration.

This community-led, geospatially validated method helps recovery planning efforts identify roads exposed to HIWeather events. Road exposure estimates support prioritising transport access restoration, detour planning, and identifying critical access constraints affecting recovery.

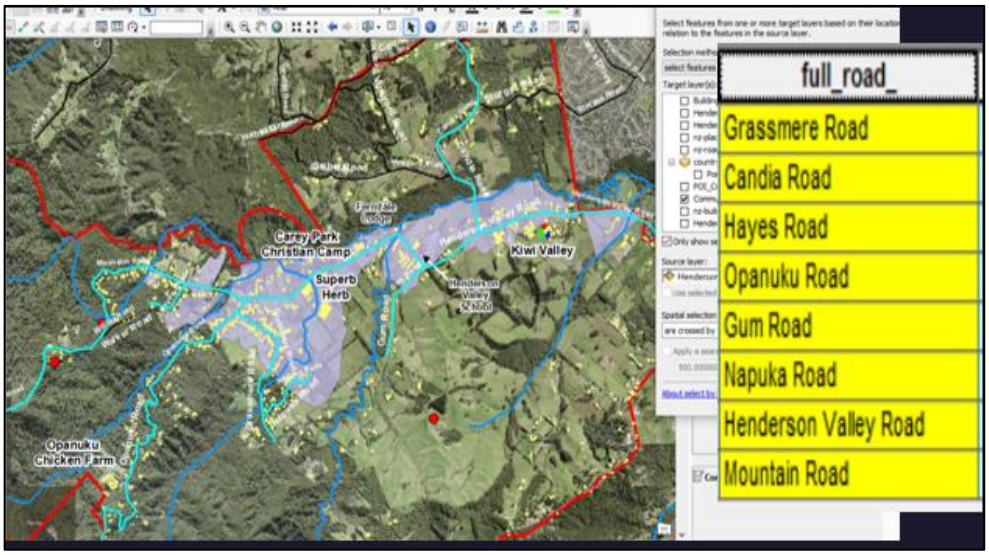

Figure 4.9 Henderson Valley Community - The Road Network was Exposed when Overlayed with the Validated August Flood Footprint. Source: The Researcher, 2023.

4.4 Discussion

The results showed variations in flood maps for buildings, population, and roads. Differences were found in the number of buildings exposed in the Kumeū-Huapai community compared to the original flood footprint used to assess building exposure during the August 2021 flood event. This was the same for population and road data exposed to the flood hazard boundary. However, Henderson Valley's exposed community assets did not see a large variance in the exposed buildings, population, and road network exposed as the Kumeū-Huapai community, however there were differences. The changes in exposure data may be because the original flood footprint was more of a 'mapped by reports of incidents' not verified on-site or validated by the community. Flood maps must be accurate because they are used to make decisions and mobilise resources post-disaster.

4.4.1 Using Geospatial Technologies to Identify Vulnerable Community Assets

The research findings provide a strong basis for integrating a wide range of geospatial data into ArcGIS software for greater visualisation (Codling, 2014). The tool is practical for capturing the extent (Pradhan *et al.* 2022), risk of flooding, and its impacts on the exposed elements at risk.

4.4.1.1 Integrating Reliable Data with Recovery Planning

Having reliable data when planning and mapping to identify exposed features is important for recovery planning (Codling, 2014; Paulik *et al.*, 2020; Alves, Djordjević and Javadi, 2021; Gacu *et al.,* 2023). Reliable data communicates and conveys accurate, objective, and complete information *(Khan et al.*, 2017). With access to accurate data, planners have a better understanding of High-Impact Weather events that face communities and allow for better decisions (Pradhan *et al.*, 2022). Recovery authorities and planners can utilise exposure maps to determine future flood risk priority areas and to plan flood mitigation management strategies (Gacu *et al.*, 2023). From the findings, it was evident that the methods of GIS tools could not only visualise the changes between the exposed data when compared to the flood extents but also provide the flood extents' measurements for each case study area. Measuring flood extents allows better planning to respond to people and places affected.

4.4.1.2 Building Better Recovery Stakeholder & Community Relationships to Improve Data Accuracy

The community-led validated flood footprint shows a more realistic flood pattern within the communities. This information can be used for more precise planning to identify those affected by flood hazards and helps planners such as land use planners, emergency management coordinators, and/or recovery managers/planners deploy the right amount of emergency management resources to those affected. To allow real-time interaction, there are various Web Map interface (Pradhan *et al.,* 2022; Auckland Council Geomaps, 2023) including ArcGIS Online Web-GIS programs that use smart mapping to guide data visualisation (Environmental Systems Research Institute, 2022) in the form of story maps (Planning, 2021; Water Resources Authority, 2022) that are available with dynamic maps of existing hydrological management and anticipating flood occurrences.

The original flood footprint data was mapped from a general area affected by the flood hazard. Illustrated original flood footprint data was not thoroughly verified at site locations, so due care needs to be taken before its use for post-disaster and or recovery planning (Auckland Emergency Management, 2021). Another limitation was that the original flood footprint map was produced as a small-scale map, which might have contributed to the vagueness and lack of precision in the original flood boundary. This was used as the researcher's base data for the flood extent, as no shapefile for the original flood footprint was available or provided. This allowed the researcher to geo-reference the original flood footprint and re-digitise the hazard extents from a small-scale map. The lack of details for the original flood footprint extent caused failures in the reliability of the data because some areas identified as exposed to flooding were inaccurate, which led to the inability of the community to identify exposed elements at risk precisely.

Recovery stakeholders must validate data by involving the community via community-based validation of flooding pre- and post-disaster events (Glas *et al.*, 2017; Rollason *et al.,* 2018; Ibrahim, Kuuire and Kepe, 2024), and ensuring that at-risk areas are accurately defined. Resources can then be allocated to help prepare for response and recovery from future events. Spatial data inaccuracy does not only lead to inefficient response (Codling, 2014), but the redundant spread of emergency relief resources.

In the future, more geospatial technologies and resources are needed to manage data accuracy better. For example, using drone technologies to undertake guided rapid post-disaster damage mapping (Kerle, 2016) and using GIS tools and engaging with residents for a realistic assessment of the impacts on community assets.

4.4.2 Decision Implications of Validated Footprints for Recovery Planning

Differences between original and community-validated flood footprints have direct decision-support implications for post-disaster recovery planning. First, changes in footprint area alter estimates of exposed buildings, population, and transport networks, which can affect how recovery authorities prioritise affected neighbourhoods and allocate recovery resources. Second, validated exposure maps support more accurate targeting of recovery assistance (for example, housing support, welfare services, debris clearance, and infrastructure repair) by identifying where exposure is concentrated. Third, improved footprint accuracy strengthens risk communication and recovery planning decisions with communities, enabling locally grounded recovery planning and advocacy with recovery authorities.

It is important to note that where the original footprint overestimates exposure, there is a risk of inefficient or misdirected allocation of limited resources. Conversely, when original footprints

underestimate exposure, recovery needs may be missed, leading to inequitable support outcomes. Community-led validation thus acts as an operational mechanism to improve the reliability of exposure datasets used for recovery decision-making.

4.5 Conclusion

This chapter explains that community-led validation of hazard footprints can ultimately alter exposure estimates and strengthen decision-support for post-disaster recovery planning. By integrating participatory validation with geospatial exposure mapping, the study produced locally grounded estimates of exposed buildings, population, and road networks in Kumeū-Huapai and Henderson Valley following the August 2021 HIWeather flood event. These outputs can inform prioritisation, resource allocation, and community recovery planning, particularly as climate-driven flood risks intensify.

The chapter highlights the usefulness of the ArcGIS tool in creating a visualisation for community-specific inundation maps that reveal exposed community asset data. It shows a useful planning and hazard mitigation tool that emergency management stakeholders can use to plan and manage HIWeather events that lead to disasters (Satheesh, 2008). This chapter looked at how the use of spatial analysis using geoprocessing tools assisted in identifying valuable data that decision-makers can use to highlight vulnerable sites, impact, and exposed areas and plan for operational response.

When several factors are involved, flood hazard extents are deemed reliable, accurate, and valuable. One main factor explored in this chapter was the reliable use of geospatial data for analysis. With this data, one can visualise critical community assets exposed, including the local population and the built environment (Oubennaceur *et al.*, 2019) at risk of hazards (Codling, 2014) and plan to manage potential hazards before events. A community with quality and reliable spatial data can be less vulnerable to potential hazards (Glas *et al.*, 2017). Locals who play a key role in validating hazard data results in greater accuracy of the extent of the flood boundary (Islam, 2022). The community is well-positioned to identify the issues that affect their community and use tools to plan for hazards to mitigate future events that drive preparedness, greater recovery (WSP, 2022) and community resilience (Vallance, 2011). Community validation of GIS data was proven helpful to these case study communities and assisted the local population in understanding their risks, visualizing assets exposed to the flood hazard, and using the data to plan for future hazards.

Educating communities about their exposure helps them make the necessary improvements for their exposed community assets. With partnership and collaboration between recovery stakeholders and the community, disaster preparedness solutions can be discussed to reduce exposure to the community and its infrastructure.

A potential limitation of this study pertains to the building shapefile acquired (Land Information New Zealand, 2022a). The shapefile did not have building typology data within its attributes or include story levels. One's level of exposure depends on the story levels of a building. This means that assets can be moved to a higher story to reduce exposure to possessions. Furthermore, having this information would have allowed greater appreciation of the extent of damage each unit experienced by classifying exposed buildings according to their risk levels (Office of Disaster Preparedness and Emergency Management (ODPEM), 2015). Additionally, the building shapefile did not include land use data. However, the researcher verified land use data and noted the residential areas on the physical map, which

was then incorporated into the ArcGIS 10.8. The researcher verified this during observation while conducting the field reconnaissance.

Another limitation is the use of the raw road shapefile (Land Information New Zealand, 2022c), which should not be considered topographic, cadastral, or legal, as the centreline does not provide actual road information. Desktop research on Google Earth Pro and field validation was done to verify the road names within the community boundaries. The highlighted roads' exposed centrelines extended beyond the flood extents; this is unavoidable, as they are line segments, making it time-consuming to measure the exposed length of the road segment.

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STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

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Student name:	ANNA-KAY SPAULDING-AGBENYEGAH		
Name and title of main supervisor:	PROFESSOR REGAN POTANGAROA		
In which chapter is the manuscript/published work?	CHAPTER 5		
Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1] Student: Planned,written, formatted and edited the chapter as seen fit based on supervisory recommendations. Prof. Regan Potangaroa: reviewed and concurred with the community engagement methodology used in the chapter. Prof Suzanne Wilkinson: reviewed and concurred with methodologies used in the chapter. Dr. Julia Becker: reviewed earlier versions and provided feedback on the methodologies employed in the paper. Dr Vivienne Ivory: reviewed earlier version of the paper and provided feedback for improvement where necessary.			
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5 CHAPTER: A Case Study of Kumeū-Huapai, Auckland, New Zealand

Abstract

This chapter examines post-disaster recovery challenges and future recovery options in Kumeū-Huapai, Auckland, New Zealand. This was one of the worst storms the community had experienced since August 2021, with precipitation of over 200mm within 24 hours. The event caused extensive flooding that damaged the community's assets and infrastructure. Drawing on data from interviews conducted by the researcher, survey responses, street stall sessions, a community workshop, and document review, the chapter analyses the factors that influenced recovery from the community's perspective and measures residents considered as crucial for future recovery planning. The study identified various recovery challenges and subsequent options to recover post-disaster. The studies show that recovery was shaped by weak communication, limited collaboration between the community and recovery authorities, insufficient preparedness and mitigation, and the absence of a community recovery plan. The chapter further highlighted communication breakdowns, governance ambiguity, and resource-related concerns that eroded trust and slowed recovery. Community participants identified improved warning systems, stronger community and recovery authority partnerships, practical mitigation actions and the development of a community recovery plan as key measures for fostering resilience and improving future recovery options.

Keywords: communication and engagement, post-disaster recovery, community expectations, recovery authorities' responsibilities, community recovery plan

5.1 Introduction

Kumeū-Huapai is a peri-urban community located in North-West Auckland, which sits within the Kumeū River catchment, with a large portion of the town located in the floodplain (Our Auckland, 2025). The community has a long history of exposure to high-impact weather (HIWeather) events[2] (World Meteorological Organisation, 2021), including significant flood events in 2021 and 2023.

This case study focuses specifically on the August 2021 flood event, which caused widespread damage to buildings, properties, infrastructures, and community assets. The recurrence of HIWeather events, which leads to flooding in recent years (see Table 5.1), shows the community's ongoing vulnerability to hydrological hazards.

This chapter addresses Research Questions 1 and 4. Research Question 1 examines: What are the factors that influence post-disaster recovery from the community's perspective? Research Question 4 considers: What measures are needed to address the concerns and challenges faced by the Kumeū-Huapai community in disaster recovery?

In addressing these questions, the chapter subsequently uncovers (1) the community's expectations regarding recovery roles and responsibilities versus the legislated responsibilities of recovery authorities (at the local, regional, and national government levels). (2) The community's perspective regarding the communication that existed before, during, and after the HIWeather event. (3) effective recovery options from future events.

5.2 Case Study Context: Kumeū-Huapai

Kumeū-Huapai is categorised as a growing, peri-urban community with approximately 3,432 people, a male population of 48.6%, and a female population of 49.7% between the ages of 30 – 64 (Stats NZ, 2018a). According to the 2018 census, 64.8% of people living in Kumeū-Huapai were employed full-time. It is worth noting that the population more than doubled over the course of 12 years, growing by 147.6% from 2006 to 2018. This may be attributed to new developments mushrooming in the community.

The community's population composition consists of a greater number of its people in the working age group. This is a positive indicator for accelerating recovery and resilience of the community, whereas the working class may act as a safety net to support its vulnerable age groups. Although this may be the case, essential provisions should be made for the vulnerable groups within the community (Civil Defence Emergency Management Group, 2019), should be included in emergency plans. During data collection from November 2022 to December 2023, this community did not have an existing emergency or recovery plan. National Institute of Standards and Technology (2016) asserts that having functional key infrastructure systems supports community restoration and helps care for the vulnerable population, enabling the community's economy to recover and thrive. Kumeū-Huapai community is vulnerable due to the community's assets' closeness to rivers, it sits within flood plains, and the frequency of events that impact the community within a century (see Table 4.1, Table 5.1). Additionally, it is considered vulnerable because there are insufficient mitigative solutions and poor maintenance of river

[2] High-Impact Weather (HIWeather) is a term defined by the World Meteorological Organisation (WMO) as a complex weather-related phenomenon that by its impact have caused losses in society, to people and infrastructure.

channels and drainage systems in the community. Furthermore, the community is considered vulnerable because there appears to be inadequate Council planning and engagement with the community in preparing for recovery post-disaster (Bush International Consulting, 2023). Vulnerable assets include the population, commercial buildings and properties, residential areas, communication systems, transportation, water, wastewater, and energy systems.

Seven months post-disaster, residents' homes were still unfit to reoccupy, some vehicles were not yet replaced by insurance, and businesses were permanently shut following the flood. With more frequent storms, more extreme floods are expected (Ministry of Civil Defence and Emergency Management, 2019),and vulnerable communities like Kumeū-Huapai will continue to be impacted by future HIWeather events.

Table 5.1 The Frequency and Impact of Major HIWeather Events on the Kumeū-Huapai Community Since 1988.

No.	Year	Period	Event	Impact
1	2023	Feb-13	Flooding from Cyclone Gabrielle	• People displaced • Roads, homes, and infrastructure flooded • Buildings, properties, vineyards, and paddocks flooded
2	2023	Jan 28-31 & Feb 1	Auckland Flooding	
3	2021	Aug 30, 31 & Sept 1	Upper North Island Weather event	• The Kumeū River burst its banks • Twin Coast Highway Oraha and Taupaki Road were flooded. State Highway 16 was impassible for eight hours • 50 -60 homes evacuated • Cars were damaged. Cars parked with water up to its windows. Some cars submerged • Farmland, homes, and properties flooded • Kumeū's main road and many of its shops were underwater
4	1988	July 17th	North Island Flooding	• Kumeū's river rose to 6m • Inundating floodplain areas and all assets within its path
5	1979	June 30th to July 1st	Upper North Island Flooding	• Kumeū's river bursts its banks • State Highway 16 between Kumeū and Helensville was closed due to flooding. • Houses, garages, and properties were flooded
6	1954	May 17th	Upper North Island Flooding	• Kumeū Railway Station property, in and around the community, was flooded
7	1936	February 1st	North Island Ex-Tropical Cyclone	• Orchards flooded and suffered serious damage. • Huapai orchardists were affected, with 90% of fruit shook to the ground, costing individual orchardists from ($20,200 - $50,500 dollars)

8	1934	June 18th	Upper North Island Flooding	• The worst flooding appeared to be between Kumeū and Waitākere • Post office flooded • The Taupaki road in Kumeū was covered with water to a depth of 4 ft (1.2 m) • Floodwaters from the Kumeū River swept rapidly over the low-lying lands in the Waimauku district.
9	1928	July 22nd	Waikato and Auckland Flooding	• The Kumeū River rose considerably to flood the main north road to a depth of 5 ft (1.52 m).
10	1926	May, December	Upper North Island Flooding	• The flood rose 12 in (30 cm) at the post office • Between Taupaki and Kumeū, the railway line was washed out

Source: The Researcher - Compiled News Reports, Residents' Interviews, Observations Post-Disaster Event, NIWA Hazards Database.

On August 30-31, 2021, a severe HIWeather event occurred in Auckland, affecting of Kumeū-Huapai (Figure 5.1) and neighbouring communities. From the residents' account, the impact of the August 2021 flood event was devastating (see Table 5.2). Most roads, homes, and flooded buildings were recovered within approximately six months post-disaster, while others were still recovering.

Recovery is dynamic with high degrees of complexity, (Civil Defence Emergency Management Group, 2019) mentioned that recovery has a long tail. This was the case for the affected community. One year post-disaster, some debris was identified within the corners of the river channel. Some victims of the flood had to relocate to another building; others had alternative units on their property that were at higher elevations and were not affected. Others rented another property or stayed with friends and family until it was safe to relocate into their homes.

The scoping interviews and online survey revealed that some people took longer than one year to recover, as most were still finalising repairs and rebuilding damaged assets. As such, interviewees mainly focused on short- and intermediate-term recovery. Some people's recovery took longer than expected due to the pandemic's physical and psychological impacts.

It must be noted that the flood event occurred under a level 4 lockdown in Auckland. Interviewed residents mentioned that businesses struggled to recover, and others had permanent business shuts. They noted that the impacts of the pandemic made their recovery slower and more stressful. Interviewees mentioned that tradesmen and carpenters were busy with other jobs and were affected by the pandemic and lockdown enforced in Auckland.

One resident mentioned, "for some businesses like cafes, they didn't have enough insurance, as flooding put them on edge, but COVID pushed them off!". According to the interviewees, most businesses did not have a recovery plan. Still, one businessman who was interviewed developed a business recovery plan a few months after the flood event with his employees to restore his livelihood.

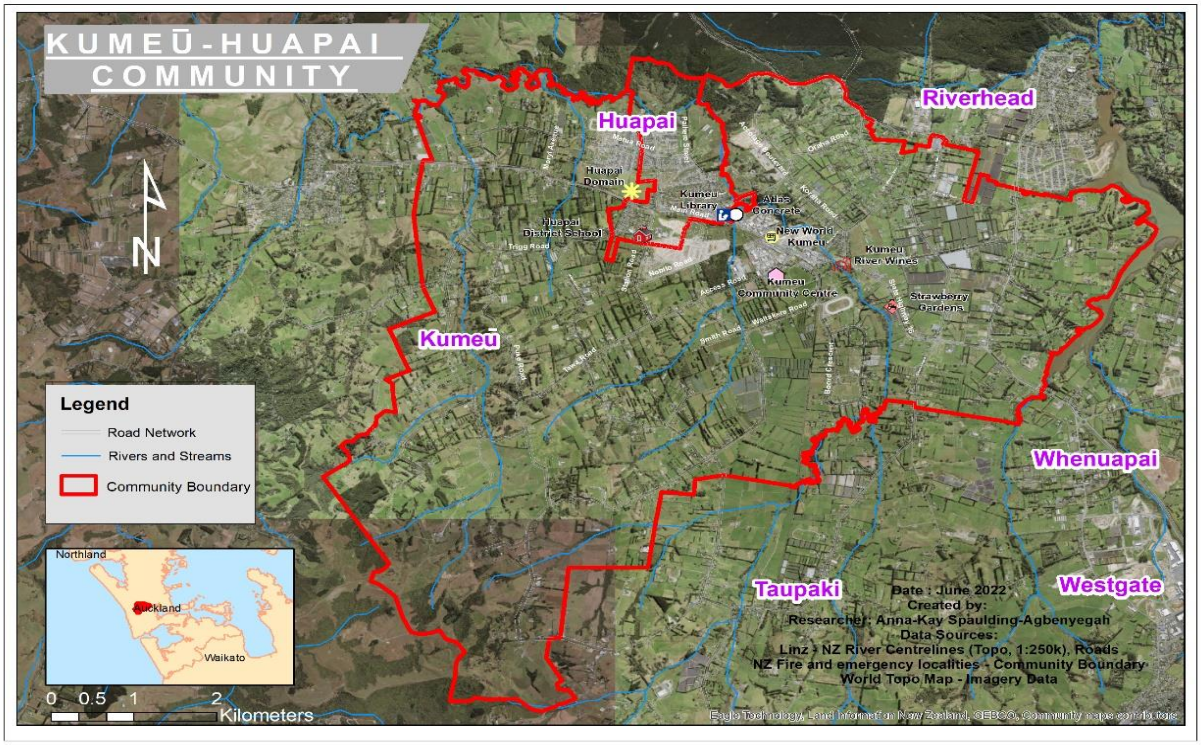

Figure 5.1: Map of Kumeū-Huapai Community. Source: The Researcher, 2022.

Table 5.2: Impacts from Flood Event – The Residents' Account

August 2021 Flood Event – Residents' Account	
Location	• Main Street Kumeū, Brood Cresent, Huapai, buildings and properties near the Kumeū river
Extent	• Flood water came from the stream and diverted to the railway track; water spilled over the railway track into the culverts under it. The culverts' capacity was too small to handle that much water. • The water went under the bridge at Kumeū and flooded roads, buildings, and businesses. • The floods in Kumeū are not just from Kumeū; it is from the rain from the Waitākere ranges which comes down to the Kumeū River. It is exacerbated by the big Kauri trees that fall, blocking the area and worsening flooding.
Impacts	• Water at chest height: 10 – 12 Trucks were damaged near Tree Scape. • In Huapai, all businesses next to the railway line were affected. • Business areas, 24-hour gyms, mechanic shops, a 40-year-old industrial estate – a cluster of businesses were all impacted.

Source: Compiled by the Researcher from Initial Scoping Interviews, 2021.

5.3 Research Methods

5.3.1 Mixed Method Approach

This case study adopts a mixed methods approach to examine post-disaster recovery in Kumeū-Huapai. This integrates both qualitative and quantitative data to provide insight into understanding recovery processes. Mixed method approach is recognised as an effective approach for investigating complex social phenomena, as it enables the combination of numerical trends with contextual and experiential insights (Creswell, and Plano Clark, 2017; Johnson, and Olshansky, 2017). In the context of post-disaster recovery, where social, institutional, and environmental factors intersect, such integration is valuable.

Here, the qualitative component comprises semi-structured interviews, community workshops, street stalls, and document review, which provide in-depth insights into community recovery experiences, perceptions of recovery, and expectations of recovery authorities. It is crucial to understand that qualitative methods are essential for capturing the lived realities and social dynamics of recovery, including issues of communication, governance and community engagement, which are often not captured through quantitative measures alone (Romm, and Ngulube, 2015; Yin, 2018).

The quantitative component is derived from survey data (Ngulube, 2015). This provides measurable evidence of community awareness, preparedness, and perceptions of recovery processes. Quantitative data support the identification of patterns and trends from the collected data within the study, which enables the findings to extend beyond individual experiences and contribute to broader analytical assumptions (Bryman, 2006).

One main strength of the mixed method approach lies in the triangulation of data sources, where findings from interviews, survey, workshops, street stalls and document analysis are cross validated to enhance the credibility and reliability of the research. Triangulation allows the comparison of multiple perspectives and aids to identify areas of convergence and divergence, therefore strengthening the robustness of the findings (Jupp, 2015; National Science Foundation, 1997)

In this chapter, I used a mixed method approach, which was operationalised through a thematic framework, where qualitative and quantitative data are integrated within key themes aligned to the research questions. Survey findings were used to support and quantify themes emerging from qualitative data, while qualitative information provide explanatory depth to the patterns observed in the survey results. This kind of integration is consistent with a convergent mixed method design, where multiple data sources are brought together during analysis to produce a more comprehensive understanding of the research problem (Creswell, and Plano Clark, 2017).

This integrated approach enables a nuanced analysis of the factors influencing recovery, the challenges encountered, and the measures required to improve future recovery outcomes, while supporting interpretation through the lens of recovery effectiveness and efficiency.

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5.3.2 Data Sources and Techniques Used

A mixed method, case study approach was used in this study for a comprehensive context-specific understanding and explanation of the nuances of the case under study (Piekkari et al., 2009). According to (Stallings et al., 1988; Saunders et al., 2009) the triangulation method[3] is often used in case studies to triangulate multiple sources of data to tell the same story. To enhance rigour and trustworthiness in qualitative and quantitative studies, the triangulation method is a useful research approach (Ngulube, 2015). A triangulation approach was used to gather data about the recovery in this community. The Triangulation research used five data collection techniques: (1) scoping interviews, (2) online community survey, (3) street stall, (4) community workshop and (5) internet research and document reviews.

5.3.3 Scoping Interviews

Scoping Interviews were done with five affected residents from the Kumeū-Huapai community. Often, local people are not involved in input into emergency management research, so grass-roots sources are needed (Gjerde, 2018) for a more inclusive approach. The researcher found a resident impacted by the August 2021 event via internet search who was willing to participate in the initial interview. Then, a community champion was contacted to participate in the subsequent interview. A snowball approach was then used to connect with other persons from the community who were affected by the event and were willing to participate in the interviews. These interviews were semi-structured and captured the recovery stories of the local people. Interview themes were developed and used as a baseline to determine the kind of questions that should be designed for the survey. Themes were decoded using NVivo software. The themes from the scoping interviews resulted in a thematic concept map that showed the community's perspective on options for recovery.

5.3.4 Online Survey

An online quantitative survey was developed based on the themes of all five scoping interviews. Additionally, themes from existing literature on recovery authorities' responsibilities and relationships between communities and recovery authorities were used to develop survey questions.

Seventeen people tested the survey: five residents in Auckland, five residents from the Kumeū-Huapai Community, another five residents from the Henderson Valley case study community who were affected by hazards in the past, and seven DRM experts. Once the online survey was finalised and validated, it captured data on 1) Knowledge of stakeholders' responsibilities, what to do, where to go, and whom to connect with after a disaster. 2) Community understanding of post-disaster recovery planning for future events and what recovery resources they know in their community. 3) Community ideas on recovery options for the future.

The survey was distributed on the community's Facebook page once every month for five months with a link to access the survey. Flyers containing a QR code were distributed at the community engagement events - street stalls and workshop sessions in Kumeū-Huapai. There were 30 questions in

[3] Triangulation method refers to using different data collection techniques within a study to tell different aspects of the study that you need to know (Ngulube, 2015).

the survey. There were 108 respondents, of which 46 respondents were from the Kumeū-Huapai case study Community.

5.3.5 Street Stall

A street stall session was hosted at a local supermarket in the Kumeū-Huapai. A visual board was set up with three main questions displayed at the supermarket entrance for community participants. This was done to find out (1) lessons learned post-disaster, (2) activities that can be done to fast-track their recovery, and (3) problems faced during recovery. Participants were asked to answer the questions displayed on the board anonymously. The participants wrote answers to the questions on Post-it notes and stuck them under the relevant questions. A total of 30 individuals participated in this activity. This method allowed the researcher to be interactive and capture views from different groups of people (Community Planning Toolkit, 2012) who might not have had the opportunity to complete the online survey? This approach was useful because it engaged and generated interest in the community's recovery issues. The data collected gave community perspectives and insights into the community's expectations from recovery authorities.

5.3.6 Workshop

A community workshop was conducted at the Kumeū Arts Centre. The workshop approach was used because (1) it allows people to discuss their thoughts and ideas in an open and relaxed atmosphere, (2) to obtain innovative thinking for a way forward on a proposed plan of action, and (3) it is a time-efficient way to meet hard to reach groups to discuss relevant issues, raise awareness on recovery experiences and talk about solutions at the local level (UNDP, 2011; Community Toolkit, 2012). There were six participants in attendance who all contributed to the workshop activities. The workshop was approximately two hours long and had four major activities. The workshop activities explored (1) The factors that influenced recovery using the HIDECs approach[4] (Alexander, 1962). (2) How well the participants understand recovery authorities' responsibility, obligations, and accountability post-disaster. (3) Could scenario planning be used to assist the community in planning for recovery? (4) What should their Community Recovery Plan (CRP) include? Activity two asked three questions: (1) who are recovery authorities accountable to? (2) what are the key obligations of key recovery authorities? and (3) What does partnership look like for community and recovery authorities' engagement? This approach, specifically for activity two, was done to understand whether the community is familiar with the legislated responsibilities and if they were communicated to them.

5.3.7 Internet Research and Document Reviews

Data collected on the impact of the HIWeather events, and recovery stories were captured from Council news, government reports and guiding policies, including the National Disaster Resilience Strategy (NDRS). Document review is an important aspect of any research done throughout the data collection process (Saunders et al., 2009; Ngulube, 2015). The documents used included those that were reported

[4] The HIDECS process was formulated by Christopher Alexander in 1962 as a way of breaking down inter-connected variables of an issue into a family tree structure. The HIDECs tool uses a set theory approach that inputs linked datasets that correlates between variables as mapped in the exercise, which then outputs the data as a "family tree" structure (Alexander, 1962).

on New Zealand emergency management legislation. They include the NDRS, the CDEM Act 2002, the Resource Management Act 1991, and legal statements from the Auckland Council's website. These documents were selected based on the research questions and literature themes, which concentrated on the legislated responsibilities at the national, regional, and local levels. The NDRS document was used to find methods for community and recovery authorities' communication and create partnerships with each other to allow for successful recovery. The Resource Management Act 1991 and the CDEM Act 2002 were used to determine recovery authorities' legislative obligations at the national, regional, and local levels.

5.4 Analytical Framework and Thematic Structure

This chapter adopts a thematic analytical framework to examine post-disaster recovery in the Kumeū-Huapai community.

5.4.1 Alignment to Research Questions

It is structured explicitly in alignment with Research Questions 1 and 4. Research Questions 1 focuses on identifying the factors influencing post-disaster recovery from the community's perspective, while Research Question 4 examines the challenges encountered and measures required to support effective recovery. In response, the analysis is organised into three thematic areas: (1) factors influencing recovery, (2) recovery challenges, and (3) recovery measures and options for the future.

5.4.2 Themes Identified for Thematic Analysis

The use of thematic analysis enables the systematic identification and interpretation of patterns across qualitative and quantitative data, facilitating a structured yet flexible approach to analysing complex social phenomena (Braun, and Clarke, 2022; Taylor-Powell, and Renner, 2003). In the context of disaster recovery, where multiple social, institutional, and environmental factors interact, such an approach allows for integration of diverse data sources while maintaining analytical coherence.

The themes presented in this chapter are derived from a triangulated dataset comprising interviews, surveys, street stall responses, workshops, and document review, which reflect recurring patterns across these sources. This approach supports analytical generalisation (Romm, and Ngulube, 2015), whereby findings are interpreted beyond individual accounts to reveal broader insights into the understanding of recovery processes (Yin, 2018). Importantly, the themes are not treated in isolation, but are analysed as interconnected dimensions of recovery, where factors, challenges, and measures collectively shape recovery outcomes.

For each thematic section, findings are presented using empirical evidence, including participant quotations and survey results, followed by an interpretation that explains how and why these elements influence recovery. This analytical approach aligns with the notion in disaster recovery research to move beyond descriptive accounts toward explanatory and critical analysis of recovery systems (Ashford, et al., 2020; Carrington, and Topp, 2023; Johnson, and Olshansky, 2017). Particularly, the analysis examines how community experiences reflect broader systemic dynamics, including institutional arrangements, governance structures, and resource distribution.

5.4.3 Establish Linkages

A key feature of this analytical framework is the explicit examination of communication, governance, and resource dynamics as cross-cutting influences on recovery. These dimensions are consistent identified in the literature as critical determinants of recovery outcomes, shaping both the coordination of recovery efforts and the distribution of support (Olshansky, 2012). In this chapter, these elements are not only analysed as challenges but also as factors that influence the effectiveness of recovery processes.

Additionally, the thematic structure aligns with the broader conceptual framing of this research, including the Community-centric Recovery Umbrella Approach (CcRUA) and perspective (see chapter 8), which emphasise the role of community knowledge, engagement, and partnerships in shaping recovery outcomes. By integrating community perspectives with institutional analysis, the framework provides a solid basis for understanding how recovery is experienced, managed, and improved.

In Summary, this analytical structure provides a coherent pathway for examining recovery in the Kumeū-Huapai community, ensuring that findings are systematically organised, empirically grounded, and critically interpreted in relation to both the research questions and the wider disaster recovery literature.

5.5 Factors Influencing Recovery

The analysis of the scoping interviews using NVivo produced a concept map (Figure 5.2) where the researcher identified key themes and factors influencing recovery from the perspectives of the Kumeū-Huapai residents. Four overarching themes were identified and analysed through thematic analysis: (1) communication and engagement, (2) preparedness and planning, (3) mitigation actions and environmental management, and (4) community-authority relationships between the residents and recovery authorities. These themes were derived from the findings in the Kumeū-Huapai community's concept map below and whereby forms the basis for the analysis presented in this section.

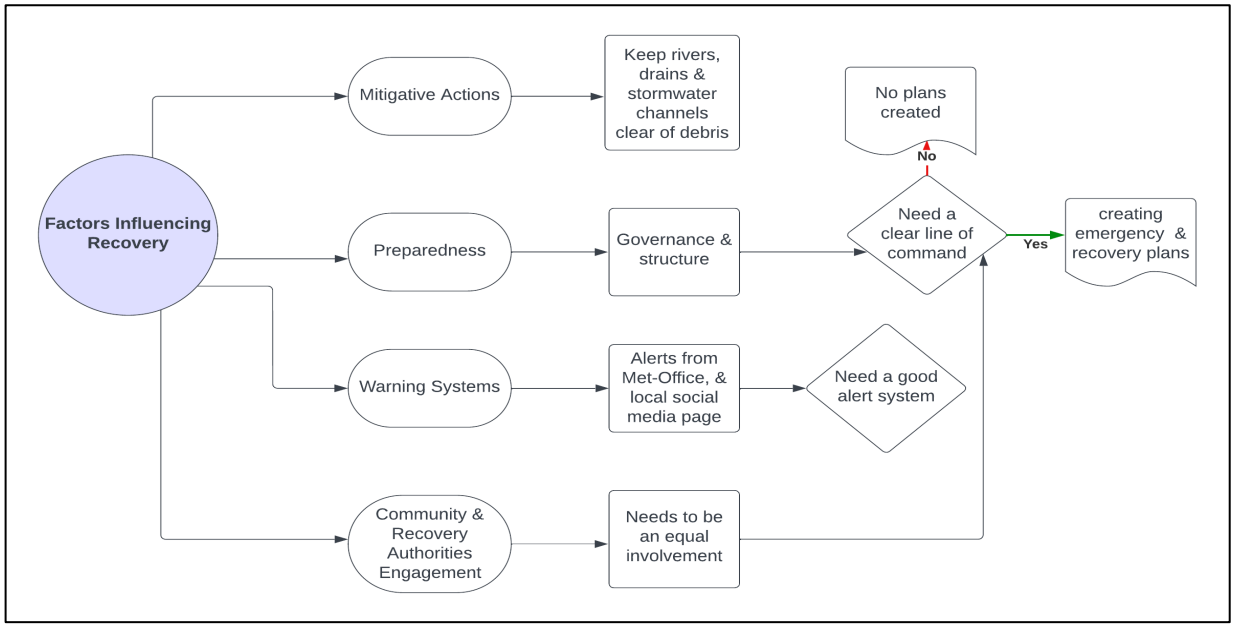

Figure 5.2 : NVivo Developed a Concept Map Showing the Community's Perspective on Factors Influencing Recovery. Source: The Researcher, 2023 - Kumeū-Huapai's Scoping Interview - Themes Identified.

From the perspective of this community, the concept map showed factors that would influence recovery and by identifying the main themes in oval-like circles: mitigative actions, preparedness, warning systems, and community and recovery authorities (Council) engagement. The rounded-edge rectangle-shaped boxes represent sub-themes that originate from the main themes. The common thread identified among these recovery factors was preparedness-related mitigation solutions and the development of a communicative relationship between the community and recovery authorities to plan for the community.

5.5.1 Communication and Engagement

Communication and engagement surfaced as critical determinants of post-disaster recovery in Kumeū-Huapai, influencing the community's ability to prepare for, respond to, and recover from high-impact weather events. Findings indicate that inadequate communication regarding an approaching event including what actions to take, where to seek assistance, significantly increases vulnerability, placing lives, properties, and community assets at risk. Evidence from interviews highlights the community's need for more effective warning and communication systems. One interviewee mentioned that,

> *"Community members are interested in: an early warning system, to rescue their stock, a lot of things that could have been done prior to the rains, such as where should families be taken,* who are you going call to get bedding for people?"

This reflects a broader concern that critical preparedness information was either unavailable or not communicated effectively to residents before the flood. Throughout data collection, residents consistently emphasised that communication from the Council needed to be strengthened, particularly before events. As one resident explained,

> *"The community should have been warned about the event in advance, but they were not, and that was not helpful. If proper warning were given to the community, then people would have had enough time to plan for the flood event."*

Table 5.3 further reinforces residents' dissatisfaction, highlighting gaps in institutional communication and in the response to the August 2021 flood event. These findings suggest that communication functions not only as an operational component of recovery but as a foundational factor shaping recovery outcomes. The absence of timely and accessible communication limited the community's ability to act proactively, contributing to avoidable losses and increased exposure risks.

This aligns with disaster recovery literature, which emphasises that effective, timely, and two-way communication is essential for reducing vulnerability, supporting preparedness, and enabling coordinated recovery et al., 2014; Doyle, and Becker 2022). Communication also plays a critical role in building trust between communities and recovery authorities, which is necessary for effective risk interpretation and collective action (Khan, et al., 2017; Vallance, S and Carlton, 2014). Where communication is absent or ineffective, mistrust can emerge, weakening social cohesion, which hinders recovery processes (Trüdinger, 2024; Vallance, 2011).

5.5.2 Preparedness and Planning

Preparedness and planning also emerged as critical factors influencing the effectiveness of post-disaster recovery in Kumeū-Huapai. The findings indicate that the absence of preparedness mechanisms – such

as early warning systems and community recovery plans, significantly constrained the community's ability to anticipate, respond to, and recover from the August 2021 flood event.

Evidence from the community engagement session highlights substantial gaps in preparedness. Residents' responses from the street stall session (see Table 5.3) indicate that, in the absence of adequate planning and warning systems, residents were unable to take pre-emptive actions to protect their assets, resulting in significant losses. Participants highlight that the lack of preparedness left them with insufficient time to respond effectively, particularly in flood-prone areas.

Interviews and workshop data further reinforce these findings, with residents consistently identifying the absence or the lack of a Community Recovery Plan (CRP) as one of the main limitations. Residents described that the lack of a community recovery plan increases confusion and the probability of loss. Participants mentioned that having a plan in place before the event occurs creates a less traumatic event, improve recovery outcomes by providing a clear course of action.

The absence of preparedness was also evident in the community's experience of the flood event itself. Resident reported that the sudden onset of flooding, combined with inadequate warning systems, resulted in the loss of irreplaceable personal assets, such as precious memories of family photographs. This suggests that existing warning mechanisms were either insufficient, localised, or lacked the clarity and urgency required to prompt timely action.

The survey showed that there was little to no preparedness for the Kumeū-Huapai community, in that, disaster emergency, resilience, or recovery plans, or resilience-related documents, were non-existent.

There were 33 respondents for this question, 'Are you aware of the following documents/ or plans in place for your community?' Figure 5.3 shows 31 respondents said that they do not have a Disaster Emergency Plan, while 32 respondents said that they do not have a Resilience Plan, and a Recovery Plan. On the other hand, only 2 respondents said that they have a disaster emergency plan, while only 1 respondent said that they have a Resilience Plan, and a Recovery Plan. The data showed that the community were not aware of an existing Emergency Plan, Resilience, and/or a Recovery Plan.

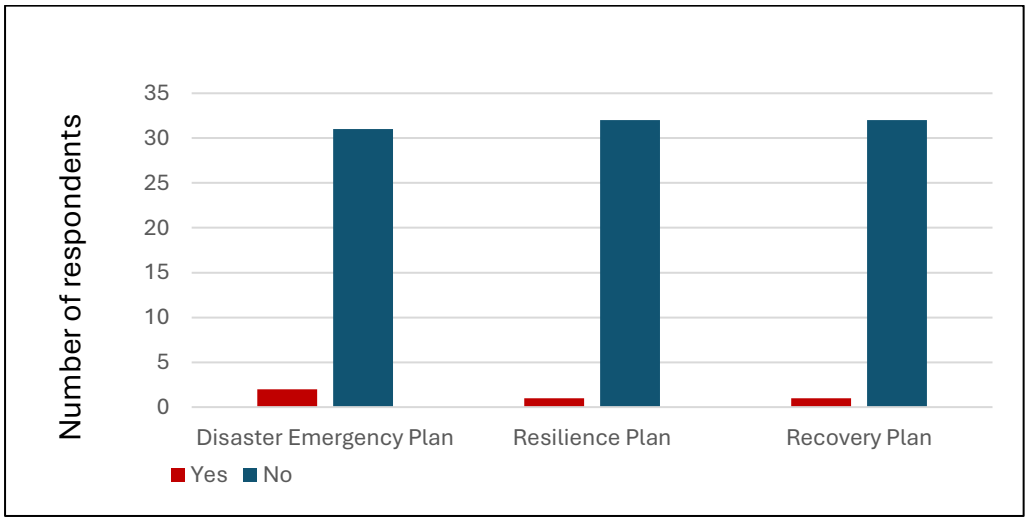

Figure 5.3: Kumeū-Huapai Community Respondents – Existing Community Plans - Does the Community Have a Disaster Emergency Plan, Resilience Plan, or Recovery Plan? Source: Survey Findings.

Collectively, these findings indicate that preparedness in this context is not solely an individual responsibility but is shaped by interaction between community awareness and institutional support. The expectation that residents should independently access and interpret preparedness information suggests a disconnect between recovery authorities and the community, potentially exacerbating vulnerability.

This aligns with the disaster recovery literature, which emphasises that preparedness planning, at the community level, is essential for reducing disaster impacts and to enable effective recovery (Smith, et al., 2007; Vallance, 2015). The existence of clear, accessible preparedness frameworks, such as community recovery plans and early warning systems, has been proven to enhance both response capacity and recovery efficiency (Aldrich, 2012; Parajuli, *et al.*, 2020). Conversely, the absence of such mechanisms can increase uncertainty (Khan, *et al.*, 2017). This is likely to delay response actions and intensify material and social losses.

Altogether, the findings suggest that strengthening preparedness through improved communication, community engagement, and institutional support is critical to enhancing recovery outcomes. In particular, the development of a CRP, alongside more effective early warning systems, represents a key pathway for improving both the effectiveness and efficiency of future recovery processes in the Kumeū-Huapai community.

5.5.3 Mitigation Actions and Environmental Management

Mitigation actions and environmental management emerged as critical factors shaping effective recovery outcomes, with inadequate drainage, land-use practices (mushrooming of new developments), and infrastructure contributing to increased flooding in the Kumeū-Huapai community. The public engagement session highlighted a few challenges faced post-disaster. These have been grouped into themes, where mitigation actions and environmental management emerged as known challenges (see Table 5.3). If these issues are addressed, better outcomes can be achieved, and impacts on people and their infrastructure can be minimised.

As one interviewee mentioned,

> *"We need a plan so that after a flood, Council can provide the necessary equipment to alleviate roadblocks as quickly as possible".*

Table 5.3 : KH's Responses from the Street Stall on the Major Problems Faced in Recovery and Underwent a Thematic Identification.

Major Problems Faced in Recovery – from the Community's Perspective	**Themes Identified**
"Cars were damaged, and to get a new car without insurance was difficult"	Preparedness and Planning, Communication and Engagement
"Not much in place from Council/Civil Defence/Met Office"	Community-Authority Relationship, Communication and Engagement
"Lack of warning systems for flood. There should be a flood warning in place, like a flash float system"	Communication and Engagement, Preparedness and Planning
"No proper drainage, or no drainage maintenance to store stormwater that would prevent overland flooding "	Mitigation Actions and Environmental Management
"Local businesses and restaurants were flooded and permanently shut, which affected the community"	Mitigation Actions and Environmental Management

"New developments are a problem as this increases the run-off in the area"	Mitigation Actions and Environmental Management
"More houses and more concrete roads promote flooding"	Mitigation Actions and Environmental Management
"The removal of trees on the hillside has caused negative impacts"	Mitigation Actions and Environmental Management
"Raised roads that cause flooding in people's homes"	Mitigation Actions and Environmental Management

Source: The Researcher, 2022 – Compiled Kumeū-Huapai's Street Stall Data.

These findings suggest that the impacts experienced by residents were not only as a result of the flood event itself but were exacerbated by a pre-existing environmental and infrastructural conditions that amplified vulnerability, which may have constrained the community's ability to recover effectively.

5.5.3.1 Clearing Waterways

The Kumeū-Huapai's Street Stall responses focused on how they were affected. The results show a lack of preparedness, mitigation mechanisms, and actions that promoted further inundation. With such perspectives, residents need to know the services the Council provides so that their expectations are not beyond the services offered by the Council. According to the Auckland Council's (2023) It is the responsibility of the owner of a private watercourse on private land to ensure that:

1. *"litter and pollutants do not enter the watercourse,*
2. *there are no obstructions or impediments to the flow of water,*
3. *grates or outlets within a property are kept clear from debris at all times."*

In Kumeū-Huapai, residents felt that clearing waterways was the Council's responsibility, including on private land. A few respondents from the workshop mentioned that some responsibility for clearing streams before a flood event and flood clean-up should be the responsibility of the resident who occupies the private land. Others felt strongly that the Council should be responsible for clearing rivers and streams on their private land. Despite this, Council information (Auckland Council, 2023) show that residents are responsible for managing watercourses with litter and pollutants within their private property.

The data showed that the community wanted to address critical issues, such as clearing streams and waterways of debris on private properties. Some respondents mentioned that the Council should consider older residents who lack the necessary resources and help them clear debris from the streams. One participant mentioned in a workshop discussion that debris is from upstream and that it should not be the responsibility of private owners to remove it from rivers and waterways.

Altogether, this indicates a governance gap, where unclear responsibilities between residents and the Council hinder the implementation of effective mitigation actions, ultimately slowing down recovery.

5.5.3.2 Floodway Mitigation Efforts

Interviews with residents during field visits and at the workshop mentioned a flood model that had existed for some time, but the community was unaware of it. They also mentioned that there was an incomplete floodway to alleviate flooding in the community but were not aware of the progress of its construction.

According to (WSP, 2022) at the time of the flood event, the floodway was partly completed, so the report considered to what extent flood effects might have differed if the flood mitigation works had been completed. The report further notes that flooding would have decreased slightly in some community areas. For example, flood levels upstream would have been lowered slightly by 0.35-0.86m on Oraha Road. Similarly, flood levels downstream of Oraha Road lowered by 0.1-0.2m but increased by 0.06m in Waimaukau (the next township northwest of Huapai).

Some residents further communicated that a modelled flood report containing flood maps only surfaced after the August 2021 floods, along with a report titled "Kumeū Floods – Predicted 12 years earlier" (Islam et al., 2022). Some residents felt that better communication was needed regarding the extreme floods the community experienced. Although the flood plain extent report was publicly available online in 2013. The Kaipara-Kumeū Catchment Management Plan, Hydraulic Modelling report was published in 2009, but the flood plain extent was publicly available online and disclosed in Land Information Memorandums 8 years before the August 2021 flood event (Islam *et al.*, 2022).

Despite this online publication prior to the August 2021 floods, residents remained unaware of the flood model, as they believed communication was not effective enough. Some residents mentioned that the language used in the "Kumeū Floods – Predicted 12 years earlier" report was direct and gave an "I told you so" impression. One resident specifically pointed to the statement below as "insensitive";

> *"The recent model results for the August 2021 flood event show good agreement between the model predictions and the observed flooding extent and maximum flood levels in Kumeū township area, (Islam et al., 2022, pp 11).*

One resident explained that since the authorities were so confident about the model, it should have been well communicated to areas predicted to be affected by the floods. Although a flood model existed and a floodway was incomplete, the survey data showed that most respondents were unaware of documents addressing Community-led Disaster Emergency, Resilience, and/or a Recovery Plan.

This indicates that partial or delayed implementation of mitigation infrastructure limited its effectiveness, reinforcing the community's exposure to flood risk. This further suggests the need for timely and coordinated implementation of mitigation measures to ensure their intended benefits are realised.

These findings align with the disaster risk reduction literature, which emphasises that effective mitigation measures, such as drainage management, land use planning, and flood infrastructure, are critical in reducing hazard impacts and supporting faster recovery (Parajuli, et al., 2020; Smith, and Wenger, 2007; Trüdinger, 2024; World Health Organisation, 2019).

