

Land Use Planning for Risk Reduction through Avoidance of Sensitive and Vulnerable Activities in Natural Hazards Zone

Author Alison Feeney



Institute of Development Studies Working Paper

November 2023

IDS Working Paper

Institute of Development Studies Working Paper Series

Title Land Use Planning for Risk Reduction through Avoidance of Sensitive and Vulnerable Activities in Natural Hazards Zone

Authors Alison Feeney

ISSN 1179-2973

Massey Research Online
Massey University's Institutional Repository

Massey authors:

Cite as: Feeney, A. (2023). Land Use Planning for Risk Reduction through Avoidance of Sensitive and Vulnerable Activities in Natural Hazards Zone. Palmerston North, NZ: Massey University. Institute of Development Studies

Handle:

<https://mro.massey.ac.nz/handle/10179/69272>

Table of Contents

.....	1
AUTHOR ALISON FEENEY	1
RATIONALE	1
KEY WORDS	1
RESEARCH QUESTION & ETHICS	2
METHODS	2
ANALYTICAL TECHNIQUES	3
DATA COLLECTION	4
KEY FINDINGS	4
USE OF SENSITIVE AND VULNERABLE ACTIVITY DEFINITIONS	4
DEFINITIONS FOR ACTIVITIES THAT ARE SENSITIVE TO NATURAL HAZARDS.....	6
HAZARD SENSITIVE ACTIVITIES – SENSITIVITY WEIGHTING PROCESS	7
NATURAL HAZARDS, CLIMATE CHANGE AND INFRASTRUCTURE.....	9
POLICES AND RULES IN RELATION TO DEFINED SENSITIVE AND VULNERABLE ACTIVITIES	9
DISCUSSION	10
INTRODUCTION.....	10
VULNERABLE ACTIVITIES, LAND USE CONTROL AND RISK REDUCTION	10
<i>Policy and Plan Implementation</i>	10
<i>Definition of Sensitive and Vulnerability Activities</i>	10
<i>Social Vulnerability and Point Source Activity Definitions</i>	11
EXISTING USES AND MANAGED RETREAT	12
MOTIVATORS FOR LAND USE PLANNING FOR RISK REDUCTION	14
CONFLICTING INTERESTS IN RELATION TO LAND USE PLANNING.....	15
TIMEFRAMES AND INFLEXIBILITY IN LAND USE PLANNING FOR NATURAL HAZARDS.....	17
ALTERNATIVE METHODS OF MANAGING NATURAL HAZARDS	18
BUILDING CAPACITY ACROSS ALL STAKEHOLDERS.....	18
MONITORING OF PROGRESS OF RISK REDUCTION	19
CONCLUSION	22
APPENDIX 1: INFORMATION SHEET	24
APPENDIX 2: REFERENCES	25

Rationale

Natural disasters around the world highlight that it is often the most vulnerable groups that are impacted due to low incomes, no insurance, and poor-quality housing (Chang et al., 2015). Land use planning is regarded as the most effective tool for protecting communities from natural hazards (including climate change), for risk reduction and increasing resilience (Beban & Gunnell, 2019; McGregor et al, 2021; Saunders et al, 2014). By avoiding vulnerable activities in natural hazard areas and protecting critical facilities like emergency response facilities/shelters, hospitals, marae and key infrastructure serves to increase resilience if a disaster happens.

In New Zealand (NZ) responsibility for disaster risk reduction is primarily given to local councils, who through their district/unitary or city plans outline how this will be achieved and controlled. Separation of “Sensitive or Vulnerable” activities from natural hazards areas and implementing rules to manage these activities is seen as the key to achieving risk reduction. Recent extreme weather events in New Zealand highlighted the urgency to increase resilience of communities, assets, and infrastructure.

The question is whether defining and classifying Sensitive and Vulnerable activities and putting in place rules in current district plans and policy statements to manage these activities in natural hazard areas can reduce risks and contribute to meeting key relevant indicator goals for SDG11 Sustainable Cities and SDG13 Climate Change, including Sendai Framework targets (UN, 2015, 2015a). The effectiveness of land use planning for risk reduction is debatable and whether more national guidance or tools are needed to assist with implementation. This research also seeks to identify indicators that Councils could use to track more closely progress in risk reduction towards meeting SDGs 11 and 13.

Key Words

Sensitive, Vulnerable, Risk Reduction, Resilience, Sustainability

Research Question & Ethics

The key objectives of the research are to explore:

1. Whether separation of vulnerable activities from natural hazards helps achieve risk reduction.
2. If land use planning is effective in achieving risk reduction through defining and classifying sensitive or vulnerable activities in natural hazard zones, and putting in place rules and policies to restrict these activities.
3. If land use planning contributes to increasing resilience to natural hazards and disasters, with specific reference to SDG 11 and SDG 13.