5.5.4 Community-Authority Relationship

Community-authority relationships emerged as a critical social factor influencing post-disaster recovery, particularly in shaping trust, engagement, and collaborative action. The findings indicate that weak relationship between the community and recovery authorities limited effective communication, reduced trust, and hindered coordinated recovery efforts. For example, one resident mentioned that,

> *"I do not feel that the Council considers our opinions on mitigation and preparedness matters related to our community before the August 2021 event."*

Another interviewee mentioned that,

> *"There has been resentment between Council and community members, dissatisfaction that the Council isn't delivering as they should. There is some confusion about the Council's job and role. I think that people don't feel they have control over many things; decisions have been made before consulting us, the people, and our feedback is not always included."*

A third resident interviewed mentioned that,

> *"It doesn't make sense for the community to share their ideas with the Council; It won't go back to Council planners to create those recovery plans. Everyone has their own agenda. However, communities bring issues to the Council. It comes to no avail."*

These perceptions strongly indicate a breakdown in trust and highlight a lack of meaningful engagement between the community and recovery authorities, undermining collaborative recovery processes.

Table 5.4 shows ideas for partnership between recovery authorities and the community from the community's perspective. The results show that a partnership did not exist in this community before and shortly after the event. Table 5.4 presents what a partnership should look like among communities and recovery authorities to prepare for disasters and facilitate recovery. Instead, the community recommended a list of ways recovery authorities can engage them and practically foster resilience and recovery post-disaster. As such, this calls for intentional engagement forums between the Council and the community.

Table 5.4: Kumeū-Huapai Workshop Data Showing What Partnership Could Mean from the Community's Perspective.

Partnership Ideas between Recovery Authorities and the Community
"The Council should actively engage and regularly meet with the community."
"Recovery authorities should act regarding drainage maintenance."
"There should be transparency and accountability."
"There is no partnership between the Council and the community."
"Council should work on mitigative actions in the community."
"Having a recovery plan to look at recovery on a regular basis."
"Council needs some form of communication among flood victims."

Source: The Researcher, 2022 – Compiled from Data Collected at the Kumeū-Huapai Community's Workshop, 2022.

The absence of established partnerships before the flood events suggests that recovery processes were reactive rather than coordinated, limiting the effectiveness of recovery actions.

This is consistent with the disaster recovery literature, which identifies trust, social capital, and community-government relationships as key determinants of recovery outcomes (Akbar, 2018; Aldrich, 2012; Chandrasekhar, 2014). Strong partnerships allows efficient coordinated action, and resource

sharing (Ahmed, 2008; Akbar, 2018; Network Neighbourhoods Partnership, 2022; Vallance, 2011), whereas weak relationships can lead to mistrust, reduced participation and slower recovery (Campbell, et al., 2021; Vallance, and Carlton, 2014).

5.6 Recovery Challenges

5.6.1 Communication Breakdown

Communication breakdown emerged as a significant barrier to effective post-disaster recovery in Kumeū-Huapai. The findings indicate that limited awareness of recovery processes and insufficient communication from recovery authorities constrained the community's ability to respond and recover effectively.

Survey results provide insight into the community's level of knowledge regarding post-disaster response and recovery actions. As shown in Figure 5.4, while 24 respondents indicated that they knew what post-disaster recovery meant, they answered 'somewhat' or 'yes', against a notable proportion of respondents who remained uncertain, with 9 answering 'no/unsure'. Similarly, 22 respondents reported some level of awareness of what to do by answering 'somewhat/yes', compared to 11 respondents who answered 'no/unsure' to the question, do you know what to do if affected by an event? It is important to note that 15 people answered 'somewhat/yes' against 17 'no/unsure' about knowing where to go after an event affects them. 19 people answered 'somewhat/yes,' while 14 were unsure, answering 'no/unsure' about whom to contact post-disaster.

These indicate that although there is a general awareness of recovery concepts, there is a lack of actionable knowledge, which is crucial for effective response and recovery. This gap between awareness and practical understanding suggests that communication from recovery authorities is either insufficient, unclear, or not reaching the community effectively.

While information on recovery roles and processes is available through official channels, the findings suggest that reliance on passive information dissemination, for example, online resources, is inadequate. Residents require more active, accessible, and locally relevant communication, particularly through engagement and partnership mechanisms.

The lack of effective communication has implications for trust and recovery outcomes. By this, I mean that where communication is limited or unclear, communities may experience uncertainty and reduced confidence in recovery authorities, which can hinder coordinated recovery efforts. This aligns with existing literature, which highlights that effective two-way communication is critical for building trust and enhancing preparedness, and enabling efficient recovery processes (Aldrich, 2012; Doyle, 2022; Hart, et al., 2024).

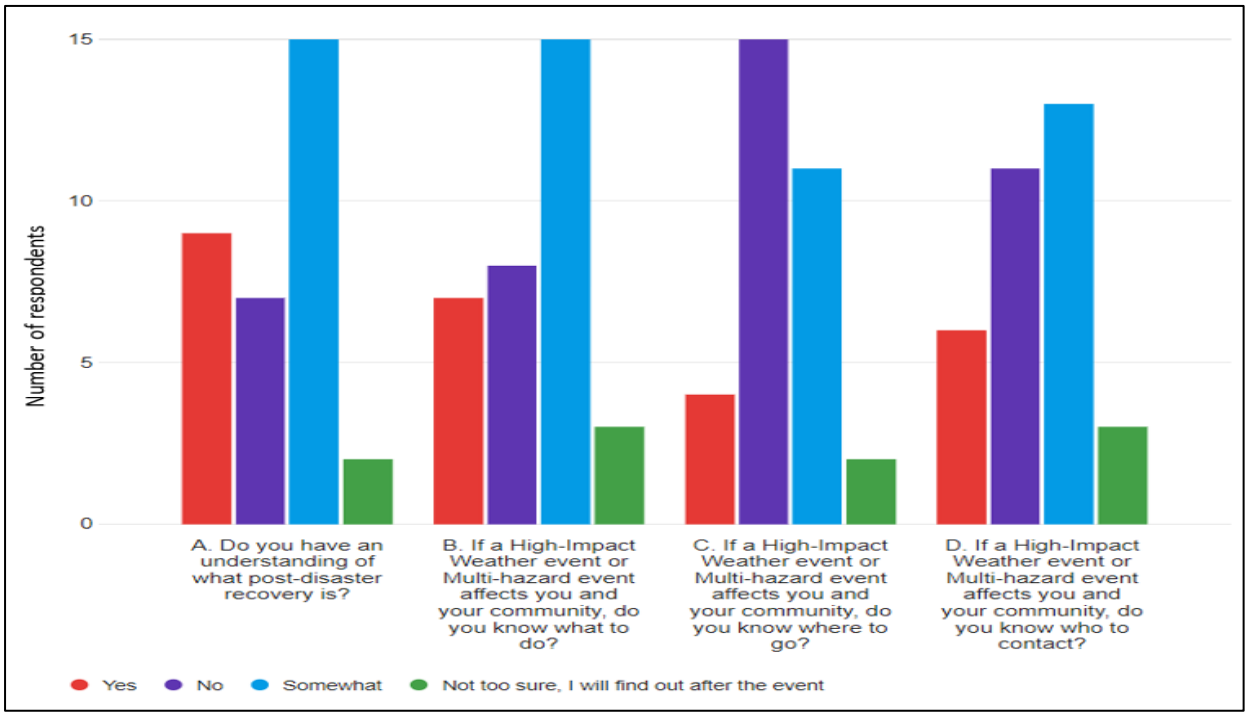

Figure 5.4: Kumeū-Huapai Community's Knowledge of Response and Recovery Actions. Source: Survey Findings, 2022.

5.6.2 Governance and Role Clarity

In Kumeū-Huapai, governance and role clarity emerged as a key barrier to effective post-disaster recovery. The findings indicate that residents had a limited understanding of institutional roles and responsibilities across recovery phases (short, intermediate, and long term), which constrained the community's ability to access support, coordinate actions, and engage effectively with recovery authorities.

Survey results demonstrated a significant gap in community awareness of governance structures. As shown in Figure 5.5, most respondents selected the 'I don't know' option when asked which organisations were responsible for recovery activities. Figure 5.5 answers the community's understanding of authorities' responsibilities in the short-term, intermediate, and long-term recovery phases. The results show that 19 to 24 respondents indicated that they do not know which organisation is responsible for recovery activities in the different stages. However, the data in Figure 5.5 indicates that under five respondents knew that the Auckland Council/Auckland Emergency Management was responsible for the short-term recovery activities. Meanwhile, 5 or fewer respondents indicated that the Local Board and Local Community leadership were responsible for recovery activities.

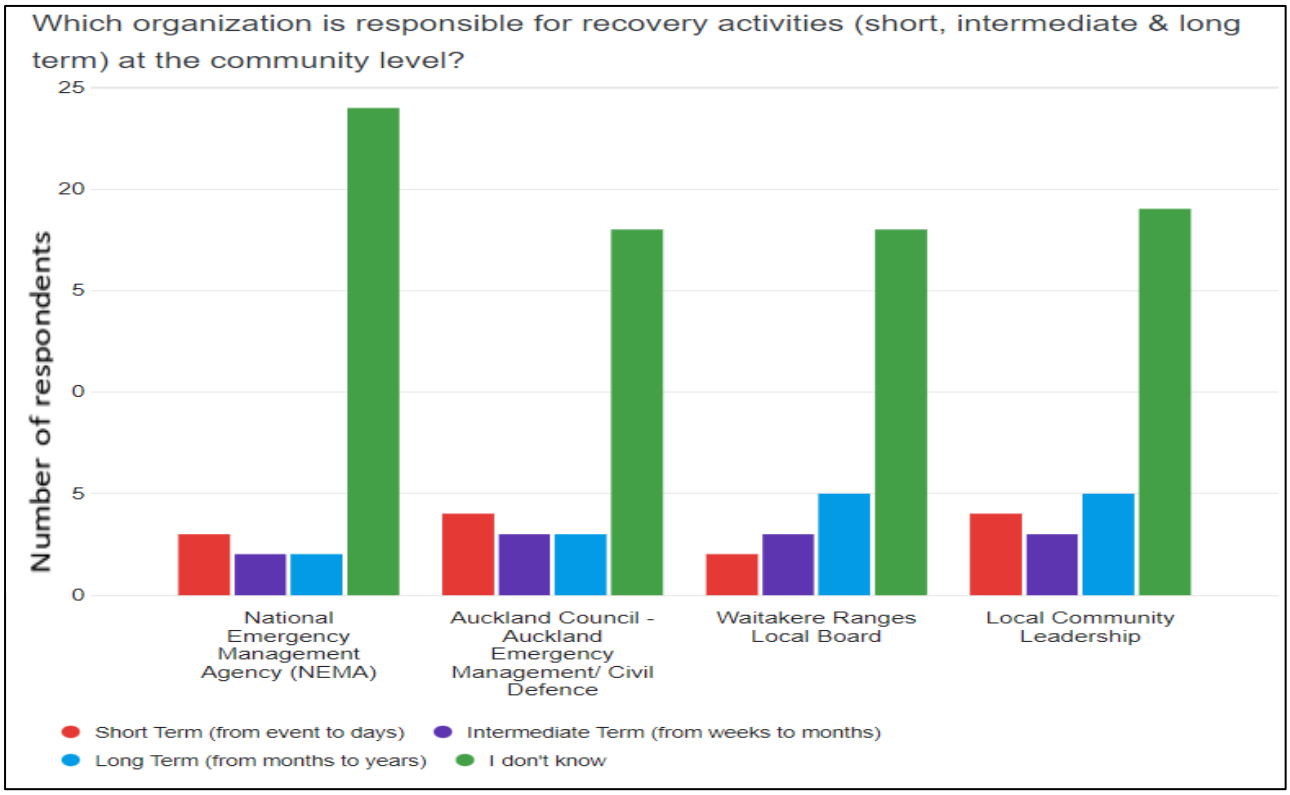

Figure 5.5: Kumeū-Huapai's Community's Knowledge of the Organisation's Involvement in Recovery activities at Different Phases. Source: Survey Findings, 2022.

These findings indicate that limited knowledge of recovery governance structures translates into reduced capacity for effective recovery, as communities are unable to identify whom to contact, what support is available, or how recovery processes are coordinated. This gap suggests that governance arrangements, while formally established, are not sufficiently communicated or understood at the community level.

The workshop data presented Table 5.5 further reinforces this disconnect between institutional structures and community understanding. Table 5.5 illustrates that participants had limited awareness or recovery authorities operating at the national level and were largely unable to articulate their roles and responsibilities. Instead, responses were concentrated at the regional and local levels, with a strong emphasis on practical expectations such as communication, mitigation actions, and follow-up support. The absence of national-level recognition suggests a lack of visibility of higher-level governance structures within the community.

In addition, participants expressed expectations that recovery authorities should provide clearer communication, implement mitigation measures, and actively engage with the community. These expectations, however, were not always aligned with legislated responsibilities, indicating a mismatch between institutional roles and community perceptions. This misalignment contributes to confusion, reduces trust, and limits the effectiveness of coordinated recovery efforts.

Overall, these findings illustrate that governance is not only a structural issue but also a communication and engagement challenge, where unclear roles and responsibilities hinder recovery processes. Effective recovery requires not only well-defined institutional arrangements but also clear

communication of those roles to affected communities, enabling them to navigate recovery systems more effectively.

This is consistent with the disaster recovery literature on governance, which emphasises that clearly defined and well-communicated governance structures are essential for coordinated recovery and efficient resource allocation (Johnson, and Olshansky, 2017; Kwok, *et al.*, 2018; Rumbach, 2016). With poor governance, the recovery process becomes delayed (International Recovery Platform, 2009; Kondo, 2018) . Where role clarity is lacking, recovery processes can become fragmented, slowed, duplicated, and ultimately reduce community confidence in recovery authorities (Aldrich, 2012; International Recovery Platform, 2005, 2009; Vallance, 2015).

Table 5.5: Data from the Workshop Showed the Community's Perceived Expectations of All Stakeholders' Responsibilities to the Community in a Post-Disaster Recovery Environment.

Group Level	***Roles - Recovery Authorities & Stakeholders***	***Perceived Responsibilities & Functions***
National	**-**	Keep the public and community informed
Regional	**Auckland Council**	Must mitigate further flooding
		Keep the public and community informed
		Must clear the river. This is an urgent matter
		Follow-up with cases and action
		Set timelines for mitigation projects
		Should put in place a flood alert system
Local	**The Individual**	Help ourselves
	The Community	Good community action plan
	Fire Brigade/Surf Lifesaving	Rescue saving lives

Source: The Researcher, Compiled Kumeū-Huapai Workshop Data – Understanding of Recovery Authorities' Obligations.

5.6.3 Resource Constraints

Resource constraints emerged as a key barrier to effective post-disaster recovery in Kumeū-Huapai, particularly in terms of financial capacity and access to recovery support mechanisms, such as insurance. The findings indicate that limitations in understanding and accessing financial recovery resources constrained the community's ability to recover effectively following the flood event.

Evidence from community engagement activities suggests that residents experienced financial strain due to a lack of insurance coverage or higher premiums, particularly following the flood event (see Table 5.3). This created barriers to recovery, as some households struggled to maintain or obtain

adequate insurance coverage to replace damaged assets and restore normal living conditions. Workshop findings further highlighted that residents identified the need for adequate insurance coverage for assets, including buildings, vehicles, and essential equipment, as a critical component of effective recovery.

In addition to financial constraints, the findings revealed gaps in accessing recovery-related resources. Residents were largely unaware of existing emergency management resources, such as the Kaipara-Kumeū Catchment Management Plan and associated hydraulic modelling reports. This lack of awareness suggests that, although such resources exist, they are not effectively communicated or accessible to the community, thereby limiting their practical value in supporting preparedness and recovery.

These findings indicate that resource constraints in this context extend beyond financial limitations to include restricted access to information and limited awareness of available support mechanisms. This combination of financial and informational barriers contributes to slower recovery and increased vulnerability.

This aligns with disaster recovery literature, which identifies access to financial resources and information as critical determinants of successful and or effective recovery outcomes (Aldrich, 2012; International Recovery Platform, 2005; Smith, and Wenger, 2007; Trüdinger, 2024; Vallance, 2015).

5.6.4 Infrastructure and Environmental Constraints

Infrastructure and environmental conditions emerged as a key barrier to effective post-disaster recovery in Kumeū-Huapai. From the community's perspective, factors such as new developments, increased impervious surfaces, roadworks, and raised roads contributed to higher runoff levels, intensifying flood impacts. In addition, the removal of vegetation, particularly trees along riverbanks, was perceived to contribute to erosion and reduce natural flood mitigation capacity (see Table 5.3).

These findings indicate that changes in land use and infrastructure development have amplified the community's exposure to flooding, thereby increasing the scale of damage and prolonging recovery. The lack of adequate drainage systems and flood warning mechanisms further compounded these impacts, limiting the community's ability to prepare for and respond effectively to flood events.

From a recovery perspective, these constraints suggest that infrastructure and environmental management are not only pre-disaster concerns but also critical determinants of recovery outcomes. Where development practices and environmental modifications increase hazard exposure, recovery becomes more complex, costly and prolonged.

This aligns with disaster risk recovery literature, which emphasises that land-use planning, environmental management, and infrastructure design play a central role in shaping both disaster impacts and recovery trajectories (Johnson, and Olshansky, 2017; Smith, and Wenger, 2007). Poorly management development and inadequate environmental protections can increase vulnerability, leading to greater losses and slower recovery processes.

5.7 Recovery Measures and Options

5.7.1 Community-led Recovery Actions

Specifically answering Research Question 4, community-led recovery actions emerged as an important option for improving post-disaster recovery outcomes.

Survey results (see Figure 5.6) highlight the importance of recovery planning options at the local level. Figure 5.6 highlights the importance of having an effective preparedness mechanism (such as an alert system, a Community Recovery Plan (CRP), and an Emergency Management group) as the top three options. This was followed by knowing your neighbours, improving community-stakeholder collaboration (a partnership between the community and recovery authorities), and community knowledge of response and recovery resources available. Other future recovery strategies, but less of a priority included having a list of vulnerable people, having a needs and wants list, and re-arrange one's space to ensure when it floods furniture, and household assets and appliances are prevented from becoming damaged. A lack of confidence in government practices may lead communities to develop their flood management systems.

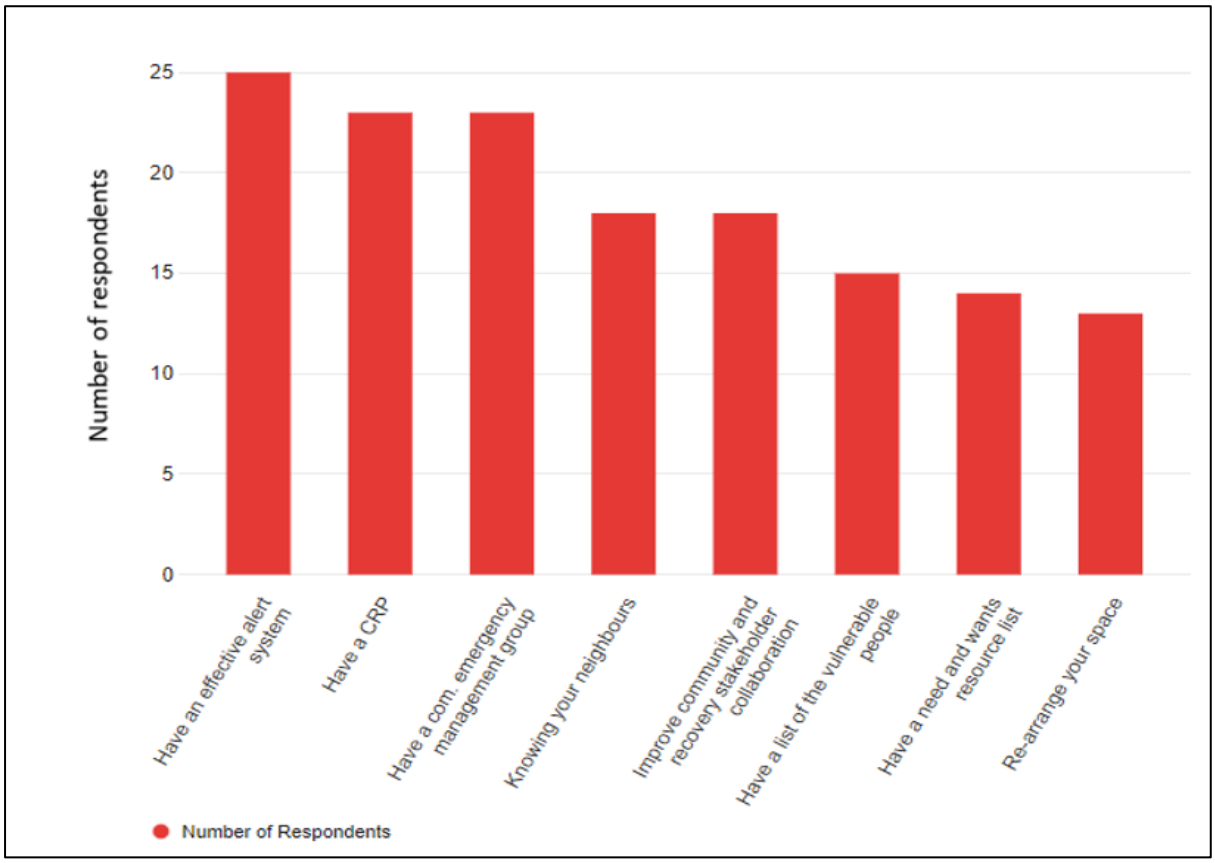

Figure 5.6: Kumeū-Huapai Respondents' Options for Recovery Post-Disaster. Source: Survey findings, 2022.

These findings suggest that communities act as first responders, particularly in the immediate aftermath of a disaster, where formal support systems may be delayed. The ability to mobilise local knowledge and resources enables faster response and reduces reliance on external agencies.

This aligns with the literature, which emphasises the role of social capital and community networks in facilitating effective and timely recovery (Aldrich, 2012; Campbell, *et al*., 2021).

5.7.2 Preparedness and Recovery Planning Mechanisms

Preparedness and recovery planning mechanisms were identified by the community as the most critical recovery options, with the establishment of an effective alert system as the highest priority among respondents (see Figure 5.6). This indicates that timely and reliable communication before and during a disaster event is central to reducing impacts and enabling effective recovery.

In addition to early warning systems, workshop participants also prioritised the development of a Community Recovery Plan (CRP) and drew what that should look like (See Figure 5.7). They mentioned that the Council should partner with locals and engage them in workshops to help create plans that can be implemented in their community. The CRP included several call-out circles (to emphasise) with details of residents' post-disaster recovery needs. These findings suggest that recovery is most effective when supported by structured, pre-established systems that enable coordinated action at the community level.

From the community's perspective, participants outlined that a CRP should include: 1. a coordination centre that communicates to facilitate communication between residents and response and/or recovery authorities, as well as systems for resource distribution - to provide the necessary resources people need post-disaster. 2. Implementing mitigation and preparedness measures such as (clearing waterways, retention ponds, and no impervious pavements). 3. Insurance for assets such as buildings, air conditioners, expensive gears, vehicles, etc., so that recovery can be fast and efficient. 4. Personal recovery, for example, involves raising pumps to avoid damage in the event of another flood. 5. Have a system that registers resources such as beds, food, boats, and pumps so that they can become easily accessible to the affected flood victims. 6. Have a secondary communication in place if there is a power outage. 7. Drones to do an initial damage assessment of the affected area to address the needs of those who need it most.

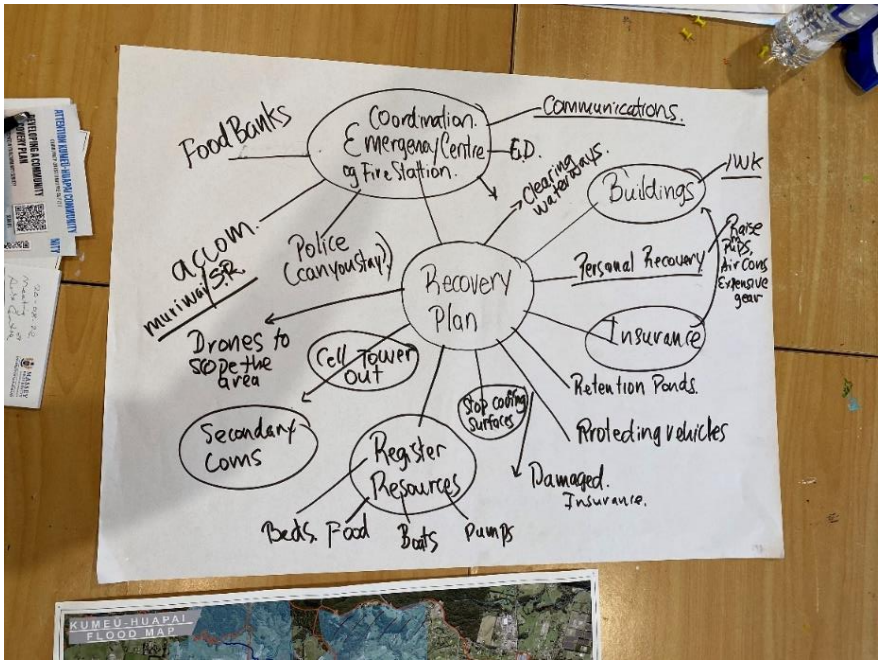

Figure 5.7: Kumeū-Huapai Community's Recovery Plan Structure. Source: Photo taken by the Researcher.

It is noteworthy to mention that participants highlighted the importance of integrating mitigation actions, such as clearing waterways and managing runoff, into recovery planning, alongside ensuring that adequate insurance coverage is available to support financial recovery. These findings indicate that preparedness mechanisms must be multi-dimensional, combining communication, coordination, resource management, and mitigation strategies.

All in all, the emphasis on alert systems and structure recovery planning reflects a shift toward proactive recovery approaches, where communities are better equipped to anticipate and respond to disaster events. This aligns with disaster recovery literature, which emphasises that early warning systems and preparedness planning are essential for reducing vulnerability and improving recovery efficiency.

5.7.3 Community-Authority Partnerships

Strengthening partnerships amongst communities – by knowing the neighbours strengthens the social capital – bond in the community (Aldrich, 2012). This measure, along with strengthening partnerships between communities and recovery authorities, was identified as a key recovery option. According to the survey findings (Figure 5.6), these two measures had the same number of respondents, indicating the importance of both internal and external collaboration in effective recovery processes.

At the community level, strengthening relationships among residents contributes to social capital, enabling mutual support and faster mobilisation of resources during and after disaster events (Aldrich, 2012). At the institutional level, participants emphasised the need for improved collaboration with recovery authorities through regular engagement, transparency, and accountability.

These findings suggest that recovery is most effective when it is co-produced, combining strong community networks with active institutional support. This aligns with disaster recovery literature, which highlights that collaborative governance and community engagement are critical for building trust and enabling coordinated recovery (Akbar, 2018; Chandrasekhar, 2014; Vallance, 2015).

5.8 The Analysis: Communication, Governance, and Resources

5.8.1 Communication and Information Flow

The document review highlights a formally structured communication pathway within the CDEM framework (Ministry of Civil Defence and Emergency Management, 2019), as shown in Figure 5.8. Information is designed to flow from regional to local levels through the Emergency Operations Centre (EOC), where key roles – such as the Group Controller, Local Controller, and Recovery Manager – are responsible for disseminating information to communities regarding readiness, response, and recovery activities. Communication includes providing information to communities about EOC services and products related to readiness, response, and recovery activities. Although this planned flow exists, the question is whether residents know how the authorities deliver these activities to the community.

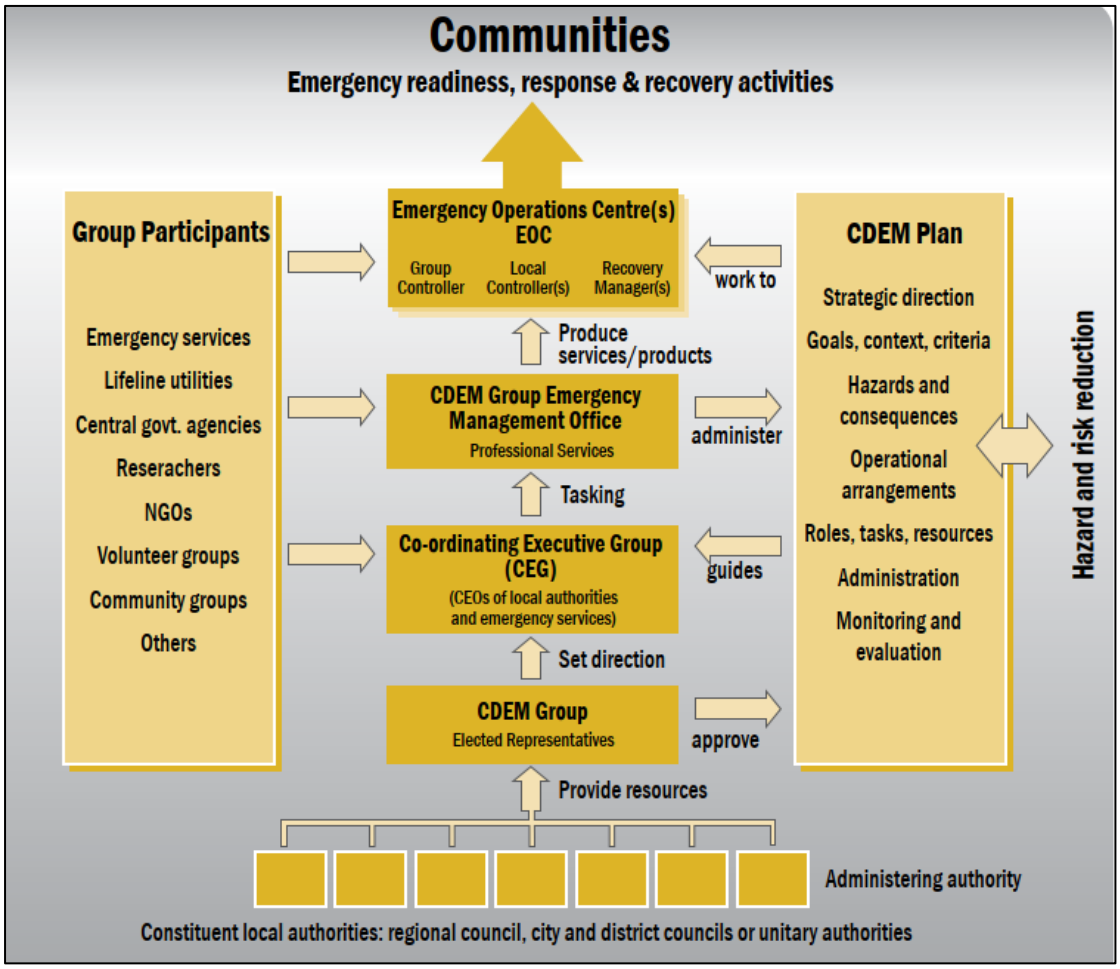

Figure 5.8: CDEM Group Structure and How it Delivers Community Recovery Activities. Source: Extracted from (Civil Defence Emergency Management Groups (CDEM), 2009).

However, when compared with empirical findings presented in Section 5.5. and 5.6, a clear disconnect emerges between formal communication structures and community experience. While the framework assumes a structured, effective flow of information, the survey and interview data indicate that many residents lacked actionable knowledge about what to do, where to go, and whom to contact during and after the flood event. This suggests that, although communication was present at a structural level, it was not effectively translated into accessible, practical information for the community.

This gap reflects a shift from a linear, top-down communication model toward an interactive, locally embedded communication system. The findings indicate that passive dissemination of information, such as through official documents or online platforms, is insufficient to ensure that the vulnerable community is prepared and can effectively recover from disaster events. Instead, communication must be timely, context-specific, and reinforced through engagement and partnerships.

This interpretation aligns with disaster recovery literature, which emphasises that effective communication is not only about information delivery but also about accessibility, clarity, and two-way engagement (Doyle, and Becker 2022; Smith, and Wenger, 2007). Where communication systems fail to resonate with communities (Vallance, S and Carlton, 2014), recovery efforts are undermined, leading to confusion, delayed response, and increased vulnerability.

5.8.2 Governance, Role Clarity, and Institutional Coordination

The governance structure underpinning disaster recovery in New Zealand is defined through legislation, with distinct roles and responsibilities assigned at national, regional, and local levels (Table 5.6). These include coordination, communication, resource allocation, and community engagement functions, with the National Recovery Manager, CDEM Group Recovery Manager, and Local Recovery Manager each playing critical roles in facilitating recovery processes.

Table 5.6, as shown below, shows a legal requirement to lead, facilitate, and enable community engagement, including developing a local recovery plan. The table shows roles, functions, and responsibilities related to communication and recovery. There is a legislated requirement to liaise, plan, coordinate, communicate, and provide recovery-related activities at all levels.

Here, we understand that at the national level, the National Recovery Manager is expected to coordinate recovery activities during a state of emergency. At the Regional level, the CDEM Recovery Manager is expected to facilitate communication between agencies and organisations undertaking recovery activities. With a microlens at the local level, recovery managers are expected to communicate with community leaders, groups, and organisations.

Despite this well-defined institutional framework, this study finds a significant gap between formal governance structures and community understanding. As demonstrated in section 5.6.2, many residents were unaware of which organisation was responsible for recovery activities across different phases. This is due to a lack of awareness of organisations' roles and responsibilities for recovery activities across different phases. This lack of awareness indicates that institutional-level governance clarity does not necessarily translate into functional clarity at the community level.

Furthermore, the findings suggest that governance challenges are not only related to role definition, but also to coordination and engagement across levels. While the framework outlines mechanisms for coordination and communication, the community experience points to fragmentation, limited engagement, and weak alignment between institutional actions and community expectations.

This misalignment has important implications for recovery outcomes. Where governance structures are not clearly communicated, communities are less able to engage with recovery systems, access support, or even participate in the decision-making process. This can lead to reduced trust, inefficiencies in recovery coordination, and delays in implementing recovery actions.

These findings are consistent with disaster recovery literature, which highlights that effective governance requires not long, but clear defined roles with strong coordination mechanisms and meaningful community engagement (Chandrasekhar, 2014; Olshansky, 2012). Moreover, collaborative governance approaches that integrate community perspectives are more likely to result in effective and inclusive recovery processes.

Table 5.6: Legislated Functions and Responsibilities of Recovery Authorities at the National, Regional, and Local Levels.

Group Level	*Role*	*Functions*	*Responsibilities*
National	National Recovery Manager (NEMA)	The CDEM Act 2002 S8 (2)(h) (h) during a state of national emergency or a national transition period, direct and control for the purposes of the CDEM Act 2002 the resources available for Civil Defence Emergency Management.	● Coordinates & plans the establishment of recovery activity in the short, medium, and long-term. ●Provide advice to the Minister and Cabinet on recovery activities, as required. ●Chairs & coordinate meetings from Recovery environment sector groups
Regional	CDEM Group Recovery Manager & Alternate	s30A (1) and s30(A)(2) (1) A Group Recovery Manager must, direct and coordinate the use of the personnel, material, information, services, and other resources made available by departments, Civil Defence Emergency Management Groups, and other persons to carry out recovery activities. (2) The Group Recovery Manager must perform any functions or duties delegated to the Group Recovery Manager by the Civil Defence Emergency Management Group or conferred on Group Recovery Managers by this Act or any other enactment and may exercise any power	●Plan, manage, direct, & coordinate activities throughout recovery. ●Liaise with, and brief, the National Recovery Manager (at the National level), & a Local Recovery Manager (at the local level). ●Facilitate communication between agencies and organisations undertaking recovery activities ●Resource Management Act 1991, S30 (C) (i, ii,) Regional councils under this Act must control the use of land for– the maintenance and enhancement of the quality of water in water bodies and coastal water

		conferred on the Group Recovery Manager by delegation under this Act.	
Local	Local Recovery Manager (AEM)	s30A (1) (refer to the above function)	● lead the development of a local recovery action plan, ensuring recovery environment sector group and community input is sought and provided. ● lead, facilitate, and enable community engagement. ● facilitate communication between community leaders, groups, and organisations.

Source: Compiled by the Researcher Adopted from (Civil Defence Emergency Management Group, 2019 pp. 39-46 Recovery responsibilities; CDEM Act 2002; Parliamentary Counsel Office, 2023).

5.8.3 Resource Access and Coordination

Resource access and coordination represent a crucial cross-cutting factor influencing recovery outcomes in Kumeū-Huapai. While formal recovery structures outline mechanisms for resource allocation and support, the findings indicate that communities experienced constraints in accessing both financial and informational resources during the recovery process.

As discussed in section 5.6.3, residents faced financial pressures related to insurance affordability, alongside limited awareness of available recovery resources such as flood modelling reports and catchment management plans. This suggests that resource availability alone is insufficient if communities are unable to easily access or understand these resources in practice.

Furthermore, the findings highlight the importance of coordinated resource distribution at the community level. Workshop participants emphasised the need for systems to manage and allocate essential resources, such as food, equipment, and temporary shelter, indicating that recovery effectiveness depends not solely on resource availability but also on how resources are organised and delivered.

This aligns with the literature on disaster recovery, which emphasises that effective resource coordination and accessibility are key determinants of recovery efficiency (Mcnaughton, et al., 2015; Norris, 2001; Olshansky, 2012). Where resource systems are fragmented and poorly communicated, recovery processes can become delayed and uneven across affected communities.

5.9 Discussion - Recovery Effectiveness and Efficiency

Here, I evaluate the extent to which recovery processes in Kumeū-Huapi were effective and efficient, drawing on the findings presented in sections 5.5. to 5.8.

From an effectiveness perspective, recovery outcomes were partially achieved. While the community demonstrated adaptive capacity through community-led actions and informal support networks, significant gaps remained in preparedness, communication, and institutional engagement. The absence of clear recovery plans, limited awareness of available resources, and weak community - authority relationships constrained the achievement of long-term recovery and resilience outcomes.

From an efficiency perspective, recovery processes were largely constrained by systematic and coordination challenges. Delays in communication, unclear roles, and limited access to financial and informational resources contributed to inefficiencies in response and recovery. In particular, fragmented communication systems and unclear governance structure reduced the ability of both communities and authorities to act in a coordinated and timely manner.

The findings suggest that recovery in this context was reactive rather than proactive, with limited integration of preparedness and mitigation measures prior to the event. This results in increased impacts and prolonged timelines.

These findings align with disaster recovery literature, which highlights that effective and efficient recovery is dependent on strong governance, clear communication, adequate resource access, and active community engagement (Aldrich, 2012; Johnson, and Olshansky, 2017a; Smith, and Wenger, 2007). Where these elements are weak or absent, recovery processed are often slower, less coordinated and less equitable.

It is crucial to add that the recovery process in the Kumeū-Huapi community demonstrated the need for a more integrated and community-centred approach, where preparedness, communication, governance, and resource coordination are aligned to support both effective and efficient recovery outcomes.

5.10 Conclusion

This study examined post-disaster recovery in Kumeū-Huapai by addressing Research Questions 1 and 4, focusing on the factors influencing recovery and the challenges and measures required to improve recovery outcomes. to investigate the expectations and communication between the community and recovery authorities.

This chapter answered Research Question 1, whereby the findings identified several key factors influencing recovery, including communication and engagement, preparedness, mitigation actions, and community-authority relationships. Among these, communication and preparedness emerged as critical factors influencing recovery outcomes, shaping the community's ability to respond to and recover from the August 2021 flood event.

In answering Research Question 4, the study identified key challenges that constrained recovery, including communication breakdowns, lack of governance and role clarity, limited access to financial and informational resources, and infrastructure and environmental constraints. These challenges

highlight a disconnect between formal recovery systems and community-level experiences, resulting in reduced recovery effectiveness and efficiency.

The findings identified several priority recovery measures and options. These include implementing effective early warning systems, developing a Community Recovery Plan (CRP), improving mitigation and infrastructure management, and establishing a Community Emergency Management Group (CEMG). Strengthening partnerships within the community and between the community and recovery authorities was also identified as a critical pathway for improving recovery outcomes.

Many factors contribute to success in recovery within a community (International Recovery Platform, 2009; Gjerde and De Sylva, 2018; Kwok *et al.,* 2018). However, a key insightful nugget from this case study is that recovery is not only dependent on institutional response but is significantly influenced by community capacity, preparedness, and engagement. While formal governance structures and resources exist, their effectiveness is limited when they are not clearly communicated, accessible or aligned with community needs. The lack of awareness of existing resources, such as flood modelling and catchment management plans, further illustrates this gap.

This case study had some unmet expectations from recovery authorities at the regional and local levels. This resulted in a lack of trust and, therefore, a lack of partnership between the community and authorities before and shortly after the flood event (Chandrasekhar, 2014).

To conclude, the findings suggest that recovery in Kumeū-Huapai was partially effective but constrained by systematic challenges, particularly in communication, governance, and resource access. Improving recovery outcomes requires a more integrated, community-centred approach, in which preparedness, communication, and partnerships are strengthened to support both immediate recovery and long-term resilience. With this support, the community may become better prepared and recover more effectively from future flood events.

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STATEMENT OF CONTRIBUTION
DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

Student name:	ANNA-KAY SPAULDING-AGBENYEGAH
Name and title of main supervisor:	PROFESSOR REGAN POTANGAROA
In which chapter is the manuscript/published work?	Chapter 6

Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work:[1]

Student: Planned, written, formatted and amended the chapter as seen fit and based on supervisory advice.
Prof. Regan Potangaroa: reviewed and provided feedback on the chapter, made recommendations for improvement.
Prof Suzanne Wilkinson: reviewed and provided feedback on the chapter, made recommendations for improvement.
Dr. Julia Becker: reviewed, and provided editorial restructuring, and suggested improvement to methodology.
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6 CHAPTER: A Case Study of Henderson Valley, Auckland, New Zealand

Abstract

Effective communication is critical for a successful post-disaster recovery. When communication between authorities and the affected community is lacking, expectations become misaligned with legislated responsibilities. Knowing who is responsible for the recovery actions in a post-disaster environment. This study examines a case study of a High-Impact Weather event in Henderson Valley, Auckland, New Zealand, in August 2021. This was one of the worst storms that the community had experienced since 1988, with precipitation of over 200 mm within 24 hours. This event caused landslides, further exacerbating flooding and damaging the community's infrastructure. Poor communication between recovery authorities and residents delayed the recovery process. A triangulation method was used to confirm the findings on communication challenges and to better understand the community's expectations and how they differed from the recovery authorities' responsibilities. This involved various research methods, including community one-on-one interviews, surveys, street stall sessions, community workshop methods, and recovery authority document reviews. This study identified communication challenges and unclear responsibilities between the residents and authorities. Communities expect more communication, but their expectations are often unmet. To address this, communities perceive that recovery authorities should improve communication and coordination, which provide options for recovery. The researcher presented a unique case study on a community's recovery from a particular HIWeather event. For building strong community resilience, options for successful recovery are communication through partnership and assisting communities develop Community Recovery Plans.

Keywords: communication and partnership, post-disaster recovery, community expectations, recovery authorities' responsibilities, post-disaster, communication challenges, recovery options

6.1 Introduction

This chapter examines post-disaster recovery in Henderson Valley, Auckland, following the August 2021 High-Impact Weather (HIWeather) event. The event caused severe flooding and landslides, significantly impacting community infrastructure, access, and residential properties.

This case study addresses research questions 1 and 4, focusing on (1) the factors influencing post-disaster recovery from the community's perspective, and (2) the challenges and measures required to improve recovery outcomes. The analysis explores how communication, preparedness, governance, and community-authority relationships shape recovery processes within this semi-rural context.

The chapter adopts a thematic analytical approach, drawing on triangulated data from interviews, surveys, workshops and document reviews. Findings are structured around three key themes: (1) factors influencing recovery, (2) recovery challenges, and (3) recovery measures and options. Within each theme, empirical evidence is presented and interpreted to explain how and why recovery outcomes were shaped.

A key focus of this case is the interaction between community expectations and institutional recovery processes, particularly in relation to communication and role clarity. The findings highlight how local context, including geographic exposure and strong community networks, influences recovery experiences and outcomes.

6.2 Hazard and Recovery Context – Henderson Valley

In August 2021, Henderson Valley, a semi-rural community on the western fringe of Auckland, New Zealand, was affected by a high-impact weather (HIWeather) event (World Meteorological Organisation, 2021). The community experienced a significant rainfall event, with over 200mm of precipitation within 24 hours. This resulted in widespread flooding, landslides, and damage to critical infrastructure, including roads and bridges. This disruption to access routes, particularly the prolonged closure of Mountain Road due to landslides, significantly constrained mobility and delayed recovery processes.

Characterised by its valley topography, multiple stream networks, and proximity of residential and infrastructure assets to flood-prone areas. These geographical characteristics increase the community's exposure to hydrological hazards, particularly flooding and landslides (see Table 6.1).

The impacts of this event must be understood within a broader hazard context. Henderson Valley has been affected by several extreme weather events, but the 2021 event was among the most severe (Table 6.1), indicating recurrent exposure and cumulative vulnerability. The presence of key assets -such as residential properties, transport networks, and utility systems – within flood-prone areas further increases risk.

The community, with the help of the Henderson Valley Residents Association (HVRA), coordinated response and short-term recovery activities with residents. Despite COVID-19 restrictions and trying to maintain protocols, they organised recovery activities such as checking in on neighbours who were affected, cooking and eating as a community, some helped with clean-up activities, and some lent resources for a more manageable clean-up.

Recovery in this context was prolonged and uneven. Eight months after the disaster event, the community was still recovering from floods and landslides that damaged houses, roads, and bridges. Climate change is exposing New Zealand communities to more frequent storms and extreme floods (Ministry of Civil Defence and Emergency Management, 2019), and vulnerable communities, such as Henderson Valley, will continue to be impacted by HIWeather events. These conditions highlight the importance of considering hazard exposure, infrastructure vulnerability, and spatial context in understanding post-disaster recovery outcomes.

Table 6.1 Impact of Major HIWeather Events on the Henderson Valley Community Since 1988.

No.	Year	Period	Event	Impact
1	2023	Feb-13	Flooding & landslides from Cyclone Gabrielle	• People displaced • Power outages & lines down from heavy wind damage • Road closures from landslides. • Roads, buildings, homes, properties, vineyards, & paddocks flooded • Trees down
2	2023	Jan 28-31 & Feb 1	Auckland Flooding and landslide	
3	2021	Aug 30, 31 & Sept 1	Upper North Island HIWeather event	• River burst its banks • Flooded homes, buildings, properties, roads, & bridges • People were displaced, & approximately 60 homes evacuated • Road closures from landslides. Upper Mountain Road was closed by slips for eight/8 months • Man found dead • Motor vehicles, among people's valued possessions were damaged • Nikau palm trees destroyed & washed away
4	2004	May 1st	Auckland Flooding	• Torrential rainfall led to Opanuku Stream bursting its banks, inundating 40 houses
5	1988	July 17th	North Island Flooding	• Parts of Henderson Valley were flooded by swollen rivers

Source: The Researcher - Compiled News Reports, Residents' Interviews, Observations Post-Disaster Event, NIWA Hazards Database.

6.3 Research Methodology

6.3.1 The Case Study - Community Background

A detailed study of the Henderson Valley community was undertaken for the first time to understand how residents recovered after the disaster.

On August 30-31, 2021, a severe HIWeather event occurred in the Auckland region, with prolonged rainfall and heavy winds leading to several landslides that blocked the flow paths in the valley. However, this was not the same for everyone. In the case of Henderson Valley, the HIWeather event led to severe flooding, negatively affecting the community and impacting community assets (Table 6.1). Recovery was ongoing from the start to the end of data collection (February to December 2022), and debris was still present along the riverbanks. The researcher observed this by maintaining frequent and ongoing communication with the community gatekeepers.

Scoping interview data revealed that people did not meet their needs on time during and after the emergency. At the time of the study, the affected people lived with friends and families and rented homes outside their community. Houses were being sold, and people moved out of the community because they feared future events. Mountain Road, which served as the main road in the community, was closed by a landslide for approximately eight months after the HIWeather event (Auckland Transport, 2021).

The community has a small, semi-rural population of approximately 1,440 (Stats NZ, 2018a), with 50.2% of the population between the ages of 30 and 64. Based on the 2018 census, 57.8% of people living in Henderson Valley have full-time employment. The community has over five streams within its boundary (see Figure 6.1).

The area is known to have high social capital because residents are warm, friendly, tight-knitted, and bond well with each other (Aldrich, 2012; Auckland Council, 2010). Much work on social capital emphases the importance of social networks, reciprocity, and interpersonal trust, allowing individuals and groups to achieve greater things than they could by their own isolated efforts (Patterson, 2010). By observation and working together with locals, the community is tightly bonded and frequently gathers at local dances, residents' association meetings, community days, and other communal events. The community has a local volunteer community group, the Henderson Valley Residents' Association (HVRA). The HVRA committee assists the community during emergencies and ensures that local information flows to local emergency first responders and Auckland Emergency Management (AEM)(Henderson Valley Residents Association Inc, 2021).

The community maintains an active social media page and engagement forums. Their Facebook page is regularly used for neighbour-to-neighbour assistance, including during natural hazards. This virtual space and its activities function as a cooperative communal communication hub. After the August 2021 HIWeather event, the community coordinated through these social media pages to help neighbours with source items and services.

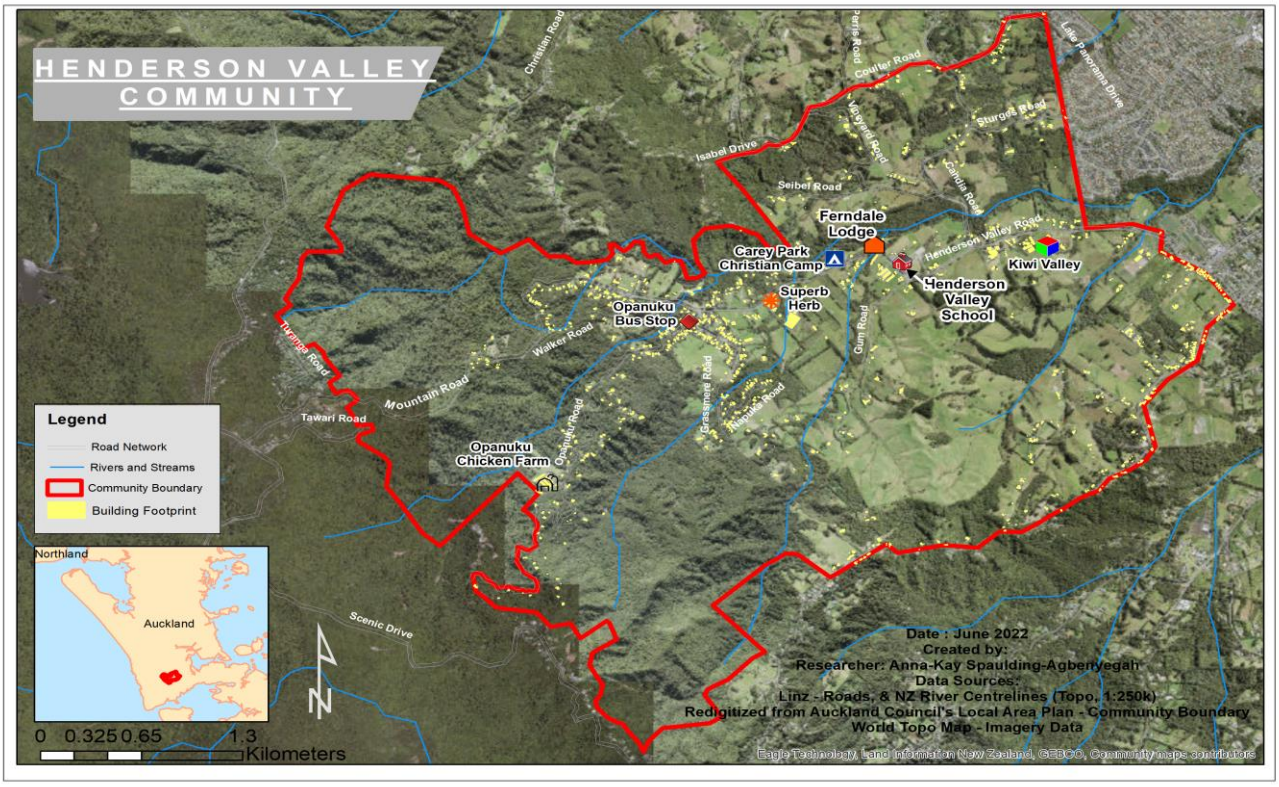

Figure 6.1 Henderson Valley Community Map. Source: The Researcher, 2022.

6.3.2 Data Collection Techniques Used

A case study approach was used to obtain a comprehensive context-specific understanding and explanation of the nuances of the case under study (Piekkari *et al.*, 2009). According to (Stallings *et al.* (1988) and Saunders *et al.* (2009), the triangulation method [2] is often used in case studies to triangulate multiple sources of data. The triangulation method is a useful research approach to enhance rigor and trustworthiness in qualitative and quantitative studies (Ngulube, 2015). A triangulation approach was used to gather and validate data on how people recovered from the August 2021 event in the Henderson Valley. The Triangulation research used five data collection techniques: (1) scoping interviews, (2) online community surveys, (3) street stalls, (4) community workshops, and (5) Internet research and document reviews.

6.3.3 Scoping Interviews

Scoping Interviews were conducted with five affected residents from the Henderson Valley. Often, local people are not involved in emergency management research, so grassroots sources are required for a more inclusive approach (Gjerde, 2018). The researcher found a resident impacted by the August 2021 event via an internet search who was willing to participate in the initial interview. Then, a community champion was contacted to participate in subsequent interviews. A snowball approach was used to connect with other affected persons willing to participate in the interviews. These interviews were semi-structured and captured the recovery stories of local people. Interview themes were developed and used as a baseline to determine the questions coined for the survey. Themes were decoded using the NVivo

software. The themes from the scoping interviews resulted in a thematic concept map showing the community's perspective on factors influencing recovery (see Figure 6.2).

6.3.4 Online Community Survey

An online quantitative survey was developed from the themes that emerged from the five scoping interviews. Additionally, themes from the existing literature on recovery authorities' responsibilities and relationships between communities and recovery authorities were used to develop the survey questions.

The survey was tested by 17 people: five residents in Auckland, five residents from the Henderson Valley Community affected by past hazards, and seven DRM experts. Once the online survey was finalised and validated, it was used to capture data on 1) knowledge of recovery authorities' responsibilities, what to do, where to go, and who to connect with after a disaster; 2) community understanding of post-disaster recovery planning for future events and what recovery resources they are aware of in their community; 3) community infrastructure recovery timeframe; and 4) community ideas on recovery options for the future.

The survey was distributed on the community's Facebook page once every month for five months, with a link to access the survey. Flyers containing a QR code were distributed at a street stall event in Henderson Valley. The survey consisted of 30 questions. There were 108 respondents, of which 46 were completed from the Henderson Valley Community and 46 completed responses were from the other case study community.

6.3.5 Street Stall

A street stall session was conducted at a local supermarket in Henderson. A visual board was displayed at the supermarket entrance, presenting three primary questions to community participants. The purpose was to ascertain (1) lessons learned post-disaster, (2) activities that could expedite recovery, and (3) challenges encountered during the recovery process. Participants were requested to respond anonymously to the questions on the board. The participants inscribed their answers on adhesive notes without identifying themselves and affixed them to the relevant questions. A total of 26 individuals participated in this activity. This methodology enabled the researcher to engage interactively and gather perspectives from diverse demographic groups (Community Planning Toolkit, 2012) who may not have had the opportunity to complete the online survey. This approach was employed because it facilitates engagement and generates interest in recovery issues faced by the community. The collected data provided community perspectives and insights into the community's expectations from recovery authorities.

6.3.6 Workshop

A community workshop was conducted at Henderson Valley Primary School. This approach was employed: (1) to allow participants (residents from the community) to share their perspectives and recovery experiences in an open and relaxed atmosphere; (2) to obtain innovative, forward-thinking perspectives on a proposed plan of action; and (3) as a time-efficient method for gathering hard-to-reach groups to discuss relevant issues, raise awareness of recovery experiences, and discuss solutions at the local level (UNDP, 2011; Community Toolkit, 2012). Twelve of 12 participants attended the workshop. Four major workshop activities were explored: (1) the factors that influenced recovery using the HIDECs approach [3] (Alexander, 1962). (2) How well do the participants understand the recovery

authorities' responsibility, obligations, and accountability post-disaster? (3) Scenario planning is a tool that assists communities in planning for recovery. (4) What a Community Recovery Plan (CRP) should include? Activity two asked three questions: (1) Who are the recovery authorities accountable to? (2) What are the key obligations of the key recovery authorities? and (3) what does partnership look like for community and recovery authorities' engagement? This approach, specifically for Activity Two, was used to understand whether the community was familiar with the legislated responsibilities and if they were communicated to them.

6.3.7 Internet Research and Document Reviews

Documents were selected based on themes from the research questions. The literature concentrates on national, regional, and local legislated responsibilities. Data collected on HIWeather events captured recovery stories from government reports and guiding policies, including the Civil Defence Emergency Management Guide document mentioned in the National Disaster Resilience Strategy (NDRS). Document review is an important aspect of any research conducted throughout the data-collection process (Saunders *et al.*, 2009; Ngulube, 2015). The documents used included those reported on New Zealand emergency management legislation, such as the CDEM Group guide document, the CDEM Act 2002, the Resource Management Act 1991, and legal statements from the Auckland Council's website. The CDEM Group guide provides communication methods for community and recovery authorities to create partnerships, resulting in successful recovery. The Resource Management Act 1991 and the CDEM Act 2002 were employed to ascertain the legislative obligations of recovery authorities at the national, regional, and local levels.

6.4 Analytical Framework and Thematic Structure

This chapter adopts a thematic analytical framework to examine post-disaster recovery in the Henderson Valley community.

6.4.1 Alignment to Research Questions

It is structured explicitly in alignment with Research Questions 1 and 4. Research Question 1 focuses on identifying the factors influencing post-disaster recovery from the community's perspective, while Research Question 4 examines the challenges encountered and measures required to support effective recovery. Accordingly, the analysis is organised into three thematic areas:

(1) factors influencing recovery,
(2) recovery challenges, and
(3) recovery measures and options for the future.

6.4.2 Themes Identified for Thematic Analysis

The use of thematic analysis enables the systematic identification and interpretation of patterns across qualitative and quantitative data, facilitating a structured yet flexible approach to analysing complex social phenomena (Braun, and Clarke, 2022; Taylor-Powell, and Renner, 2003). In the context of disaster recovery, where multiple social, institutional, and environmental factors interact, such an approach allows for integration of diverse data sources while maintaining analytical coherence.

The themes presented in this chapter are derived from a triangulated dataset comprising interviews, surveys, street stall responses, workshops, and document review, which reflect recurring

patterns across these sources. This approach supports analytical generalisation (Romm, and Ngulube, 2015), whereby findings are interpreted beyond individual accounts to reveal broader insights into the understanding of recovery processes (Yin, 2018). Importantly, the themes are not treated in isolation, but are analysed as interconnected dimensions of recovery, where factors, challenges, and measures collectively shape recovery outcomes.

With each theme, findings are presented using empirical evidence, including participant quotations and survey results, followed by an interpretation that explains how and why these factors influence recovery outcomes. This analytical approach aligns with the notion in disaster recovery research to move beyond descriptive reporting toward analytical and critical explanatory insight.

6.4.3 Establish Linkages

A key feature of this analytical framework is the explicit examination of communication, governance, and resource dynamics as cross-cutting influences on recovery. These dimensions are widely recognised as critical determinants of recovery outcomes, shaping coordination, decision-making, sand access to support (Olshansky, 2012).

In this chapter, these elements are analysed not only as challenges, but as factors influencing the effectiveness and efficiency of recovery processes. The analysis integrates community perspectives with institutional structures, providing insight into how recovery is experienced and managed in practice.

This approach aligns with the broader conceptual framing of this research including the Community-centric Recovery Umbrella Approach (CcRUA) and perspective (see chapter 8), which emphasises the roles of community knowledge, engagement, and partnerships in shaping recovery outcomes.

6.5 Factors Influencing Recovery

Data from the scoping interviews highlighted several key factors that assisted the community in recovering post-disaster. Several factors emerged from several data sources used in this research. These factors were organised in themes to create a concept map (see Figure 6.2). The four main themes include: social capital, community knowledge, recovery authorities' involvement, and preparedness (shown in the square-like boxes). Sub-themes were identified and linked to the main themes (shown in the rounded rectangle-shaped boxes) to provide a comprehensive view of what the community identified as necessary for recovery.

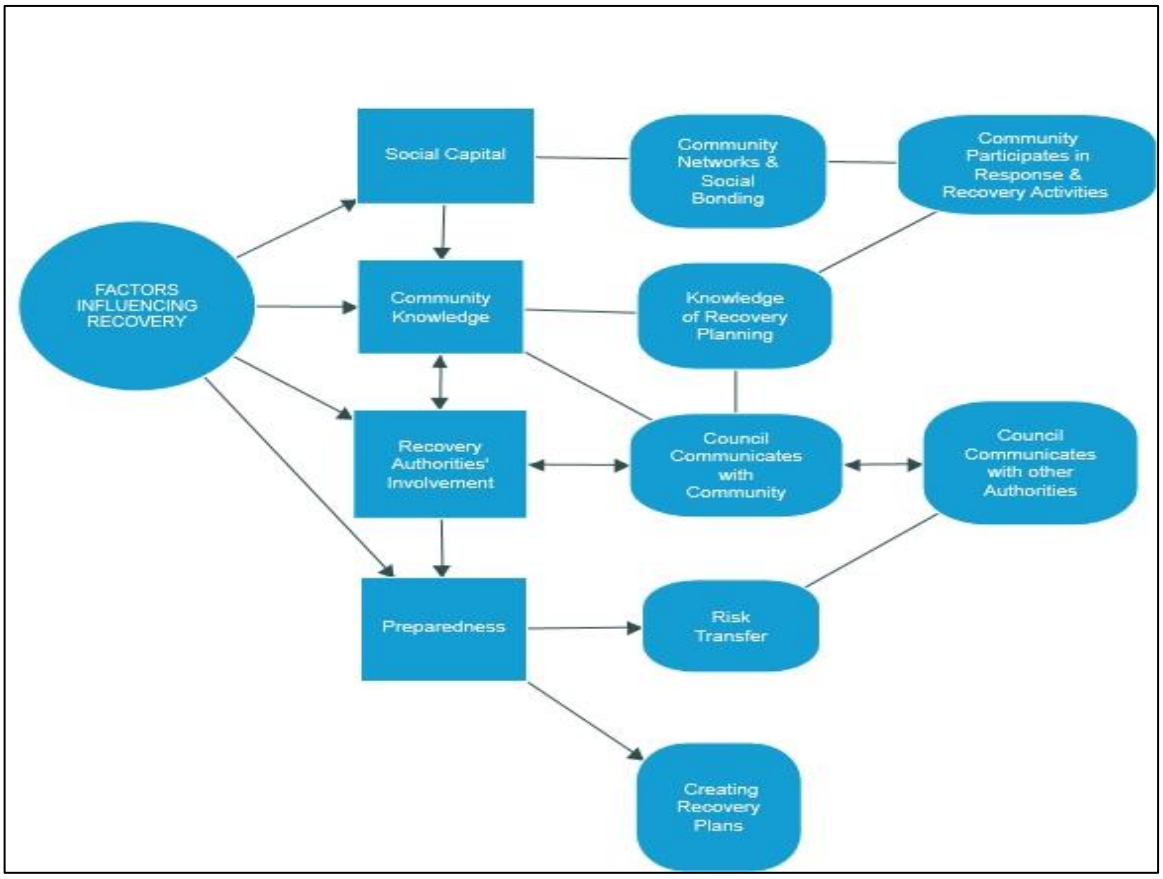

Figure 6.2: Concept Map Showing the Community's Perspective on Factors Influencing Recovery. Source: The Researcher, 2023, Themes Derived from Scoping Interviews.

6.5.1 Communication and Engagement

Communication and engagement emerged as key factors of post-disaster recovery in Henderson Valley, cutting across all major themes identified in the concept map. From the community's perspective, effective communication is essential for building social networks, sharing knowledge, and enabling coordinated recovery actions.

One interviewee aptly stated that,

> *"Communication is key for recovering quickly after a disaster, and so I think there should be a lot of involvement with the Council and the community, especially regarding sharing information on recovery planning."*

The concept map further illustrates communication as an integrating mechanism, linking community knowledge with recovery authorities' involvement. However, the findings reveal significant gaps. For instance, one resident noted that they were unaware that the area designated (by the HVRA) as a community emergency gathering point was susceptible to flooding, as this was never mentioned before the flood event. This indicates a lack of locally relevant and risk-specific communication before the event.

Furthermore, effective communication from the community's perspective required dialogue between community members and recovery authorities, as well as collaboration with other key support services, such as insurance companies and utility providers. One interviewee noted the need for better

communication with support services to care for the community post-disaster. The perception of poor communication among these entities was also evident, as residents expressed frustration with the lack of coordination between insurance companies and the Council.

> "*It would be good if insurance companies and the Council would have been on the same page so that the recovery process could be streamlined to help the community recover faster*"

These findings indicate that communication is not only a facilitating factor but also a point of failure, where breakdowns contribute to delays, confusion, and inefficiencies in recovery. The reliance on informal communication channels, such as community-led Facebook groups, further highlights gaps in formal communication systems.

For successful recovery, it was a common view throughout the interviews that communication needs strengthening before, during, and after an event. Rumbach *et al.*, 2016; Council, 2019; Kwok *et al.*, 2019; and Campbell *et al*., 2021 support the view that strengthening communication between emergency management organisations and the community is necessary to build trust, partnerships, social connections, and engagement in recovery planning before an event. Gaps in communication were littered throughout the interviews, as one interviewee mentioned,

> *"We didn't hear much about the storm from the authorities and didn't think that it would have adversely impacted the Valley…, if it weren't for the community's communication and the Community-led Emergency Guide on our community Facebook page, we wouldn't know what resources to access after the storm."*

This suggests that, in the absence of effective institutional communication, communities compensate through informal networks, reinforcing the importance of local social capital. Considering this, effective recovery depends on timely, coordinated, and context-specific communication across multiple actors.

These findings align with the disaster recovery literature, which emphasises that communication is fundamental to building trust, enabling participation, and supporting coordinated recovery process (Akbar, 2018; Aldrich, 2012; Campbell et al., 2021; Doyle and Becker, 2022). Moreover, two-way communication (Doyle and Becker, 2022) community resilience is built on community communication and active engagement (Vallance, 2011), are critical for ensuring that information is no only announced but also understood and implemented at the community level(Cretney, 2016).

6.5.2 Preparedness: Community Knowledge

Preparedness, particularly regarding community knowledge, emerged as a key factor influencing post-disaster recovery in Henderson Valley.

Interestingly, survey findings revealed significant gaps in community knowledge about resilience plans and recovery responsibilities. Even though most respondents knew of a Community-led Disaster Emergency Plan for their community, many were unclear about resilience and recovery plans or the specific responsibilities of different recovery authorities. This lack of awareness calls for improved communication about post-disaster recovery information.

Survey findings indicated that ‘community knowledge’ is key to recovery. In response to a specific question, 28 respondents answered whether they were aware of specific documents or plans in place for their community.

Figure 6.3 shows 22 respondents said that they have a community Disaster Emergency Plan, while 5 respondents said that they have a Resilience Plan, and 8 respondents said that they have a Recovery Plan. On the other hand, 11 respondents said that they do not have a community Emergency Plan, 27 respondents said they do not have a Resilience Plan, and 25 respondents said they do not have a Recovery Plan.

Available for the community was the following document: Henderson Valley Community-led Emergency Guide (Henderson Valley Residents Association Inc, 2021). The Henderson Valley Community-led Emergency Guide (Henderson Valley Residents Association Inc, 2021) was issued by the Henderson Valley Resident’s Association to the community via their Facebook social media page two weeks before the flood event.

Most respondents (22 out of 28) were aware of a Community-led Disaster Emergency Plan. This document proved useful before and during the event, as mentioned by a community member’s comment during the scoping interviews. The plan communicated information about important numbers to call, the role of community street coordinators, community response during an emergency, hazards, and actions, and personal readiness information (Henderson Valley Residents Association Inc, 2021).

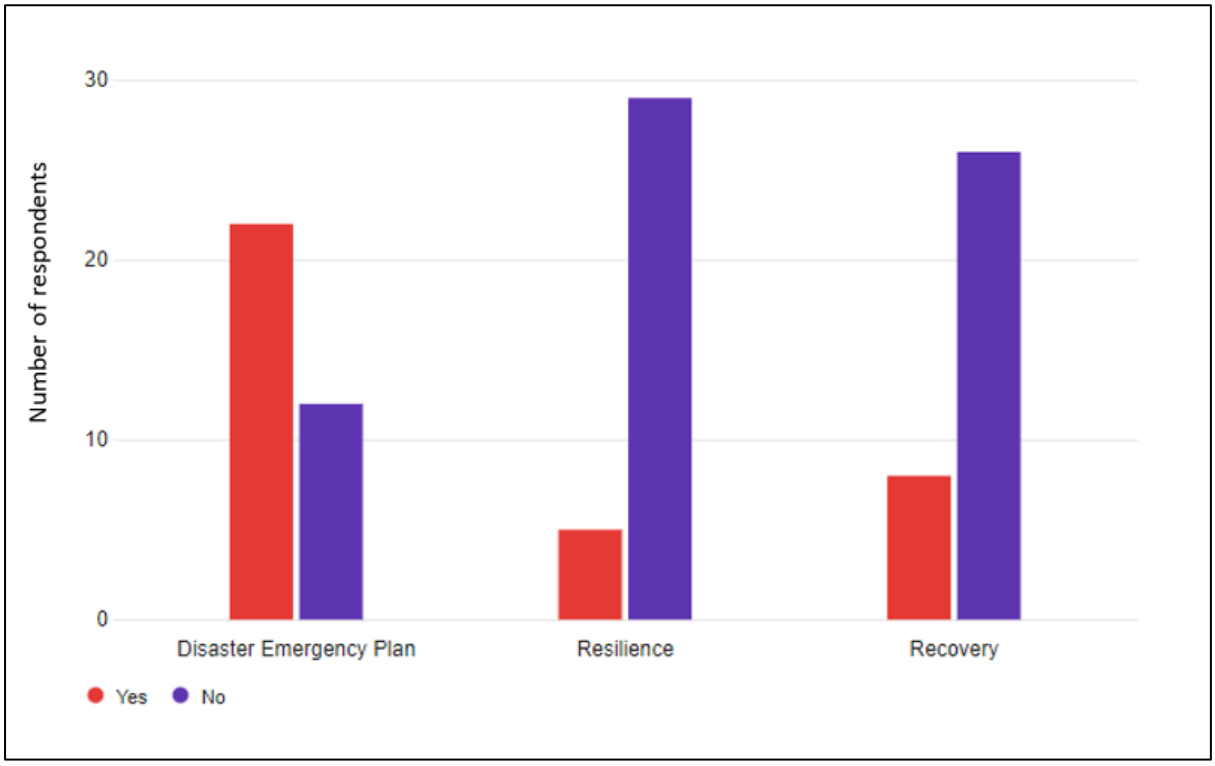

Figure 6.3 Does the Community Have a Disaster Emergency Plan, Resilience Plan, and or Recovery Plan? Source: Survey Findings, 2022.

Figure 6.4 shows that there was a good understanding of what post-disaster recovery meant (33 'yes/somewhat' against 2 'no/unsure'). Figure 6.4 also shows that 28 people answered 'somewhat/yes' compared to 6 who answered 'no/unsure' to the question, do you know what to do if affected by an event? It is important to note that 22 people answered 'somewhat/yes' against 12 'no/unsure' to knowing where to go after an event affects them. While 26 people answered 'somewhat/yes', against 8 'no/unsure' to knowing who to contact post-disaster.

The survey results (Figure 6.3) showed a mixed level of awareness of preparedness and recovery-related plans. While most of the respondents were aware of the Community-led Disaster Emergency Plan, significantly fewer respondents were aware of the resilience and recovery plans. This shows that these plans might not have been available at the community level.

Despite these gaps, the presence of the Henderson Valley Community-led Emergency Guide demonstrated a level of local preparedness. With this guide being distributed prior to the flood event, it created a state of readiness, particularly useful in supporting response actions during the event.

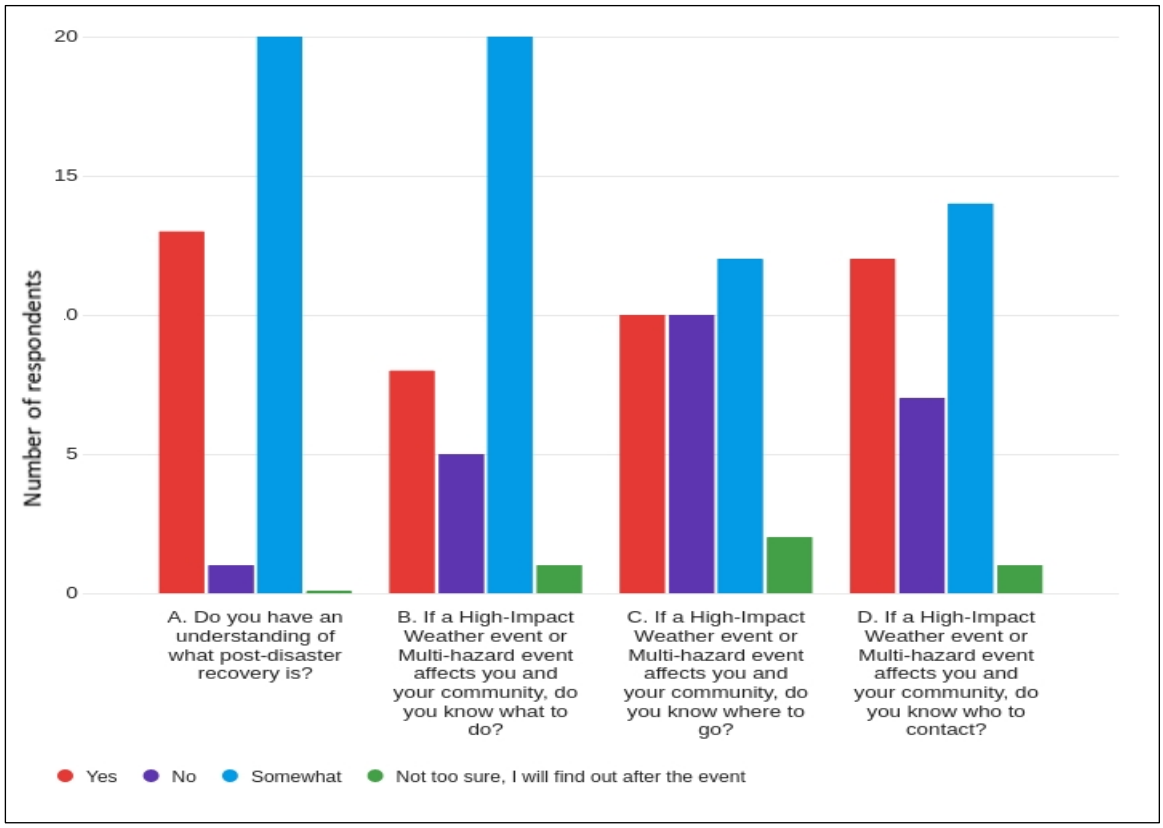

Figure 6.4: Community Knowledge of Response and Recovery Actions. Source: Survey Findings, 2022.

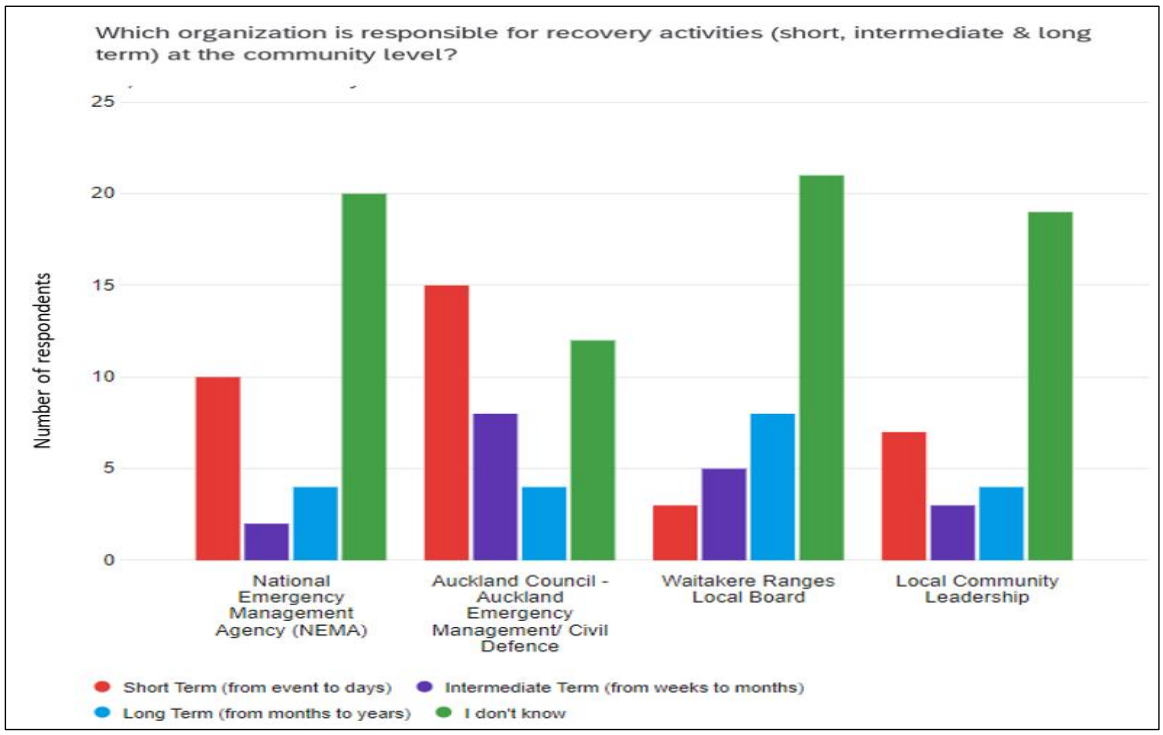

Figure 6.5: Community's Knowledge of the Organisation's Involvement in Recovery Activities at Different Recovery Phases. Source: Survey Findings, 2022.

Survey findings (Figure 6.3) indicate a relatively strong awareness of recovery-related documents. In Figure 6.4, most respondents understood what post-disaster recovery entails and understood to some extent what actions to take if affected. However, this general awareness did not fully translate into practical, actionable knowledge, particularly regarding where to go and whom to contact.

When asked which organisations were responsible for recovery activities, most respondents selected the 'I don't know' option (see Figure 6.5). The results show that 19 to 21 respondents indicated they do not know which organisation is responsible for recovery activities in the different phases. It is important to note that 15 respondents knew the Auckland Council was responsible for recovery activities.

Most residents were unaware of who was responsible for recovery activities at different phases in their community. This shows that there may be a communication issue that needs attention. This also indicates that while community-level preparedness was relatively strong, knowledge of formal recovery systems was limited.

Overall, in Henderson Valley, these findings suggest that preparedness is characterised by a combination of strong local initiatives and gaps in institutional awareness. Meanwhile, community-led knowledge supports immediate response and resilience, but a limited understanding of recovery structures constrains the effectiveness and coordination of recovery processes.

The literature emphasises that preparedness is not only about the existence of plans, but also about building capacity - community awareness, accessibility of information and understanding of roles and responsibilities (International Recovery Platform, 2005; Parajuli, et al., 2020; Smith, and Wenger, 2007).

6.5.3 Mitigation: Stormwater Waterways and Road Infrastructure

6.5.3.1 Stormwater drains and waterways

Mitigation and infrastructure management emerged as a key factor influencing post-disaster recovery in Henderson Valley.

From the community's perspective, the condition and management of stormwater drains and waterways significantly shaped both the severity of impacts and the pace of recovery. The street stall data highlighted concerns regarding blocked drains, unmanaged waterways, and limited maintenance of stream channels. The need to maintain blocked stormwater drains and waterways (on private and public property) (see Table 6.2) shows the residents' perspectives about their problems before and after a flood event. Residents wanted clarity on the services the Council offers to ensure their expectations do not exceed what the Council is legislated to provide.

Table 6.2: Responses Regarding Major Problems Faced in Recovery.

"A lot of apathy from Council, no one wants to fix the real problem."
"The need to address issues like stream blockage, clearing of streams."
"Little or no funding for the community to help to maintain the streams."
"Stormwater issues are the major problem."
"Blocked roads caused by landslips needs clearing."

Source: The Researcher - Compiled Henderson Valley's Street Stall Data (2022).

These findings indicate that inadequate maintenance of stormwater systems and waterways increased the community's exposure to flooding, thereby amplifying damage and recovery demands. According to the Auckland Council(2023b), it is the responsibility of the owner of a private watercourse on private land to ensure that:

1. *"litter and pollutants do not enter the watercourse,*
2. *there are no obstructions or impediments to the flow of water,*
3. *grates or outlets within a property are always kept clear from debris."*

Despite this public information, data found that residents perceived that clearing roads, riverways, and waterways of debris on private properties should be the Council's responsibility. However, residents did not understand this well before or after the storm event. One participant mentioned in the scoping interviews that whole trees must be removed from roads and streams. Still, residents did not have the correct equipment to assist in the clean-up process, so the debris remained on the side of river channels for months following the August 2021 flood event. Residents believed the debris eventually blended into the floodplain, as the Council did not remove it along the river sections (see Appendix 11.9, Photographs 21 & 22).

The data reflects a high level of uncertainty among residents regarding waterways and drainage maintenance, despite the information being available on the Council website. This suggests that the was not clearly understood, leading to misaligned expectations and delayed action. Furthermore,

removing debris from riverbanks highlights that limited mitigation capacity exists at the community level. This, combined with unclear governance, can hinder the effectiveness of recovery.

6.5.3.2 Road Infrastructure

This paper emphasised the road infrastructure recovery timeframe because it was one of the main infrastructures impacted and had an extended recovery post-disaster. Some roads were severely impacted after several hours of rainfall and landslide occurrences. This resulted in major delays and inconvenienced residents for months after the August 2021 event. However, the survey respondents marked different timeframes for "road access," "power," and "bridge access" (Figure 6.6). Some parts of the community could return these community infrastructure services quicker than others. For instance, some roads in parts of the community were impassible at different timeframes because the bridge access was cut off, which negatively impacted access to other services.

Residents mentioned that one of their main roads, 'Mountain Road,' was blocked and unfunctional for eight months post-disaster (see Figure 6.6, and Appendix 11.9 - Photograph 23). This was due to a major landslide in the Valley, which delayed travel time to and from the community. Post-disaster August 2021 event, residents swept gravel from main roads and removed debris that could be moved with some household equipment neighbours had within the community. However, the debris on Mountain Road, where the landslide occurred, was a significant task for residents to clear using their personal equipment.

> "Access through Mountain Road made getting out of the community much easier, but without that road access, this made local commute longer for children and workers going to local schools, it added 20 extra minutes to their commute time." One resident mentioned this in a scoping interview.

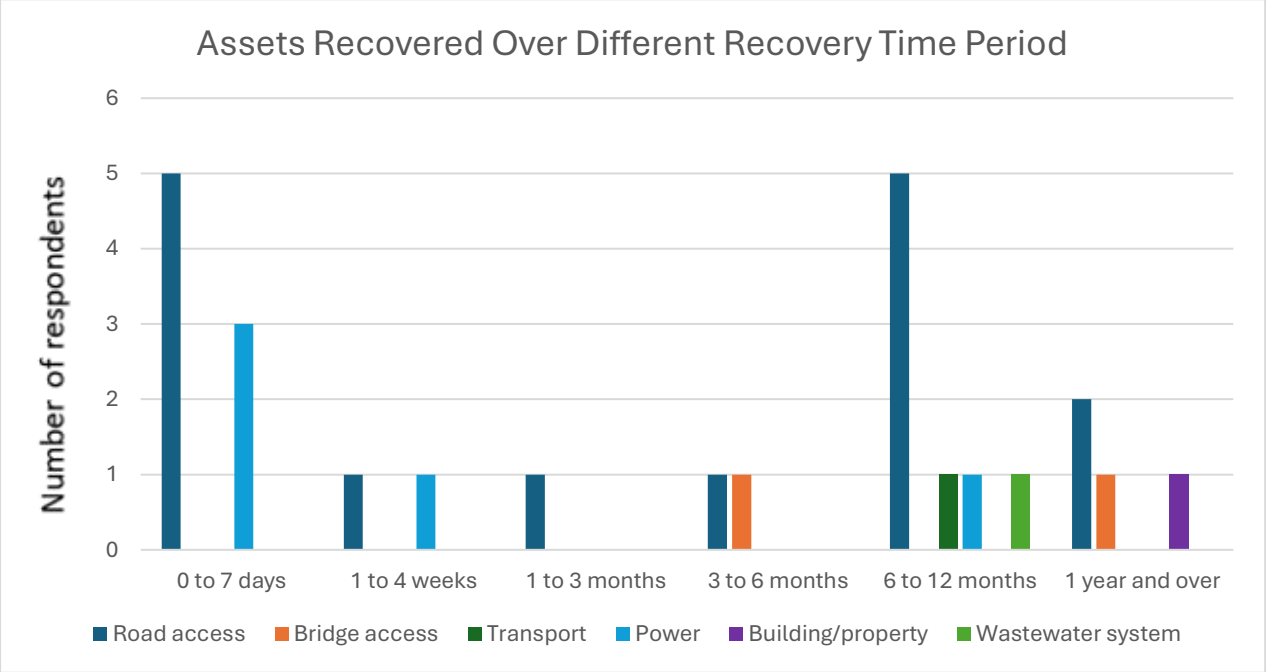

Figure 6.6: Henderson Valley's Assets' Actual Recovery Time. Source: Survey Results.

There was a lack of clear communication from the recovery authorities to the community regarding an anticipated date for full restoration. Residents perceived that the delay was attributable to pandemic restrictions. Other residents believed the road repairs were excessively prolonged, which may be attributed to the semi-rural nature and the ideology that the community is a non-priority area. Predominantly, residents suggested that it might have been due to the lack of inter-agency communication among authorities.

Interactions between and among infrastructure systems can depend on several factors (NIST, 2016). (For example, communication systems need the power to operate, and crews need to repair the damage to electrical systems, which also need access via roads that may be blocked) (NIST, 2016).

6.5.4 Relationships: Social Capital - (Community-Authority, and Neighbourhood - Bonding)

6.5.4.1 Community-Authority Relationship and Partnership

Community-authority relationship and partnership stood out as a determinant factor that influences recovery. Table 6.3 shows ideas for a partnership between recovery authorities and the community. The table presented partnership ideas for coordinated efforts among communities, recovery authorities, and stakeholders to prepare for disasters and facilitate recovery. These ideas, similarly explored in (Campbell *et al*., 2021), illuminated communication among stakeholders to form genuine relationships to establish the engagement needed to provide support services in a disaster context.

Table 6.3: Workshop Data Showing What Partnership Means from the Community's Perspective.

Partnership ideas between recovery authorities and the community
"The Council should communicate and work with communities to help plan for disasters and following up post-disaster"
"The community needs a recovery plan to extend communication with other stakeholder groups including: (Vector, Chorus, Insurance groups) so that everyone knows what is needed"
"Better communication with Councillors, lifeline utilities, ratepayers, and HVRA"
"Collaboration with stakeholders to facilitate recovery training for community members (e.g., First Aid training etc.)"
"Partnership: Involve Tangata Whenua [4], mucking-in, respect to people & their environment, working with existing groups, sharing resources, and cultural safety"
"Being present: emergency services, Council checking on residents"

Source: The Researcher - Compiled Data Collected at the Community's Workshop, 2022.

This suggests that there was a weak partnership between the community and authorities before the HIWeather event. With weak ties – poor engagement and partnership between the community and authorities, community risk amplifies.

Jerolleman (2019) believes that disaster risk reduction is possible if all stakeholders involved understand public policies. According to Panton *et al.* (2009)This can be achieved by stakeholder interaction (between communities and recovery authorities) through communication, engagement,

partnership, and community participation, which becomes important for achieving community resilience.

6.5.4.2 Social Capital - Neighbourhood Bonding

Social capital, particularly neighbourhood bonding, emerged as a strong factor influencing recovery in this community. This community often hosts events such as family fun days and community days, where they share food, and activities with the whānau and children. The community was the first to respond and the last to leave. The findings show that social capital was mentioned in direct linkage with the community networks, and community institutions responding and participating in recovery activities post-disaster August 2021 HIWeather event (see Figure 6.2). Evidence from one interviewee mention that,

> *"We and our internal community groups, got together, distributed food to those members of our community who didn't have power. There was also a community food truck set up for those who didn't have dinner. Whoever had generators in the community shared their resources with other members who needed to charge their phones. We even went door-knocking to check on the elderly members of our community, to ensure they are safe."*

This suggests that the community already had a strong bond among its members. Thereby, participating in disaster response and recovery activities was second-nature to them.

After the HIWeather event in the Gulfport, Mississippi, civic involvement or community engagement with other members of the community, boosted preparedness through activities like visiting elderly residents, and improving communication to address public safety concerns, to strengthening neighbourhood ties (Chandra, 2015). Post-disaster Katrina, residents were encouraged to create disaster plans and develop toolkits to coordinate neighbourhood strategies. The community's collaborative efforts created stringer bonds and a sense of surety for the affected.

In addition, Aldrich (2012) argues that stronger social capital encourages participation among network members and provides information and knowledge to communities– creating trustworthiness. For example, studies show similar factors such as civic involvement, rich social capital, and active citizenship helped survivors of the Kobe earthquake (2004) to recover from the tragedy (Tatsuki, 2008). Aldrich also notes that communities with greater levels of social capital tend to overcome obstacles and become more resilient, as in the Kobe earthquake (2004) and Hurricane Katrina (2005).

Overall, the findings demonstrate a contrast between strong internal community relationships and weaker external institutional partnerships. While social capital enables effective community-led response and support, limited engagement with recovery authorities constrained broader recovery coordination. This highlights the importance of integrating community strengths with institutional support systems to achieve more effective and efficient recovery outcomes (Bush International Consulting, 2023; Doyle, 2022; WSP, 2022).

6.6 Recovery Challenges

Recovery in Henderson Valley was hindered by several key challenges, including communication breakdowns, governance and role clarity issues, resource limitations, and infrastructure and

environmental constraints. These challenges highlighted gaps between institutional recovery systems and at the community-level, which limit the effectiveness and efficiency of recovery processes.

6.6.1 Communication Breakdown

Communication breakdown is one of many post-disaster challenges highlighted in this case study. Communities need to know what to do, where to go, and whom to ask for help to become resilient to post-disaster flood events.

Workshop data show that the community was interested in clear communication, partnerships, and collaborations between recovery authorities and communities. In the workshop session, 'engaging in partnership' was found to be a suitable recovery strategy. The research found that residents would like the recovery authorities to partner to facilitate communication before and after disasters.

Table 6.4 presents the community's perspective on the obligations of recovery authorities and stakeholders at the National, Regional, and Local levels. Interestingly, the community had no specific views at the National level. This suggests that, at the national level, there is no real engagement with local communities. That may be due to little knowledge about recovery authorities at that level (see Figure 6.5 and Table 6.4), and reliance on informal communication networks. This also shows that the formal systems were insufficient in meeting local needs.

Table 6.4: Workshop Data Show that the Community's Perceived Expectations of All Stakeholders' Responsibilities to the Community in a Post-Disaster Recovery Environment.

Group Level	***Roles - Recovery Authorities & Stakeholders***	***Perceived Responsibilities & Functions***
National	**-**	-
Regional	**Auckland Council**	Supply emergency equipment
		Clear streams and culverts (on private & public properties)
		Address infrastructure such as roads, sewerage, and the safety of people
		Provide the Local Board with planning support
		Engage the people & do better follow-up activities.
		Public health hazards and animal management
	Healthy Waters	Should communicate better with community
		To test water quality
		To address stream protection
	Auckland Emergency Management	To better prepare and communicate with community
	Civil Defence	Obligated to the wellbeing and safety of the people
	Auckland Council: Lifeline Utilities (power, internet, water)	Power (vector): needs to communicate the hazards in the area and respond better by addressing fallen lines
		Chorus (internet restoration)
		Need to restore services

Local	**Local Boards**	Medium response to the community, they need to protect the community
	Henderson Valley Residents' Association	Accountable to the community
	The Individual	To let people know they need help

Source: The Researcher – Compiled Workshop Data on Understanding of Obligations.

Considering this, ineffective communication contributed to confusion, delayed decision-making, and reduced coordination during recovery in this community. This aligns with literature highlighting that communication failures can significantly hinder recovery processes and increase vulnerability. Effective communication between regional and local recovery authorities is crucial for reducing community vulnerability (Lansford *et al.,* 2010), as its absence hinders the recovery process (Comfort, 2007).

6.6.2 Governance and Role Clarity

Governance and role clarity emerged as a significant challenge in the post-disaster recovery process in Henderson Valley. Findings indicate that many residents were unclear about which organisations were responsible for recovery activities across different phases (see Figure 6.5).

This lack of clarity reflects a disconnect between formal governance structures and community understanding (see Figure 6.5), limiting residents' ability to access support and engage effectively with recovery authorities. Although institutional roles are clearly defined within emergency management frameworks, these were not well communicated or understood at the community level.

As a result, recovery processes appeared fragmented, with unclear expectations contributing to delays and inefficiencies. This highlights the importance not only of defining roles institutionally but also of ensuring that these roles are clearly communicated and understood by affected communities.

6.6.3 Infrastructure and Environmental Constraints

Infrastructure and environmental conditions significantly hindered recovery in this semi-rural community, Henderson Valley. Flooding and landslides disrupted critical infrastructure, particularly road access, limiting mobility and delaying recovery efforts.

The prolonged closure of key access routes, such as Mountain Road, had cascading impacts on the community, affecting access to essential services, employment, and education. These disruptions highlight how infrastructure vulnerability can amplify the impacts of disasters and prolong recovery timelines.

In addition, environmental factors such as unmanaged waterways, debris-filled riverbanks, and debris accumulation in streams further complicated recovery. These conditions demonstrate that recovery is heavily influenced by both physical infrastructure resilience and environmental management practices.

6.7 Recovery Measures and Options

Recovery options are an important factor in achieving effective, and efficient recovery outcomes. Figure 6.7 shows survey results on the community's views of recovery options. The results show that knowing neighbours was the number one option, followed by preparedness mechanisms (such as an alert system, a Community Recovery Plan (CRP), and an EM group). A partnership between the community and recovery authorities about community knowledge on response and recovery resources were third and fourth options, respectively. The 'Other' option was linked to communication challenges by the Council, transport agencies, and utility suppliers. Respondents noted that the Council should do more to ensure that communication infrastructure (such as roads and telecommunications networks) is not extremely disruptive to local family's post-disaster.

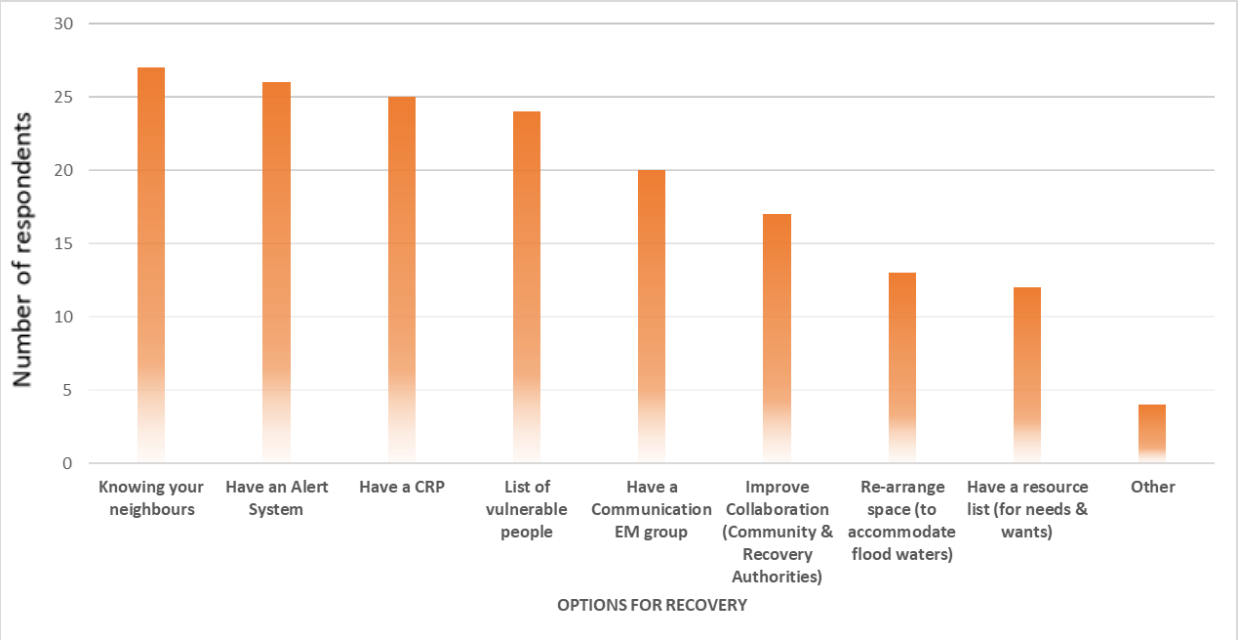

Figure 6.7: Henderson Valley's Respondents' Options for Recovery Post-Disaster. Source: Survey Findings, 2022.

These findings indicate that recovery measures are strongly centred on strengthening community capacity, improving preparedness systems, and enhancing communication and coordination between communities and recovery authorities.

6.7.1 Pre-Planning for Recovery

Ganapati (2016) mentions that one collaborative activity, such as strengthening community social ties with decision-makers, improves dialogue and engagement. This approach is preferred instead of a top-down structure, which has not been proven to integrate well into communities (Akbar, 2018).

Across the board, these efforts have been adopted for the region's most vulnerable impacted population. It must be highlighted that the value of pre-disaster recovery planning is one of the most effective ways to address the challenges of community recovery plans and implement a successful disaster recovery (International Recovery Platform, 2005). If there had been adequate planning for recovery before the disaster struck, then this would have "enabled governments and partners to build consensus on recovery goals and strategies with communities, gather critical information to inform

recovery decisions, define roles and responsibilities, and develop the necessary implementation capacity to manage recovery operations efficiently." (International Recovery Platform, 2005, p. 5).

The problem with Katrina was in the pre-planning and scale of the disaster (Chandrasekhar, 2014; Ganapati, 2016; Nguyen, 2014). Although the level of destruction was at an unprecedented scale, if there had been some pre-planning and comprehensive community response and recovery plans in place before the disaster, the recovery process would have been more fluid and rapid response (Lansford *et al.*, 2010). This would clearly show what to do in the recovery phases. Furthermore, local planners must not be complacent when preparing disaster recovery plans for both the usual and worst-case scenarios.

6.7.2 The Importance of a Community Recovery Plan

The findings show similarities between the workshop results and the survey data related to partnership and communication. This participatory method (in the form of a workshop session) allowed for collaborative explorations about recovery planning and provided a platform for community members to express their views on options for recovery, partnerships, and communication strategies. This led the participants to split into two groups, brainstorming ideas about creating tangible outputs in the form of a Community Recovery Plan (CRP) (see Figure 6.8 and 6.9). The community participants realised this was an option necessary for their successful recovery. Workshop participants mentioned that, perhaps with assistance from the Council to facilitate the creation of the CRP, recovery would be much smoother. Data from the workshop enriched the study by capturing a collective perspective and a consensus on recovery strategies.