The research project was completed as a part of an internship at GNS Science undertaken for the Masters of Sustainable Development Goals (MSDG). Permission of GNS Science was sought and granted to use the data collected in the MSDG Practicum for this research paper.

Methods

This study involves reviewing and analyzing data from regional policy statements (which give direction to district plans) and territorial authorities' (district, city and unitary) plans to assess how Sensitive and Vulnerable activities are defined and classified in relation to Natural Hazards and the relationship between these definitions and policies and rules. It will then be explored how these land use planning tools contribute towards meeting SDG11 or SDG13. The research design was based on similar previous reviews of planning documents undertaken by Saunders et al. (2014), Saunders and Ruske (2014b), and Sullivan-Taylor et al. (2022),

For the District plans and Regional Policy statements the most update version was reviewed which in some cases was the proposed given that current thinking should be influenced by the SDGs and the Sendai Frameworks 2015-2030, and by recent NZ natural disasters. The reason for this is that operative plan or policy were often more than 10 years old. The geographical location of the councils shown in Figure 1.

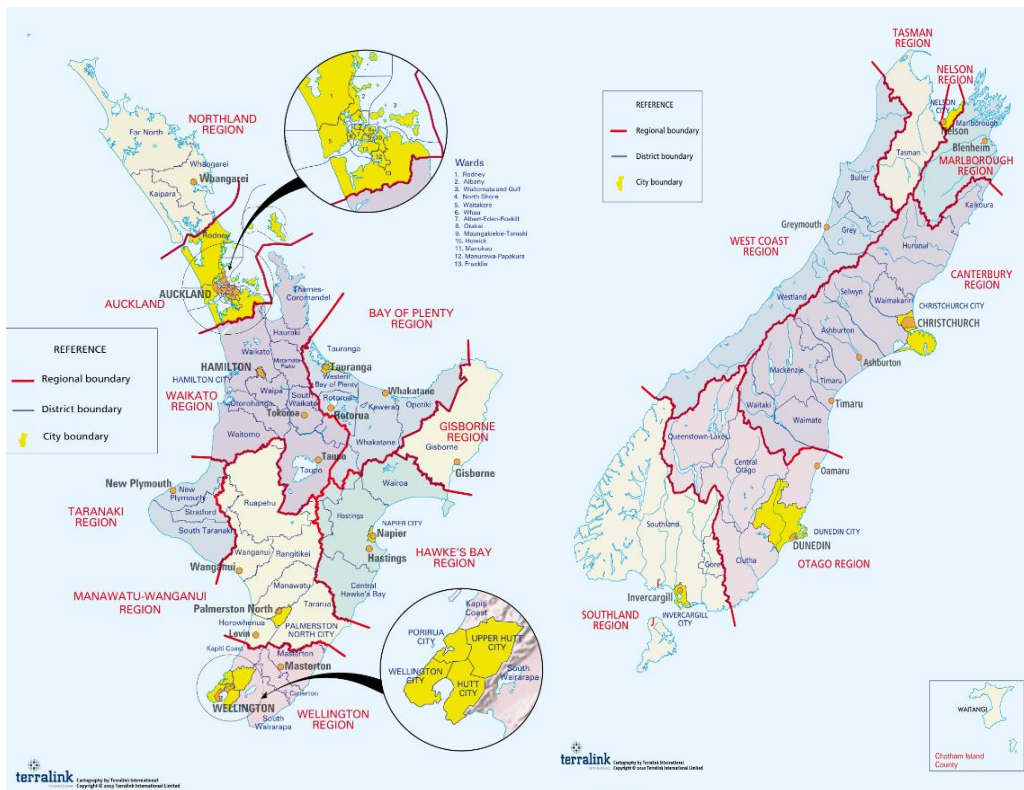


Figure 1 Location of District (incl Unitary and City) and Regional Councils (Source Terralink)

The review looked at how the sensitive and vulnerable definitions are utilized within natural hazards/coastal hazards/subdivision chapters of the district/city and unitary plans/regional policy statements to manage natural hazard risk. Other related insights within the resource management documents were also captured (e.g. specific hazards being managed), including resource management planning practice in this regard, highlighting trends and good practice examples.

Analytical Techniques

The research process involved two types of analysis both quantitative and qualitative. The primary technique to be used is descriptive quantitative analysis whereby the frequency of use was determined of certain terms like “Sensitive and Vulnerable activities”, vulnerable activity classifications (meaning childcare, residential etc.), and the presence of policy and rules, and then compared based on counts and percentages (Sarantakos, 1998). The qualitative analyses will involve analyzing the inferences from the plans reviewed and determining patterns and relationships within findings (Krippendorff, 2019). The data will then be tabulated by counting and grouping similar descriptive inferences together. Counting is justified as the resulting

frequency here will have meaning, and can be related to the research question (Krippendorff, 2019).