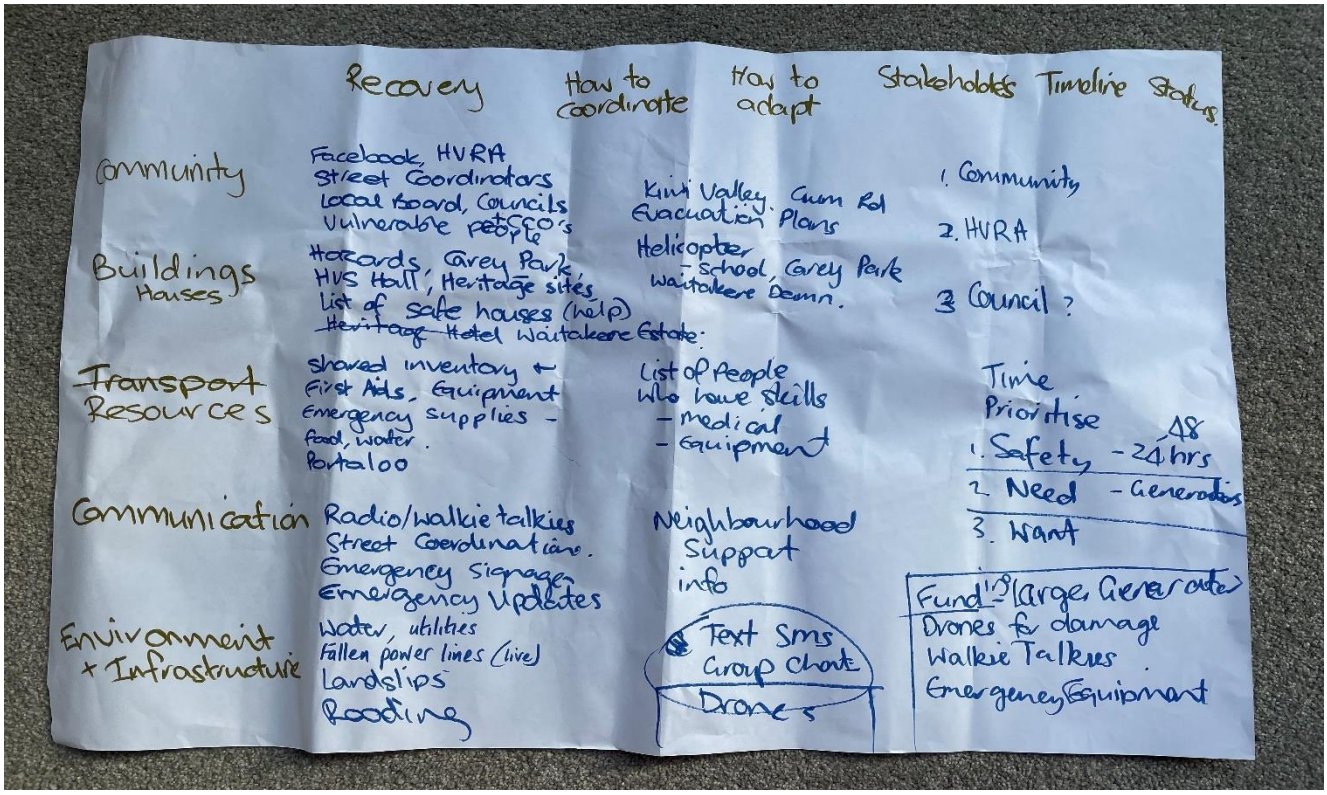

Figure 6.8: Group 1 Brainstormed Ideas of What Henderson Valley's CRP Would Look Like. Source: The Researcher Captured Photo - Community Workshop.

The recovery plan developed by Group 1 (see Figure 6.9) showed five critical factors of recovery (displayed on the left rows) that were affected by the August 2021 flood event. They created the plan in a tabular format with determinants on the top-most columns of – what would be included in their recovery plan, how they would coordinate activities for future events, how they plan to adopt, stakeholders who are a part of the recovery process, timeline to recover and status on how long it would take to recover.

Group 2 also brainstormed what their CRP would look like (see Figure 6.9). They mapped out their ideas in a think-cloud diagram with pull-out points addressing what to do, who to contact, and preparedness strategies like making recovery part of the community event and keeping the community at the heart of recovery. They mentioned the importance of finding out who has the necessary resources needed for recovery, developing local household groups to coordinate recovery activities, and the Henderson Valley Residents Association (HVRA) involvement to collaborate and partner with the Council.

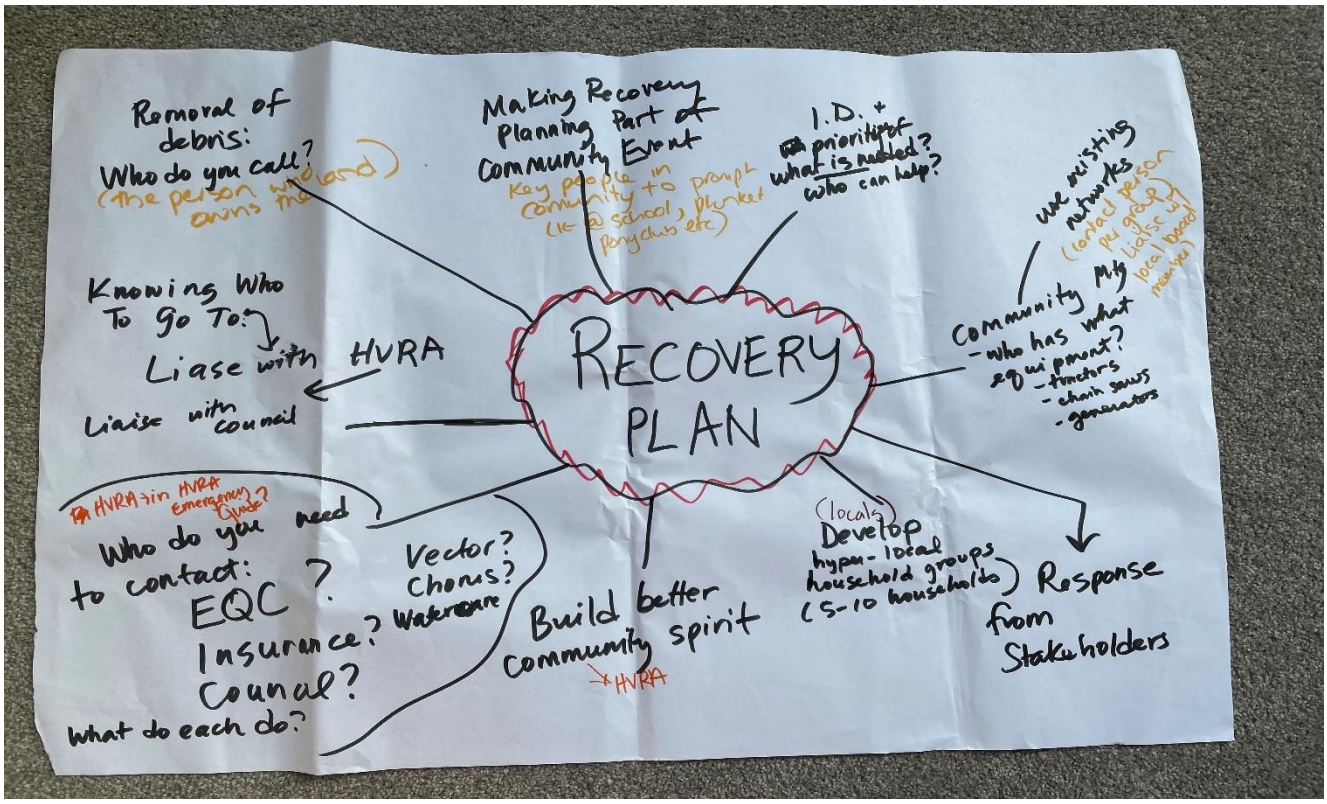

Figure 6.9: Group 2 Brainstormed Ideas of What Henderson Valley's CRP Would Look Like. Source: Researcher Captured Photo - Community Workshop.

6.8 Analytical Framework: Communication, Governance, Infrastructure Coordination

6.8.1 Communication

Recovery authorities' legislative responsibility is to communicate information to communities**.** The document review describes the legislated information flow of emergency management activities and responsibilities, as shown in Figure 6.10 and Table 6.5.

Figure 6.10 shows the planned flow of emergency management, response, and recovery activities delivered to communities at the regional and local levels (via emergency management stakeholders). Executing these activities may involve some form of communication that may originate from the Civil Defence. Civil Defence is the localised emergency response authority in New Zealand (Cretney, 2016).

Communication may include providing information about services and products from the Emergency Operation Centre to communities regarding readiness, response, and recovery activities (Civil Defence Emergency Management Groups (CDEM), 2009). With such a flow of information, as depicted in the diagram, this type of communication appears as one-way instead of two-way communication between recovery authorities and community members. (Doyle, 2022) addressed the fact that communicating risks via two-way communication is more effective.

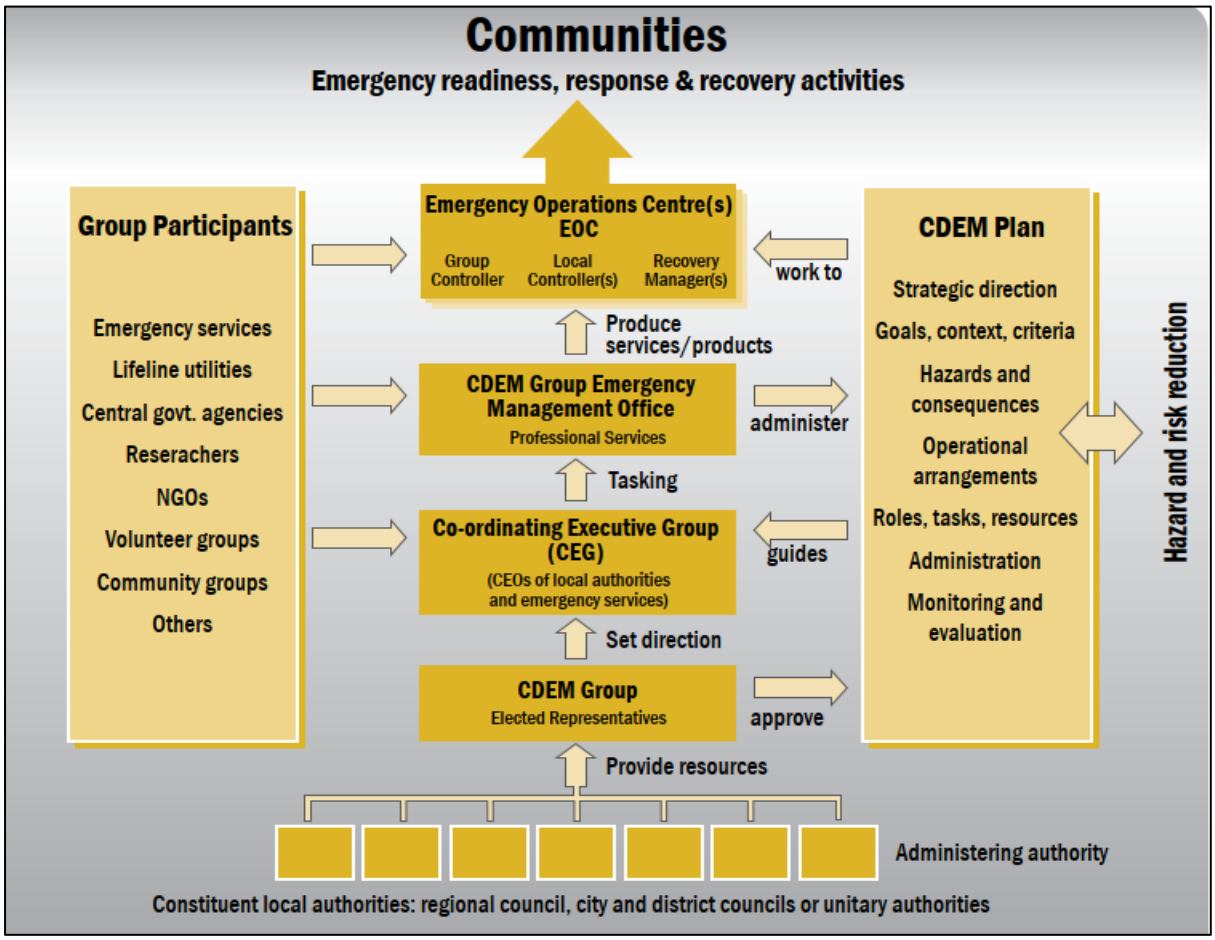

Figure 6.10: CDEM Group Structure and How it Delivers Recovery Activities to Communities. Source: Extracted from (Civil Defence Emergency Management Groups (CDEM), 2009)**.**

6.8.2 Governance

The governance structure underpins disaster recovery in New Zealand is defined through legislation, with distinct roles and responsibilities assigned at national, regional, and local levels (Table 5.6).

Table 6.5 lists a legal requirement for the Local Recovery Manager to lead, facilitate, and enable community engagement, including the development of a local recovery plan. The table shows roles, functions, and responsibilities related to communication and recovery. There is a legislated requirement to liaise, plan, coordinate, communicate, and provide recovery-related activities at all levels. Meaning, this can be tailored to the community's needs based on the Local Recovery Manager's assessment.

According to the Civil Defence Emergency Management Group, 2019, the Group Recovery Manager must perform any functions or duties delegated to them by the CDEM Group and/or conferred on them by the CDEM Act 2002 or any other enactment.

Understanding roles and responsibilities in the recovery space can be complex (Vallance, and Carlton, 2014; Mcnaughton *et al.,* 2015; Gjerde and De Sylva, 2018). At the national level, the National Recovery Manager is expected to coordinate recovery activities during a state of emergency. At the Regional level, the CDEM Recovery Manager is expected to facilitate communication between agencies and organisations undertaking recovery activities. At the Local level, recovery managers are expected to communicate with community leaders, groups, and organisations.

Table 6.5: Legislated Functions and Responsibilities of Recovery Authorities Provided at the National, Regional, and Local Levels.

Group Level	***Role***	***Functions***	***Responsibilities***
National	National Recovery Manager (NEMA)	The CDEM Act 2002 S8 (2)(h) (h) during a state of national emergency or a national transition period, direct and control for the purposes of the CDEM Act 2002 the resources available for Civil Defence Emergency Management.	● Coordinates & plans the establishment of recovery activity in the short, medium, and long-term. ●Provide advice to the Minister and Cabinet on recovery activities, as required. ●Chairs & coordinate meetings from Recovery environment sector groups

Regional	CDEM Group Recovery Manager & Alternate	s30A (1) and s30(A)(2) (1) A Group Recovery Manager must, direct and coordinate the use of the personnel, material, information, services, and other resources made available by departments, Civil Defence Emergency Management Groups, and other persons to carry out recovery activities. (2) The Group Recovery Manager must perform any functions or duties delegated to the Group Recovery Manager by the Civil Defence Emergency Management Group or conferred on Group Recovery Managers by this Act or any other enactment and may exercise any power conferred on the Group Recovery Manager by delegation under this Act.	●Plan, manage, direct, & coordinate activities throughout recovery. ●Liaise with, and brief, the National Recovery Manager (at the National level), & a Local Recovery Manager (at the local level). ●**Facilitate communication between agencies and organisations undertaking recovery activities** ●Resource Management Act 1991, S30 (C) (i, ii,) Regional councils under this Act must control the use of land for– the maintenance and enhancement of the quality of water in water bodies and coastal water
Local	Local Recovery Manager (AEM)	s30A (1) (refer to the above function)	● lead the development of a local recovery action plan, ensuring that recovery environment sector group and community input is sought and provided. ● lead, facilitate, and enable community engagement. ● **facilitate communication between community leaders, groups, and organisations**

Source: The Researcher – Compiled and Adopted from (Civil Defence Emergency Management Group, 2019 pp. 39-46 Recovery Responsibilities; CDEM Act 2002; Parliamentary Counsel Office, 2023).

The analysis demonstrates that communication, governance, and infrastructure systems are interconnecting factors that shapes recovery outcomes. While formal structures for recovery exist, gaps in communication, role clarity, and coordination limited the effectiveness of the community's recovery.

This highlights a disconnect between institutional frameworks and community experiences, whereby recovery systems are not fully aligned with local needs. Strengthening these linkages is critical for improving both the effectiveness and efficiency of recovery processes. An external and independent review done by (Bush International Consulting,2023) also concluded that there was a sense of a disconnect between the Council response and the community recovery needs, they indicated a sense of complacency, poor command, and lack of urgency in the Council's response to the recent Auckland 2023 floods.

6.9 Case Specific Highlights and Discussion

6.9.1 Brief Case-Specific Comparison

Henderson Valley demonstrated several distinctive recovery characteristics when compared to Kumeū-Huapai. Henderson Valley demonstrated heightened community cohesion and strong social capital among community members, enabling a rapid, community-led response and mutual support during and immediately after the event. This contrasts with Kumeū-Huapai, where greater emphasis was placed on expectations of recovery authorities and gaps in community-authority engagement, which delayed the development of the community's mitigation infrastructure – floodway and river alert system. Despite strong internal community capacity, recovery in Henderson Valley was more heavily constrained by infrastructure disruption – particularly prolonged road closures and access limitations - reflecting its semi-rural context.

Noteworthy to mention, that while both communities experienced communication challenges, Henderson Valley relied on informal, community-led communication systems, whereas Kumeū-Huapai highlighted broader dissatisfaction with formal communication from authorities. These differences highlight how contextual factors – such as geography, infrastructure dependency, and existing social networks shape recovery experiences differently across communities, providing a foundation for the cross-case comparison developed in Chapter 7.

6.10 Discussion and Conclusion

6.10.1 Key Findings

This chapter examined post-disaster recovery in Henderson Valley, addressing Research Questions 1 and 4. The findings identified key factors influencing recovery, including communication, preparedness, mitigation, and social capital. Strong community networks supported immediate response, while gaps in communication, governance, and infrastructure constrained recovery effectiveness.

From an analytical perspective, recovery outcomes in Henderson Valley were partially effective but uneven. While having strong social capital enabled a rapid community-led response and support, limitations in institutional communication, governance clarity, and infrastructure resilience reduced the overall effectiveness of recovery processes, leading to a prolonged recovery.

In terms of efficiency, recovery was constrained by delays in coordination, infrastructure disruption, and limited alignment between community needs and institutional systems. These challenges highlight a disconnect between formal recovery frameworks and community-level experiences, resulting in fragmented and prolonged recovery.

According to (Odiase, 2020) the ability of a community to maintain a cohesive, interdependent, and sustainable social network, including participation from all stakeholders, defines the conceptual development and practice of resilience. Aldrich (2012) supports the assertion that linking social networks (interactions between locals and government agencies) is crucial as they provide a conduit for external resources and information for communities to recover effectively and build resilience. Furthermore, an established Residents' Association (Henderson Valley Residents Association Inc, 2021) represents a positive step towards effective recovery and promoting resilience. The study revealed that the community desired various options for recovery, including strong social capital (Akbar, 2018; Aldrich, 2012), preparedness mechanisms (Nakabayashi, 2008), establishing a partnership with recovery authorities (Vallance, 2011), and community knowledge of response and recovery resources (Fekete, 2017).

It can be concluded that Henderson Valley understands local recovery planning well and is generally prepared to face flood disasters. They are aware of the available emergency management resources and those they lack. However, it is important to further strengthen their recovery by fortifying their relationship and engagement opportunities (Auckland Emergency Management/ Auckland Council, 2019), with authorities via good communication. Planners mention that the 4Rs in Emergency Management are incomplete; perhaps a 5th 'r' should be added – relationship.

6.10.2 Implications

This study has practical implications for community recovery planning by recommending hands-on communication, engagement, and partnership relationships between the community and authorities.

6.10.3 Actionable Recommendations

Vallance (2011) supports partnerships and involvement of recovery authorities. The study found a need for a communicative relationship at all levels of government, especially at the regional and local levels to communities. International Recovery Platform, 2005; and Ganapati, 2016 agrees that, once flexibility can be addressed from public agencies to communities, this can open an opportunity to create a communicative relationship and partnership for communities to plan for future recovery.

The literature found that to guide recovery procedures, legislation is in place to establish institutions to carry out full responsibility for post-disaster recovery (NEMA, 2023). This also creates a framework to prepare for, manage, and recover from emergencies at the local, regional and national levels (FEMA, 2016; The Department of the Prime and Minister and Cabinet (DPMC) and National Emergency Management Agency (NEMA), 2021). This can be effective if the material is communicated to residents through an engaging community forum. The literature supports the need for clear communication and engagement, which encourages social trust that shapes and builds relationships between communities and recovery authorities (Rumbach *et al.*, 2016; Kwok *et al.*, 2019; Campbell *et al*., 2021). This can be done by forming formal and informal partnerships (Auckland Emergency Management/ Auckland Council, 2019) with communities and create programmes that involve working

together with residents. This is necessary for building awareness to plan for effective recovery (Mackie, 2009; Doyle *et al*., 2014; Khan *et al.*, 2017), and eliminating unrealistic expectations, which can bring inherent tensions (Morley, 2014).

To improve recovery efforts, bolstering communication and partnerships among the community, recovery authorities, and stakeholders is imperative. Authorities can achieve this by actively engaging residents and building relationships (Auckland Emergency Management/ Auckland Council, 2019). This can be practically done by being present in the community, listening to residents' concerns, involving and engaging residents, ensuring that they are genuinely a part of recovery planning decision-making, maintaining regular communication, and organizing regular forums.

6.10.4 Relevance to the Local Community

This study positively impacts the community by providing data about its perspective on recovery planning, recovery needs, critical factors influencing their recovery, the challenges hindering recovery, and possible options that promote recovery. This data allows the leaders in the community to plan for recovery by involving the required stakeholders, with the involvement of some willing locals, and engaging with them to assist the community in the recovery planning process to build resilience. This is the first research conducted at this level to recognise local realities and to ascertain the community's voice on this long-standing issue to improve an affected community's recovery and resilience.

6.10.5 Limitations

One main limitation of the study may be the scope of the online surveyed population, as the study may have captured a subset of the Henderson Valley community and missed diverse opinions. These could have been from marginalised groups who may not have had the ability to contribute to the survey findings. It is necessary to mention the practical constraints of the recovery authorities at the time of disaster. The August 2021 HIWeather event occurred during the COVID-19 pandemic, when Auckland was under its highest lockdown level, meaning there were limited movements and restricted physical interactions before and after the event. Additionally, the scope of the study did not delve into the practical challenges faced by recovery authorities in implementing their legislative responsibilities, eliminating the causes of why certain actions were not taken post-disaster.

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7 CHAPTER: Cross-Case Comparison of Factors Influencing Recovery in Kumeū-Huapai and Henderson Valley

Abstract

Natural disasters are increasing globally, interrupting daily life functions and destroying communities' infrastructures, which takes communities months to recover from high-impact weather events (HIWeather). This chapter presents a cross-case comparison of post-disaster recovery in two Auckland communities – Kumeū-Huapai and Henderson Valley, following the August 2021 HIWeather events. Addressing Research Question 3, the chapter examines similarities and differences in recovery experiences across key factors, including communication, preparedness, social capital, governance, infrastructure, and resource access. A comparative analytical framework supported by the Hierarchical Decomposition System (HIDECS) approach is used to synthesise findings from both case studies. The findings indicate that recovery outcomes are influenced by a combination of communication effectiveness, access to resources, community cohesion, and institutional support. While both communities experienced shared challenges in communication, governance clarity, and resource coordination, notable differences emerged in preparedness levels, strength of social capital, and infrastructure constraints. Henderson Valley demonstrated stronger community cohesion and reliance on informal communication networks, whereas Kumeū-Huapai exhibited lower preparedness and greater dependence on formal recovery systems. The comparison further highlights that community, and institutional capacity and capability can both enable and hinder recovery outcomes. Strong community capacity supported rapid response and mutual aid, while limitations in institutional capability hindered recovery effectiveness and prolonged disruption. Overall, the findings show that recovery is shaped by both shared systemic challenges, and context -specific factors, including geography, infrastructure dependency, and existing social networks. This chapter provides a structured comparison that informs the broader discussion of recovery effectiveness and resilience in Chapter 8.

Keywords: cross-case comparison, Capacity Building, Community Perspectives, Factors Influencing Recovery, HIDECS Methodology, Post-disaster Recovery.

7.1 Introduction

This chapter presents a cross-case comparison of post-disaster recovery of two Auckland communities - Kumeū-Huapai and Henderson Valley, following the August 2021 HIWeather event. Reflecting on individual case study findings in Chapters 5 and 6, this chapter addresses Research Question 3; What are the similarities and differences between community groups in perceiving factors influencing disaster recovery?

The purpose of this chapter is to synthesise findings across both case studies and to identify key similarities and differences in recovery processes. The comparison focuses on six key factors: communication, preparedness, social capital, governance, infrastructure and environmental context, and resource access. These factors provide a basis for examining how recovery is experienced at the community level and how different contextual conditions shape recovery outcomes.

A comparative analytical framework is used to organise and present findings across the two cases. This approach enables a systematic comparison of recovery experiences, highlighting both shared challenges and context-specific variations. While both communities were affected by the same HIWeather event, their recovery journeys differed due to variations in geography, infrastructure dependency, and existing social and institutional capacities.

It is therefore important to note that this chapter focuses on comparative findings rather than interpretation. The aim is to clearly present similarities and differences between the two communities, without extensive theoretical explanation. Broader interpretation, discussion of implications, and integration with disaster recovery literature are explored in Chapter 8.

This chapter will apply the HIDECS approach, which utilises quantitative and qualitative data to break down complex problems into a hierarchical structure. This approach, along with supporting survey and workshop methodologies, will assist in conveying the perspectives of the affected communities. The HIDECS methods assist in understanding the issues and challenges the affected communities face. This allows for a comprehensive understanding of the interconnections between variables and characteristics that helps one to understand the relationships among multiple factors at play (Potangaroa *et al*., 2023).

Overall, this chapter provides a structured comparison of recovery experiences, establishing a foundation for understanding how community and institutional capacity and capability shape recovery outcomes across different contexts.

7.2 Methodology

This chapter adopts a cross-case comparative approach to examine similarities and differences in post-disaster recovery between Kumeū–Huapai and Henderson Valley. The analysis draws on findings from Chapters 5 and 6, which utilised a mixed methods approach comprising interviews, surveys, workshops, and document reviews.

The comparison is guided by the Hierarchical Decomposition System (HIDECS), which enables complex recovery systems to be broken-down into key analytical components. In this study, HIDECS is applied to structure recovery into core factors, including communication, preparedness, social capital, governance, infrastructure, and resource access**,** allowing for consistent comparison across both case studies.

These themes were derived from the thematic analyses conducted in each case and provide a structured basis for identifying shared patterns and context-specific differences in recovery experiences. The use of HIDECS supports a systematic comparison by linking community-level experiences with broader recovery system components.

This chapter presents comparative findings only, while interpretation, theoretical integration, and implications are explored in Chapter 8.

7.2.1 The Workshop Activity

A workshop was held on Saturday, August 20, 2022, with six members of the Kumeū-Huapai community. Followed by another workshop on September 10th, 2022, with 12 members of the Henderson Valley community. This occurred approximately one year after the August 2021 floods that affected both communities.

During the workshops, conversations were recorded on a recorder device during each activity and later transferred for storage on the One Drive Cloud. A linkage exercise was done in activity one to identify the factors that influence their community to recover from HIWeather events. The representatives (residents/workers) from Kumeū-Huapai and Henderson Valley communities completed a linkage exercise. Participants were briefed on what was expected to be done in the exercise by a PowerPoint pictorial demonstration of an example found in (Alexander, 1962) article on HIDECS mapping activity that was done in Myanmar (Potangaroa *et al.*, 2023). The activity was explained and demonstrated so that participants were able to attempt the exercise.

In this exercise, each workshop participant listed 10 -15 factors that influenced their recovery after the August 2021 flood on the right side of a sheet of paper, then copied those same factors on the left-hand side of that same sheet of paper. Although the participants were asked not to think about it, this activity requires deep thinking. Some participants could not list all ten factors that influenced their community to recover. Instead, some only listed the most important factors they could think of. Participants who listed less than ten factors listed only those they could think of during the activity and others due to a lack of deep thinking during the workshop.

As participants listed their factors on each side, they then drew a line from the right to the left to identify the perceived linkages between the listed factors. Linkages were explained to be factors impacting one another (Alexander, 1962). Once the factors were linked, a simple ‘mapping’ output or spider’s web diagram, like that produced by (Potangaroa et al., 2023), was produced for this exercise, as shown in (Appendix 11.6 - Kumeū-Huapai, KH – Sheet 4, HIDECS results – Access to funds). The figure showed that participants’ web-mapped ideas were entered into the HIDECS tool, and results were mapped like a family tree structure, highlighting a main factor that influenced a community member’s recovery in Kumeū-Huapai. The figure below shows the web-mapped ideas of a systematic family tree breakdown structure. The listed words or statements are key issues identified by the participants as factors that influence their recovery.

It cannot be stated enough that the results are based entirely on the perception of the workshop participants. This exercise aimed to ascertain the factors that they perceive would influence recovery. This activity led the researcher to discover these communities' core problems post-disaster. Once materials were collected from activity one of the workshops, the data was scanned and manually entered the HIDECS software.

7.2.2 HIDECS Algorithm and How it Works

HIDECS is an algorithm for breaking down interconnected problems into a family tree-like structure with the most "connected" component at the top and the least one at the bottom. The process articulates a hierarchy without disruption to the variables used in the analysis, nor does it require changing aspects that do not need to be changed.

The HIDECS process follows the steps below (Alexander, 1962; Potangaroa *et al.,* 2023):

1) The key variables of the issues listed
2) This is duplicated on either side of the sheet
3) Lines are drawn between the variables from the list on the left to the right side of the sheet to link those connected variables.
4) Once completed, a "Graph" is drawn of the links and the nodes (the characteristics), and the HIDECS process then starts by finding where that graph can be split into two separate data sets. If the links are seen as having some "statistical correlation between the variables," then the best split should be where there is a minimal correlation.
5) The correlation is measured by the algorithm developed by Alexander (shown below)

$$STR = \frac{RR - \left(\frac{total}{NSQ1}\right)MN}{\sqrt{\mathrm{MN(NSQ1 - MN)}}} \qquad INFO = (STR)(|STR|)$$

Where
'RR' is equal to the number of links that would be cut if graph was split.
'Total' is equal to the total number of links in the graph,
'NSQ1' equals the maximum possible number of links for the graph,
Namely n(n-1)/2 where n+ the number of requirements,
'M' equals the number of requirements in one of the split sets.
'N' is equal to the number of requirements in the other split sets, 'MN' (M x N) is equal as prior listed. Finally, INFO is the algorithm measuring the strength of a proposed split within the requirements. This is calculated for each possible graph split, with the weakest (lowest value) being taken as the split, resulting in two subsequent datasets. The decomposition process is repeated until there are no more differences in strength or just one variable/ characteristic as the most connected node.

Notwithstanding, this approach is a unique and innovative approach that helps make sense of wicked problems in chaotic situations (Potangaroa et al., 2023). The HIDECS approach has rigor and is repeatable in analysing the factors influencing recovery in these case study communities. Christopher Alexander developed this approach to break downlinked factor maps in 1962 systematically. It contributes to advancing knowledge in hydrology and disaster management scholarship by allowing researchers to contribute to other existing bodies of literature. This can be done by exploring new methodologies for assessing and understanding the issues underlying the impacts of HIWeather events.

7.3 Cross-Case Comparison Matrix

To examine similarities and differences in post-disaster recovery experiences across the two case study communities, a comparative framework was developed based on key factors identified in Chapters 5 and 6. These factors include: communication, preparedness, social capital, governance, infrastructure, and access to resources. These factors represent the main aspects influencing post-disaster recovery outcomes in these two West Auckland communities.

The framework enables a structured comparison of how each community experienced recovery following the August 2021 HIWeather event (see Table 7.1). It also highlights how variations in local context, including geographic conditions, infrastructure dependency, and existing community networks, shape recovery processes. Table 7.1 summarises the comparative findings across both communities.

Table 7.1: Cross-Case Comparison of Recovery Factors.

Number of Factors	Recovery Factor	Kumeū–Huapai (peri-urban)	Henderson Valley (semi-rural)
1	**Communication**	Dissatisfaction with formal communication; limited early warning	Strong reliance on informal, community-led communication. For e.g. Community Facebook Page for Response and recovery information. Local emergency community hub led by the HVRA to coordinate emergency relief and recovery resources
		Little to no engagement with authorities	Gaps in formal communication;
2	**Preparedness**	Low awareness of disaster resilience and recovery plans	Limited awareness of exposed areas and community risks in some areas
		No existing recovery, response or disaster resilience plan	No existing resilience or recovery plans. Presence of community-led emergency guide; stronger local preparedness

3	**Social Capital**	Moderate community cohesion; reliance on authorities	Strong neighbourhood bonding; high levels of mutual support and community response. For e.g. Frequent Community Family Days
4	**Governance / Role Clarity**	Limited understanding of recovery roles and responsibilities	Similar lack of clarity across recovery phases
5	**Infrastructure / Environmental Context**	Low-lying, flood-prone environment; repeated flood exposure	Valleys and steep hills environment, flood-prone, areas with evident landslides/or scars. Landslides prolonged road access disruption. For e.g., Mountain Road closure for approximately 8-months
6	**Resource Access**	Financial constraints, including insurance-related challenges	Constraints related to infrastructure access for several months, and delayed resource coordination, mainly to remove landslide or flood-related debris from access areas

Source: The Researcher, 2026.

The table highlights both similarities and differences in the community's recovery experience. The comparative matrix shows shared challenges and distinct differences in how recovery factors unfold in each community.

7.4 Comparative Findings Across the Two Cases

7.4.1 Communication

Communication was identified as a critical factor influencing post-disaster recovery in both Kumeū–Huapai and Henderson Valley. However, differences were observed in how communication functioned in practice across the two communities.

In the community of Kumeū–Huapai, communication challenges were primarily associated with dissatisfaction with formal communication systems, including limited early warning, delayed updates (including follow-ups), and insufficient engagement from recovery authorities. Residents expressed the need for clearer, more proactive communication before and after the event to support preparedness and recovery actions. In contrast, Henderson Valley demonstrated a stronger reliance on informal, community-led communication networks, which played a key role in supporting response and recovery activities. Community platforms, such as local social media groups and networks, were used to share information, coordinate assistance, and identify available resources. These informal systems helped to partially compensate for gaps in formal communication from authorities.

Despite these differences, both communities faced limitations in institutional communication, particularly with clarity, timeliness, and coordination across agencies. This indicates that while

communication was universally recognised as important, its effectiveness varies depending on the presence of strong community networks and the extent of engagement with formal recovery authority systems.

To that end, the comparison shows communication in both communities was characterised by a combination of shared challenges and context-specific adaptations, with Henderson Valley demonstrating greater reliance on community-driven communication, and Kumeū–Huapai highlighting greater dependence on formal communication from recovery authorities.

7.4.2 Preparedness and Community Knowledge

Preparedness and community knowledge differed across the two case study communities, influencing how effectively residents responded to and recovered from the August 2021 HIWeather event.

In Kumeū–Huapai, preparedness levels were relatively low, due to limited awareness of disaster, resilience, and recovery plans. Survey findings indicated that many residents were unaware of existing plans or lacked clarity on what actions to take during and after a disaster. This suggests that preparedness mechanisms were either not well communicated or not effectively rooted within the community. In contrast, Henderson Valley demonstrated a higher level of community preparedness, supported by the presence of their community-led emergency guide. This resource provided practical information on response actions, contact points, and community coordination, enabling residents to respond more effectively during the event. The existence of this guide reflects a more proactive, locally driven approach to preparedness.

Despite these differences, both communities showed gaps in institutional preparedness, particularly in awareness of formal recovery structures and their respective responsibilities. While Henderson Valley demonstrated stronger local preparedness, institutional-level knowledge of recovery systems remained limited in both cases.

Overall, the comparison highlights that preparedness is influenced not only by the existence of plans but also by community awareness – building capacity and capability, information accessibility, and local ownership of preparedness initiatives.

7.4.3 Social Capital

Social capital was evident in both communities but differed in its strength and in its role in supporting recovery.

In Henderson Valley, social capital was a strong defining feature of the recovery process. The Henderson Valley community had a higher level of bonding, where the ‘knowing your neighbours’, mindset was the prevailing mood. Strong neighbourhood networks enabled rapid mobilisation of support, including resource sharing, welfare checks on vulnerable residents, and coordinated community-led response actions. These networks functioned as an immediate support system, allowing residents to ‘get there first’ respond effectively in the absence of timely external assistance. The presence of established community relationships and regular local engagement contributed to a high level of trust and collective action. In contrast, Kumeū–Huapai demonstrated more moderate levels of social capital, with less emphasis on community-led coordination. While community members did support one another,

recovery efforts were more reliant on external support from recovery authorities. This suggests that internal community networks in Kumeū–Huapai were less developed or less mobilised compared to Henderson Valley. Despite these differences, social capital played an important role in both communities by facilitating information sharing via social media pages and providing support during the recovery process. However, the extent to which communities could rely on their own networks varied significantly.

In summary, the comparison indicates that stronger social capital was observed in Henderson Valley. This contributed to more immediate and coordinated local response efforts in the Valley, while lower levels of cohesion were seen in Kumeū–Huapai, which was associated with greater dependence on institutional recovery systems.

7.4.4 Governance and Role Clarity

Governance and role clarity emerged as a shared challenge across both Kumeū–Huapai and Henderson Valley, affecting the coordination and effectiveness of recovery processes.

In Kumeū–Huapai, residents expressed uncertainty regarding the roles and responsibilities of recovery authorities at local, regional, and national levels. This lack of clarity contributed to misaligned expectations, particularly regarding communication, service delivery, and recovery planning. As a result, residents were often unsure of whom to contact or what support was available during different stages of recovery. Similarly, in Henderson Valley, findings indicate that many residents were unclear about which organisations were responsible for recovery activities across short-, medium-, and long-term phases. Although some awareness existed in this community regarding the role of the Auckland Council, there was limited understanding of the recovery authorities' roles and responsibilities, and the coordination between agencies.

Regardless of the presence of formally defined governance structures, both communities experienced a disconnect between institutional arrangements and community understanding. This suggests that governance systems, while established at an organisational level, were not effectively communicated or operationalised at the community level.

In summary, the comparison indicates that challenges related to governance and role clarity were consistent across both communities, contributing to fragmented recovery processes and limiting the ability of residents to engage effectively with recovery authorities.

7.4.5 Infrastructure and Environmental Context

Here, both communities faced the same HIWeather event but with unique impacts. Infrastructure and environmental context played a significant role in shaping recovery outcomes in both communities, with notable differences in the type and impact of disruptions experienced**.**

In Kumeū–Huapai, the community is located within a low-lying flood-prone environment, with repeated exposure to flooding events affecting residential properties, roads, and community assets. This recurrent flooding increased the community’s vulnerability and placed sustained pressure on infrastructure systems, requiring ongoing recovery and mitigation efforts. In contrast, Henderson Valley

experienced compounded hazard from landslides, leading to excessive riverine flooding, as debris blocked the river channel and flooded roads. This, along with prolonged road access disruption from the slip, resulted in the closure of key access routes, particularly Mountain Road. This significantly affected mobility within the community, limiting access to essential services, employment, and education for approximately 8 months. These and other infrastructure disruptions, such as destroyed bridges to residential properties, created additional challenges for recovery, as physical isolation constrained both response and recovery activities.

While both communities experienced infrastructure-related challenges, the nature and severity of these disruptions differed. Recovery in Kumeū–Huapai was shaped by repeated flood exposure within a low-lying environment, whereas Henderson Valley's recovery was more heavily influenced by geographical constraints and infrastructure dependency, particularly in relation to road access.

Overall, the comparison highlights that environmental and infrastructural conditions and or context are key determinants of recovery, influencing not only the scale of impacts but also the duration and complexity of recovery processes across different communities.

7.4.6 Resource Access

Resource access influenced recovery in both communities, though the nature of these constraints differed across Kumeū–Huapai and Henderson Valley.

In Kumeū–Huapai, resource-related challenges were primarily associated with financial constraints, particularly regarding insurance affordability, funding for recovery, and the cost of mitigation measures. Residents expressed concerns about increasing insurance premiums and the financial burden of repairing damaged properties and assets. These financial pressures post-disaster limited the ability of some households to recover efficiently and to invest in future preparedness. In contrast, Henderson Valley experienced constraints related more to physical access of machinery and resource coordination to move debris and large displaced trees out of the riverbanks, their property or the road infrastructure. Infrastructure disruptions, particularly road closures and restricted access routes, limited the movement of people, services, and recovery resources into and within the community. This created delays in response and recovery activities, as external support and essential services were not always readily accessible.

As a result of these differences, both communities experienced limitations in accessing recovery support – delayed response or slowed recovery, whether financial or physical. These constraints affected the timeliness and effectiveness of recovery efforts, highlighting the importance of both resource availability and accessibility in post-disaster contexts.

Overall, the comparison indicates that while resource constraints were present in both communities, Kumeū–Huapai was more affected by financial and insurance-related pressures, whereas Henderson Valley faced greater challenges related to infrastructure access and resource delivery.

7.5 HIDECS Findings – Factors Influencing Recovery

7.5.1 Factors that Influence the Recovery Process in Kumeū-Huapai

The results from the HIDECS approach identified factors that influence recovery but also showed many complex problems faced in the post-disaster recovery period.

For the Kumeū-Huapai community, several (social, economic, and physical) factors influenced their recovery. Some factors mentioned in the findings encouraged recovery and some hindered recovery. By encouraging recovery, we mean positively influencing recovery effectively and efficiently so communities can bounce back post-disaster. By hindering recovery, we mean negatively influencing recovery, in that recovery becomes prolonged or delayed and takes a long time for community members to bounce back forward.

The Kumeū-Huapai community had six data sheets from each workshop participant (See Appendix 11.6 sheets 1 - 6). The HIDECS study showed the following factors that influence their recovery post-disaster. Four main factors influenced this community's recovery: (1) communication (with recovery authorities/council support, insurance agencies, community members' initiative), (2) insurance and access to funds, (3) Council support, and (4) loss and mitigative solutions.

One main finding from the HIDECS activity was the lack of clear communication among stakeholders and the community. The findings showed a connection with the lack of communication regarding repair work and prolonged recovery (see Appendix 11.6).

7.5.1.1 Communication

In the Kumeū-Huapai community, the 'communication' issue was one factor mentioned in the HIDECS linkage exercise (see Appendix 11.6). Residents spoke about communication issues concerning (a) the causes of the flood and the lack of feedback from recovery authorities. (b) A lack of inter-agency communication among recovery authorities. (c) A lack of communication about lifeline utility service restoration. (d) A lack of communication regarding data that should be collected for insurance companies, the repayment turnover time, and having access to funds after the event. (e) Limited communication with landlords about property restoration and the uncertainty of the property habitability status after the flood event.

Another factor that linked with communication was the community taking initiative regarding their preparedness and plan of action post-disaster. It also includes families acting and having a plan to know how to function post-disaster.

One resident said,

> "*The Council can do so much according to their resources and capacity, but it is also our responsibility, as residents, to take our own initiatives to prepare well before a flood happens and not solely depend on the authorities to help us."* Taking initiative, according to the participants, also means communication among citizens, the Council, and emergency management authorities.

Survey data also showed that there were gaps in communication about knowing how to answer questions relating to 'where, who, what, and how' before and after a disaster. However, the survey data showed that 45% of respondents had somewhat of an idea about what to do post-disaster, 34% had

somewhat of an idea about where to go, and 39% had somewhat of an idea about who to contact. What about the larger percentage of others who do not know what to do, where to go, and who to contact post-disaster? How is this information communicated to them? Survey data also reveals that resourceful documents on disaster management were not well communicated before the August 2021 Flood event. Figure 1 shows that most respondents were not aware of certain critical disaster management plans that should exist for a community that is prone to flooding. Research showed that there were no existing disaster emergency management plans or documents for the community before the August 2021 flood event (see Figure 7.1).

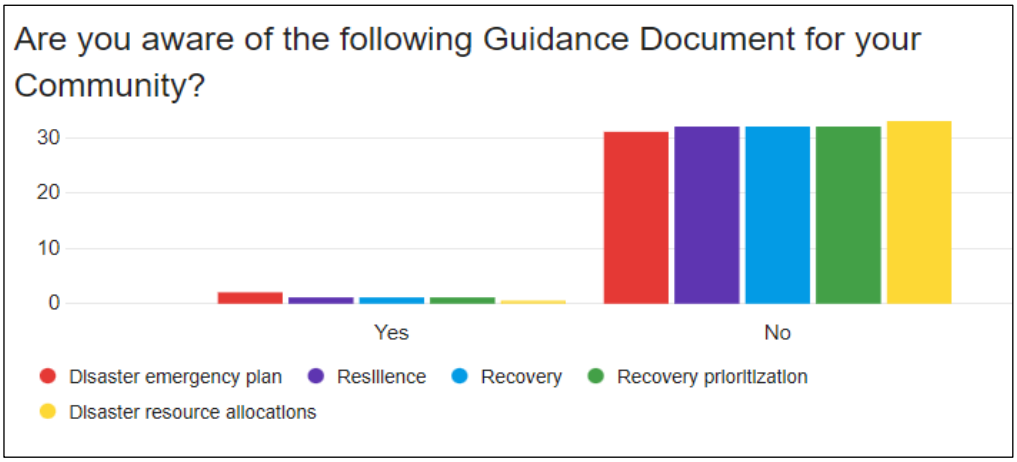

Figure 7.1: Kumeū-Huapai's Awareness of the Disaster Management Resources Available for their Community. Source: Survey Respondents, 2022.

7.5.1.2 Insurance & Access to Funds

The insurance mentioned here was linked to miscommunication. This factor hindered recovery, and there were reports of miscommunication between insurance agencies and residents. One participant relayed that *"there were a lot of unnecessary back-and-forth conversations and miscommunications that ended in delayed solutions."* The loss of assets such as cars made recovery more challenging. This frustration led to anger with the insurance's inability to deliver claims in a good time frame. If claims are produced in good timing, then this may assist with buying an alternative car, which would positively influence one's recovery post-disaster. The HIDECS method revealed that access to funds was an important factor influencing the Kumeū-Huapai community's recovery. This would encourage citizens to repair and replace damaged assets and recover faster.

7.5.1.3 Council Support

The second factor that stood out from the HIDECS linkage exercise was the lack of sufficient Council support. The data points to the ideology that Council support should be readily available for residents and workers in a community who need to access certain recovery services like repairs of damaged assets, drying solutions, where to go to seek help, restoring personal needs, and assistance with insurance claims. Instead, workshop participants mentioned that they were not warned about the potential magnitude of the flood.

One participant mentioned,

> *"Look, they predicted the floods years before this one, and yet nothing was done to mitigate it; they were just too slow to communicate with residents."*

They added,

> *"It would be a step in the right direction to start having meetings and consultations with the community, which was not done before the August 2021 flood event."*

The workshop participants also mentioned that there were not enough river clearing mitigative actions to clear drains before the weather event occurred. This also connects with a lack of communication from the Council before the August 2021 flood event to ensure that the community was prepared to face future disasters.

7.5.1.4 Prevention of Loss and Mitigative Solutions

The fourth factor was 'loss' which resulted from excess debris in the river. A suggested mitigative solution was to clear rivers and waterways. This includes minimising loss that contributes to prolonged recovery. Another factor that came out of this exercise was the problem of fear and worry of unknown factors and the repeat of the flood experience post-disaster. Data showed great concern about the lack of mitigation measures to prevent loss such as, the loss of assets, animals, and resources. Conversations from the workshop mentioned that this could have been avoided if adequate mitigative actions were made to clear the river.

> *"There would be very little impact if the river was cleared, and therefore reducing loss",*

said one member of the workshop. Other mitigation factors mentioned were reducing impermeable surfaces and clearing the river.

7.5.2 Factors that Influence the Recovery Process in Henderson Valley

For the Henderson Valley community, several (social, economic, and environmental) factors influenced their recovery. These factors mainly surrounded (1) communication, (2) human capital and (3) insurance. This activity not only identified factors that influenced recovery but also produced a myriad of wicked problems faced in post-disaster recovery. This community produced nine data sheets from each workshop participant (see Appendix 11.7 sheets 1 - 9). Some participants arrived late, so they were not included in this exercise.

7.5.2.1 Communication

Communication has been the main concern and guiding factor that can change how people recover in the Henderson Valley community. The majority, if not all, participant responses voiced their concerns about developing good communicative relationships between 1. community people with community people, 2. community people and recovery authorities, and 3. recovery authorities among themselves (which includes insurance agencies, utility partners, and key emergency management responders) (see Appendix 11.7).

> For the latter point, one workshop participant said, *"The authorities don't seem to talk to each other; no one seems to communicate nowadays; I think everyone is just doing their own thing."*

The issue in Henderson Valley is that there has been very little communication between recovery authorities and the community before impending hazards and after. Communication issues were identified from HIDECS results (See Appendix 11.7, sheets 1-7) and survey data. This tells a story that

there are some gaps in communicating about who does what, who goes where, and what resources are available before, during, and after a disaster.

Survey findings identified that there was somewhat of an understanding of who does what following a disaster. The survey findings for this community showed that 59% had somewhat of an idea about knowledge of what to do, 35% knew somewhat about where to go, and 41% of respondents knew who to contact if a high-impact weather event impacted their community.

The data shows that Henderson Valley has a higher percentage than the Kumeū-Huapai community regarding having somewhat of an understanding of communicating about who does what, who goes where, and what resources are available before, during, and after a disaster. This could possibly be due to Henderson Valley's existing community Emergency Management Document guidance document. We can see here that education through a preparedness document affects a community's awareness and knowledge, which builds capacity and capability. The lack of such communicative documents hinders a community's recovery through a lack of awareness. Furthermore, the non-existence of recovery guidance plans and resources further hinders recovery (International Recovery Platform, 2005).

With regards to communication, the survey asked about the awareness of residents regarding community guidance documents on disaster emergency plans, resilience, recovery, recovery prioritization, and disaster resource allocations (see Figure 7.2). Figure 7.2 shows that residents are mostly unaware of such documents for Henderson Valley. Figure 7.2 also depicts that over 20 respondents were aware of a Disaster Emergency Plan. In contrast, most respondents were unaware of other plans that would communicate disaster preparedness, response, recovery, and resilience. This community has an established Emergency Management Guide document developed by the community's Resident Association and endorsed by the Auckland Council.

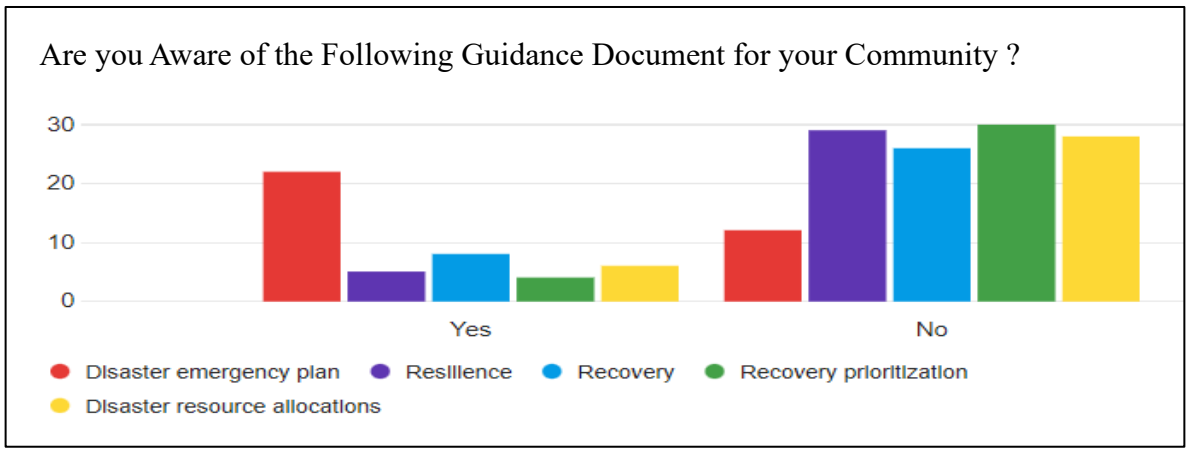

Figure 7.2 : Henderson Valley's Awareness of Disaster Management Resources Available to their Community. Source: Survey Respondents, 2022.

This data shows that there is poor Council communication within the community. From the workshop sessions, it was expressed that there seems to be a lack of understanding and willingness to serve the public's good.

One of the workshop participants expressed that

"There should be more active communication that must be in place before events happen. There should be some level of preparedness that involves proper planning before a disaster event".

It was also pointed out at the workshop that there is a need for further communication among community folks, as this is needed to build trust among residents, suppress PTSD and trauma and build strong social relationships within the community.

The HIDECS data also showed a communication gap between utility providers and the community. Without lifeline utilities after a disaster, recovery becomes a long haul (Cretney, 2016; Mcnaughton, Elizabeth., Wills, Jolie., Lallemant, David., Griffin, Holly., and Banfield, 2015). It is important to note that community members voiced that there needs to be a central system that sends out emergency mobile alerts to communicate to the affected population so that people are aware of the potential disaster and act before much damage is done.

7.5.2.2 Council Support

The data showed communication issues around Council Support. Workshop conversations voiced that there was a brief presence from the Council post-disaster. A member of the Local Board Residents requested that Council support the community after the storm event. This was reported to be a challenge for Council staff, as people were working from home, during level four lockdown.

Data also showed that there is a need for communication, training and capacity-building sessions that should prioritise communicating land ownership duties post-disaster. This communication should be made clear, so that community members are aware about their responsibility to address certain needs related to the repair and recovery of their environmental and infrastructural assets.

Workshop participants mentioned that it would be needful if Council could hold education sessions in the community. That is to get into the community to form a relationship with the people, build trust to offer recovery support, especially for the vulnerable, prepare the community for these events, and ensure that people know where recovery support services can be found. This also highlighted that the Council should offer emergency management services to support the needs of the community such as getting access to certain recovery services related to financial recovery grants, mental health support, and general safety of the environment.

7.5.2.3 Social Capital

Social capital seems to be an integral part in the recovery process. Appendix 11.7, (Sheet 8), showed that having a neighbourly bond and communicating with neighbours before a disaster event is critical to recovering from disasters. The HIDECS study found that mental health is connected to the needs of the family. It is important to meet the needs of the family by protecting one's mental space. This is critical to one's wellbeing. Making connections within the community can also provide access to the necessary resources that are needed to help people recover post-disaster. Having a community who is knowledgeable about the impacts of a disaster and is knowledgeable about where to go for recovery services, and resources is important to the community's recovery. To recover well, the community requires a strong support system, even in the event of a pandemic lockdown.

The data also revealed that this community had a strong social capital (bonding and linking). This was revealed by their connections via social media, community meetings and community functions that provide a support system and a space to build trust. The community provided very strong support for

each other who have been impacted by the weather events. Workshop discussions showed that they made connections amongst themselves before, during and after the disaster occurred. This strengthened the relationship that the community has, even in the wake of the pandemic. This is proven resilience and shows the community's ability to absorb and successfully recover from a shock and adapt successfully to make a community more secure (Neeraj, 2021), through its adaptive capacity during the intermediate to long-term phase of recovery.

7.5.2.4 Insurance

Communication with insurance companies was highlighted so that adequate follow-ups and updates can be relayed to community members so that they can cope better during the recovery phase. The data shows that there is a communication gap between insurance agencies and community members. This creates space for isolation between recovery stakeholders and the community. The data revealed that good communication is needed among insurance, EQC agencies, and the community. If there is a good flow of communication among neighbours and insurance agents, the concerns of the community will be considered, therefore helping residents recover well from disasters.

7.6 Implications for Practice and Policy

7.6.1 Recommendations for Disaster Management Practitioners

Based on these factors that influence community recovery, the following recommendations may be applied in practice. It is recommended that recovery authorities build genuine relationships between themselves and community members which include (iwi leaders, key Māori partners, local groups) (Campbell *et al.*, 2021), first responders, and other recovery stakeholders. This encourages communication and establishes trust. According to the Auckland Anniversary Flood Review Report (Bush International Consulting, 2023), this supports the view that it is essential that whānau, hapū and iwi are involved in response and recovery, as there should be engagement based on partnership built on mutual respect and shared values.

It is recommended that the Council, Auckland Emergency Management Group, and Local Boards build capacity and capability through scenario training. That is training among themselves with first-response agencies and with key community groups. This is to ensure that all understands their roles before a weather event takes place.

It is pertinent to mention that the August 2021 flood event that impacted sections of Auckland, including Kumeū-Huapai and Henderson Valley, seem to have been counted as a 'training' ground, for the Auckland Emergency Management Staff according to Bush's report. This finding suggested that the emergency management team needed both field and tabletop-based scenario training in partnership.

Regarding access to resources, we recommend that the AEM hold frequent capability-building hui with community groups to inform them about ways of accessing possible emergency funds and other emergency resources that can be available post-disaster.

It is recommended that the AEM host education and training sessions to be implemented to build resilience and enhance disaster preparedness and response. They could consider sessions on understanding risks and how residents can prepare for disasters for example, by creating a community recovery plan that is unique to each community.

It is recommended that human resources be dedicated at a micro-level to send alerts on community social media pages. The AEM may consider working with key community influencers to encourage majority participation in emergency management planning from community members before, during and after events. This way, information can be communicated on the community's social media page to assist with decision-making.

It is recommended that a practical approach be taken to maintain stormwater infrastructure and clear riverways from debris. Residents should be made aware by clear communication of their responsibilities on their private property and the Council's responsibility for public properties where riverways are located.

7.7 Conclusion

7.7.1 Summary of Findings

The cross-case comparison highlights both shared challenges and context-specific differences in recovery experiences across Kumeū–Huapai and Henderson Valley. While both communities experienced limitations in communication, governance clarity, and access to resources, key differences emerged in levels of preparedness, the strength of social capital, and the nature of infrastructure disruptions. These findings demonstrate that recovery outcomes are shaped by both systemic factors and local contextual conditions, providing a foundation for further discussion in Chapter 8.

Indeed, there is no one-size-fits-all community recovery approach (David Morley, 2014), as each community's needs are unique. For this reason, communities require adequate attention, resources, and prioritization from recovery authorities before weather events strike (International Recovery Platform, 2005). However, similar factors that affect recovery concerns were effaced from the HIDECS findings, including communication, Council support, resource access, human capital, and mitigative solutions.

The research highlighted the need for good communication and establishing partnerships, better preparedness, strong social capital, and building capacity so that residents understand governance systems and processes to enable good coordination post-disaster to access resources when necessary. In both communities, these findings show that good communication is lacking between recovery authorities and communities. This shows that before the August 2021 flood event; there was no mention of any education and training or programmes that communicated critical information of floods to the at-risk communities. This relationship between Council and the community has resulted in hindered recovery for communities. Communities are therefore left with their own internal resources and human capital to assist them to recover post-disaster. This lack of community capability and capacity increases a community's vulnerability and hinders recovery to future disasters.

Further research is needed to monitor and evaluate subsequent impacts of high-impact weather events and how communities respond and recover from these events if recovery authorities have implemented the aforementioned factors. Several future research studies emerge from this paper. One is the need to prioritise community engagement by recovery authorities. This is to understand the perspective of how this engagement has changed their recovery experiences following a disaster. Another is the need for community education and training to be implemented in community disaster management, including scenario planning exercises. Lastly, further research on how well the approach to maintaining

stormwater infrastructures and clearing riverways has worked for the community following a disaster event.

Potential limitations of this study were considered. One was the workshop participants' low turnout from the Kumeū-Huapai community. Although the workshop event was advertised a month in advance on the community's Facebook social media page, personal invitations were sent to businesses from affected areas at the street stall session, but many people did not respond. This may have been due to political conflict between Council and disgruntled residents. It was mentioned at the workshop that people are weary of the lack of action and the lack of communication from the Council. This may have been due to an undeveloped relationship between the locals and the Council. (Bush International Consulting, 2023) report supports that there is generally an underdeveloped relationship between the locals and the Auckland Council. The low turnout could be attributed to a lack of a developed relationship with emergency management authorities. Although this sample size was small, the data captured was sufficient and has rigour.

Another limitation identified with the HIDECS methodology is that the 'the city is not a tree'. HIDECS can become overly ridged, with the subsets only divisible by two, which may oversimplify the complexities of disaster recovery dynamics. Furthermore, HIDECS is an evolving methodology, although created in 1962, and with computerised intelligence, its capabilities have excelled in usability (Potangaroa et al., 2023). Despite this, HIDECS still provides valuable insights, particularly when used in conjunction with other approaches. Combining HIDECS with other complementary methodologies could offer a more comprehensive analysis, which has the potential for future work.

8 CHAPTER: Discussion and Analysis

8.1 Introduction

Three years post-disaster, the August 2021 event in Auckland, this study provides a comprehensive examination of post-disaster recovery processes across two case study communities. Building on the findings presented in Chapters 4, 5, 6, and the comparative analysis in Chapter 7, this chapter moves critically interpret the results in relation to existing literature and the research questions guiding this study.

First, this research investigates how community involvement in validating flood data through geospatial technologies improves the accuracy of hazard mapping and supports the identification of exposed community assets. It further examines the role of these methods in informing recovery planning processes for affected communities. The study then explores the key factors influencing effective post-disaster recovery, including communication, preparedness, social capital, governance, and infrastructure/environmental context, and resource access. Overall, the findings showed dominance given to how communication and the lack thereof can either hinder or facilitate recovery outcomes.

This chapter also examines how communities can plan effectively for recovery through community-authority relationships, that is, community partnerships with recovery authorities, contributing to long-term resilience. In doing so, it integrates findings across the case studies to assess how recovery processes are shaped by both community-level dynamics and institutional systems.

The purpose of this chapter is threefold. First, it interprets key findings in relation to disaster recovery literature, identifying areas of alignment and divergence. Second, it explicitly addresses the research questions, including the role of community-led geospatial methods in supporting recovery planning (RQ2). Third, it presents the study's conceptual contribution through the Community-centric Recovery Umbrella Approach (CcRUA), including its positioning, application, and limitations.

Finally, this chapter is organised around key thematic areas—community involvement and geospatial technologies for decision making, factors influencing recovery, and recovery challenges—followed by a discussion of novelty versus confirmatory findings. It then operationalises the CcRUA framework, by giving a step-by-step practical application to HIWeather-affected communities and outlines practical implications for collaborative recovery planning within the New Zealand context.

8.2 Interpreting Key Findings in Relation to the Literature

8.2.1 Community Involvement and Geospatial Technologies

Chapter 4 explores a participatory approach to each community case study. The findings show how validation of flood data by the engaged and involved community resulted in accurate flood footprints. It should be noted that flood depth was not collected, only the flood boundary. This aligns with Research Question 2, whereby the comparison between the original council map versus the validated community flood map showed significant disparities. The council map had a more generalised flood hazard footprint, whilst the validated community map showed detailed mapped flood-inundated areas.

This allowed the researcher to quantify assets (building, population, and road network) exposed to flooding. The findings also suggest that involving community members can improve hazard mapping accuracy by allowing local communities to point to the boundaries of flood events. This does not only provide accuracy to flood boundaries and assets exposed but provides participation, engagement, inclusiveness, and empowerment and gives locals a sense of ownership and willingness to share their local knowledge and experience (Joy *et al.*, 2019; Srinurak and Sukwai, 2023; Bullen and Miles, 2024; Ibrahim, Kuuire and Kepe, 2024). Inclusive, participatory planning is a significant aspect of community involvement that should not be ignored but included to give credence to official data (Bullen, 2024; Ibrahim, 2024). Each community is knowledgeable about the impact of the disaster event in their locality, so it is best suited to have dialogue with the affected residents (Joy *et al.*, 2019) so that specific information can be discovered (Srinurak, 2023).

8.2.1.1 Geospatial Methods in Recovery Planning

In recovery planning, the efficiency of using GIS and geospatial technologies for decision making has demonstrated its effectiveness in visualizing flood impacts and exposed assets (Kumar *et al.*, 2008; Joy *et al.,* 2019; Environmental Systems Research Institute, 2023), by community members verifying and validating those assets exposed to the flood event (Glas *et al.*, 2017). As mentioned in Chapter 4, this participatory GIS approach is an effective technique for obtaining information from affected populations and making important decisions (Joy *et al.*, 2019). This finding is consistent with the second research question by confirming that geospatial methods are useful and efficient tools for recovery planning, decision-making, and resource allocation (Glas *et al.* 2017) .

8.2.2 Factors Influencing Recovery

The study identifies multiple factors that influence community recovery from high-impact weather events, causing mainly flooding in Kumeū-Huapai, along with flooding and landslides in Henderson Valley community. The findings in chapters 5, 6, and 7 revealed that several critical factors in community recovery should not be ignored which include: Communication, preparedness, social capital, governance, and infrastructure and resources.

Among these identified in Chapters 5 is an NVivo-developed concept map from scoping interviews with Kumeū-Huapai residents. These critical factors include – communication and engagement, preparedness and planning, mitigative actions (floodway and river warning/alert systems) and environmental constraints, and a participatory approach or what was identified as community-authority relationship (i.e., involving local community and recovery authorities) to plan for community recovery.

Chapter 6 explores factors alike, however, with stronger factors influencing recovery towards communication, social capital, community knowledge of recovery planning, communicating with local communities and with other authorities, preparedness by risk transfer (i.e., acquiring and reading through insurance policies), and preparedness by having recovery plans in place.

Based on the comparative and HIDECS study in Chapter 7, highlights communication, access to resources, government support, and community cohesion as critical factors that influence recovery. Though unique to each community, these factors share one theme: a participatory approach through communication with recovery authorities and local communities. This validates that multifaceted

approaches to keeping the community at heart are necessary for a successful recovery (Campbell *et al.*, 2021; Bush International Consulting, 2024; Elkady *et al.,* 2024).

8.2.3 Communication

Communication, or the lack thereof, emerged as a dominant factor influencing post-disaster recovery across both case study communities. While communication challenges were evident in Chapters 5 and 6, they were particularly pronounced in the Henderson Valley case, where the role of communication in shaping recovery outcomes became more explicit.

The findings demonstrate that ineffective communication between recovery authorities and communities led to delays, confusion regarding roles and responsibilities, and unmet expectations. In both communities, residents reported uncertainty about what actions to take, whom to contact, and what support was available during different phases of recovery. This aligns with existing disaster recovery literature, which emphasises that poor communication undermines coordination, erodes trust, and delays recovery processes (Khan *et al.,* 2017; Vallance, 2011; Doyle and Becker, 2022). In contrast, where communication was clear, timely, and collaborative, recovery processes were more efficient and coordinated. In Henderson Valley, informal community-led communication networks, supported by strong social capital, played a critical role in bridging gaps in formal communication. This supports the findings of Aldrich (2012) and Skerratt (2013), who highlight that communities with strong social networks are better positioned to access, interpret, and act on information during disasters.

It is important to note that the findings extend the existing literature by demonstrating that communication is not just an institutional responsibility but a shared function between communities and recovery authorities. In the same breath of two-way communication (Doyle, and Becker., 2022) where communication is had between institutional and local stakeholders. While formal communication systems are essential, their effectiveness is significantly enhanced when complemented by strong community networks and two-way engagement. This highlights the need for communication strategies that are both top-down (institution-led) and bottom-up (community-driven). It is also noteworthy that these findings directly address Research Question 1 and 4 by showing how communication between residents and authorities and inclusiveness of engagement is a strong factor, measure and or option to promote effective recovery. Effective communication supports coordinated action, informed decision-making, and trust-building, whereas communication breakdowns contribute to fragmented recovery and prolonged disruption.

This study reinforces the central role of communication in post-disaster recovery while highlighting the importance of integrating formal communication systems with community-based networks to achieve more effective, resilient recovery outcomes.

8.2.4 Preparedness

Preparedness emerged as a critical factor influencing post-disaster recovery across both case study communities, reinforcing its central role in shaping recovery outcomes from the community's perspective. The findings indicate that preparedness extends beyond the existence of formal plans to include community awareness, engagement, and the capacity to act on available information.

Across both communities, residents highlighted the need for clear recovery action plans, early warning systems, and stronger engagement with recovery authorities. This aligns with disaster risk recovery literature, which emphasises that preparedness is most effective when it is embedded within a collaborative, community-based approaches in advance of the disaster event, rather than relying solely on top-down institutional planning (Ahmed, 2008; Campbell *et al*., 2021; Doyle, 2022; Elkady *et al.*, 2024; Vallance, 2011, 2015), and rather showing up at the event after damage has been done. Preparedness, therefore, is not only a technical function but also a social process, shaped by communication, participation, and shared responsibility between communities and authorities.

However, the findings also reveal a disconnect between preparedness frameworks and their practical implementation. In Kumeū–Huapai, limited awareness of disaster, resilience, and recovery plans suggests that preparedness mechanisms were not effectively communicated or internalised at the community level. In contrast, Henderson Valley demonstrated stronger local preparedness through community-led initiatives, such as the emergency guide, highlighting the effectiveness of locally driven and context-specific preparedness strategies.

These findings both confirm and add to the existing literature. In that, the research highlights the importance of preparedness in enhancing resilience (Ministry of Civil Defence and Emergency Management, 2019; Network Neighbourhoods Partnership, 2022), this study demonstrates that preparedness is most effective when it is co-produced with communities, rather than solely designed and delivered by institutions. This reinforces the importance of participatory approaches in disaster planning (Patterson, 2010; Trüdinger, 2024; Vallance, 2015), where local knowledge and community engagement contribute to more relevant and actionable preparedness measures.

Important to note here is that preparedness in this study is closely linked to community–authority partnerships, which were consistently identified as essential for building long-term resilience. Communities expressed a clear expectation for ongoing engagement, not just during disaster events but as part of continuous planning processes, which may extend after the event. This highlights that preparedness is not a one-off activity but a dynamic and relational process that evolves through sustained collaboration.

Altogether, these findings reinforce the role of preparedness as a key factor influencing recovery which links to Research Question 1. This also links to Research Question 4, in that, demonstrating effective preparedness mechanisms—particularly those grounded in partnerships and community engagement—are essential measures for improving recovery outcomes.

8.2.5 Social Capital

Social capital emerged as a critical factor influencing post-disaster recovery across both case study communities. This reinforces its importance in shaping community resilience and recovery outcomes. The findings showed that the presence and strength of social networks significantly affect a community's ability to mobilise resources, share information, and provide immediate support during and after disaster events.

In Henderson Valley, social capital was particularly pronounced, with strong bonding, enabling coordinated, community-led response efforts. Residents engaged in collective actions such as resource sharing, checking on vulnerable individuals, and disseminating information through informal networks. This aligns with existing literature, which emphasises that social capital enhances collective efficacy, trust, and the capacity for self-organisation in disaster contexts (Aldrich, 2012; Chandra, 2015). These findings support the argument that communities with strong social ties are better equipped to respond rapidly and adapt to disruptions.

In contrast, Kumeū–Huapai exhibited more moderate levels of social capital, with greater reliance on recovery authorities for coordination and support. While community members did provide mutual assistance, the findings suggest that local networks were less centralised and connected to organising recovery activities compared to Henderson Valley. This highlights how variations in social cohesion can influence the degree of community self-reliance and responsiveness in the post-disaster recovery context.

Notably, the findings add to the existing literature by demonstrating that social capital does not operate independently or insolation but interacts closely with other recovery factors, particularly communication and governance. In Henderson Valley, for example, strong social capital complemented informal communication systems, enabling communities to compensate for gaps in formal institutional support. However, the findings also indicate that social capital alone is insufficient if not supported by effective communication and clear governance structures. Without alignment between community networks and institutional systems, recovery efforts may remain fragmented.

These insights reinforce the understanding that social capital is a key determinant of recovery, which aligns well with Research Questions 1 and 4. Additionally, these insights also highlight that strengthening community networks and fostering collaborative relationships are essential measures for improving recovery outcomes.

In summary, the study demonstrates that social capital, when integrated with broader recovery systems, rather than functioning in isolation, enhances the effectiveness of recovery.

8.2.6 Governance

The research found that governance and role clarity were significant factors influencing post-disaster recovery across both case study communities. The findings indicate that while formal governance structures for disaster recovery are well established, there is often a disconnect between these institutional arrangements and community-level understanding and experience.

In both communities - Kumeū–Huapai and Henderson Valley, residents reported uncertainty regarding the roles and responsibilities of recovery authorities across different phases of recovery. This lack of clarity contributed to confusion about whom to contact, what support was available, and how recovery processes were coordinated. These findings align with existing literature, which highlights that unclear governance structures and poor role communication can hinder effective recovery by creating fragmentation and inefficiencies (Johnson, and Olshansky, 2017a; Smith, and Wenger, 2007).

The findings also reinforce the importance of multi-level governance coordination, where national, regional, and local authorities must work cohesively to deliver recovery outcomes. However, the study demonstrates that governance effectiveness is not solely dependent on institutional design but

also on how these roles are communicated and understood at the community level. This supports literature suggesting that governance systems must be both operationally clear and socially accessible to affected communities (Khan, *et al.*, 2017; Kwok, *et al.*, 2018; Vallance, 2015)

Important to note, the study adds to the existing literature by highlighting that governance challenges are not only structural but also relational. The lack of clarity observed in both communities was closely linked to limited engagement and weak communication between authorities and residents (Doyle, and Beacker 2022; International Recovery Platform, 2009; Vallance, 2015). This suggests that governance effectiveness is strengthened through ongoing interaction, transparency, and partnership, rather than relying solely on formal hierarchies and predefined roles.

Furthermore, the findings indicate that communities have expectations of governance systems that go beyond statutory responsibilities. Residents expected proactive engagement, clear guidance, and visible leadership during recovery. Where these expectations were unmet, there were reduced trust in recovery authorities, further complicating recovery processes.

All in all, these findings confirm that governance and role clarity are key determinants of recovery and clearly answer Research Question 1, while also demonstrating that improving governance through clearer communication, coordination, and community engagement represents an essential measure for enhancing recovery outcomes, further answering Research Question 4. The study highlights the need for governance approaches that are not only structured but also adaptive, transparent, and community oriented.

8.2.7 Infrastructure and Resources

Infrastructure and resource access surfaced as critical factors of post-disaster recovery, shaping both the speed and effectiveness of recovery processes across the two case study communities. The findings demonstrate that recovery is not only influenced by social and institutional factors but also by the physical environment and the accessibility of essential resources.

In Kumeū–Huapai, recovery challenges were closely linked to its flood-prone geography, where repeated flooding placed sustained pressure on infrastructure systems and community assets. Residents experienced ongoing disruptions to homes, roads, and essential services, highlighting the cumulative impact of environmental exposure on recovery capacity. In addition to this, residents experienced financial constraints—particularly those related to insurance affordability and rising premiums—further limited households' ability to recover efficiently and invest in mitigation measures.

In contrast, Henderson Valley experienced infrastructure challenges due to landslides and prolonged road closures, which significantly constrained mobility in and out of the community, and access to services. The closure of key routes, such as Mountain Road, created physical isolation, delaying both emergency response and longer-term recovery efforts. These findings underscore the importance of infrastructure connectivity for effective recovery, as limited access can restrict the flow of resources, services, and external support.

These findings align with existing literature, which emphasises that infrastructure systems and resource availability are fundamental to recovery processes, particularly in terms of enabling access to

services and supporting economic and social stability (Carrington, and Topp, 2023; National Institute of Standards and Technology, 2016; Smith, and Wenger, 2007). However, this study extends prior work by illustrating how different types of infrastructure disruption—flood exposure versus access isolation—produce distinct recovery challenges, even within the same regional context.

It must be noted that, the findings also highlight that resource constraints are multidimensional, encompassing both financial capacity and physical accessibility. While Kumeū–Huapai was more affected by financial pressures, Henderson Valley faced greater challenges related to the delivery and coordination of resources due to infrastructure mainly due to blocked road limitations. This distinction underscores the need for recovery strategies that are context-specific and responsive to local conditions, rather than adopting a one-size-fits-all approach.

In summary, the study answered Research Questions 1 and 4. Whereby, it confirms that infrastructure and resource access are key factors influencing recovery outcomes, while also demonstrating that improving infrastructure resilience and ensuring equitable access to resources are essential measures for supporting effective recovery. These findings highlight the need for integrated approaches that consider both environmental conditions and resource systems in recovery planning.

8.3 Challenges in Recovery Found in the Literature

Disaster-affected communities are riddled with challenges post-disaster involving the local community in disaster recovery efforts (Vallance, 2011). Challenges arise post-disaster a flood event, whether it is related to implementing a recovery plan, programme, or project.

Some of these challenges include – marginalised community voices – where communities are not engaged with in decision making for their own challenges faced post-disaster, and the lack of community engagement (Ahmed, 2008), the reluctance of the community to be engaged with and participate in the recovery process (Vallance, 2011), lack of proper communication (Bush International Consulting, 2023) erodes trust (Khan *et al.,* 2017) and a lack of partnership among agencies (Vallance, 2011). It must be noted that good communication improves trust (Khan *et al.,* 2017). Trust develops with empowerment through interactions with different agencies, ultimately influencing response and recovery post-disaster.

In Bangladesh, under the UNDP housing recovery programme, flood-affected communities used local materials and the local to rebuild houses post-disaster (Ahmed, 2008). Their recovery programme focused on cost-effectiveness. The recovery programme incorporated DRR into their repair and reconstruction process so that the community's physical assets were built better and protected from future floods. Despite this approach, some challenges were encountered. For example, one challenge encountered in post-disaster flood events within several communities in Bangladesh was the lack of willing community engagement (Ahmed, 2008). This compromised the quality of the resources and labour available to rebuild shelters for the affected population. The Partner NGOs (PNGOs) were the drivers for the community engagement, given their experience working directly with communities. Ahmed asserted that results varied depending on the level of engagement of different PNGOs. While the local PNGOs were closer to the community, the larger PNGOs had more resources and staff who could offer assistance for longer periods.

Certain communities often adopt a passive stance regarding engagement and express dissatisfaction about the lack of information provided when the responsibility should lie with the

communities to seek information and participate in recovery activities actively (Vallance, 2011). Vallance observes that one of the challenges impeding recovery is insufficient community participation. For instance, in the aftermath of severe floods in Grand Forks and East Grand Forks in 1997, Vallance noted that East Grand Forks implemented extensive citizen initiatives, resulting in high levels of citizen satisfaction. Conversely, Grand Forks adopted a more bureaucratic top-down approach, which led to changes in their government structure, a high turnover of elected and appointed officials, and more negative citizen evaluations.

However, one must consider the community's strengths and weaknesses (Patterson *et al.*, 2010). On the positive side, well-functioning community organisations (like in Henderson Valley) (Auckland Council, 2010; Henderson Valley Residents Association Inc, 2021) have the trust of their members and possess the moral authority to encourage cooperative behaviour and teamwork that authorities often lack (Patterson *et al.,* 2010). They have strong abilities to assess needs and distribute goods and services equitably. Therefore, observers stress the importance of including communities in disaster response and creating meaningful partnerships between communities and authorities. On the contrary, not all communities have established organisations or are willing to engage. Some communities want to maintain sustainability in that they do not become dependent on external sources of funding for recovery (Vallance, 2015). For instance, partnerships with government authorities may neutralise a community's potential benefits by undermining the independence and autonomy of community organisations. As a result, communities may act in an exclusionary way concerning non-community members (Patterson *et al.,* 2010).

Capacity building is a necessary approach that facilitates post-disaster recovery and rehabilitation (Murphy, 2007; Otsuyama, 2017; Campbell *et al*., 2021)Without it, recovery may be hindered. One such challenge of non-existent capacity building in communities is the lack of awareness, which may affect how a community prepares, responds to, and recovers from disasters (Fekete, 2017). With this in mind, building capacity takes a holistic approach (Arnold et al., 2014) that prepares communities for disaster events and make them more resilient. For example, with a capacity-building approach at the community level, local and international NGOs implement preparedness for Disaster Risk after Cyclone Nargis (Fekete, 2017). This was also true for the World Vision Myanmar (WVM), which implemented the Myanmar Disaster Risks Reduction (MDRR) Project in its locality. The project aimed to increase awareness, knowledge, and practices of the target communities on Disaster Risk Reduction (DRR) utilizing training and seminars and information, education, and communication materials of the Disaster Management Committees (DMCs) (Fekete, 2017). As a result, communities have identified evacuation locations in case of future events.

8.4 Addressing the Research Questions

8.4.1 Research Question 1: Factors Influencing Post-Disaster Recovery

This study set out to identify the key factors influencing post-disaster recovery from the community's perspective. The findings demonstrate that recovery is shaped by a combination of communication, preparedness, social capital, governance, and infrastructure and resource access, all of which interact to influence recovery outcomes.

Among these, communication emerged as the most dominant factor, influencing how communities access information, coordinate actions, and engage with recovery authorities. Where communication was clear and collaborative, recovery processes were more efficient. In contrast, breakdowns in communication resulted in confusion, delays - ‘a slowed recovery’, and unmet expectations. This reinforces the importance of communication as a central mechanism through which other recovery processes operate.

Preparedness was also identified as a key factor, particularly in relation to the presence of clear action plans and the level of community awareness. The findings show that preparedness is most effective when it is supported by strong community engagement and locally relevant planning, rather than relying solely on institutional frameworks.

Social capital further influenced recovery by enabling communities to mobilise support, share resources, and respond collectively to disruption. Communities with stronger social networks, such as Henderson Valley, were better able to coordinate immediate response efforts and support vulnerable members.

Governance and role clarity were also significant, as both communities experienced uncertainty about the responsibilities of recovery authorities. This lack of clarity limited effective engagement with recovery systems and contributed to fragmented recovery processes.

Finally, infrastructure and resource access played a critical role in shaping recovery, particularly when environmental exposure and physical access constraints affected service delivery and support. The findings show that recovery is influenced not only by social and institutional factors but also by the physical and economic conditions within which communities operate.

In summary, the findings demonstrate that post-disaster recovery is a multidimensional and interconnected process, in which no single factor operates in isolation. Instead, recovery outcomes are shaped by the interactions among these factors, underscoring the need for integrated, context-specific recovery approaches.

8.4.2 Research Question 2: Role of Community-Led Geospatial Methods

This study examined how community-led geospatial methods support the identification of exposed community assets for recovery planning. The findings demonstrate that integrating community knowledge with geospatial technologies enhances the accuracy and relevance of hazard mapping and exposure identification.

Using geospatial technologies to make decisions, the study identified community assets, vulnerable populations, and areas of repeated impact in both communities. However, the findings show that geospatial data alone is insufficient without community input. Community involvement in validating and interpreting spatial data provided additional context, ensuring that localised knowledge—such as informal infrastructure, frequently affected areas, and community-specific vulnerabilities—was captured. This approach improves decision-making by providing a more comprehensive understanding of risk, thereby better aligning recovery planning with actual community conditions. It also supports prioritisation of resources and targeted interventions, particularly in areas where data is not fully available.

The findings suggest that community-led geospatial methods act as a decision-support tool, bridging the gap between technical data and lived experience. By combining spatial analysis with community insight, recovery planning becomes more inclusive, accurate, and responsive to local needs.

In summary, this study demonstrates that community-led geospatial approaches strengthen recovery planning by improving exposure identification and supporting more informed and effective decision-making processes.

8.4.3 Research Question 3: Similarities and Differences across Communities

This study compared recovery experiences between two west Auckland communities - Kumeū–Huapai and Henderson Valley to identify similarities and differences in how communities perceive and respond to factors influencing recovery. The findings show that both communities faced common challenges, particularly in communication, governance, and resource access.

However, key differences emerged in the strength of social capital, levels of preparedness, and the nature of infrastructure constraints. Henderson Valley demonstrated stronger community cohesion and reliance on informal communication networks, enabling more coordinated community-led response efforts. In contrast, Kumeū–Huapai exhibited lower levels of preparedness and greater dependence on formal recovery systems. The environmental and infrastructural context also influenced recovery experiences. For Kumeū–Huapai, its low-lying, flood-prone setting near the Kumeū River led to repeated flooding, while Henderson Valley faced additional challenges due to its physical terrain, being situated in a valley and plagued by landslides and prolonged road access disruptions. These contextual differences shaped how recovery processes unfolded in each community.

In general, the findings demonstrate that while recovery is influenced by shared systemic challenges, local context plays a significant role in shaping recovery outcomes, highlighting the importance of tailored recovery approaches that reflect the specific conditions of each community.

8.4.4 Research Question 4: Measures to Address Recovery Challenges

This study identified several key measures to address the concerns and challenges the two communities face in post-disaster recovery. Central to these measures is the need for improved communication, stronger community–authority partnerships, and enhanced preparedness mechanisms.

The findings highlight that effective communication systems, including early warning systems and clear information pathways, are essential for supporting informed decision-making and coordinated recovery efforts. In addition, ongoing engagement between communities and recovery authorities is necessary to build trust and ensure that recovery processes are inclusive and responsive to community needs. Preparedness measures, such as the development of community recovery plans and locally relevant emergency frameworks, were also identified as critical. These measures enable communities to respond more effectively to future events and reduce vulnerability. Furthermore, strengthening social capital through community engagement and local networks supports collective action and resilience. At the same time, improvements in governance, including clearer role definitions and better coordination between agencies, are needed to reduce confusion and enhance recovery efficiency.

Finally, addressing infrastructure and resource constraints—both financial and physical—is essential for enabling timely and effective recovery. This includes improving infrastructure resilience and ensuring equitable access to resources and support.

Overall, the findings demonstrate that recovery measures must be integrated, collaborative, and context-specific, combining social, institutional, and technical approaches to support effective and sustainable recovery outcomes.

8.5 Novelty vs Confirmatory

8.5.1 Confirmatory Findings

This research confirms several well-established findings in the disaster recovery literature, particularly regarding the key factors that influence recovery outcomes. Consistent with previous research, communication emerged as a critical factor influencing recovery. The findings reinforce that effective, timely, transparent, collaborative, and two-way communication supports coordination, builds trust, and enables informed decision-making, while poor communication leads to confusion, delays – slowing recovery, and fragmented recovery processes (Aldrich, 2012; Doyle, and Becker 2022; Vallance, 2011).

Similarly, the study confirms the importance of social capital – community connectedness enhances community resilience and recovery. Communities with strong social networks were better able to mobilise resources, support vulnerable members, and coordinate response efforts. This aligns with existing literature, which highlights the role of trust, reciprocity, and collective action in improving recovery outcomes (Aldrich, 2012; Chandra, 2015; Cretney, 2016; Trüdinger, 2024).

Preparedness was also reaffirmed as a key factor influencing recovery. The findings support existing research that emphasises the importance of preparedness mechanisms for recovery planning: including early warning systems, building capacity and capability by increasing community awareness - this not only reduces vulnerability but improves recovery efficiency (Campbell et al., 2021; Cretney, 2016; Vallance, 2015). In addition, the study confirms that governance and role clarity are essential for effective recovery, as unclear institutional responsibilities can hinder coordination and limit community engagement (Cretney, 2016; Johnson, and Olshansky, 2017b; Smith, and Wenger, 2007).

In Summary, these findings demonstrate strong alignment with existing disaster recovery literature, reinforcing the understanding that recovery is influenced by a combination of social, institutional, and environmental factors.

8.5.2 Novel Contributions

While this study confirms several established findings, it also makes important contributions by extending existing knowledge and offering new insights into post-disaster recovery. First, the study highlights the role of community-led communication systems as a critical complement to formal institutional communication. In Henderson Valley, informal communication networks for e.g. the community-led Emergency Operation Centre led by the HVRA and residents, who coordinated resources in a pre-disaster and post-disaster context. This informal-localised structure enabled their community to respond effectively despite gaps in official communication. This extends the existing literature by showing that communication in disaster recovery is not only institutional but is strengthened through community-driven mechanisms, particularly in rural and semi-rural contexts.

Second, the study provides new insight into how different environmental and infrastructural contexts shape recovery outcomes, even within the same regional setting. The contrast between flood-prone conditions in Kumeū–Huapai and landslide-induced access constraints in Henderson Valley

demonstrates that recovery challenges are highly context-specific. This finding extends existing research by showing that recovery processes cannot be fully understood without considering localised environmental and infrastructural conditions.

Third, the study contributes methodologically by demonstrating the value of community-led geospatial approaches in recovery planning. By integrating community knowledge with spatial data, the research shows how exposed assets can be more accurately identified, improving decision-making and resource prioritisation. This extends the application of participatory geospatial methods beyond risk assessment into the recovery planning and decision-making phase, a less commonly addressed area in the existing literature.

Fourth, the study highlights the significance of community–authority partnerships as an operational mechanism for recovery, rather than treating them as a supporting element. The findings demonstrate that effective recovery requires sustained engagement between communities and institutions, moving beyond consultation toward stronger relationships that allow for inclusive co-production of recovery strategies.

Finally, the study introduces a new Community-centric Recovery Umbrella Approach (CcRUA) as a conceptual framework for understanding and improving recovery processes. The CcRUA originated from research findings that link the dominant emerging themes influencing post-disaster recovery. Unlike traditional recovery frameworks that are often institutionally driven, the CcRUA places communities at the centre of recovery, emphasising the integration of communication, partnerships, preparedness, and local knowledge. This provides a structured yet flexible approach that bridges the gap between policy and community-level implementation.

These contributions demonstrate that while existing theories provide a solid foundation for understanding disaster recovery, this study extends current knowledge and provided a new framework/approach by emphasising the importance of community-led processes, contextual variability, and integrated approaches to recovery planning and implementation.

8.6 Implications of Findings, What's New and So What?

The findings of this thesis have significant implications for disaster recovery, particularly regarding community engagement and the application of geospatial technologies. By involving communities, engaging them in hazard mapping, and assisting in validating flood data, the study provides credibility to hazard data, enabling users, particularly recovery and emergency management authorities, to identify exposed assets and vulnerable populations that can inform more intentional recovery planning.

Furthermore, the research underscores the importance of effective communication and partnerships between recovery authorities and communities to facilitate recovery processes and foster long-term resilience. These findings suggest that authorities could consider a more targeted, integrated approach to community recovery. It is imperative to note that there is a critical need to incorporate 'successful' community recovery solutions in New Zealand communities. So that communities can be informed, consult with authorities, get involved in recovery activities, collaborate on recovery planning, and be empowered. Integrating technical solutions with local knowledge can significantly improve disaster preparedness and post-disaster recovery strategies, particularly for HIWeather events.

8.6.1 What's New and So What?

The newness of this study was built on research findings and a robust methodology that showed how communities can be engaged with, from the embryonic stages utilising the Community-centric Recovery Umbrella Approach (CcRUA) (see Figure 8.1) toward recovery planning and building resilience. That is, communities partnering with authorities to provide options or 'solutions' to generate innovative recovery planning strategies, plans, and outputs. This allows local knowledge sharing following a high-impact weather event through geospatial technology, promoting collaborative governance and meaningful conversations between authorities and communities. This will ultimately nurture community cohesion, which is the icing on the cake of community resilience and improved communication among institutional and local stakeholders.

In Auckland, it is important to note that there is no standardised recovery plan for communities to adopt. Recently, the Auckland Council released a working paper titled 'Wellbeing Recovery Plan for Tamaki Makaurau', which aims to support the well-being recovery of individuals, whānau and communities in Auckland, in the context of the 2023 weather events (Auckland Council, 2024). The document focuses on the Wellbeing Recovery Plan for Auckland, with a specific scope to define 'well-being recovery' for communities. This includes coordinating the delivery of initiatives, supporting efforts across central and local government agencies, NGOs, and service providers, and taking a long-term perspective on health and well-being to ensure that communities impacted by the 2023 weather events have access to the support they need for effective recovery. Similarly, although looking at distinct aspects of recovery and with a different scope, this thesis attempts to provide a nuanced understanding of holistic community recovery (keeping community at the heart of recovery), focusing on community-centric recovery of infrastructure (buildings and road network) and population. The research proposed many useful options for post-disaster recovery, including creating a community recovery plan (see Chapters 5 and 6), which was among the top three responses for both case study communities.

To build long-term resilience, the CcRUA prioritises educating communities, scenario planning, and proactive mitigation measures facilitated by community recovery lead personnel. This lays the foundation for future disasters by preparing, adapting, and transforming recovery into an opportunity for resilience.

8.7 Operationalising - Community-centric Recovery Umbrella Approach (CcRUA)

The CcRUA provides a structured yet flexible framework for operationalising post-disaster recovery at the community level. As illustrated in Figure 8.1, the approach places communities at the centre of recovery, supported by four interrelated components: community-led geospatial mapping, two-way communication, collaborative governance, and social capital.

Unlike conventional recovery frameworks that are predominantly institutionally driven, the CcRUA adopts a bottom-up, participatory approach, while remaining aligned with international, national, and regional disaster risk reduction frameworks. It operates as an iterative and adaptive system, allowing communities and recovery authorities to continuously refine recovery strategies based on evolving conditions and lessons learned.

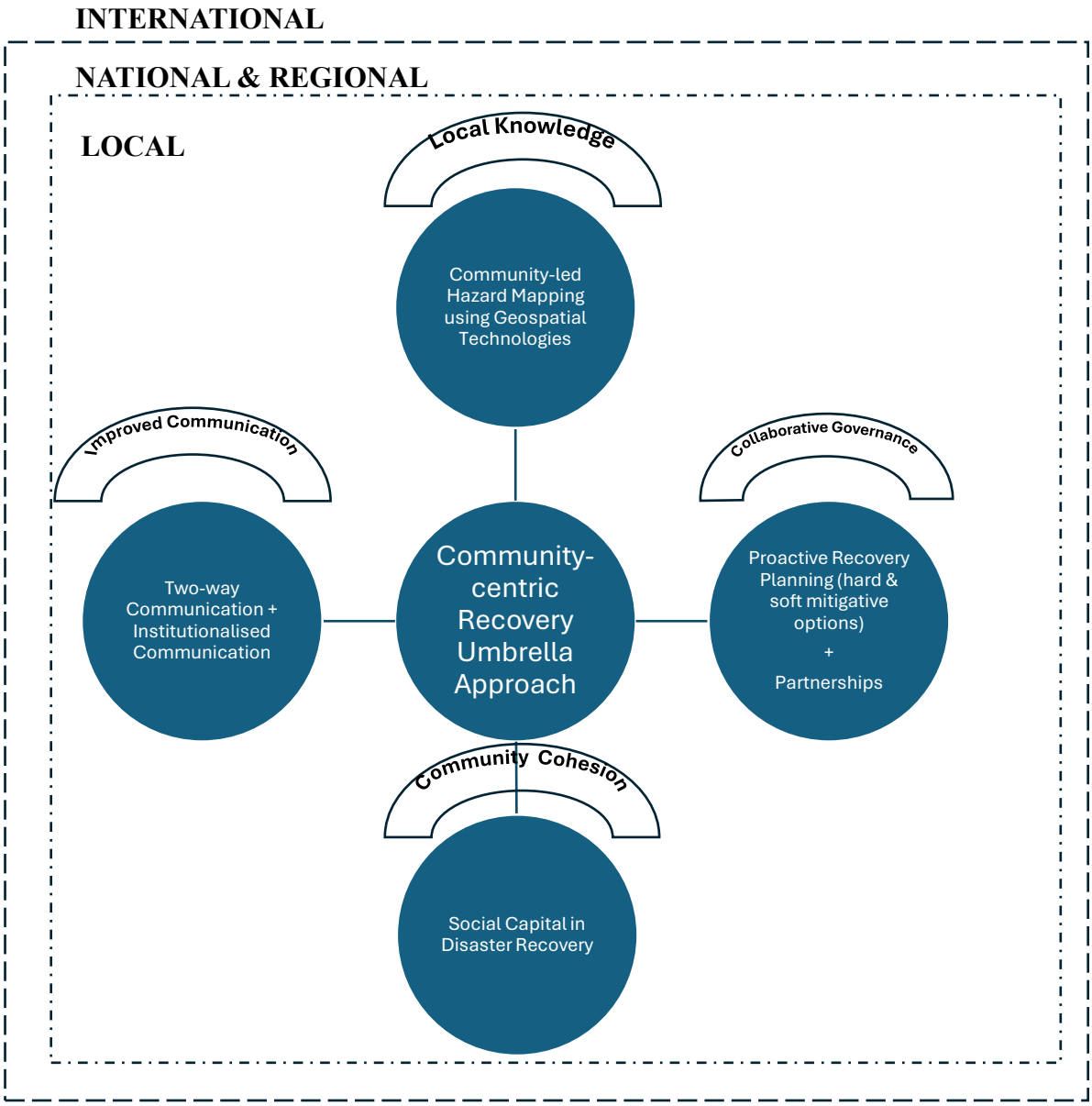

Figure 8.1 Pro-active Recovery Planning: Community-centric Recovery Umbrella Approach (CcRUA) Source: The Researcher, 2024.

8.7.1 Positioning CcRUA within Existing Frameworks

CcRUA is designed to align with international, national, and regional governing frameworks, creating synergies that enhance disaster risk management and recovery efforts (see Table 8.1). This holistic approach offers an iterative process, meaning it could adapt to changing circumstances, challenges, and opportunities post-disaster. It incorporates lessons learned from past events and ensures ongoing communication (feedback/discussions) from communities and authorities.

Like the National Recovery Framework (NRF) (Ministry of Civil Defence and Emergency Management, 2019), CcRUA manages, monitors, coordinates, advises, and produces outputs and reports. However, unlike the NRF, this approach addresses recovery more specifically at the micro-level, is locally relevant and operationally feasible, and collaborates with recovery authorities.

This framework can ultimately be used to create and improve strategies, programmes, plans, and or projects - that are substantial (direct involvement in recovery activities) and procedural (participation in the decision-making process) in nature (Vallance, 2015).

At the international level, the New Zealand government has largely welcomed and emphasised the importance of the Disaster and Climate Risk Reduction sector adopting the priorities for action from the Sendai Framework (priority 4) and Sustainable Development Goals (goal number 11)[5] (United Nations Office for Disaster Risk Reduction, 2020a). Enhancing Disaster Preparedness for Effective Response to "Build Back Better" in Recovery, Rehabilitation and Reconstruction.

Table 8.1 Synergies Between International Agreements and Different Policies and Commitments of New Zealand in the Disaster and Climate Risk Reduction Sector.

Sectorial Aim	Policies/Plans with potential links to the Sendai Framework for Disaster Risk Reduction 2015 – 2030 Objectives	Policies/Plans with potential links to Sustainable Development Goals
Disaster and Climate Risk Reduction	Civil Defence Emergency Management Act (2002/2016) National Disaster Resilience Strategy (2019), Operational Structure Coordinated Incident Management Systems (CIMS) Auckland Recovery Framework	National Disaster Resilience Strategy (2019

Source: Adopted from (United Nations Office for Disaster Risk Reduction, 2020a, p. 23), and Amended by the Researcher.

At the national level, the Civil Defence Emergency Management Act (2002/2016) serves as the primary legislation governing DRM and DRR in New Zealand (Ministry of Civil Defence and Emergency Management, 2019; National Emergency Management Agency, 2023a; United Nations Office for Disaster Risk Reduction, 2020a). Generally, global agreements such as the Sendai Framework 2015-2030 and SDGs have outlined how nations should approach disaster risk. As such, these frameworks have been a key influence in developing the National Disaster Resilience Strategy (NDRS) Strategy (Ministry of Civil Defence and Emergency Management, 2019).

The National Disaster Resilience Strategy (NDRS) is the national framework that sets three main priorities to improve New Zealand's resilience to disasters. These priorities include: 1. Managing risks, 2. Effective response to and recovery from emergencies, 3. Enabling, empowering, and supporting community resilience (Ministry of Civil Defence and Emergency Management, 2019). The strategies promote a holistic approach to resilience that connects with various authorities, agencies, and sectors to deliver improved outcomes for the public. However, disaster resilience requires a participatory whole of community approach between authorities, relevant stakeholders, and the wider public (MCDEM,2019). Therefore, CcRUA promotes a holistic, participatory approach at the micro-level, umbrellaed by these overarching frameworks.

[5] Make cities and human settlements inclusive, safe, resilient, and sustainable.

At the regional level, to build Auckland's resilience, the Auckland Council follows the Framework for Action, which looks at Reduction, Readiness, Response, Recovery, and Resilience. The framework for action sets out the current state, all action points, delivery lead, and delivery support, along with the timeframe (Auckland Civil Defence and Emergency Management (ACDEM), 2016). For the most part, the Auckland Emergency Management (AEM) acts as the delivery leading body to implement this Recovery Framework for actions (ACDEM, 2016, p166, Table 14). Regarding recovery planning, the issue to address is 1. increasing knowledge of the Sendai Framework principles and ensuring that consideration is given to DRR when planning for recovery; 2. Improving coordination, recovery is uncoordinated across agencies and all levels, which can hamper recovery; 3. Strengthening the CDEM Group's recovery framework to align with national recovery arrangements.