Data collection

The review involved a desk based review of 67 territorial authority plans (district, unitary and city) and 11 regional policy statements (Conducted in November, 2022). Following collection of the data an evaluation will be undertaken of whether the use of sensitive and vulnerable definitions in the district plans and the regional policy statements contributes to risk reduction/adaptation to climate change as outlined in SDG and Sendai Frameworks. The primary data collection for this research was from secondary documents.

Key Findings

Use of Sensitive and Vulnerable Activity Definitions

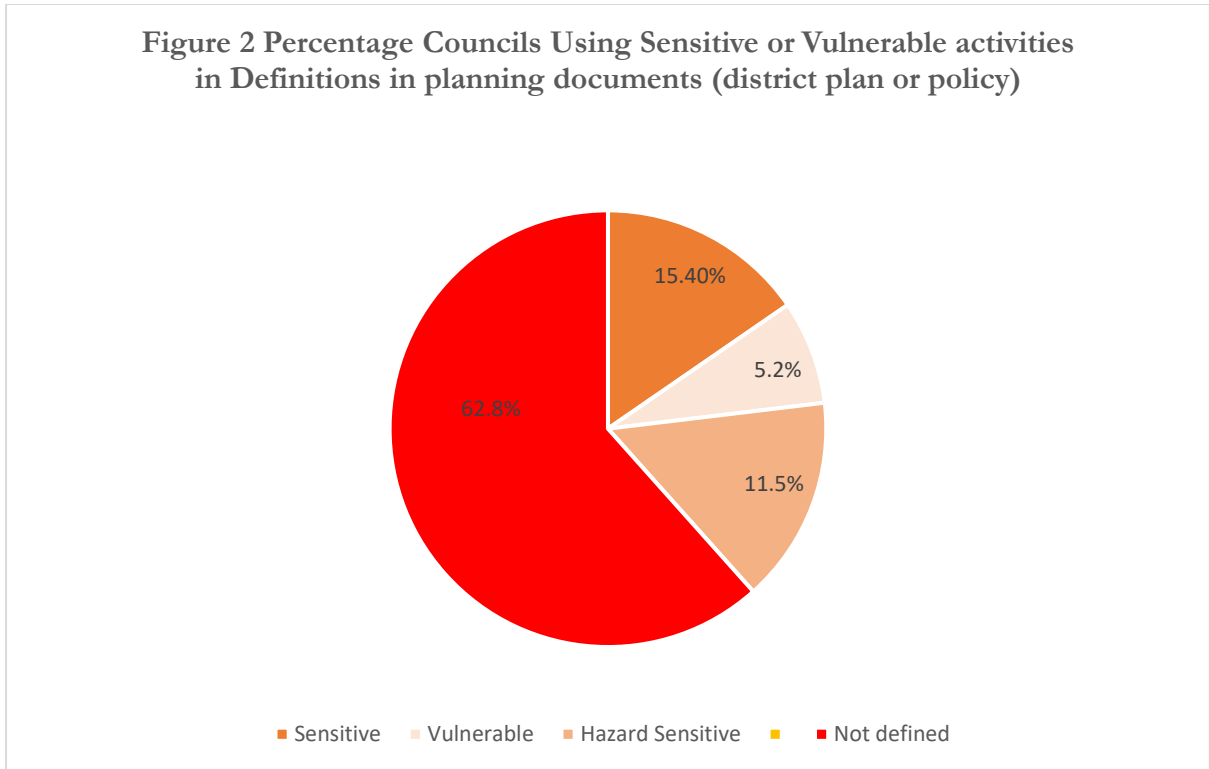
The main definitions used to define activities that are sensitive to natural hazards, were ‘Sensitive Activities’, ‘Vulnerable Activities’ and ‘Hazard Sensitive Activities’. The analysis (refer Table 1) shows that since 2015 there has been an increase in Councils defining activities that are sensitive/vulnerable in their plans and policies, with approximately 38% of councils having defined them. But there is still a significant gap (post 2015) with 36% of operative plans or policy statements and 13% of those Proposed making no attempt to define activities that are sensitive to natural hazards, meaning these councils offer no greater protection to sensitive and vulnerable activities.

Table 1 Percentage Councils Using Sensitive or Vulnerable activities in Definitions in planning documents (plan or policy) Post 2015

Definition	Operative pre 2015	Operative 2015	post Proposed	Total Combined
Sensitive		6.4%	9%	15.4%
Vulnerable		2.6%	5.1%	7.7%
Hazard Sensitive		3.8%	11.5%	15.3%
Sensitive and Vulnerable and Hazard Sensitive combined		12.8%	25.6%	38.4%
No definition provided	12.8%	36%	12.8%	61.6%

‘Sensitive activities’ are the most common terminology used to define activities that should be avoided in natural hazard areas (Refer figure 2 below). This may be due to familiarity as this term has commonly been used in the past in relation to sensitivity to national grid activities or reverse sensitivity. The definition of ‘Vulnerable activities’ was in less frequent use in relation to Natural Hazards notably only Far North District Council, Kaipara District Council, Auckland Council, Hamilton City Council, Taupo District Council, and Waitaki District Council used this terminology.