The CcRUA aligns closely with the principles outlined in the Recovery Framework for Action. Specifically, it corresponds to Action 69 of the framework (ACDEM, 2016 p. 166, Table 14), which emphasises understanding the sensitivities, values, and priorities of Auckland communities. This is achieved through direct and indirect engagement with local boards and community members to collaboratively establish a clear recovery vision and desired outcomes.

The CcRUA brings international, national, and regional disaster management frameworks into practical application at the community level. Integrating local knowledge, scientific knowledge, and resources, strengthens community resilience and enhances disaster risk reduction and recovery efforts, giving rise to successful recovery efforts while encouraging participation, and a whole of community approach (Federal Emergency Management Agency, 2011; Cadag and Gaillard, 2012; Donovan, 2015; Vallance, 2015; Kwok *et al.*, 2018; Ministry of Civil Defence and Emergency Management, 2019). CcRUA effectively connects top-down policies with grassroots initiatives, fostering a disaster resilience strategy that is inclusive and responsive to local needs. We often find that community voices are disconnected from recovery planning (Alexander C, 1962; Campbell *et al.,* 2021; Civil Defence: Northland Emergency Management Group, 2023; Bush International Consulting, 2024). A lesson we are not learning is putting the community at the heart of recovery planning. This approach seeks the opposite by making communities the heart of recovery planning. As such, the CcRUA can be used to implement sustainable recovery action plans.

8.7.2 Components of CcRUA – At a Glance

The findings of this study shows that effective recovery is achieved through the integration of these key components:

- Community-led geospatial mapping
    - Enhances the identification of exposed assets and supports evidence-based decision-making by combining spatial data with local knowledge (utilising local experts on the ground).
- Two-way communication
    - Facilitates information exchange between communities and authorities, improving trust, coordination, and responsiveness.
- Collaborative governance and partnerships
    - Strengthens coordination across stakeholders and ensures shared responsibility in recovery planning and implementation. This promotes accessibility and the mobilisation of resources.
- Social capital and community cohesion

- Enables collective action, resource sharing, and support for vulnerable populations during recovery.

Important to note, these components are interconnected and must operate concurrently to achieve effective and efficient recovery outcomes.

8.7.3 Step-by-Step Application of CcRUA

The following step-by-step approach is proposed to operationalise CcRUA:

1. *Establish a community-led recovery group*
   Form a local committee or working group that represents community interests and partners with recovery authorities.
2. *Conduct community-led hazard and asset mapping*
   Use geospatial technologies combined with local knowledge to identify vulnerable areas and critical assets, and to identify areas of exposure and risks.
3. *Develop a Community Recovery Plan (CRP)*
   Co-produce a recovery plan that includes mitigation measures, response strategies, and long-term recovery actions.
4. *Implement communication systems (based on budget allowance & restrictions)*
   Establish both formal and informal communication channels, including early warning systems and community networks.
5. *Strengthen partnerships and coordination*
   Engage with local authorities, emergency services, and stakeholders to ensure alignment and resource support. For example, plan frequent community engagement sessions, workshops, and follow-up assessment site visits, just to name a few.
6. *Monitor, evaluate, and adapt*
   Continuously review recovery actions, incorporate lessons learned, and adjust strategies based on changing conditions.

This process ensures that recovery is proactive, inclusive, and adaptable, rather than reactive and fragmented.

8.7.4 Scalability and Transferability

The CcRUA is designed to be scalable across different community contexts, including rural, peri-urban, and urban environments. Its flexible structure allows it to be adapted to varying levels of community capacity, governance arrangements, and hazard exposure. The findings from both communities demonstrate that while the specific challenges differ, the underlying principles of community engagement, communication, and collaboration remain applicable across differing contexts. As such, the approach has potential for broader application within communities in New Zealand and similar disaster-prone regions.

8.7.5 Limitations of the CcRUA

While the CcRUA offers a comprehensive framework and or approach for recovery planning, several limitations must be acknowledged. First, the effectiveness of the approach depends on community capacity and willingness to engage, which may vary across contexts. Communities with lower levels of social capital or limited resources may require additional support to implement the approach effectively. Second, successful implementation relies on institutional support and collaboration, which may be constrained by existing governance structures, resource limitations, or organisational silos. Third, due to time and resource constraints of this research, the theory has not been tested in another community to truly appreciate the recovery outcome.

Despite these limitations, the CcRUA provides a practical and adaptable framework that can be refined and strengthened through ongoing application and evaluation.

9 CHAPTER: Conclusion and Recommendations

9.1 Conclusion

This thesis examined factors influencing post-disaster recovery and the measures required to support effective and efficient recovery following the August 2021 HIWeather event, in two Auckland case study communities - Kumeū–Huapai and Henderson Valley. The findings show that recovery is shaped by the interaction of communication, preparedness, social capital, governance, infrastructure, and resource access, with communication emerging as the most critical factor. Empirically, the study demonstrates that poor communication, unclear roles, and limited engagement hinder recovery, while strong social capital and community-led initiatives support more effective outcomes. Methodologically, it employed a mixed method case study approach, integrating a community-led geospatial approach with local knowledge to support recovery decision-making. The key contribution in this research, is the development of the Community-centric Recovery Umbrella Approach (CcRUA), which provides a structured and adaptable framework for community-centred recovery. The findings highlight the need for stronger communication systems, clearer governance, improved preparedness, and sustained community–authority partnerships within New Zealand's disaster management context. Overall, this research shows that effective recovery requires integrated, community-centred approaches that bridge policy and practice, contributing to more resilient communities.

9.2 Translating Findings into Actionable Recommendations for Recovery Planning

The study used the findings from this research to translate emerging themes into a set of practical recommendations for improving post-disaster recovery planning in the New Zealand context (see Table 9.1). The focus of these implications is to move from fragmented, top-down approaches to collaborative, community-centred recovery systems that integrate communication, preparedness, partnerships, and geospatial decision-support.

Table 9.1: Prioritised Recommendations for Collaborative Post-Disaster Recovery Planning.

Theme	Key Recommendation	Period	Actors Involved	Evidence from the Study
Communication	Implement two-way, multi-channel communication systems (formal + community networks)	Short-term	AEM, Councils, Community Groups	Communication gaps identified in both communities
Preparedness	Develop and maintain Community Recovery Plans (CRPs) with local input	Medium-term	Councils, Community Groups	Little awareness of local community plans in Kumeū-Huapai; strong awareness of local plans in Henderson Valley

Social Capital	Strengthening networks among community members as a safety net for overwhelmed institutional systems	Long-term	Community Groups	Strong bonding improved recovery in Henderson Valley, this was not the same for Kumeū-Huapai
Governance	Clarify roles and responsibilities across recovery phases	Short-term	NEMA, AEM, Councils	General lack of awareness and confusion about responsibilities (Chapters 5 & 6)
Infrastructure	Invest in mitigation structures/non-structures, improve resilient infrastructure and ensure access during disruptions	Long-term	Councils	Flood exposure versus landslide constraints (Chapter 7)
Resources & Finance	Improve insurance awareness and integrate financial recovery into planning	Medium-term	Councils, Insurance Sector	Insurance and resource constraints identified (Chapter 5 & 6)
Geospatial Support	Use community-led mapping to identify exposed assets and guide planning	Medium-term	Councils, GIS Teams, Communities	Community-led mapping improved exposure identification, and knowledge of exposure (Chapter 4)

Source: The Researcher, 2026.

Collectively, these findings demonstrated that effective recovery requires integrated, context-specific, and collaborative approaches. Strengthening communication, partnerships, preparedness, social capital governance clarity, infrastructure resilience, and geospatial decision-support will enable more efficient and inclusive recovery outcomes. These actions provide a practical foundation for prioritised recommendations.

9.3 What was Done?

The thesis examined two Auckland communities, Kumeū-Huapai, and Henderson Valley, as case study areas and looked at their exposure to HIWeather events, particularly flooding from the August 2021 event. This thesis has provided a mixed method multi-case study approach – with qualitative and quantitative evidence of how community engagement and community-centric approaches influence post-disaster recovery from HIWeather events in two Auckland communities.

The thesis looked at how communities used local knowledge in combination with geospatial technologies (ArcGIS, aerial imagery, TouchGIS, a GPS tool) to validate hazard maps that were used to accurately identify exposed assets (population, buildings, and road infrastructure). The recovery authorities used the original flood map to identify zones affected by the August 2021 flood event. The

original flood maps were compared with community-validated flood maps to determine differences in hazard extents and exposed assets.

The thesis identified key factors influencing community recovery through the community-engagement mixed methodologies used. The thesis used community engagement methods like scoping interviews, field reconnaissance – (field mapping, conversations with the community, attending community meetings), workshops and street stalls, and administering online surveys. Furthermore, trust was built by forming genuine relationships with community leads and gatekeepers. Follow-up conversations and meetings occurred following community engagement data collection sessions to ensure the validity and accuracy of the data were documented.

Furthermore, to develop strategies for collaborative recovery planning, the data from this research led the researcher to conceptualise and develop a holistic, participatory, and collaborative Community-centric Recovery Umbrella Approach (CcRUA) that can facilitate recovery and foster long-term resilience.

9.4 What was Found?

Recovery is an experience (Vallance, 2011). Disaster recovery is not just a technical process with structured phases (Smith and Wenger, 2007; Vallance, 2011, 2015; Pine and Gupta, 2014; Vallance, S and Carlton, 2014; Elkady *et al.,* 2024), but includes - personal and social experience, community interactions, social capital, and the nuances between formal institutional and informal local community efforts that deeply shapes it.

9.4.1 Recovery in Kumeū-Huapai Community

For the Kumeū-Huapai community, recovery was indeed an experience. I say this because the community has experienced significant delays since the August 2021 HIWeather event. The delays were due to the lack of communication and collaboration between recovery authorities and affected residents. The data showed gaps in the community's preparedness and awareness of recovery plans and unmet expectations for engagement and adequate support from recovery authorities. Here, the main concern was the gaps in communication and the infrastructure system delays. This included: gaps in communication about the August 2021 HIWeather event, mitigation aspect – delays in floodway, cleaning the drains and rivers to reduce loss and impact on the community. Here, residents were often unaware of existing frameworks, roles, and obligations of recovery authorities, other emergency management stakeholders, and community members - before, during, and after disasters. This frustrated and confused residents about what must be done post-disaster flood events. This resulted in inefficiencies in the recovery process and significant delays in recovery for this community.

Key findings showed the need for improved two-way communication between residents and recovery authorities to ensure the community is kept at the heart of recovery. It also showed the need for partnerships and the co-development of Community Recovery Plans. The study highlighted the need for great community participation and involvement in recovery planning, including enhanced access to information for all recovery phases, better warnings or flood alert systems, and a community emergency management group focused on recovery planning. The study showed that these findings are important to empower the community, build trust, and, most importantly, accelerate recovery efforts. Generally,

the thesis identified the significance of aligning recovery efforts with community-specific needs while prioritising resilience-building measures to prepare for recovery from future disasters.

9.4.2 Recovery in Henderson Valley Community

On the other hand, the Henderson Valley community's recovery post-disaster August 2021 event had similar challenges that mainly focused on the issue of communication.

A consistent theme throughout the findings was mainly, the lack of clear communication between recovery authorities – such as the Council, Auckland Emergency Management, Healthy Waters, Civil Defence, EQC, and other lifeline utilities and emergency management services – and the affected community. The findings also showed that communication was lacking between recovery responders and authorities, as residents believed that "they don't talk to each other." However, this community had a strong social capital via social media and frequent community events. Communication can be improved among residents, which fosters social cohesion.

Other themes included a lack of collaboration, partnership, and preparedness. This disconnect hindered the recovery process in the Valley, which led to frustrated residents who lacked clarity about the roles and responsibilities of the stakeholders involved in the recovery process versus their obligations, such as maintaining rivers and streams on their property.

Despite these challenges, the community adapted well, post-disaster, and bounced back quickly due to the strong social capital, and cohesion that built a strong social network within the community. This strong foundation for resilience was demonstrated through the emergency management activities executed by the Henderson Valley Residents Association (HVRA). However, the findings show that there is a need for stronger partnerships with recovery authorities, emphasising the importance of direct engagement, building trust, and post-disaster follow-up actions.

The research highlights the ability of the community to think creatively and critically about their recovery situation to plan for future events. This was demonstrated through the community engagement sessions (see Appendix 11.9), particularly through creating potential scenarios to plan for future events and create their own Community Recovery Plan.

Although the Valley is enhancing its resilience through a community-led Emergency Management Guidance document (Henderson Valley Residents Association Inc, 2021) that addresses preparedness for the community's hazards according to the before, during, and after phases. There remain gaps, particularly in recovery and resilience. Findings show that the community's resilience can be strengthened through practical guidance from recovery authorities - via regular two-way communication, structured coordination, partnership and collaboration, preparedness and capacity-building sessions, and ongoing support to clarify authorities' roles and responsibilities. When this occurs, efficient and effective (results-oriented) recovery planning can be integrated into daily community activities.

9.4.3 Disaster Recovery Findings

This thesis identified critical factors influencing disaster recovery and resilience. These factors included using geospatial technologies and community participation to improve accuracy in hazard mapping and assets exposed to the flood disaster. Additionally, the research emphasised the importance

of communication and community engagement, one of the most common themes identified. The research highlighted poor communication between recovery authorities and communities, consistently hindering recovery. Community knowledge and pre-recovery planning (preparedness), community involvement, partnership between locals and authorities, and collaboration to enhance recovery outcomes are other factors influencing recovery. Significant knowledge gaps about residents regarding recovery plans, responsibilities, expectations, and preparedness measures highlighted the need for community education and capacity building. Mannakkara and Wilkinson (2012) surmised that community engagement and input in recovery decisions fosters a sense of ownership, ultimately strengthening trust between authorities.

The research also found that social capital and community cohesion, drawing on community networks, to build strong and resilient communities, is crucial for recovery (Vallance, 2011, 2015; Aldrich, 2012; Mannakkara and Wilkinson, 2012; Vallance, and Carlton, 2014; Campbell *et al.*, 2021; Trüdinger, 2024).

The challenges of government support and infrastructure recovery post-disaster were another critical finding in this thesis (Federal Emergency Management Agency, 2011; Salmon *et al.,* 2011; National Institute of Standards and Technology, 2016; Elkady *et al.,* 2024). The thesis found that community recovery is often hampered by a lack of communication and support from government authorities and insufficient mitigation strategies before a high-impact weather event.

The findings across the case studies and other papers revealed insights into the challenges of disaster recovery, leading to the development of the CcRUA. The research findings highlighted that recovery approaches are not one-size-fits-all and require a tailored approach to address the unique needs of communities. The CcRUA operationalises this by facilitating co-creating Community Recovery Plans that align with local priorities and regional and international goals. This approach serves as a cornerstone of this research, providing a structured yet scalable and flexible method to facilitate recovery at the local level while fostering effective collaboration with recovery authorities. The CcRUA ensures that community voices shape recovery strategies and outcomes. It empowers communities to communicate with authorities proactively to clarify roles and responsibilities and reduce confusion, making the recovery journey less complex. The CcRUA emphasises partnerships between recovery authorities and communities and other institutionalised relationships. The CcRUA uses community engagement methods to communicate well with authorities so that recovery needs, such as those for affected infrastructure, are restored and built back better. This inclusive approach bridges the gap between top-down directives and grassroots realities while ensuring that recovery plans are actionable and community-driven and that recovery efforts are inclusive, effective, and sustainable. Through these findings, the CcRUA was born as a transformative approach to effective recovery planning, paving the way for stronger and more resilient communities prepared for future high-impact disaster events.

9.5 Existing Frameworks and Their Alignment with the CcRUA

International, national, and regional frameworks are good for handling disaster recovery at a macro level but have proved less than ideal at the local level (Aldrich, 2012). This results in a disconnect between the community and recovery authorities, which creates a top-down approach to managing recovery and attempting to build resilience (Vallance, 2011, 2015; Elkady *et al.*, 2024).

In New Zealand, the overarching CDEM Act 2002/2016 and the National Disaster Resilience Strategy (NDRS) govern disaster recovery and resilience (Ministry of Civil Defence and Emergency Management, 2019; National Emergency Management Agency, 2023a). Although Auckland has a Recovery Framework that looks at recovery planning in the short, medium, and long-term phases, as per task groups (Auckland Civil Defence and Emergency Management, 2016). Auckland does not have a standardised community-led holistic community-centric recovery approach that can be adopted locally. For this reason, I call for a local-level, micro-approach to empower communities, enhance community recovery, and build resilience.

Frameworks are governed and guided by policies or an Act (Federal Emergency Management Agency, 2011; Ministry of Civil Defence and Emergency Management, 2019; United Nations Development Programme (UNDP), 2011). In religion, Christians are guided by the bible, Muslims by the Qur'an, and Jews by the Torah – likewise, internationally, DRM is guided by the Sendai Framework 2015- 2030 and SDGs. In New Zealand, we are guided by the Civil Defence Emergency Management Act 2002/2016. Further to this context, policies and frameworks emerge from the CDEM Act 2002/2016 (Ministry of Civil Defence and Emergency Management, 2019), including the – NDRS and the Auckland Recovery Framework. These documents emphasise the need for incorporating local knowledge into recovery planning frameworks (Auckland Civil Defence and Emergency Management, 2016; Federal Emergency Management Agency, 2011). This aims to ensure the community is included in building resilience, but it is often not well-acted into practical recovery experiences.

The Act 2002/2016 mandates (National Emergency Management Agency, 2023a)that local councils and recovery authorities engage with the community during disaster emergency planning and recovery efforts. This can be translated into identifying and incorporating community needs and local knowledge into recovery strategies. The Act 2002/2016 encourages communication between recovery authorities and communities, which was emphasised in the CcRUA.

The NDRS highlights the need for communities to be included and become drivers of recovery by including local experiences and knowledge in recovery planning. This is translated in "the whole of society approach" (Ministry of Civil Defence and Emergency Management, 2019). This approach is sound but, the challenge lies in the communication and operationalising aspect (Trüdinger, 2024; Vallance, 2011, 2015). Although the NDRS advocates for collaborative partnerships between recovery authorities and communities, encouraging community participation and consultation. Achieving this is often much easier said than done (Gjerde, 2018; Vallance, 2015). To that end, the aims of the NDRS align with CcRUA's emphasis on community voices at the heart of recovery and keeping two-way communication at the helm of recovery.

The Auckland Recovery Framework encourages the integration of local knowledge and community partnerships into recovery planning (Auckland Civil Defence and Emergency Management, 2016). It highlights using local knowledge to improve effective recovery strategies, building community partnerships to create plans, and ensuring solutions are grounded in the community's priorities and goals. It recognises Māori knowledge and practices, by integrating Māori perspective and traditional knowledge into recovery planning efforts (Campbell *et al.*, 2021). This supports the CcRUA's advocacy for an inclusive and culturally appropriate approach.

Recovery efforts should create a better balance between the community's needs and the authorities' responsibilities concerning communicating intentions through proper communication channels while minimising distances between communities and authorities (Gjerde, 2018). This can be done by creating synergies through two-way communication between authorities and communities in co-creating recovery plans, programmes, strategies, and activities for communities.

9.6 Significance and Implications of Findings

The significance and implications of the findings in this thesis lie in the ability to transform disaster recovery from a reactive, top-down process into a proactive, community-driven approach intended to build long-term resilience.

This can be done by offering practical operational solutions that bridge gaps in current frameworks. The findings emphasise integrating local knowledge into recovery planning by demonstrating how recovery strategies can effectively address a community's needs and priorities. One significant finding is hinged on integrating geospatial technologies coupled with community-led validation to improve hazard data collection accuracy. This ensures that recovery efforts are data-driven and reflective of the grassroots realities.

As such, the CcRUA operationalises the integration of local knowledge in recovery planning by encouraging two-way communication, enhancing transparency, and building trust between communities and recovery authorities. This, in turn, addresses communication gaps, which is a common challenge in this discourse (Doyle, 2022; Gjerde, 2018; Trüdinger, 2024; Vallance, 2015). By addressing communication gaps, the findings ensure that communities are 'actively involved' in owning their recovery process.

The findings show that empowering communities and their leaders through building capacity – by educating and training communities in the pre-disaster preparedness stage emerged as essential for building long-term resilience and ultimately reducing vulnerabilities to future disasters. This approach is simple and straightforward and can be implemented and reinforced in policy as an actable goal.

Another implication is accelerating recovery by creating bonds and networks through social capital and social cohesion. The CcRUA emphasises the importance of fostering partnerships and leveraging existing local networks. This work can influence recovery practices in other communities both nationally and internationally.

Furthermore, the research findings and development of the CcRUA align with disaster and emergency management international, national, and regional policies articulated in the Sendai Framework 2015-2030, Sustainable Development Goals, NDRS, CDEM Act 2002/2016, and the Auckland Recovery Framework. This is significant because the CcRUA provides ways to translate these inclusive and collaborative recovery processes into actionable goals that can inform policy development and empower communities to lead their recovery journeys.

Finally, research encourages the need to tailor recovery planning adaptable to unique community contexts, offering a flexible and iterative framework for recovery authorities. Ultimately, the findings in this research look at the CcRUA as a novel, transformative, and proactive approach that bridges the gaps

between policy and practice, integrating technical expertise with local knowledge to foster long-term resilience.

9.7 Contribution to Disaster Recovery Discourse

The study contributes to disaster recovery and resilience by offering practical methods for empowering communities and improving the efficiency and outcomes of disaster recovery efforts. The study improves on community-centric approaches, the prioritization of community in the decision-making process of recovery, the role of local knowledge and community participation, addressing challenges faced in recovery, and offering options for recovery. The study improves on substantial and procedural aspects of recovery, as mentioned in Vallance's paper "Disaster Recovery as Participation: Lessons from the Shaky Isles" (Vallance, 2015). Vallance mentioned that community participation in recovery activities and involvement in the decision-making process must be aligned to achieve successful recovery. This occurs when there is a collaboration between the affected community and recovery authorities and weaving community recovery stories into recovery plans and processes (Vallance, 2011, 2015; Elkady *et al.*, 2024; Trüdinger, 2024). This community-centric model can potentially address gaps identified in existing recovery approaches by putting communities' needs at the centre. The literature often speaks about the nuances, complexities, and challenges of communities engaging with authorities and how exactly this engagement and non-token participation can be achieved (Kumar *et al.*, 2008; Patterson, Weil and Patel, 2010; Vallance, 2011, 2015; Kwok *et al.*, 2018; Campbell *et al.*, 2024; Trüdinger, 2024).

The research demonstrates the value of community participation in hazard mapping and improving accuracy. It highlights the importance of two-way communication between communities and authorities throughout recovery. It emphasises partnership and collaboration between the community and authorities and underscores the need for capacity building within communities. It advocates for developing community recovery plans tailored to local needs and contexts, but most importantly, it provides a blueprint for a holistic, iterative, inclusive, collaborative, and sustainable post-disaster recovery, through the development of the CcRUA.

9.8 Connecting with Communities

Connecting with communities was the first step into knowing more about what happened, their recovery experience and their recovery need to move forward.

I aimed to form genuine relationships that are long-lasting by getting in the mud with the community. Calling to check in on residents following a HIWeather event and check their community's social media pages to ensure their safety. On field visits and community engagement sessions, I was transparent with residents about the research and the possible implications of the findings.

I aimed to draw back from being seen as a researcher who wants to "extract information"; instead, I aimed to listen, learn, offer information, and enhance their resilience. Though my research methodology took a community-friendly engagement approach, I patiently listened to how residents have been impacted by the August 2021 event from conversations had during field visits (see Appendix 11.8 to 11.9). I learned their coping mechanisms, how they adapt post-disaster, and how they prepare for future events by being around their community, conversing with residents, and attending community meetings when invited. I created recovery pamphlets and handed them out during fieldwork exercises (see Appendix 11.12). I created a community hazard map for each community, which was non-existent before

the research. By conducting this research, I believe interacting with the communities allowed them to think critically about recovery and future disasters. Engaging them in workshop activities, especially activity 4, to create a Community Recovery Plan. Finally, this research has provided the opportunity to analyse data collected and interpret the results to design and create a Community-centric Recovery Umbrella Approach, a step towards enhancing community resilience.

In my studies, it became apparent that trust must be earned. So, I took an honest approach to help enhance their recovery by taking ownership of their recovery, ascertaining their needs, and finding the best approach to address them. This has been achieved through community engagement sessions (see Appendix 11.8 to 11.9), when I created a bond with the community by giving them a voice in recovery.

By taking this approach, I ensured that it was clear who I was representing Massey University, sponsored by the National Science Challenge, to conduct this research. By establishing this, potential political problems were avoided.

9.9 The Influence and Impact of COVID-19 on my Ph.D.

21 February 2020, New Zealand identified its first COVID-19 case (Department of the Prime Minister and Cabinet (DPMC) - Covid-19 Group, 2023). A significant peak in daily cases rose to 89 by April 2, 2020. By then, the Traffic Light System was introduced to differentiate the various alert levels based on the state of transmission and increasing risk to at-risk populations (COVID-19 Group - Beehive News Release, 2021). The COVID-19 Protection Framework, also known as the traffic light system, started in 2020 and ended on September 12, 2022 (Beehive News Releases, 2022; Department of the Prime Minister and Cabinet (DPMC) - Covid-19 Group, 2023). The system used by the New Zealand Government during the COVID-19 pandemic differentiated alert levels by traffic light colours: red, orange, and green. This varied according to different regions in New Zealand (COVID-19 Group - Beehive News Release, 2021). These colours represent the transmission state and actions needed to protect health systems and communities at risk of further transmission

My Ph.D. commenced on 1st August 2020, when the pandemic was already underway. At that time, Auckland had been declared under the Traffic Light Level 3, colour code Red. The pandemic both negatively and positively affected my PhD.

In the embryonic stages of my Ph.D., total lockdown restrictions affected my mental state, so work started at a slow pace. At this stage, all meetings with supervisors, recovery authorities -government and non-government stakeholders, disaster management personnel, and community people- were conducted via Zoom or Teams. I was unable to meet stakeholders face-to-face due to alert-level restrictions. In a level 3 lockdown situation, social activities were restricted. As a result, outdoor meetings were permitted at alert level-2 - orange, given certain conditions were met. I started data collection with scoping interviews between November 2021 and April 2022. In total, I scheduled ten scoping interviews with residents and conducted one face-to-face outdoor scoping interview with a resident from the Kumeū-Huapai in November 2021 (See Appendix 11.8).

The pandemic also affected my PhD, as fieldwork felt somewhat detached when communicating with residents who were wearing masks. This was also reflected in fieldwork photographs (see Appendix 11.8 and 11.9 Street Stall sessions). This felt quite restricting as face-to-face interaction is always better than wearing masks.

This situation might also have influenced low workshop turnout in the Kumeū-Huapai community. Residents might have been reluctant to meet in close groups indoors, given that COVID was still lingering.

If this situation had been absent, I would have been able to meet most residents in person to conduct the scoping interviews and have had the opportunity to wade in the muck with them to gain firsthand insight into their experience. The positive side of COVID-19 is the economic aspect; it saves time and cost. Time was saved by eliminating travel time, and cost was saved by limiting trips to and from different locations to conduct interviews.

9.10 Limitations

This research addresses limitations on only two case study communities in Auckland, which limits the generalisation of findings to most communities in Auckland. Each community is unique and may require a different approach to community recovery.

While community involvement in validating flood data can improve the accuracy of flood footprints, this may also introduce some level of bias and subjectivity. Community members who participated in the mapping exercise may have some levels of knowledge or an understanding of geospatial technologies, which may have influenced the precision of data collected and affected the accuracy of buildings, road networks, and populations exposed.

Another limitation of the study is the low response rate in the survey and workshop participants. Some community members may have been underrepresented due to lack of access to the online survey. This may affect the breadth of perspectives and experiences that could have been captured and included in the analysis.

One must also consider temporal limitations whereas the research scope only captured recovery efforts following the August 2021 HIWeather event. Recovery is a complex process that has a long tail (Mcnaughton *et al.,* 2015). So, due to this long process, the study may not fully account for all changes in community recovery or improvements in government response over time.

This study captures limited perspectives through conversational engagement with the main recovery authority – the Auckland Council. After the community engagement with communities, the researcher requested a formal interview with the representatives from the Auckland Council, specifically Auckland Emergency Management and Healthy Waters. This was to ascertain how they plan to engage with communities, bridge the gap, and become involved in recovery planning to nurture good communication between themselves and the community. This request was denied, and instead, an email was sent from the Council encouraging the researcher to consider documents regarding the Council's Community Resilience Plans (available on the AEM website) and see whether the findings can be developed into a self-sustaining community-driven framework. Also, the researcher was encouraged to use existing tools (for example, the "Report a Problem" tool, the Auckland Hazards Viewer) to empower the community.

Throughout the research, the communities studied had probing questions for recovery stakeholders. Some of these questions include - what engagement or plans are in place to bridge the gap between the community and recovery authorities? How can the authorities help communities find the

appropriate services post-disaster to meet the needs of the community? How can the Council help the community feel a part of recovery planning? At what juncture should the community anticipate intervention or support from the Council, and how can this be more clearly delineated to ensure appropriate community response and preparedness for recovery? Is funding allocated for mitigation activities, like cleaning our rivers? Attempts were made to interview to understand the Council's perspective on the delayed response to the post-disaster August 2021 event, but these were denied.

Finally, another limitation identified is that the CcRUA was developed from case study findings aimed at addressing gaps in recovery and enhancing resilience; however, in real-world implementation, it has not been tested within its scope or proven in another community following a post-disaster event. This is constrained by time, and resources allocated for this thesis.

9.11 Future Research

There are potential areas for future research that would build on the current findings, address gaps, and broaden knowledge in post-disaster recovery, resilience, and community involvement. Some potential areas for future research include but are not limited to the broader application of community-validated data to investigate data across different types of hazards and determine how community engagement varies in a multi-hazard scenario. Another area that warrants further study is the influence of different government levels (national, regional, and local) on recovery outcomes. Future studies could examine how governance structures, collaborative governance, and recovery funding mechanisms impact community participation and resilience, particularly in response to HIWeather events. Lastly, future studies could examine applying the CcRUA and test in other communities in Auckland to observe whether there are notable changes in recovery outcomes.

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11 APPENDIX

11.1 Appendix 1 – Questionnaire

Post-disaster Recovery to HIWeather Events - Survey

Start of Block: Default Question Block

*

START Click to write the question text

☐ I have read the Participant Information Sheet, and I have understood the nature of the research.

☐ I agree to take part in this research. I understand that I am free to withdraw my participation at any time up to the point of final submission.

☐ I understand that by the time I complete the survey, I am not able to withdraw my participation as responses are unidentifiable to the researcher.

Welcome!

Kindly note that this survey is **ONLY** for people living and or working in ***Kumeū-Huapai***and/or ***Henderson Valley*** Community.

"This project has been evaluated by peer review and judged to be low risk.

Consequently, it has not been reviewed by one of the University's Human Ethics Committees.

The researcher(s) named in this document are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Professor Craig Johnson, Director (Research Ethics), email humanethics@massey.ac.nz."

The Research Project This Research Project is about how communities can recover from High-Impact Weather Events in a timely and effective manner. The research will investigate what needs to be done to make communities recover and become more resilient in a multi-hazard environment. Ultimately, the research seeks to develop a proposed Post-disaster Community Recovery Plan (CRP) with input by the community.

This questionnaire has 30 Questions with sub-parts and may take approximately 15 - 20 minutes to complete.

At the end of the survey, there is a prize draw for those who have completed the survey. Kindly note that this is an anonymous link to the prize draw which does not link you to your survey responses. You have to option to decide whether or not you would like to participate in the draw.

If you are ready, let us begin!

"For this survey, a community is defined as a group of people living in a defined geographic location/area."

Tick the option (s) that best apply.

Q1. Which of these two communities do you live and/or work in?

- [ ] I live in Kumeū-Huapai
- [ ] I work in Kumeū-Huapai
- [ ] I live in Henderson Valley
- [ ] I work in Henderson Valley
- [ ] I live /or work in another community, I was affected by the flood, and I interact with these communities (conduct business, do activities, and have families and friends who live there). Please name the community you live/work in below.

  _____

- [ ] I do not live and or work in the communities listed above, and do not wish to continue this survey

Skip To: End of Survey If "For this survey, a community is defined as a group of people living in a defined geographic local. I do not live and or work in the communities listed above, and do not wish to continue this survey

Q2. How long have you lived or worked in your community?
(drag & drop /or click & tap your answer in the appropriate box)

	0 to 1 year	1 to 5 years	5 to 10 years	more than 10 years
⊗Lived in Kumeū-Huapai	○	○	○	○
⊗Worked in Kumeū-Huapai	○	○	○	○
⊗Lived in Henderson Valley	○	○	○	○
⊗Worked in Henderson Valley	○	○	○	○

Q3. How old are you?

- ○ under 18
- ○ 18 - 29
- ○ 30 - 64
- ○ 65 and over
- ○ Prefer not to answer

Skip To: End of Survey If 3. How old are you? = under 18

Q4. What is your gender?

- ○ Male
- ○ Female
- ○ Another gender, please specify
- ○ Prefer not to answer

Q5. Do you rent or own your property (home or business) in this same community above?

- [ ] Place of Residence - owner (s)
- [ ] Place of Residence - rental
- [ ] Business - owner (s)
- [ ] Business - rental
- [ ] Work in community
- [ ] Other (6) _____

Q6 6a. Are you aware of your exposure to Hazards or High-Impact Weather (HIWeather) Events in your community?

Hazard related definition list

- ○ Yes
- ○ No
- ○ I don’t know, never thought about that before

6b. What asset or/ thing (s) are exposed to Hazards or High-Impact Weather (HIWeather) Events in your community?

- ☐ Buildings/properties
- ☐ Transport networks (roads, railway etc.)
- ☐ Communication systems
- ☐ Water (utility)
- ☐ Wastewater system
- ☐ Energy system (utility)
- ☐ Other
- ☐ I don’t know

---

*

Q7. Which hazards have negatively impacted your community.
Please tick all or the one (s) that apply.

Hazard related definition list

- [ ] High-Impact Weather event
- [ ] Climate Change
- [ ] Flood
- [ ] Pandemic
- [ ] Landslides (induced by floods)
- [ ] Other
- [ ] No hazards have impacted my community

Skip To: Q9 If 7. Which hazards have negatively impacted your community. Please tick all or the one (s) that applies = No hazards have impacted my community

Q8. If you have been negatively impacted by a hazard (s), to what extent have you been impacted?

(consider negative impacts to the built environment like disruption to business, critical facilities like clinics/medical centres, disruption to utility services, transport, damage to housing, property, loss of possessions etc.).

Which hazard best represents this damage from a scale of 1 to 10, where 1 - little impact and 10 severe impact.

1 - little impact 10 - severe impact

	0 1 2 3 4 5 6 7 8 9 10
High-Impact Weather Event ()	
Climate Change ()	
Flood ()	
Pandemic ()	
Landslides (induced by floods) ()	
Other ()	

Q9. When do you next think each of these hazard events could negatively affect your community's future?

	Within this or next year	Within 2 – 10 years	Within 10 - 50 years	Within 50 – 100 years	Never	Not sure
High-Impact Weather Event	☐	☐	☐	☐	☐	☐
Climate Change	☐	☐	☐	☐	☐	☐
Flood	☐	☐	☐	☐	☐	☐
Pandemic	☐	☐	☐	☐	☐	☐
Landslides (induced by floods)	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

Q10. Please answer the question which best applies to you. Kindly answer all sub-parts of this question.

multi-hazard event means two or more types of hazards happening at the same time within the same space/ within a geographical area.

	A. Do you have an understanding of what post-disaster recovery is?	B. Do you understand what recovery planning is?	C. If a High-Impact Weather event or Multi-hazard event affects you and your community, do you know what to do?	D. If a High-Impact Weather event or Multi-hazard event affects you and your community, do you know where to go?	E. If a High-Impact Weather event or Multi-hazard event affects you and your community, do you know who to contact?
Yes	☐	☐	☐	☐	☐
No	☐	☐	☐	☐	☐
Somewhat	☐	☐	☐	☐	☐
Not too sure, I will find out after the event	☐	☐	☐	☐	☐

*

Q11. Which local community group (s) are you a member of?

- [ ] Social Media Page e.g. Facebook, Neighbourly etc
- [ ] Sports Clubs/ Social Groups e.g. Rotary Club, Lions Club etc
- [ ] Rate Payers/Residents Association
- [ ] Religious Groups
- [ ] Interest Groups e.g. Gardening/baking/parent groups, business groups, music/arts groups, cultural groups etc
- [ ] Other Local Community Group _____
- [ ] I am not a member of any community group

Q12. Are you aware of a community guidance document for the following in your community?

	Community Guidance Document	
	Yes	No
Disaster emergency plan	○	○
Resilience	○	○
Recovery	○	○
Recovery prioritization	○	○
Disaster resource allocations	○	○

Q13 .When a High-Impact Weather Event occurs in your community, are you aware of a Community Recovery Plan in-place that you can readily act on?

Community Recovery Plan (CRP): is a recovery plan developed for a community by the community to utilise and support the renewal of the whole sector of the community after disasters occurs.

- ○ Yes, there is a Community Recovery Plan in place for my community
- ○ No, I am not aware of a Community Recovery Plan
- ○ I don't know, never thought about it

*

Q14. In your opinion, what do you think your community can do to improve recovery or recover quickly from High-Impact Weather Events and multi-hazards?

- [ ] Having a list of the vulnerable people in your community.
- [ ] Having a need and wants resource list for your community.
- [ ] Re-arrange your space so that you are not completely affected by a flood.
- [ ] Knowing your neighbours and their contact information and having a good neighbourly bond.
- [ ] Having an effective alert system and or mitigation measures in place before the disaster to minimise impact.
- [ ] Improve community and recovery stakeholder (s) (for e.g. Civil Defence) collaboration
- [ ] Create a community emergency management group to manage and organise post-disaster recovery activities, initiate an agreed process of how to respond and recover from disasters at different stages of recovery.
- [ ] Having a Community Recovery Plan in place: which may include but not limited to all the above choices.
- [ ] Other _____

Q15. Do you know which emergency management organisation is responsible for recovery activities (Short, Intermediate & Long term) at the community/ local level?

	Short Term (from event to days) (1)	Intermediate Term (from weeks to months) (2)	Long Term (from months to years) (3)	I don't know (4)
National Emergency Management Agency (NEMA) (1)	☐	☐	☐	☐
Auckland Council - Auckland Emergency Management/ Civil Defence (2)	☐	☐	☐	☐
Local Board (3)	☐	☐	☐	☐
Local Community Leadership (4)	☐	☐	☐	☐
Other (7)	☐	☐	☐	☐

*

Q16. Whose responsibility do you believe it is to help you and your community develop a Community Recovery Plan for future High-Impact Weather and/or Multi-hazards events? (tick all that apply).

- [ ] National Emergency Management Agency (NEMA)
- [ ] Auckland Council - Auckland Emergency Management/ Civil Defence
- [ ] Local Board
- [ ] The local community leaders
- [ ] The individual/my responsibility
- [ ] I don't know
- [ ] Other _____

Q17 MULTI-HAZARD SCENARIO

Imagine if the scenario below were to happen to you and your community in the future? Please think about how you might respond.

A devastating 100-year flood occurs in your community from a major storm or cyclone, bringing floodwaters to more than 1.5 meters in height into some people's houses, destroying furniture and appliances. A lot of local infrastructure is damaged. Buildings and properties are flooded, communication and electricity lines are down, road infrastructure is compromised, and water pipes and sewage systems are damaged. Main assets, monuments, parks and public spaces in your community are out of use. You and your family and the community are cut off from regular daily activities. This, coupled with an ongoing Pandemic where the virus can spread rapidly, and you are advised to take caution in maintaining your bubble. Because there is so much damage, the recovery from this event will take a long time.

17. In the scenario above, if a devastating multi-hazard situation happens, would you be interested to get involved in community recovery activities?

(Some recovery activity may include but not limited to raising funds for those badly affected, clean-up flooded areas, photographing/recording damage, helping neighbours with logistics, and or participate in recovery planning to create a CRP in your community.)

- ○ Definitely yes
- ○ Probably yes
- ○ Might or might not
- ○ Probably not
- ○ Definitely not

Display This Question:

If Building a Scenario = Might or might not

Or Building a Scenario = Probably not

Or Building a Scenario = Definitely not

Q17b Please, briefly explain your answer

_____

*

Q18. Based on the previous scenario, in what way might the pandemic further impact your personal overall recovery from the flood?

Tick one or all that applies

- [ ] It would delay and slow down the process of recovery from the flood
- [ ] It would make me feel helpless and isolated
- [ ] It would make every other aspect of recovery difficult
- [ ] It would heighten my fear of breaking bubbles and catching the virus
- [ ] Other _____

Q19. In an effort to develop a Community Recovery Plan, do you think that using a disaster scenario similar (or worse) to the one above, can help your community to better identify likely recovery requirements and plan for recovery in the future?

- ○ Definitely yes
- ○ Probably yes
- ○ Might or might not
- ○ Probably not
- ○ Definitely not

Display This Question:

If 19. Related to the Scenario above = Might or might not

Or 19. Related to the Scenario above = Probably not

Or 19. Related to the Scenario above = Definitely not

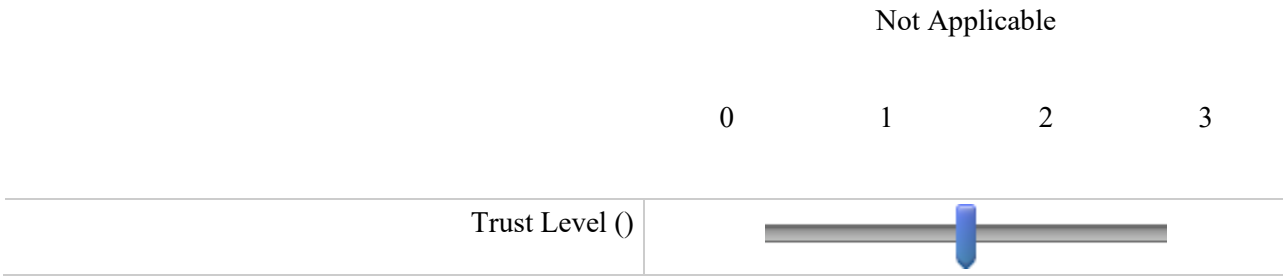
Q19b Please, briefly explain your answer

_____

Q20. How much trust do you have in the Emergency Management arrangements for your community at the local level to respond to the recovery needs of your community post-disaster?
(i.e. Think about the organisations who lead recovery efforts; their engagement, capability and ability to plan for post-disaster recovery at the local level.)

On the scale below, drag the bar back and forth to show what best represents your trust level.

0 = lack of trust,
1 = low trust level,
2 = medium trust level,
3 = high trust level.



Q21. Based on your response above, briefly state what can be done to build trust between community members (the public) and recovery or emergency management organisations (the stakeholders)?

- [ ] Organisations that lead recovery efforts should engage with the community to understand their needs and support them with the development of their Community Recovery Plan.

- [ ] Organisations that lead recovery efforts should support the local community with a Community Hub to coordinate agencies and services to address recovery needs.

- [ ] Organisations that lead recovery efforts should support and communicate with the local community to listen and understand the needs of post-disaster affected individuals and whānau to provide the necessary services to address recovery needs.

- [ ] Organisations that lead recovery efforts should support the local community by regularly organising community meetings and engaging with the community: to develop

community connections and information-sharing sources, disaster management skills training, and offer suggestions/or solutions to recovery needs/challenges.

☐ Organisations that lead recovery efforts should build good relationships with local community and/or community leader(s) before and after disasters occur to readily mobilise recovery support services post-disaster.

☐ Other _____

Q22. Do you think the organisations who lead recovery efforts should engage, coordinate and communicate with the community to guide them in developing their unique community recovery plan ?

- ○ Strongly agree (13)
- ○ Somewhat agree (14)
- ○ Neither agree nor disagree (15)
- ○ Somewhat disagree (16)
- ○ Strongly disagree (17)

Display This Question:

If 22. Do you think the organisations who lead recovery efforts should engage, coordinate and commun... = Neither agree nor disagree

Or 22. Do you think the organisations who lead recovery efforts should engage, coordinate and commun... = Somewhat disagree

Or 22. Do you think the organisations who lead recovery efforts should engage, coordinate and commun... = Strongly disagree

Q22b Please, briefly explain your answer

_____

Q23. Do you think having a Community Recovery Plan with political buy-in (support from elected politicians) would aid your community to recover and become more resilient after a disaster event (s)?

- ○ Strongly agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Strongly disagree

Display This Question:

If 23. Do you think having a Community Recovery Plan with political buy-in (support from elected pol... = Neither agree nor disagree

Or 23. Do you think having a Community Recovery Plan with political buy-in (support from elected pol... = Somewhat disagree

Or 23. Do you think having a Community Recovery Plan with political buy-in (support from elected pol... = Strongly disagree

Q23b Please explain your answer

_____

Q24. What **level of participation** would you prefer to have in the creation of the Community Recovery Plan with **members of your community** and other **stakeholders** to help prepare for future disasters?

- ○ Responsible and accountable – I want to add a valuable contribution and/or play an integral role when creating the plan
- ○ Consulted – I want my opinion (s) to be considered
- ○ Informed – I only want to know about the outcome of the plan
- ○ Not sure

Q25 25. Did the last **High-Impact Weather Event** that took place on **August 30 - 31, 2021**, in Auckland, impact you and your community in any way?

- ○ Yes
- ○ No

Skip To: Q27 If 25. Did the last High-Impact Weather Event that took place on August 30 - 31, 2021, in Auckland, ... = No

Q26a. Think about the recent flood event that took place on August 30 - 31, 2021.

How were you and your property/business affected?

(If you don't have property or business that was affected, please give your general views about the flood impact) over the Short-term (days), Intermediate (weeks to months) and Long-term (more than a year) period, related to the built environment.

Sections of the Built Environment may include but not limited to: {buildings/properties, communication systems, transportation, water (utility), wastewater system, energy system}.

- ○ In the short term (days) _____
- ○ In the Intermediate (weeks to months)

_____

- ○ In the long term (more than a year)

_____

26b. How did you recover?

- ○ In the short term (days) _____
- ○ In the Intermediate term (weeks to months)

_____

- ○ In the long term (more than a year)

_____

Q27. Name one **critical community asset** related to the built environment that was recovered, after the High-Impact Weather Event or Multi-hazard Event in your community.

Sections of the Built Environment may include but not limited to: {buildings/properties, communication systems, transportation, water (utility), wastewater system, energy system}.

(For Example: road access or bridge access or school building etc.)

_____

Q28. How long did it take (for the section of the built environment named in Q27) to recover?

- ○ 0 to 7 days
- ○ 1 to 4 weeks
- ○ 1 to 3 months
- ○ 3 to 6 months
- ○ 6 to 12 months
- ○ 1 year and over

Q29. What was your expected timeframe for the section of the built environment named in Q27 to be recovered?

- ○ 0 to 7 days
- ○ 1 to 4 weeks
- ○ 1 to 3 months
- ○ 3 to 6 months
- ○ 6 to 12 months
- ○ 1 year and over

*

Q30. What do you foresee as some challenges of implementing a Community Recovery Plan for your community?

- [ ] The lack of capacity and capability needed to ensure that the community have the right people, who are qualified, experienced, and ready to assist in any recovery situation
- [ ] The lack of synergies amongst community members and emergency management stakeholders
- [ ] The lack of financial resources and other local resources to implement the plan
- [ ] The challenge of making sure that it reaches everyone in the community, and make sure that everyone is on the same page
- [ ] Hard to keep track of community members' location, especially those who are involved in the plan
- [ ] The issue of not getting along with those responsible to implement the plan
- [ ] Emergency management services not working well together
- [ ] Plan is outdated, and not flexible if changes need to be applied
- [ ] I don't foresee any challenges
- [ ] Other, please specify below.

_____

The End!

Thank you for completing this survey.

Would you like to participate in the prize draw to win a $40 supermarket gift voucher?

- ○ Yes
- ○ No

Display This Question:

If The End! Thank you for completing this survey. Would you like to participate in the prize draw to... = Yes

. N.B. This is an anonymous link to the prize draw which does not link you to your survey responses.

Click this link to the prize draw competition

End of Block: Default Question Block

11.2 Appendix 2 – Survey Information Sheet

POST-DISASTER RECOVERY TO HIWEATHER EVENTS IN AUCKLAND
MASSEY UNIVERSITY
SCHOOL OF THE BUILT ENVIRONMENT

What is this Research about?

The academic research aims to study two (2) exposed communities (Kumeū-Huapi and Henderson Valley) to High-Impact Weather (HIWeather) events communities in Auckland, with a focus on the built environment.

This research will investigate how communities can recover in a timely and effective manner, and what needs to be done to make communities become more resilient in a multi-hazard environment.

The researcher will develop a scenario of 'high-impact weather events coupled with the impact of the pandemic' particularly like that of the past events, looking at impacts from flooding and how these communities have recovered overtime.

From this, a tool to plan for community recovery will be developed. This will then look at existing recovery frameworks that can be used as a guide to develop a proposed community-led 'Post-disaster Community Recovery Plan (CRP)'. More specifically, the study will look at the post-disaster recovery of the Community and its built environment within each case study area.

What will the data collected be used for?

If you agree to take part, you will remain anonymous as your responses will not be linked to your personal identification information. Your responses will be kept securely on the researcher's computer and will not be disclosed to other parties outside of this research. Once the research has come to an end, the data collected will contribute to the body of knowledge on disaster management, recovery, resilience, flood disasters as well as multi-hazards, and may drive change where necessary.

Sections of the survey include but are not limited to:

Knowledge

- Community demographics.

- The knowledge of hazards faced in the community.
- Knowledge of factors that would influence post-disaster recovery.

Preparation & Recovery Planning

- Community multi-hazard scenario planning.
- Recovery Stakeholders' involvement in community recovery planning.
- Preparing to recover, using lessons learned to identify how people have recovered after a disaster.

Participant's rights and consent

You should be 18 or older to participate in this survey.

You are under no obligation to accept this invitation.

If you decide to participate, you have the right to decline to answer any particular question; withdraw from the study (before the final write-up commences in August 2023); or provide information with the understanding that your identity will not be used unless you give permission to the researcher. Also, note that you may be given access to a summary of the project findings when it is concluded upon request.

Contact Information:

This Ph.D. is being undertaken by the researcher: Mrs Anna-Kay Spaulding-Agbenyegah and under the supervision of the supervisors listed below. If you would like any more information, please contact me.

Ph.D. Student:

Mrs. Anna-Kay Spaulding-Agbenyegah at Massey University – School of the Built

Environment: A.Spaulding-Agbenyegah@massey.ac.nz
Contact: [redacted]

Supervisors:

Prof. Suzanne Wilkinson at Massey University - S.Wilkinson@massey.ac.nz

Dr. Julia Becker at Massey University - J.Becker@massey.ac.nz

Dr. SR Uma at GNS - s.uma@gns.cri.nz

Vivienne Ivory at WSP - vivienne.ivory@wsp.com

Ethics

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Professor Craig Johnson, Director (Research Ethics), email humanethics@massey.ac.nz."

11.3 Appendix 3 – Interview Questions

Post-disaster Recovery from HIWeather Events in Auckland

Semi-structured Interview

Good day, my name is Mrs. Anna-kay Spaulding-Agbenyegah, a Ph.D. Student at the School of the Built Environment (SBE), Massey University Albany Campus, Auckland. My research is titled "Post-disaster Recovery from HIWeather Events in Auckland". This will look at floods from high impact weather events in various communities, and how these communities can become resilient and recover quickly through recovery planning. The focus will mainly be on the recovery to the built environment, particularly (Residential, Commercial buildings, and road infrastructure).

For this interview, digital audio recording will be collected, utilised, and stored by methods that comply with the Code of Ethical conduct. Data will be stored securely on password-protected computers and only be used for research purposes.

Please note that you are allowed to cease participation and or stop the recording at any time should you wish to discontinue the interview. There is no expectation that you should feel obligated to share information that you are uncomfortable with.

The consent sheet is attached for your reference to the interview proceedings.

Community Name:

Time of Interview:

1. How long have you lived or worked in the community?
2. Tell me a little background about your community, history, demographics etc
3. Would you say that you are very involved in your community? (What types of community groups do you participate in)?
4. Tell me about the last major flood hazard in your community

(a. when do events happened, b. where they are located, c. how often does it occur, d. who were mostly affected, e. have they recovered, f. For e.g. the

recovery of houses - how long did it take to resettle), e.g. were peoples' livelihood impacted? h. how did the pandemic affect the recovery of members of the community?)

5. Do you understand what recovery planning is?

6. What are your ideas about what recovery planning encompasses?

7a. Say your community was hit with a similar storm event or worst to that of the most recent event, do you have opinions on ideal recovery timeframes?

b. If your community was to experience a similar weather event and or worse than the last event, what would you do differently to fast-track recovery?

8. What are your thoughts on recovery planning in your community? Do you think that community are interested/not interested in getting involved in recovery planning?

9a. What are the perceived benefits/advantages of recovery planning/having a recovery plan?

9b. What are the perceived challenges/disadvantages of not having a recovery plan?

9c. Assuming that there was a recovery plan for your community, what do you perceive could be some of the challenges in its implementation?

10. What do you think the community can do to recover quickly and become resilient from High-impact weather events

11.4 Appendix 4 – Interview Consent Form

Participant Consent Form for Post-disaster Recovery to High Impact Weather Events Research.

Please take the time to read the information sheet carefully and consider whether you would be willing to take part in this research. Please contact the researcher if you would like more information.

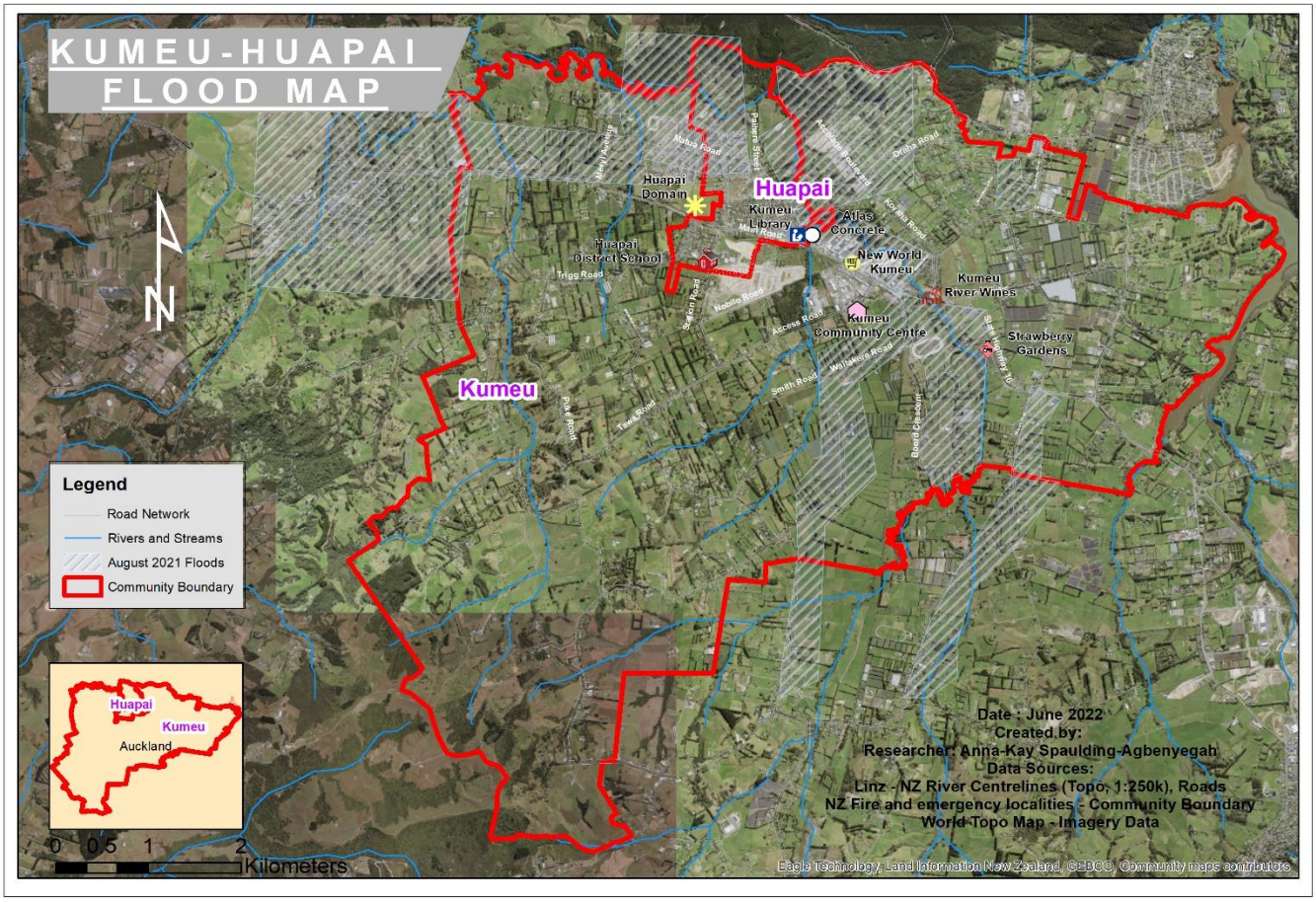
I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

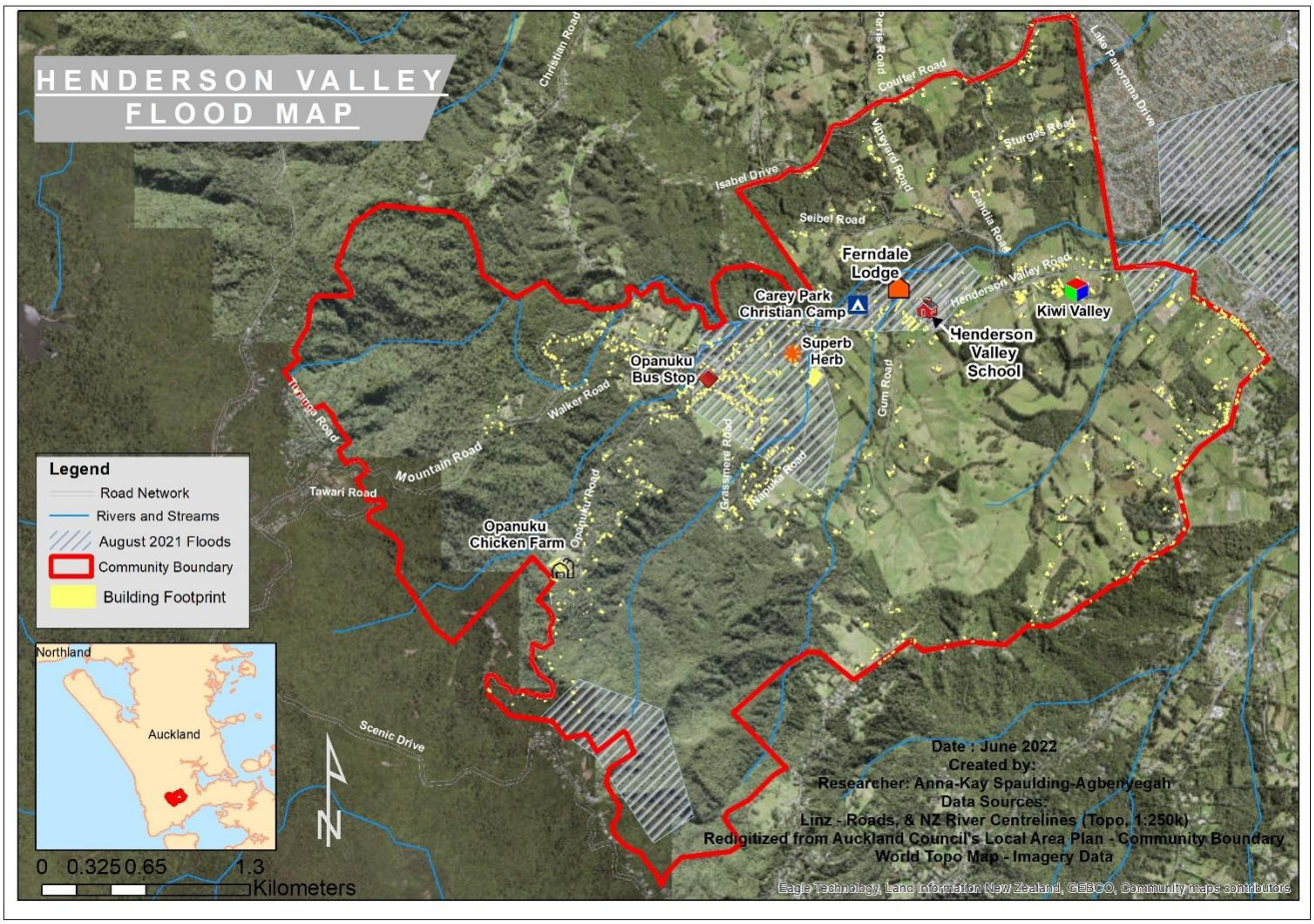
I agree/do not agree to the interview being sound recorded.

I agree/do not agree to participate in this study under the conditions set out in the Information Sheet.

Signature:	
Date:	/ /
Participant name (printed):	
Role/Position title:	
Organisation:	

11.5 Appendix 5 – Community Field Maps for Participatory Incident Mapping

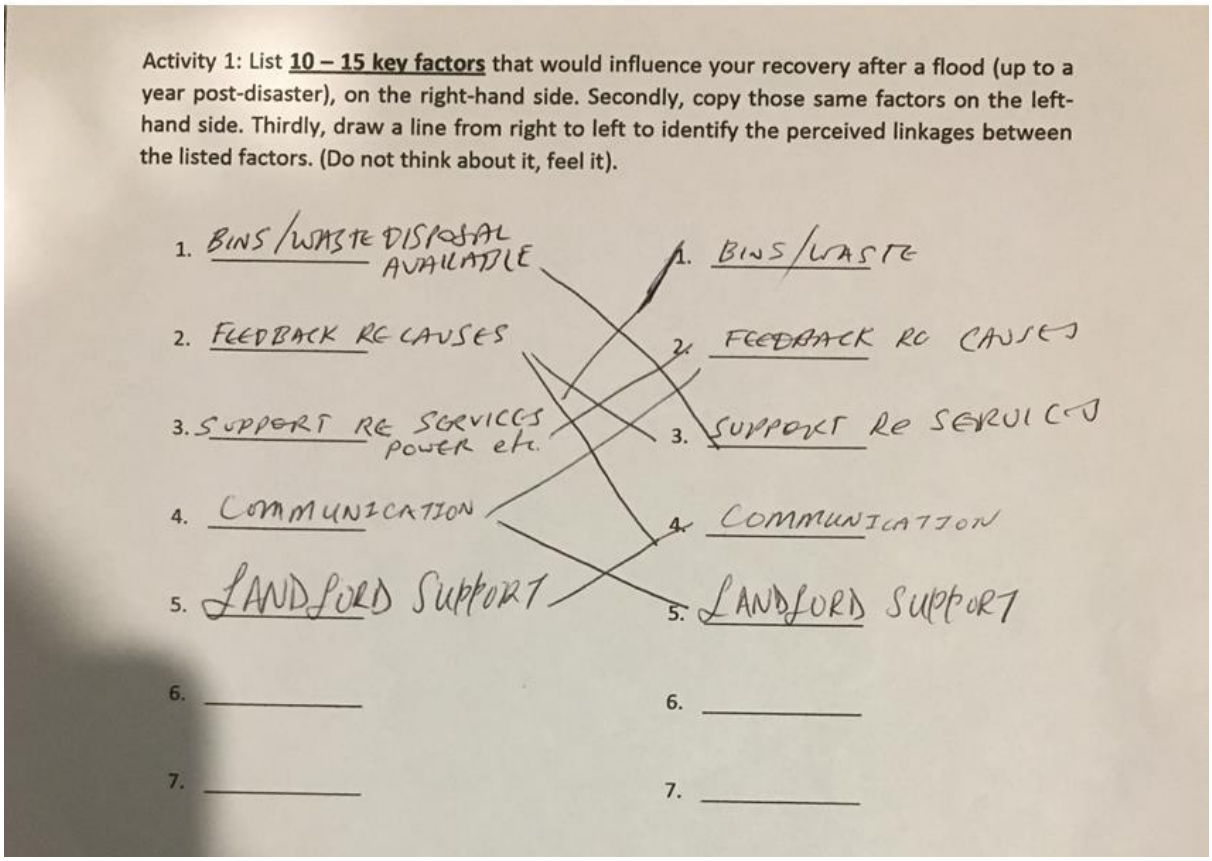



HENDERSON VALLEY
FLOOD MAP
Christian Road
Coulter Road
Lake Panorama Drive
Vanguard Road
Sturges Road
Isabel Drive
Seibel Road
Candia Road
Ferndale Lodge
Carey Park Christian Camp
Henderson Valley Road
Kiwi Valley
Henderson Valley School
Superb Herb
Opanuku Bus Stop
Gum Road
Walker Road
Tauranga Road
Mountain Road
Tawari Road
Grassmere Road
Maphia Road
Opanuku Road
Opanuku Chicken Farm
Scenic Drive
Legend
Road Network
Rivers and Streams
August 2021 Floods
Community Boundary
Building Footprint
Northland
Auckland
N
0 0.325 0.65 1.3
Kilometers
Date : June 2022
Created by:
Researcher: Anna-Kay Spaulding-Agbenyegah
Data Sources:
Linz - Roads, & NZ River Centrelines (Topo, 1:250k)
Redigitized from Auckland Council's Local Area Plan - Community Boundary
World Topo Map - Imagery Data
Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

11.6 Appendix 6 – HIDECS Results for Kumeū-Huapai community

Kumeū-Huapai

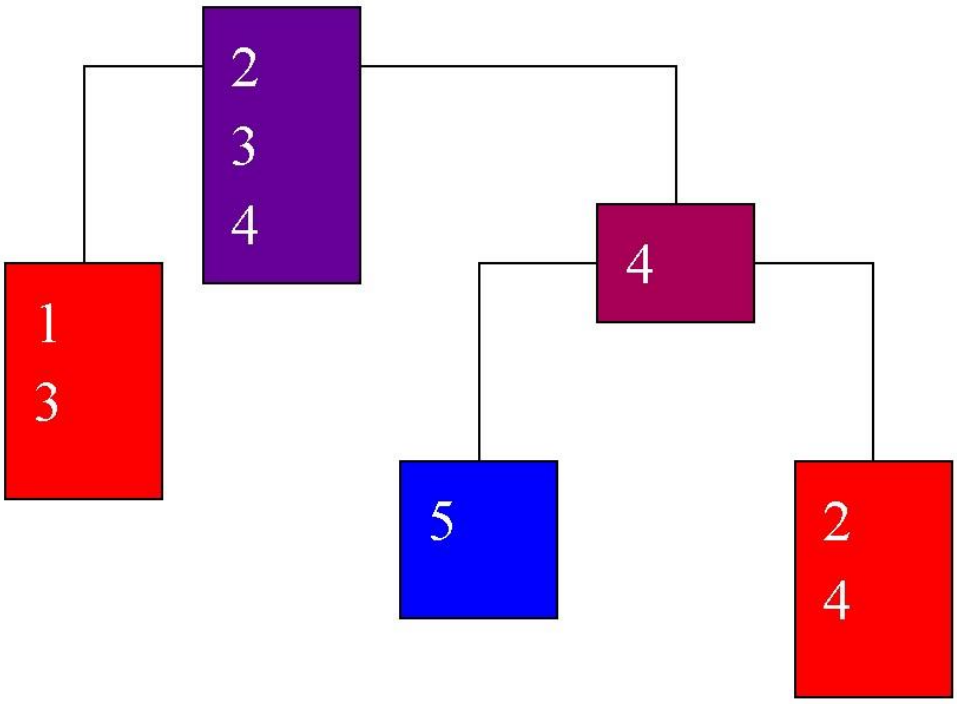
KH - Sheet 1, HIDECS Results – Communication



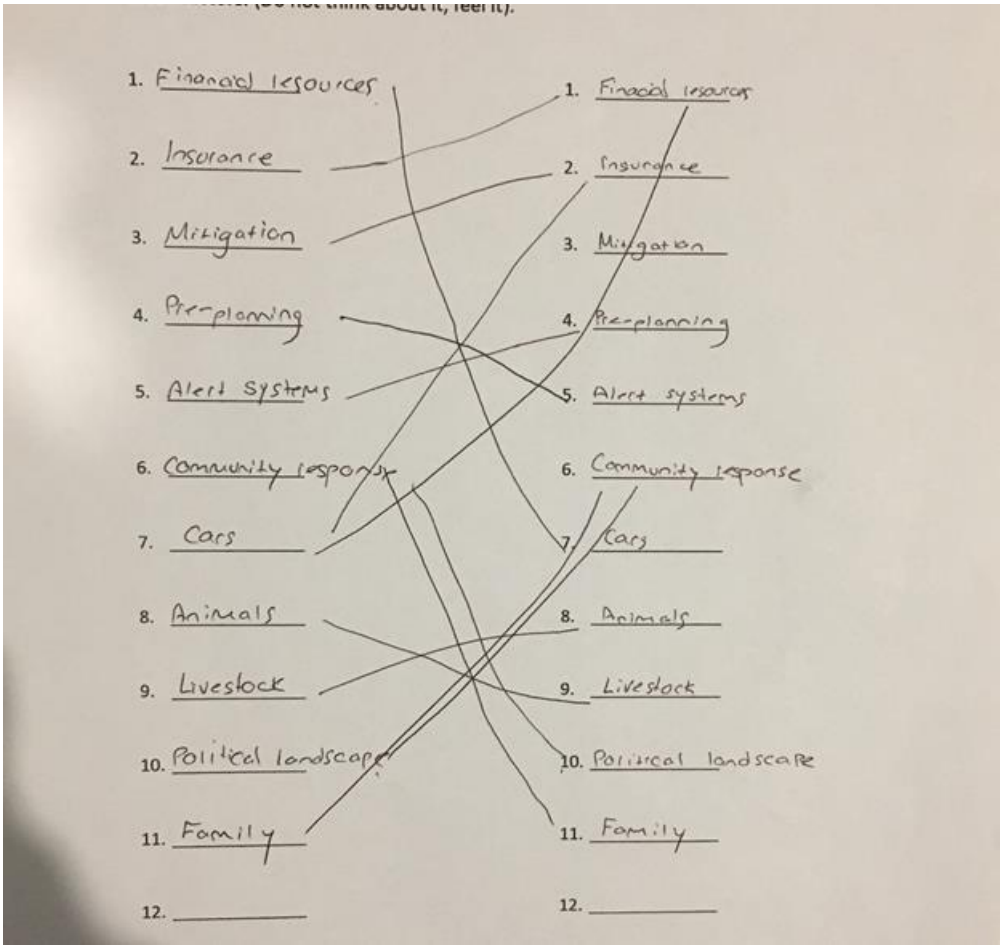
Activity 1: List **10 – 15 key factors** that would influence your recovery after a flood (up to a year post-disaster), on the right-hand side. Secondly, copy those same factors on the left-hand side. Thirdly, draw a line from right to left to identify the perceived linkages between the listed factors. (Do not think about it, feel it).

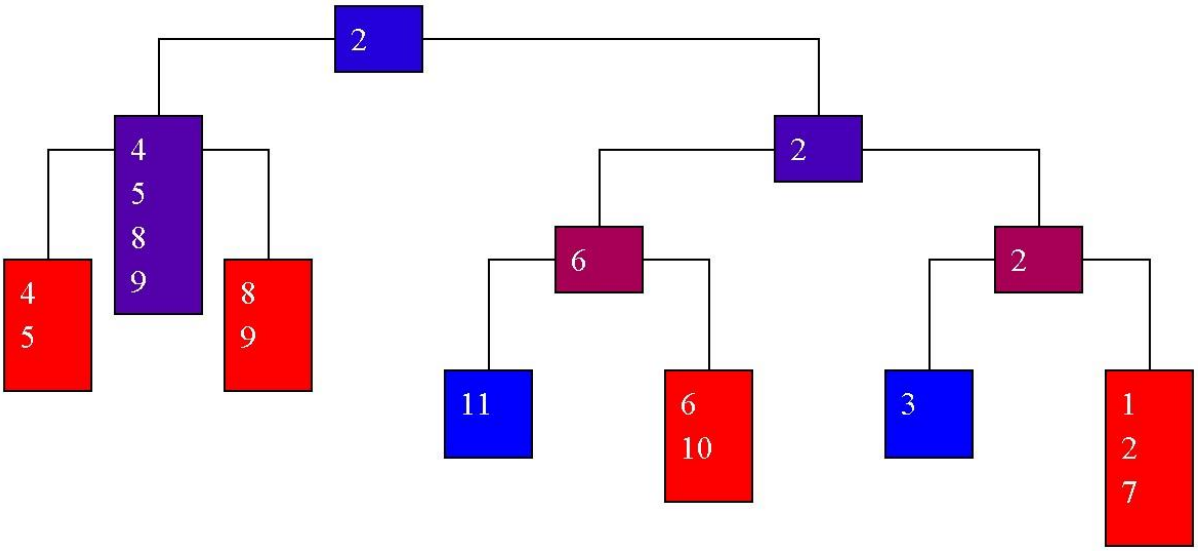
1. BINS/WASTE DISPOSAL AVAILABLE
2. FEEDBACK RE CAUSES
3. SUPPORT RE SERVICES POWER etc.
4. COMMUNICATION
5. LANDLORD SUPPORT
6. _____
7. _____

1. BINS/WASTE
2. FEEDBACK RE CAUSES
3. SUPPORT RE SERVICES
4. COMMUNICATION
5. LANDLORD SUPPORT
6. _____
7. _____

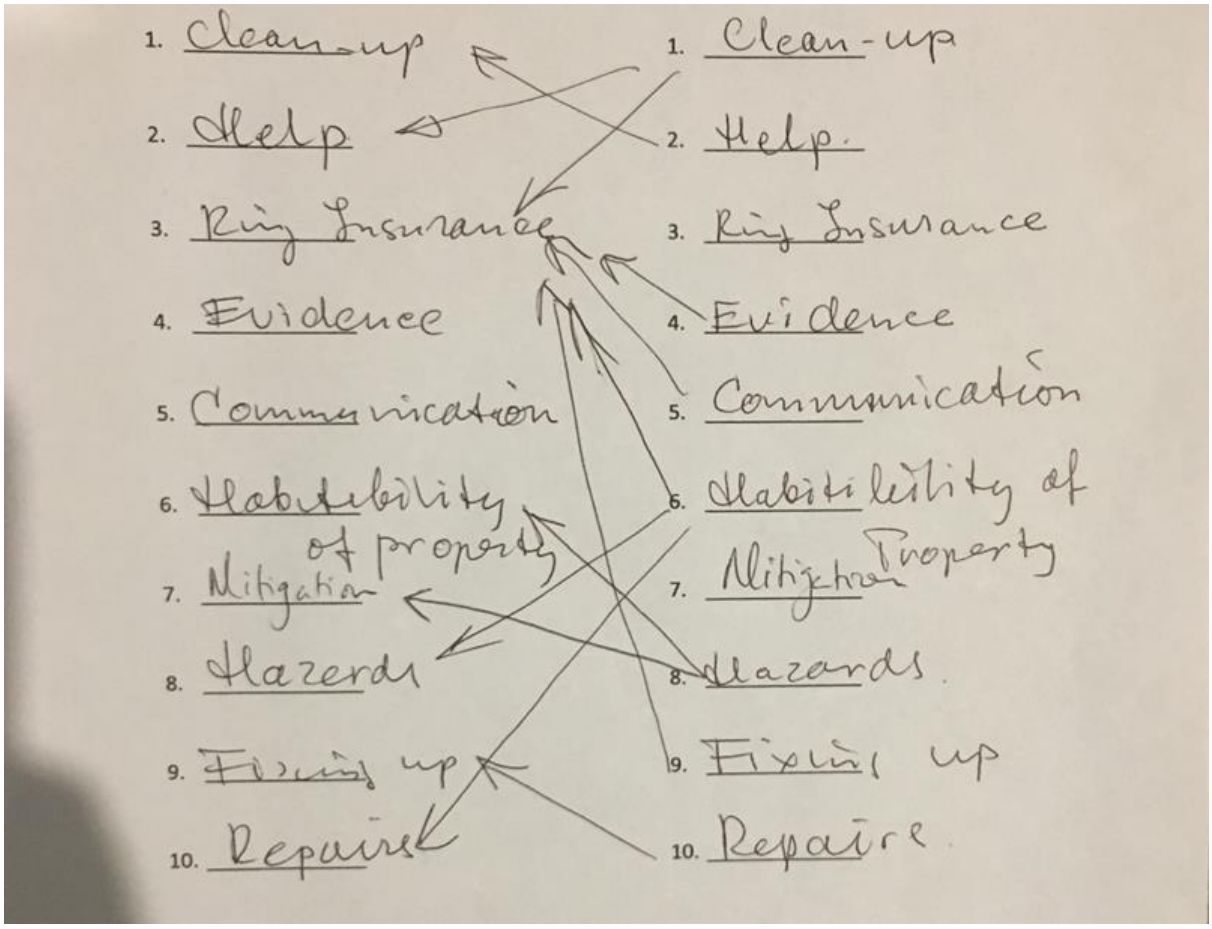


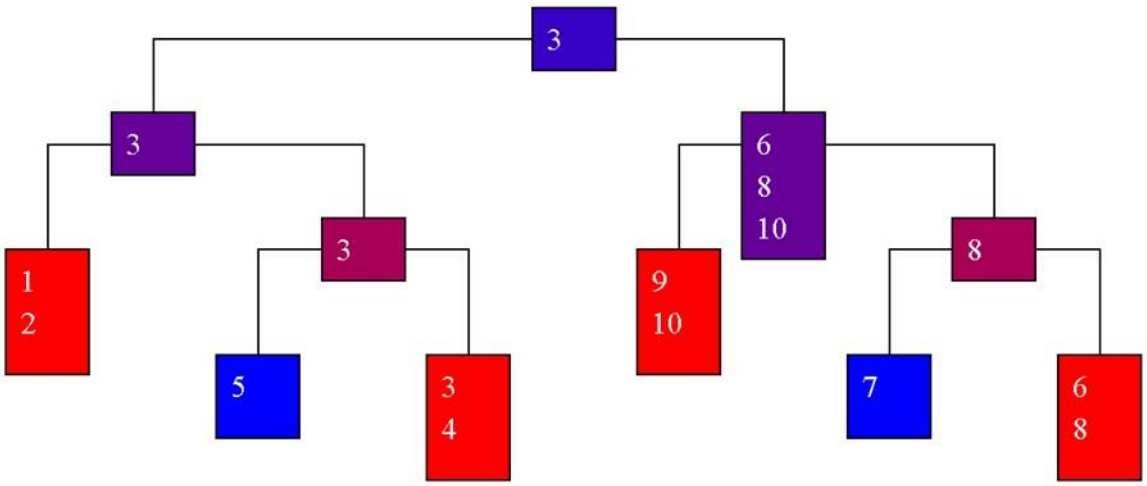
KH - Sheet 2, HIDECS Results - Insurance



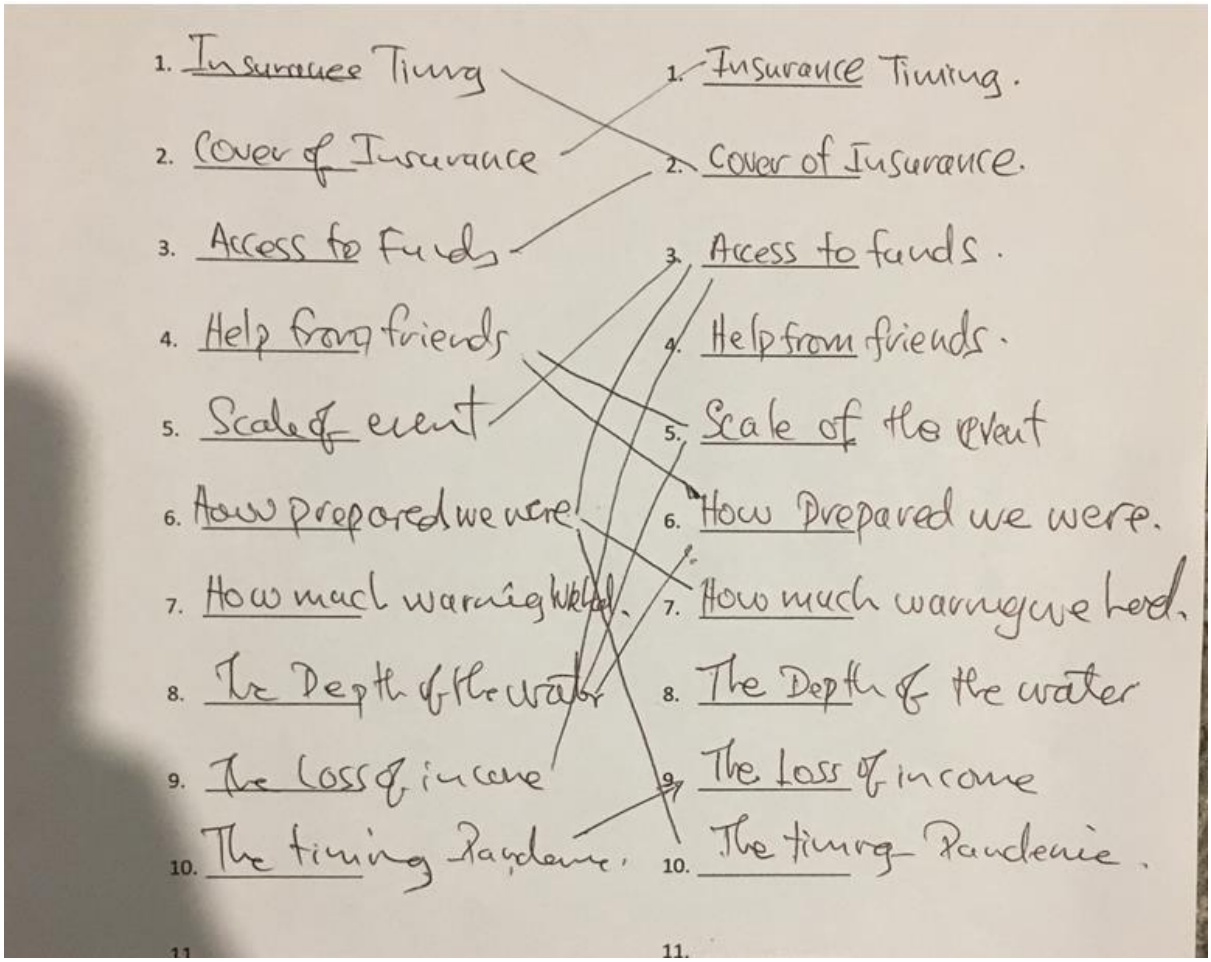


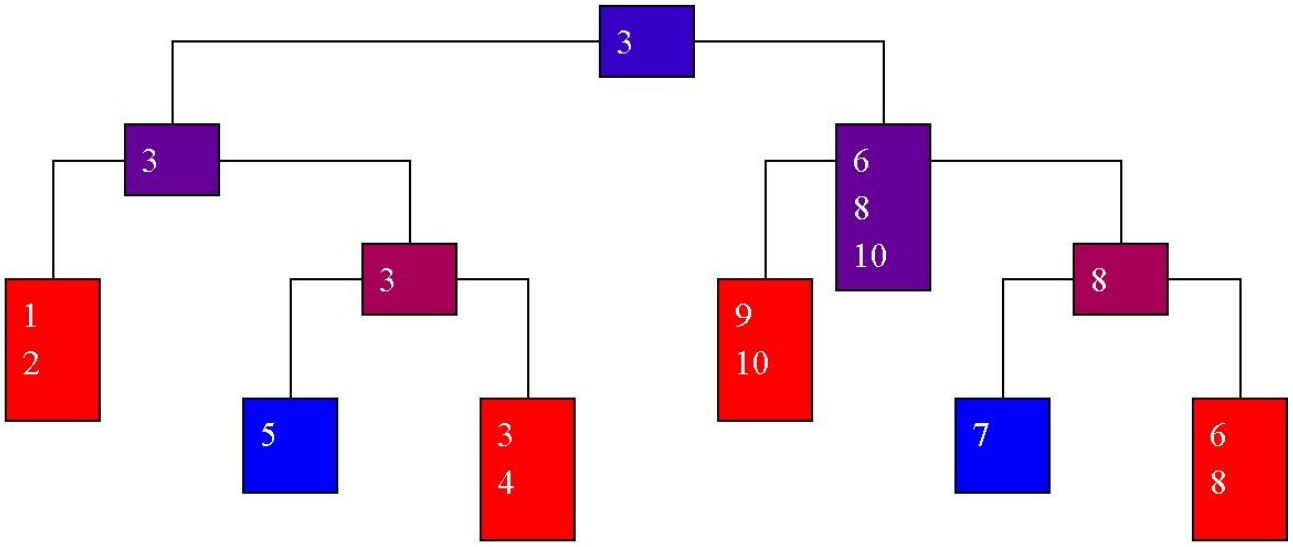
KH - Sheet 3, HIDECS Results - Insurance



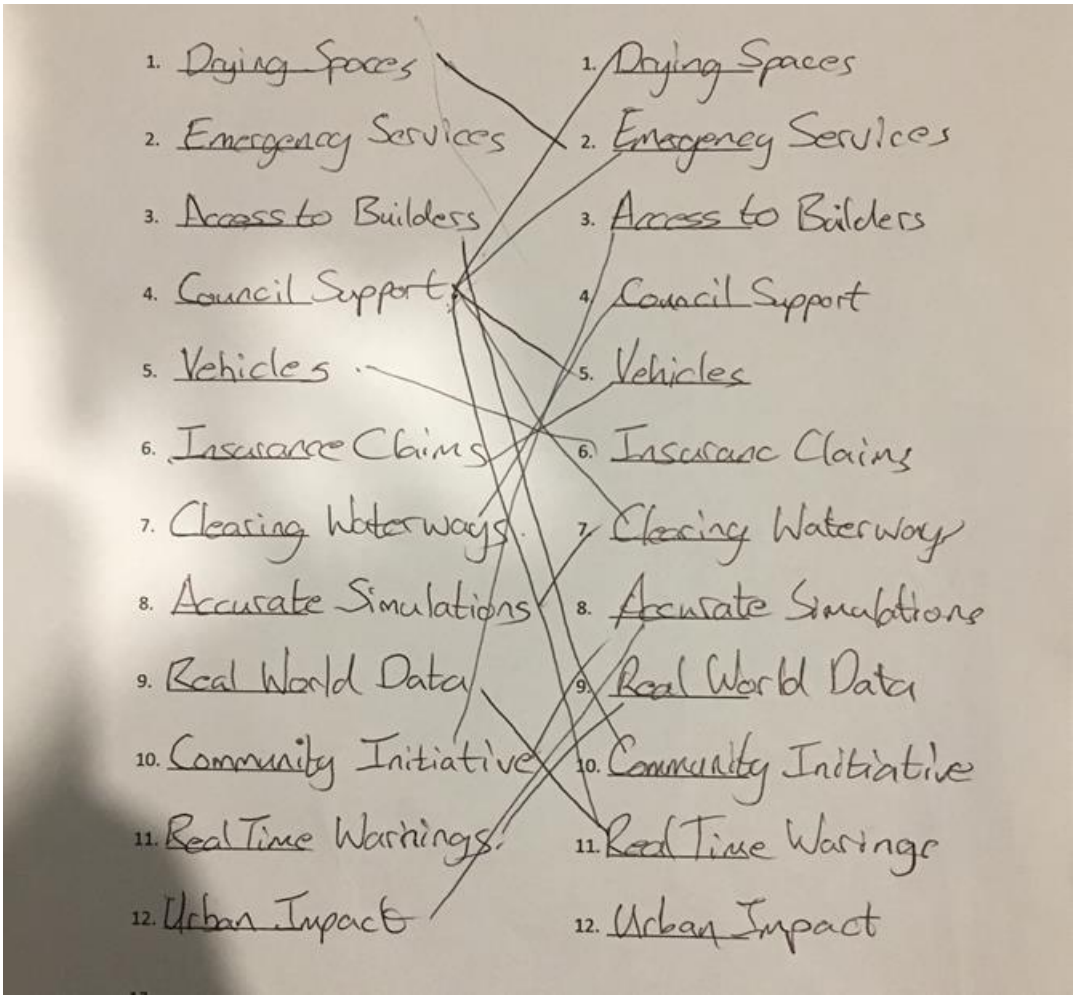


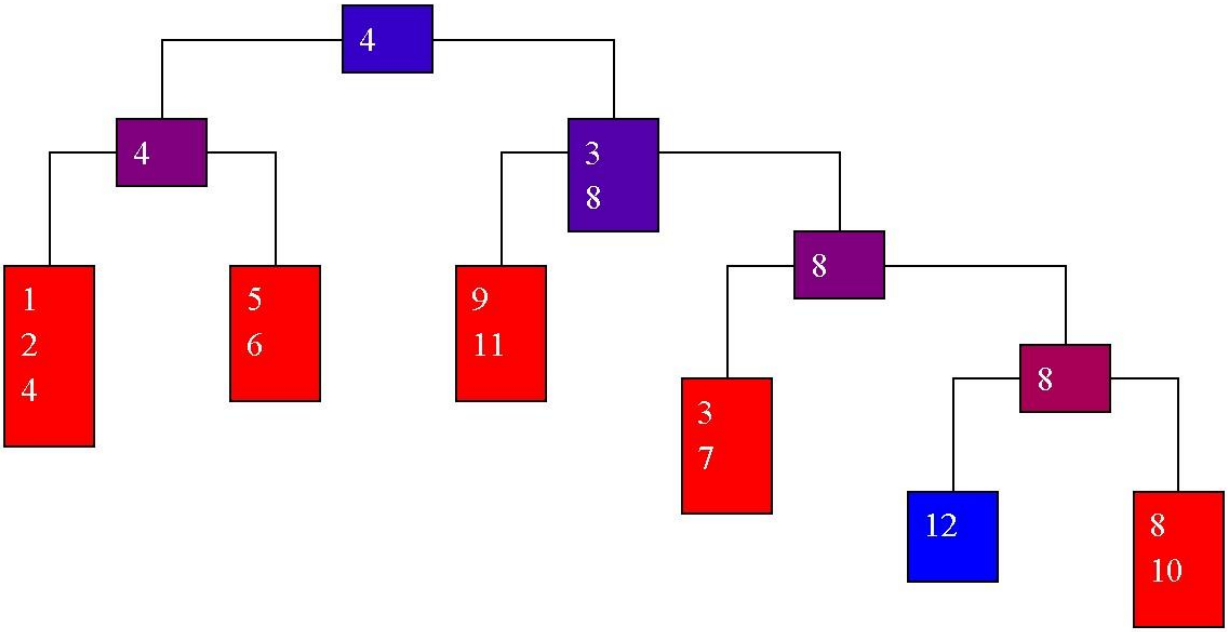
KH - Sheet 4, HIDECS Results - Access to Funds



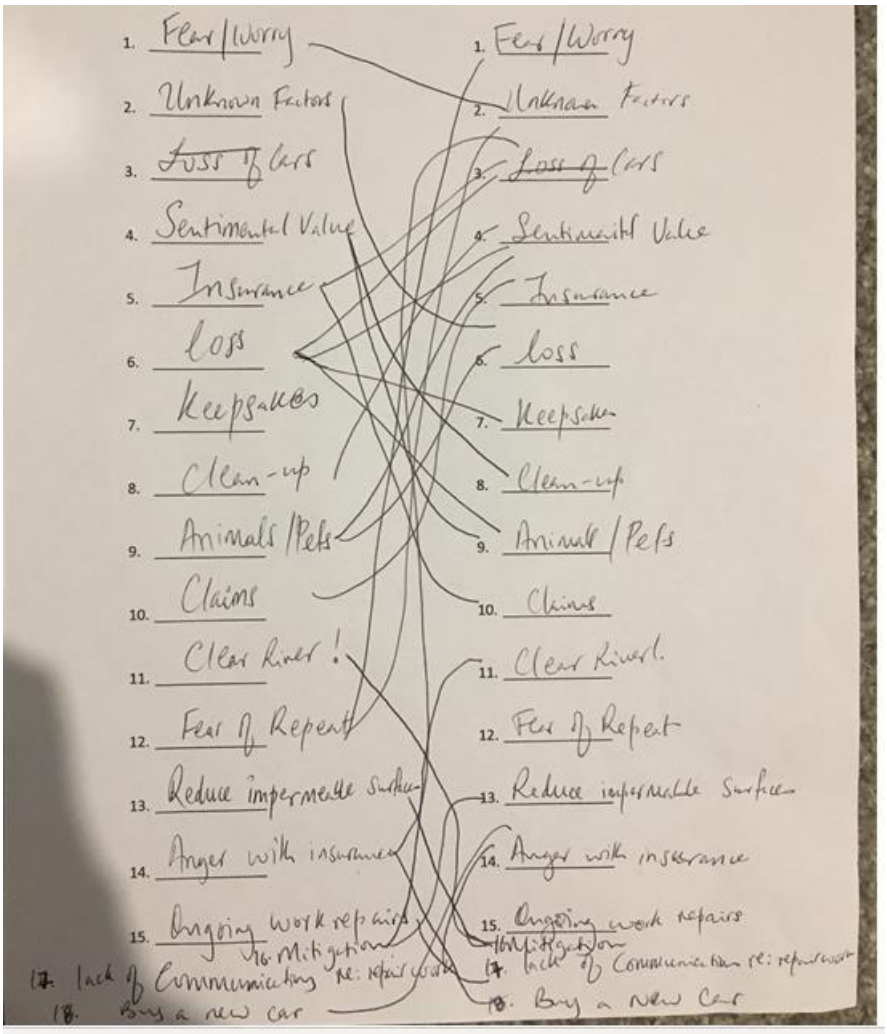


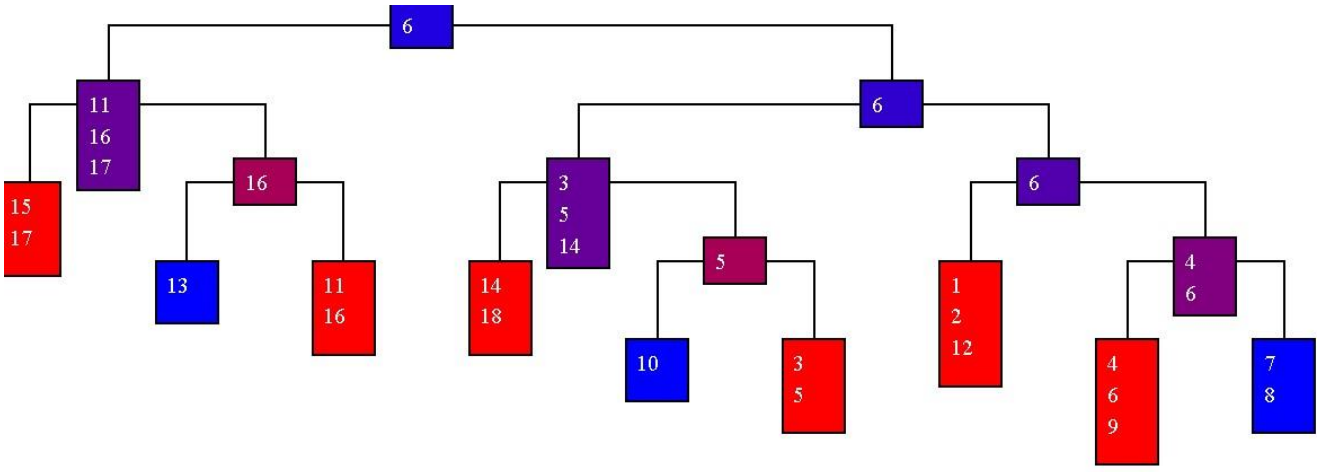
KH - Sheet 5, HIDECS Results - Council Support





KH - Sheet 6, HIDECS Results - Loss & Mitigative solutions

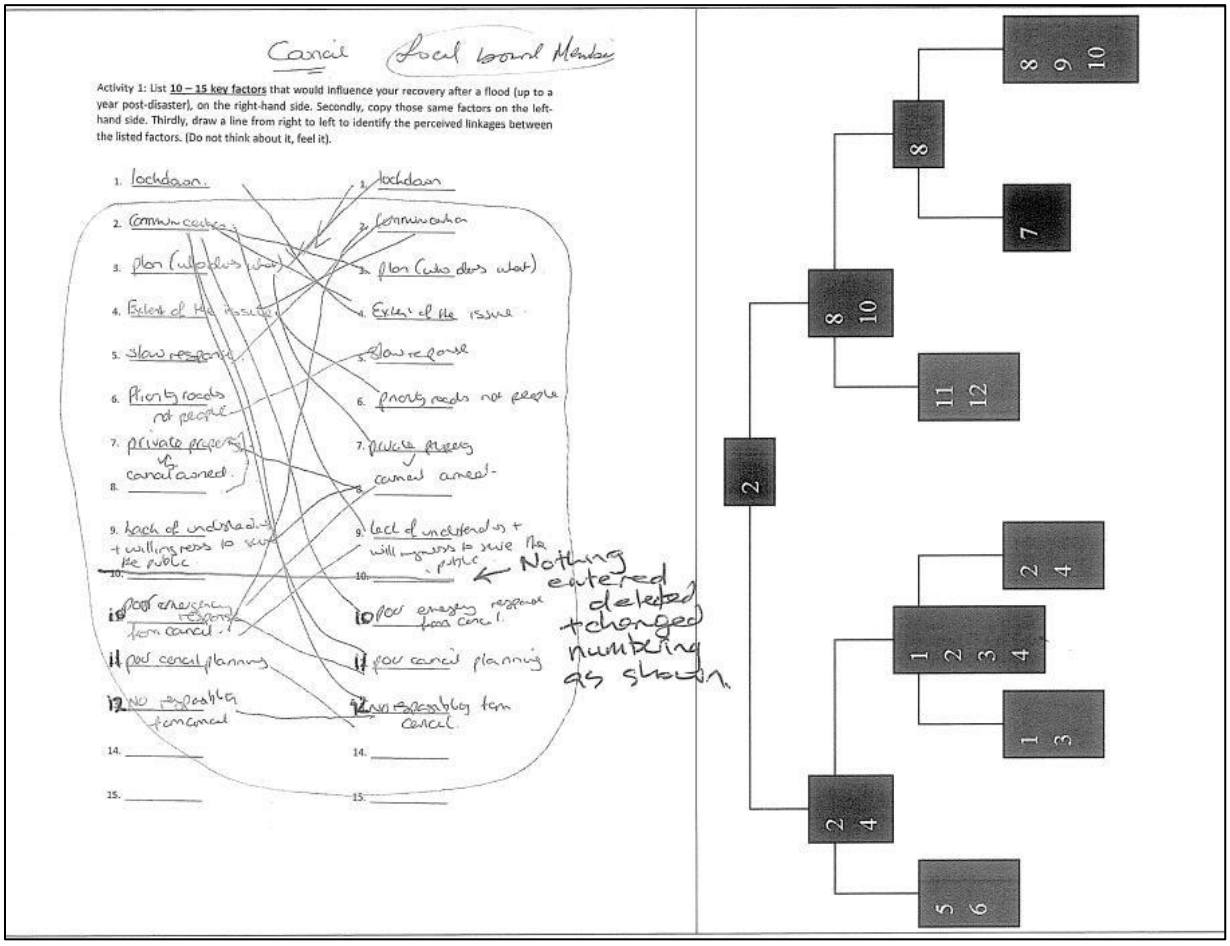




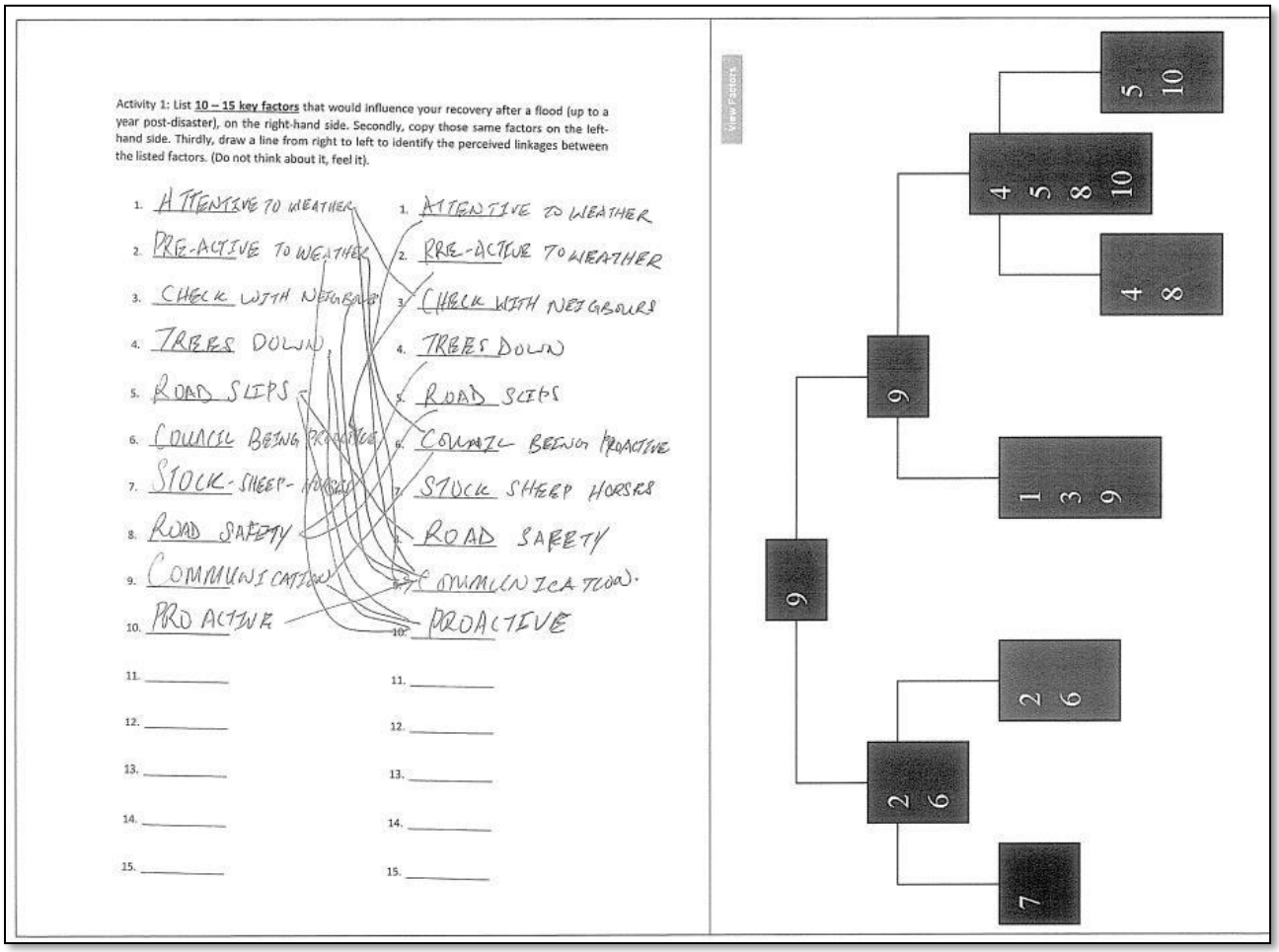
11.7 Appendix 7 – HIDECS Results for Henderson Valley Community

Henderson Valley

HV - Sheet 1, HIDECS Results – Communication



Sheet 2, HIDECS Results – Communication



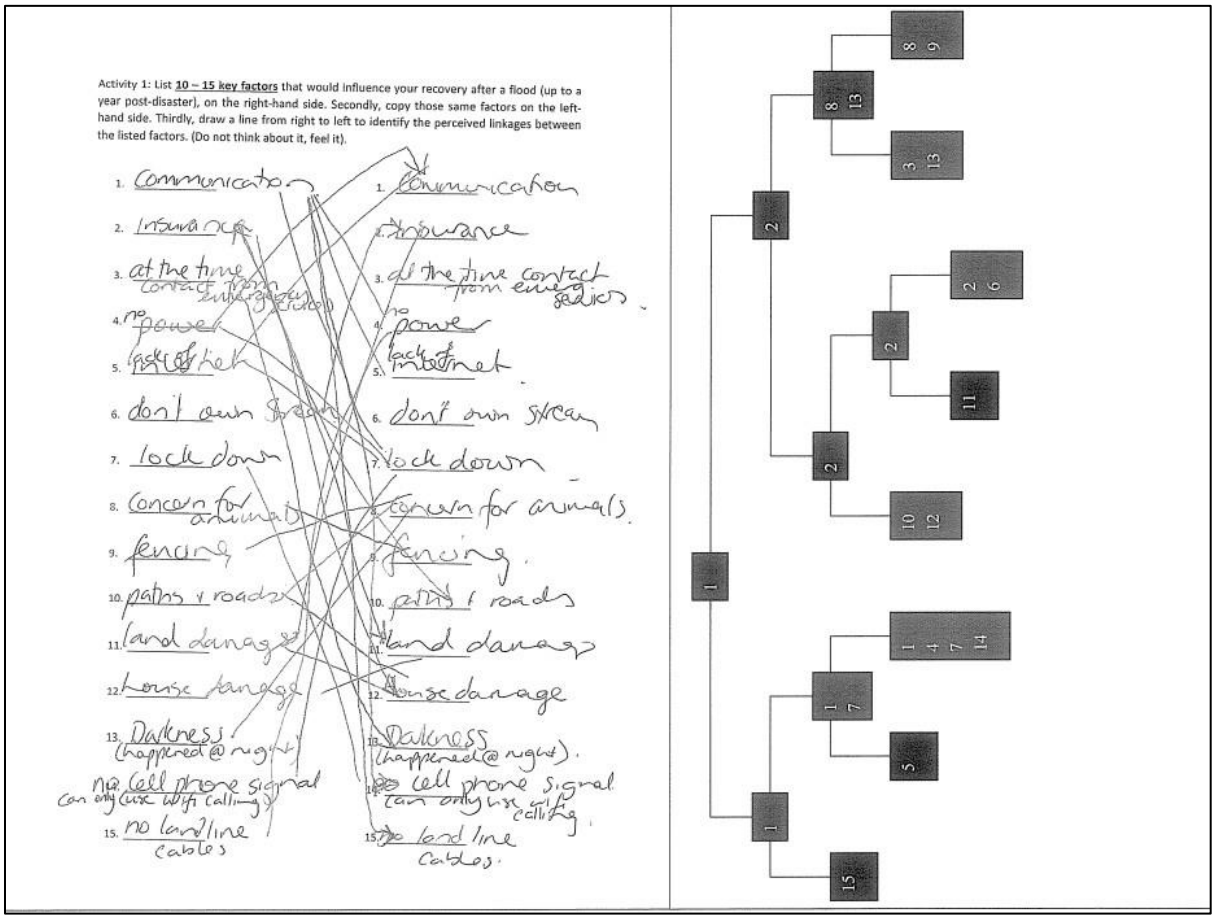
Activity 1: List **10 – 15 key factors** that would influence your recovery after a flood (up to a year post-disaster), on the right-hand side. Secondly, copy those same factors on the left-hand side. Thirdly, draw a line from right to left to identify the perceived linkages between the listed factors. (Do not think about it, feel it).

1. ATTENTIVE TO WEATHER	1. ATTENTIVE TO WEATHER
2. PRE-ACTIVE TO WEATHER	2. PRE-ACTIVE TO WEATHER
3. CHECK WITH NEIGHBOUR	3. CHECK WITH NEIGBOURS
4. TREES DOWN	4. TREES DOWN
5. ROAD SLIPS	5. ROAD SLIPS
6. COUNCIL BEING PROACTIVE	6. COUNCIL BEING PROACTIVE
7. STOCK - SHEEP - HORSES	7. STUCK SHEEP HORSES
8. ROAD SAFETY	8. ROAD SAFETY
9. COMMUNICATION	9. COMMUNICATION.
10. PRO ACTIVE	10. PROACTIVE
11.	11.
12.	12.
13.	13.
14.	14.
15.	15.

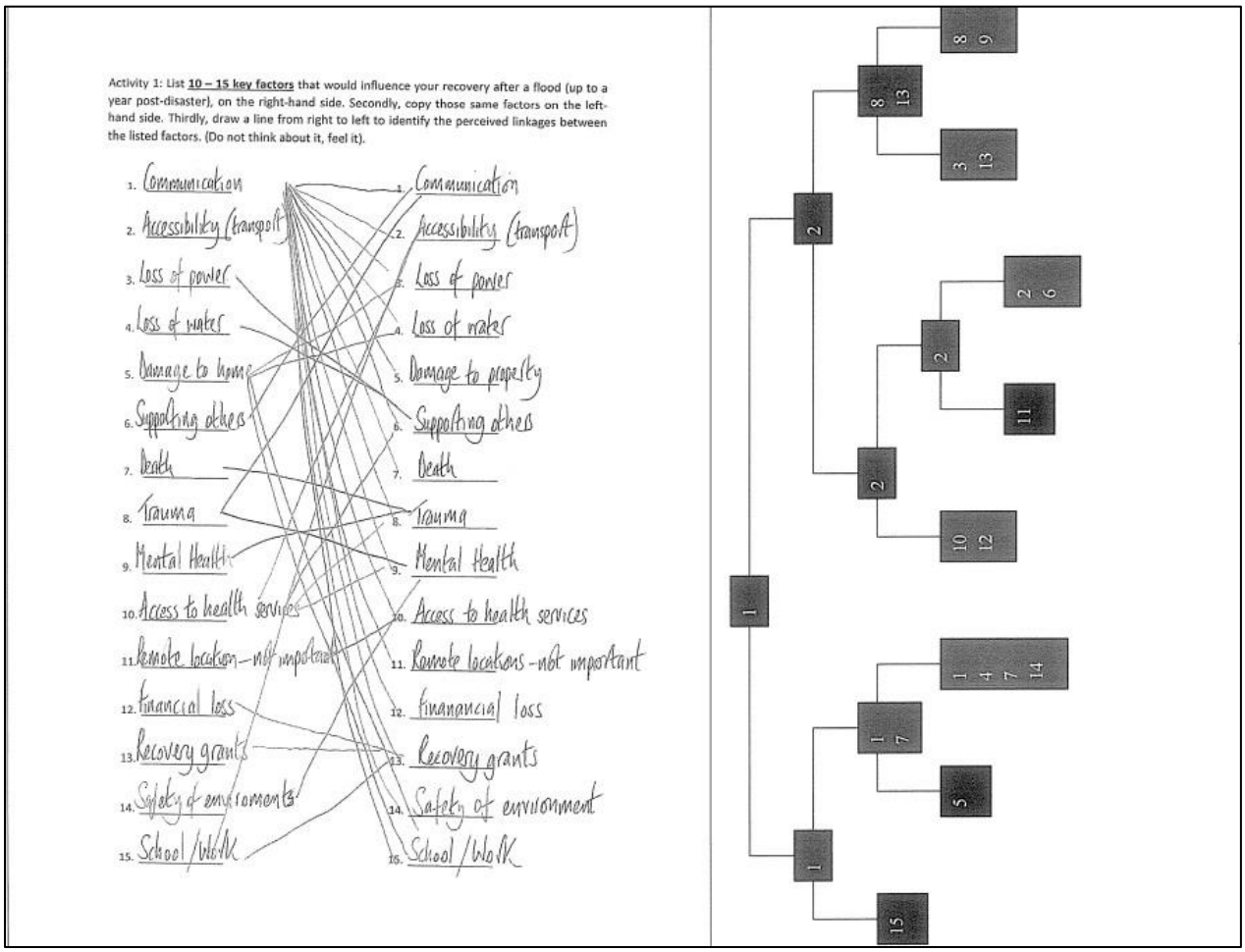
View Factors

5 10
4 5 8 10
4 8
9
1 3 9
9
2 6
2 6
7

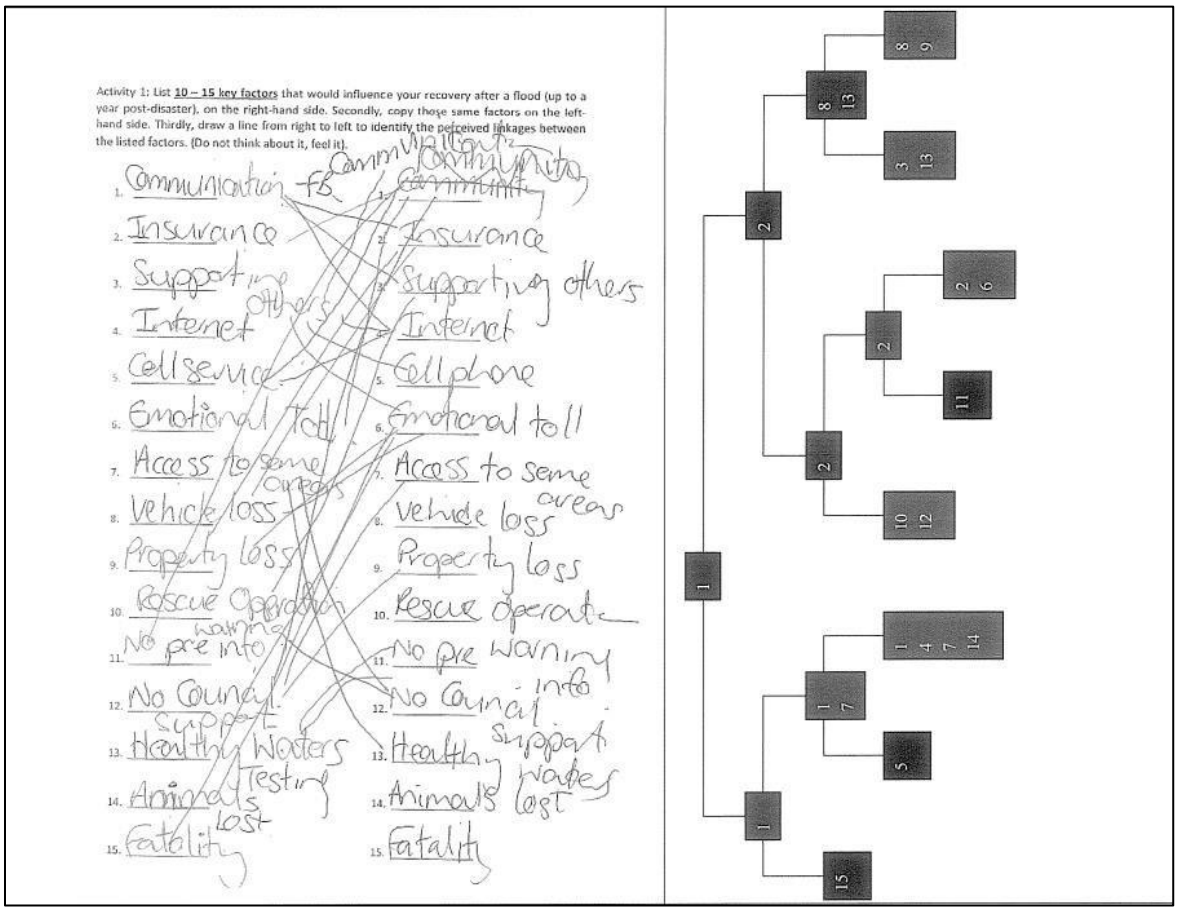
HV - Sheet 3, HIDECS Results – Communication



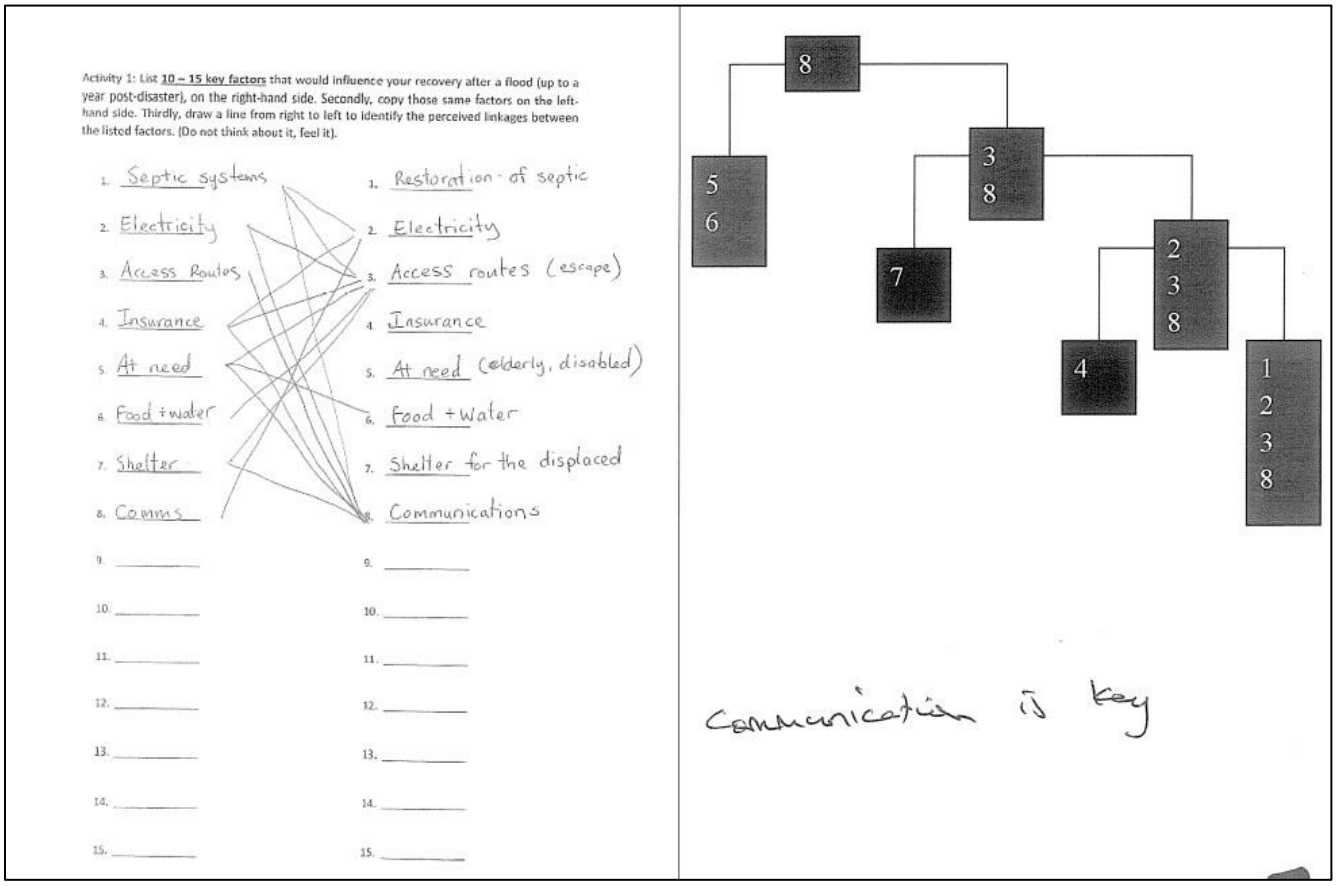
HV - Sheet 4, HIDECS Results – Communication



HV - Sheet 5, HIDECS results – Communication



HV - Sheet 6, HIDECS Results – Communication

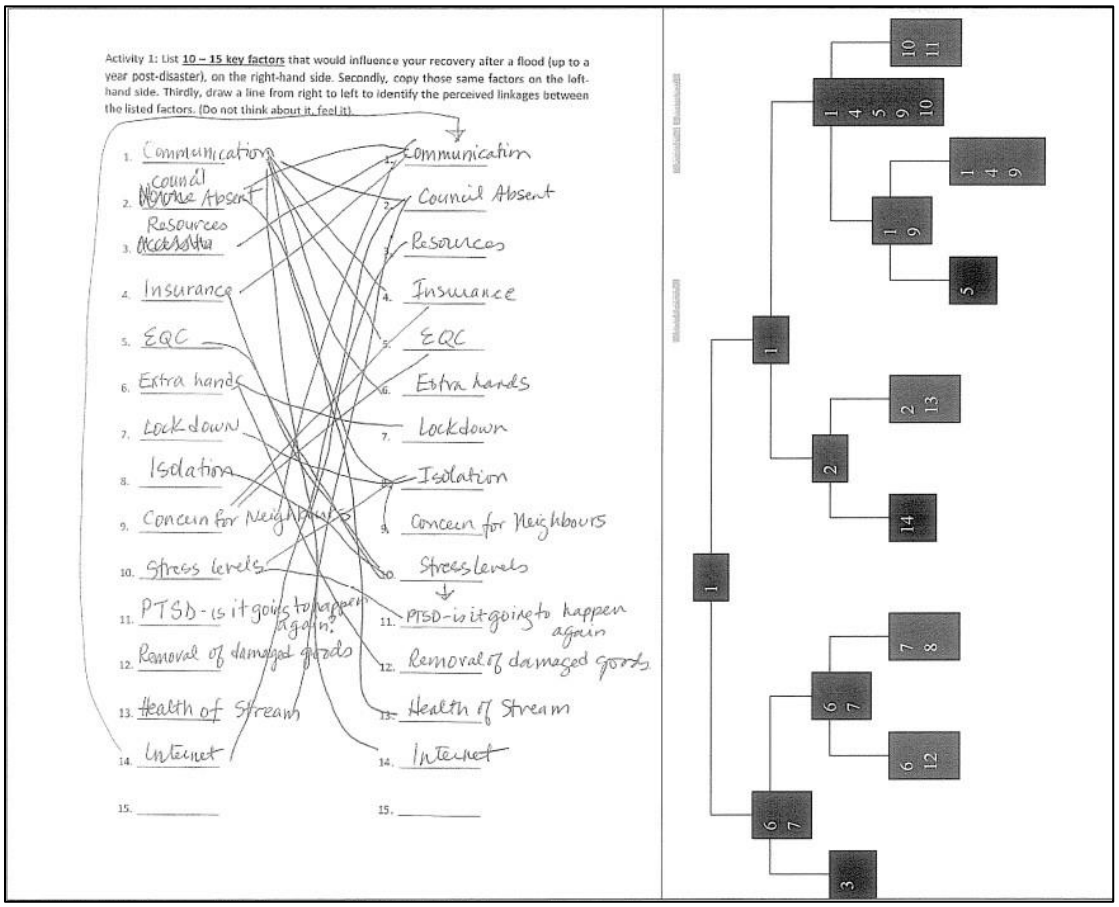


Activity 1: List **10 – 15 key factors** that would influence your recovery after a flood (up to a year post-disaster), on the right-hand side. Secondly, copy those same factors on the left-hand side. Thirdly, draw a line from right to left to identify the perceived linkages between the listed factors. (Do not think about it, feel it).

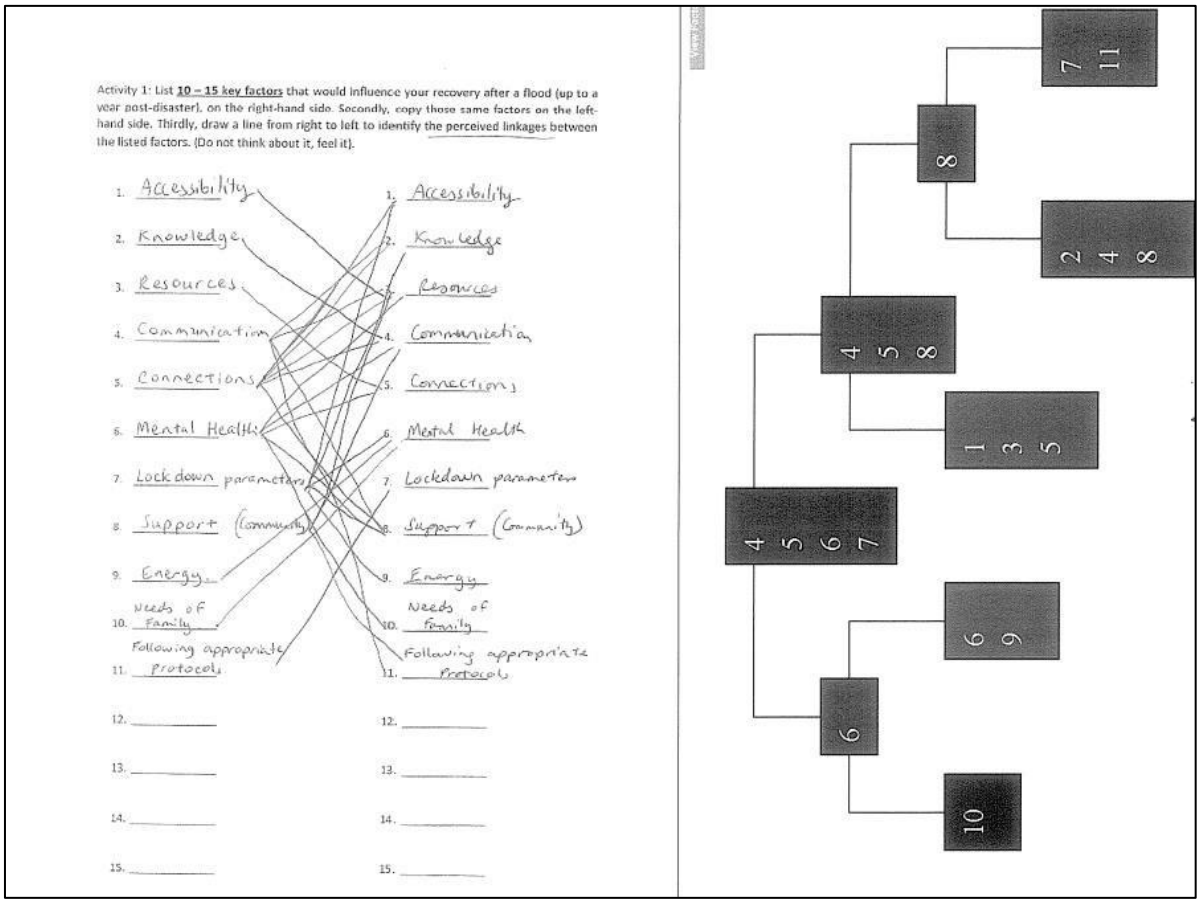
1. Septic systems	1. Restoration of septic
2. Electricity	2. Electricity
3. Access Routes	3. Access routes (escape)
4. Insurance	4. Insurance
5. At need	5. At need (elderly, disabled)
6. Food + water	6. Food + Water
7. Shelter	7. Shelter for the displaced
8. Comms	8. Communications
9.	9.
10.	10.
11.	11.
12.	12.
13.	13.
14.	14.
15.	15.

Communication is key

HV - Sheet 7, HIDECS Results – Communication



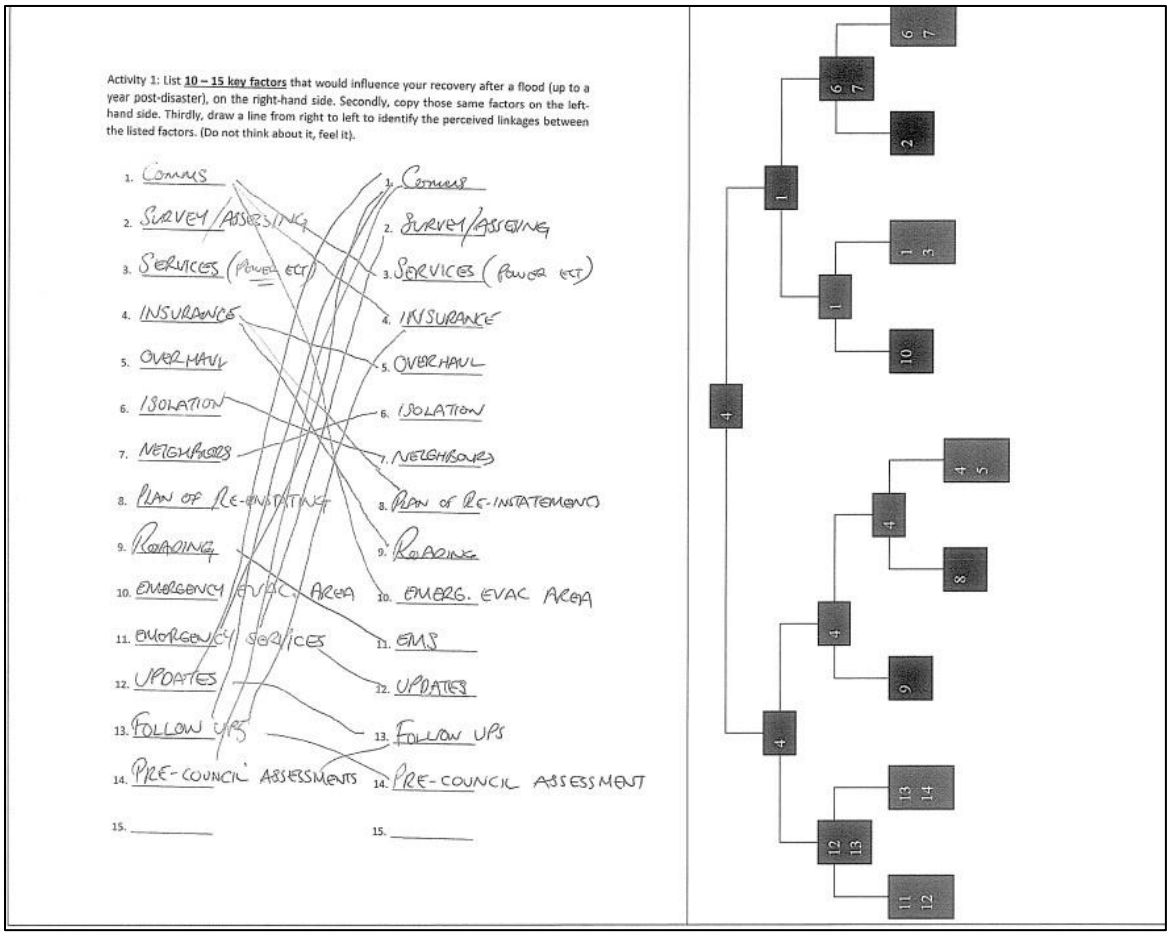
HV - Sheet 8, HIDECS Results – Human Capital



Activity 1: List **10 – 15 key factors** that would influence your recovery after a flood (up to a year post-disaster), on the right-hand side. Secondly, copy those same factors on the left-hand side. Thirdly, draw a line from right to left to identify the perceived linkages between the listed factors. (Do not think about it, feel it).

1. Accessibility	1. Accessibility
2. Knowledge	2. Knowledge
3. Resources	3. Resources
4. Communication	4. Communication
5. Connections	5. Connections
6. Mental Health	6. Mental Health
7. Lock down parameters	7. Lockdown parameters
8. Support (Community)	8. Support (Community)
9. Energy	9. Energy
10. Needs of Family	10. Needs of Family
11. Following appropriate protocols	11. Following appropriate Protocols
12.	12.
13.	13.
14.	14.
15.	15.

HV - Sheet 9, HIDECS Results – Insurance



Activity 1: List **10 – 15 key factors** that would influence your recovery after a flood (up to a year post-disaster), on the right-hand side. Secondly, copy those same factors on the left-hand side. Thirdly, draw a line from right to left to identify the perceived linkages between the listed factors. (Do not think about it, feel it).

1. COMMS
2. SURVEY/ASSESSING
3. SERVICES (POWER ECT)
4. INSURANCE
5. OVERHAUL
6. ISOLATION
7. NEIGHBOURS
8. PLAN OF RE-INSTATING
9. ROADING
10. EMERGENCY EVAC AREA
11. EMERGENCY SERVICES
12. UPDATES
13. FOLLOW UPS
14. PRE-COUNCIL ASSESSMENTS
15. _____

1. COMMS
2. SURVEY/ASSESING
3. SERVICES (POWER ECT)
4. INSURANCE
5. OVERHAUL
6. ISOLATION
7. NEIGHBOURS
8. PLAN OF RE-INSTATEMENT
9. ROADING
10. EMERG. EVAC AREA
11. EMS
12. UPDATES
13. FOLLOW UPS
14. PRE-COUNCIL ASSESSMENT
15. _____

11.8 Appendix 8 – Field Work Pictures for Kumeū-Huapai

Scoping Interview with a senior resident

Photograph 1: First Scoping Interview with a Kumeū-Huapai Senior Resident. Held outdoors at his residence in Kumeū, due to COVID-19 Restrictions.

Field Reconnaissance and engaging with residents and workers

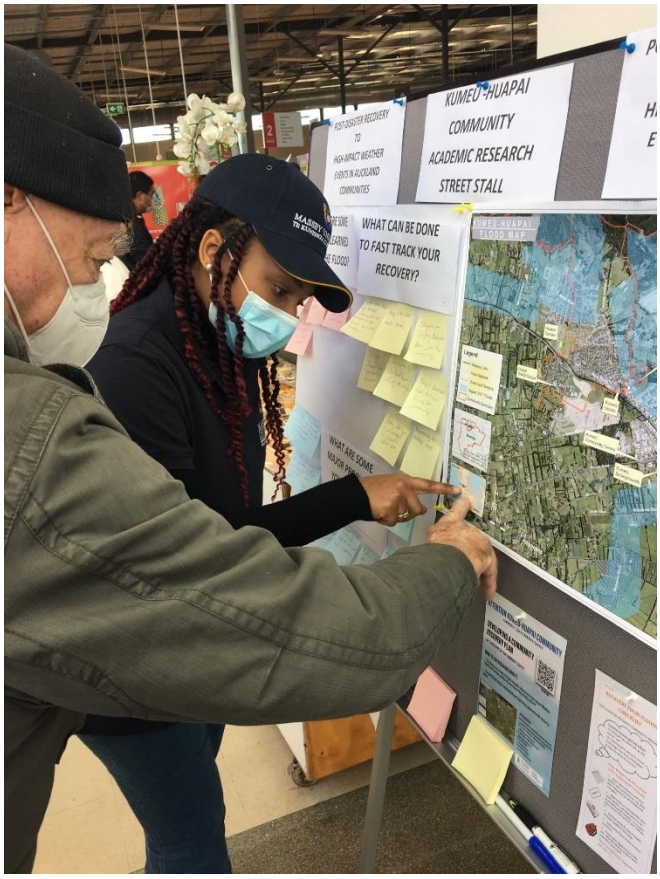
Photographs 2-4: Fieldwork reconnaissance, community walkthrough, and conversations with residents and workers in the Kumeū-Huapai community about the impact, location, and height of the flood.

Photograph 5: A resident and worker of the Kumeū-Huapai community showed the researcher the height of the floods, the morning following the event.

Photograph 6: The researcher pointed to the height of the flood on the flood gauge, located less than 20 meters from the Kumeū River. This shows the height of the flood waters in the morning following the event.

Street Stall Event Photos at the New World Supermarket in Kumeū-Huapai

Photograph 7 & 8: KH Street Stall Event - Engaging residents in conversations regarding the impact and how they have been affected by the August 2021 floods.



Photographs 9 & 10: Residents engage with researcher and participate in the hazard mapping validation exercise.

Kumeū-Huapai Workshop held at the Kumeū Arts Centre

Photograph 11(far left): The Researcher delivered a workshop presentation and introduced the exercises to community participants.

Photographs 12 (far right) & 13 (bottom): Researcher discussing with residents their recovery experiences.

Photographs 14 & 15: Residents and researcher engaging with various workshop exercises.

Photograph 16: Residents engaging with each other to form a consensus on the flood boundaries that affected areas in the community.

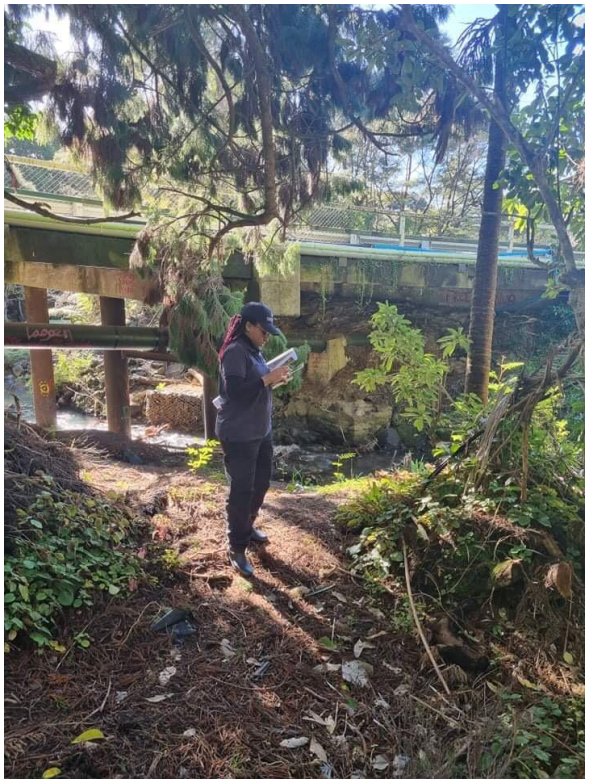
Photograph 17: The price winner for the most active workshop participant.

Funded by the National Science Challenge.

11.9 Appendix 9 – Field Work Photographs for Henderson Valley

Henderson Valley Community Walk-through & Field Mapping

Photograph 1: Affected by the August 2021 Flood event, resident showed the researcher the height at which the floods affected her property using a piece of twig found lying on the ground.

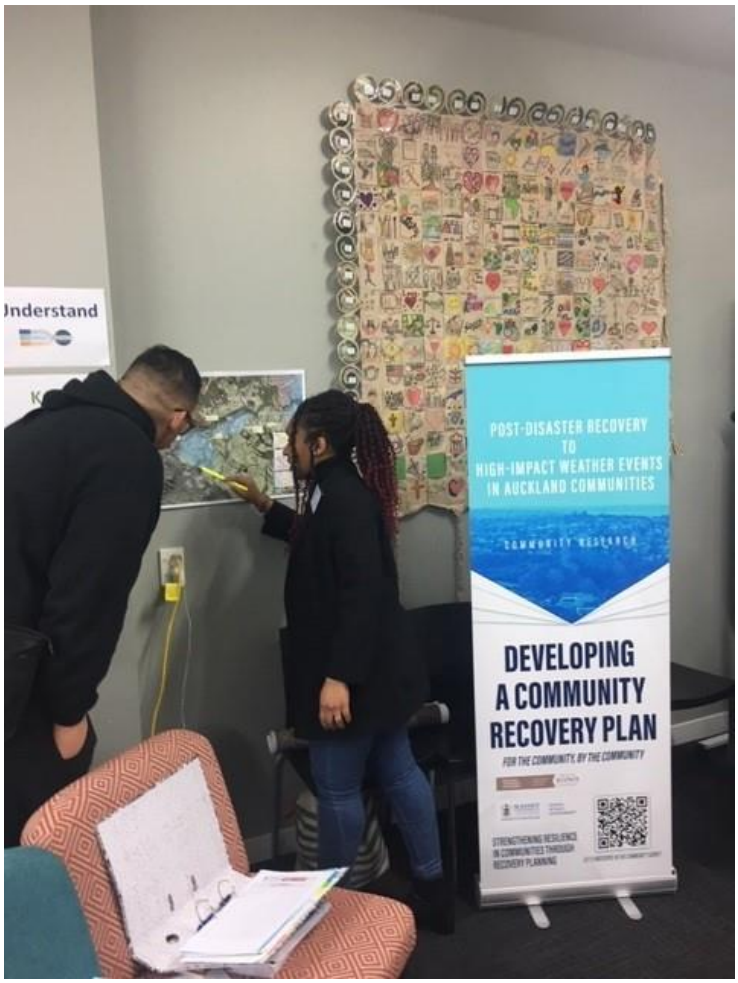


Photograph 2: assisted by the lead community gatekeeper, the researcher mapped the floodplain zone using TouchGIS geospatial application, using an Ipad.

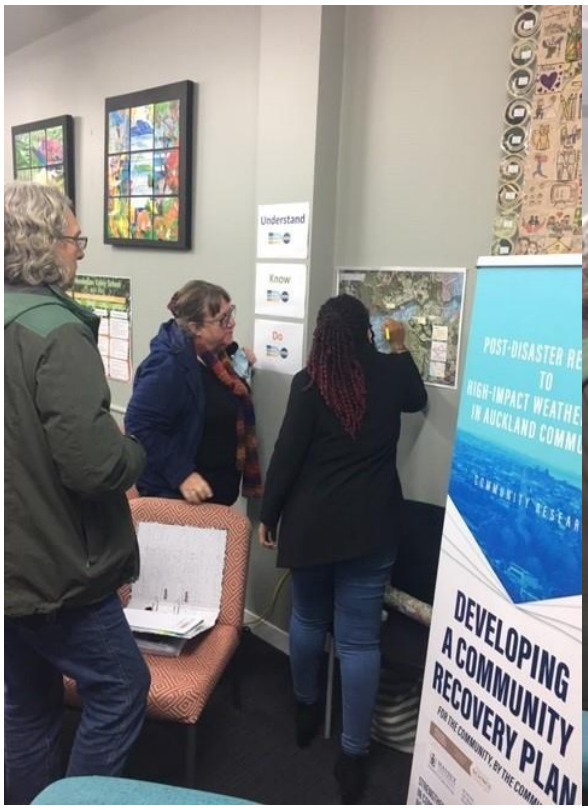
Photograph 3: Affected HV Senior resident sat down with the researcher to have a conversation about her recovery experiences and complete her online survey on the researcher's Ipad.

Photograph 4: Lead community gate keeper, and President of the HVRA showed the researcher the height of the flood waters, debris on a campsite property (the identified location for community meetup during a flood event) which was closed for nearly a year Post-disaster August 2021 flood event.

Henderson Valley Residents' Association Meeting, and Hazard mapping exercise



Photographs 5,6, and 7: Researcher interacting and engaging with residents, validating areas that flooded during the August 2021 event at their quarterly Residents Association Community meeting.



Henderson Valley Street Stall Event – Held at the Local Pak N Save in Henderson Valley

Photograph 8: Residents of Henderson Valley Community were the first two participants to contribute and interact with in the street stall board.

Photograph 9: Residents of the Henderson Valley Community discussed some lessons learned after the flood event, and what can be done to fast track recovery in their community.

Photographs 10 and 11: Depict the Street Stall set-up, with completed residents' thoughts under each question.

A community hazard map was also posted on the board, where contributions and flood boundary validation from residents were welcomed.

Photograph 12 - Henderson Valley Community Workshop, held at the Henderson Valley Primary School

Community members discuss workshop exercises after the researcher's opening presentation at the start of the workshop.

Photograph 13 - Second workshop exercise: residents discuss their expectations of recovery authorities and post answers on sticky notes under each question.

Photograph 14 shows responses for activity 2, from workshop participants

Photographs 15 and 16 show workshop participants from Group B presenting and discussing the findings about what their CRP would look like.

Photographs 17 & 18, show workshop participants engaging with the researcher and each other.

Photographs 19, Shows workshop participants being attentive to Group A's presentation, presented by a member of group A (shown on the left-hand side of the flip-chart paper). Held/supported by Researcher on the right-hand side of the image.

Photograph 20 – Overall Workshop set-up and facilitation in Henderson Valley

Photograph 21 - Researcher pointing to debris littered along the riverbanks and floodplain in Henderson Valley, 1-year post-disaster August 2021 flood event.

Photograph 22 – Nikau Palms and other trees littered the Henderson Valley's river bank the morning following the flood event.

Photograph 23 - Major landslide scar in Henderson Valley. Landslide triggered by the August 2021 HIWeather event which blocked Mountain Road for several months.

11.10 Appendix 10 – Workshop Activities

Workshop Objectives

- To identify factors that influence the community to recover from HIWeather Events.
- To create a realistic and probable multi-hazard damage scenario (What ifs scenarios) to plan for high-impact weather (HIWeather) events that lead to flooding to assist the community to plan for recovery.
- To plan for recovery at the community level by developing a recovery plan (template) that focuses on the built environment.

Workshop Activities

Activity 1

The representatives (residents/workers) of the Henderson Valley community completed a linkage exercise where workshop participants listed 10 -15 factors that influence their recovery after a flood on the right side of a sheet of paper and then copied those same factors on the left-hand side. They then drew a line from the right to the left to identify the perceived linkages between the listed factors.

The activity was explained and demonstrated so that participants were able to attempt the activity. Although the participants were asked not to think about it, this activity requires some level of deep thinking, and so some participants were not able to list all ten/10 factors that would influence their recovery. Support was provided to each participant as needed.

The aim of this exercise was to ascertain the factors that they feel would influence recovery, and in fact, this activity led the researcher to find out the core problems that this community face. Below are the data collected back from each participant and the output from the HIDECS software. The HIDECS software identifies a hierarchical family tree that tells a story about how factors are related to each other, and this points to the main point of concern. This method tries to create patterns and break problems down by linking issues without the bias of the researcher.

Activity 2

The workshop representatives from the Henderson Valley community were asked to participate in a “Post-it exercise” where three/3 questions on a flip chart paper concerning recovery stakeholders, partnerships, obligations & accountability were asked. The instruction was given to the workshop participants to write their thoughts on Post-it notes and stick it under each question. Participants were allowed to post more than one response for each question.

The questions asked on the flip charts are listed below.

Depict on the flip chart and post your answers under each question

1. Who are recovery stakeholders accountable to?
2. What are the obligations of key recovery stakeholders?
3. What does partnership look like for community and stakeholder engagement?

Activity 3

The Scenario Planning exercise

The workshop representatives of the Henderson Valley community were asked to contribute to creating a practical scenario of a possible high-impact weather event that could take place again or in the future.

They were asked to think of a possible flood situation and stretch their thinking to imagine a worst-case scenario and the impacts that it could have on the community guided by a descriptive set of statements that would wholistically explore a scenario to consider not only the experience and constraints but to think about the unusual opportunities and consequences.

They were guided by four/4 listed statements under creating a worst-case scenario story, they are listed below:

1. Describe the Experience:
2. Imagine Constraints:
3. Identify Unusual Opportunities:
4. Imagine Consequences:

Activity 4

The workshop representatives of Henderson Valley community were asked to split in two/2 groups and decide what their Community Recovery Plan should look like.

The researcher showed examples of template designs of other plans used in various communities and districts, as a guide to develop their own unique Community Recovery Plan.

The Researcher created a template with an example of a Community Recovery Plan with a focus on the (Built Environment) based on examples used from wide research done for other recovery plans globally.

For this activity, flip charts were provided, and workshop participants were split into two groups. Group A & B. Each group was given 25 minutes to discuss and 5 minutes to present what their plan should look like to the workshop audience.

Group A created a guided template of what they visualise their Community Recovery Plan would look like (depicted in photo #1) and Group B created a mind map that visualises the core tenets that should be included in their recovery plan.

11.11 Appendix 11 – Street Stall Questions

Held at central supermarkets in each case study area, where the researcher interacted with residents and workers within the community on the following.

1. What were some lessons learned after the flood?
2. What can be done to fast-track your recovery?
3. What are some of the major problems faced in recovery?

Other activity conducted: Community Hazard Mapping and Validation exercise

11.12 Appendix 12 – Community Recovery Pamphlets

JULY 2022

RECOVERY FROM FLOODS CHECKLIST

POST-DISASTER RECOVERY COMMUNITY RESEARCH

Consider recovering from a flood

Q1: What will I do, where will I go and who do I call?

Q2: How long will it take me to recover from floods in the short, intermediate & long term phase of recovery ?

Some things I can do to assist with recovering from floods:

- ☐ Make a Recovery Plan with your whānau and community, for e.g. think about temporary accommodation for relocation.

- ☐ Make copies or scan important documents, photos, and keep them in a waterproof/fireproof container, e.g. Insurance papers, Passport, Wills, Land titles, Birth certificates etc.

- ☐ Pack first-aid kit & medical supplies in known location to the family.
- ☐ Keep survival items stored on elevated shelves.

- ☐ Prepare grab bags/recovery ready kits —Map the location of where you'll store this in your house.

These are just some suggestions, you can +/- ...

POST-DISASTER RECOVERY COMMUNITY RESEARCH

PREPARE TO RECOVER FROM FLOODS

- Make a Recovery Plan
- Get essential items together and pack them overtime
- Check if your insurance policy covers flood - damage
- Know your neighbors and their contacts

For more info please visit: https://getready.govt.nz/en/emergency/floods/

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

RESILIENCE TO NATURE'S CHALLENGES | Kia manawaroa – Ngā Ākina o Te Ao Tūroa | National SCIENCE Challenges

Compiled by researcher:

Ph.D. Student — Mrs. Anna-Kay Spaulding-Agbenyegah,
a.spaulding-agbenyegah@massey.ac.nz

11.13 Appendix 13 – List of Conference Presentations, Research Symposiums, Highlights and Features

- Australian & New Zealand Disaster & Emergency Management Conference - July 2021
- Geospatial Conference in Wellington - August 29-30, 2022
- DEVORA & RNC Forum Oct 2022 - Post-disaster recovery from a high-impact weather event in Auckland (Flooding)
- i-Rec Conference - June 2023
- AUBEA Conference - December 2023
- Presentations at RNC & RPM Hui - 7 Nov 2022 at Massey, Wellington
- Kumeū Courier News – https://www.Kumeūcourier.co.nz/uploads/issues/Kumeū%20Courier%20September%202022.pdf …page 3/48
- Kumeū Courier Facebook feature - https://www.facebook.com/KumeūCourier/posts/6101403979873284/

11.14 Appendix 14 – Ethics Approval

From:humanethics@massey.ac.nz
To:A.Spaulding.1@uni.massey.ac.nz,J.Becker@massey.ac.nz,S.Wilkinson@massey.ac.nz
Cc:humanethics@massey.ac.nz
Mon, Aug 23, 2021 at 7:56 AM
HoU Review Group

Ethics Notification Number: 4000023804
Title: Post-disaster recovery from HIWeather events in Auckland

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the Massey University Human Ethics Committee.

The low-risk notification for this project is valid for a maximum of three years.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.
If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Professor Craig Johnson, Director (Research Ethics), email humanethics@massey.ac.nz. "

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish require evidence of committee approval (with an approval number), you will have to complete the application form again answering yes to the publication question to provide more information to go before one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the information in the low risk notification has met the requirements and guidelines for submission of a low risk notification.

If you wish to print an official copy of this letter, please login to the RIMS system, and under the Reporting section, View Reports you will find a link to run the LR Report.

Yours sincerely

Professor Craig Johnson
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)