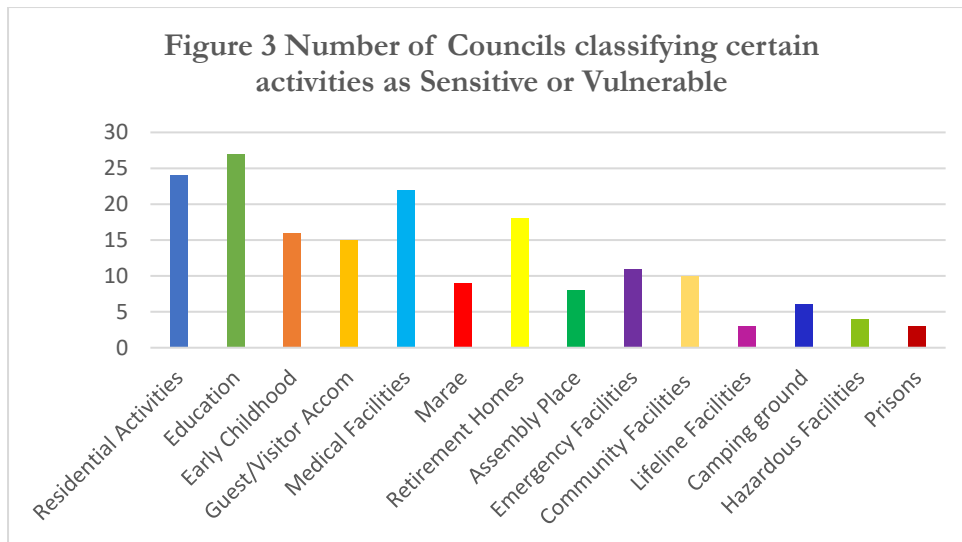
Figure 2 Percentage Councils Using Sensitive or Vulnerable activities in Definitions in planning documents (district plan or policy)



Definitions for Activities that are Sensitive to Natural Hazards

The review of activity definitions shows that Sensitive, Vulnerable and Hazard Sensitive activities were defined in the context of Point Source activities. In most plans very little background information or interpretation is given as to why the nominated activities have been deemed to be ‘Sensitive or Vulnerable’, though in some cases this can be surmised from the policies and rules. For Councils that defined Hazard Sensitive activities there seemed to be a more logical process that had been followed to determine the activity(s) and their degree of sensitivity.

A large cross section of activities was defined in the plans and policies under the broad headings of Sensitive/Vulnerable. The commonality across the definitions was they include a prolonged stay of duration (possibly overnight), or assistance was needed due to reduced mobility or age or disability. The definition of Vulnerable activities was broadly similar to Sensitive Activities, but also included Visitor Accommodation and Lifeline Facilities. For the ‘Hazard Sensitive Activities’ there appeared to be a greater focus on buildings that were considered critical in Disaster response like major healthcare facilities, emergency facilities, maraes and community facilities, and slightly less focus on residential activities. The key activities that have been deemed sensitive/vulnerable to natural hazards are shown in the bar graph (refer Figure 3). Activities that were ranked highest were residential, education, medical facilities and retirement homes.



Hazard Sensitive Activities – Sensitivity Weighting process

More in depth definitions for Hazard sensitive activities and for Vulnerable activities have been used by some councils suggesting that greater analysis has gone into classifying these activities, and for managing them. Nine Councils provide greater definition of the Hazards Sensitive Activities and categorise them according to the degree of sensitivity i.e. Hazard Sensitive, Potentially Hazard Sensitive Activity, and Less Hazard Sensitive, and separated out activities that fall into each category (refer Table 3). Activities are generally defined by whether people are regularly present in buildings, whether they are vulnerable as they sleep overnight, require medical treatment, or require extra assistance due to complex needs to evacuate, or if the building was damaged would create a significant public health issue. Vulnerable activities were also defined in some cases in relation to specific natural hazards.

Table 3 Examples of Key Activities defined as least, potentially or sensitive to natural hazards (Source: Poirua City Council District Plan 2020).

Definition	Hazard Sensitive Activities	Potentially Hazard Sensitive Activities	Less Hazard Sensitive Activities
Activity	childcare services community facility educational facility emergency service facilities healthcare activity hospital; marae multi-unit housing places of worship residential units and minor residential units (including those associated with pakakāinga)	buildings associated with primary production (excluding residential units) commercial activity commercial service activity community corrections activity entertainment facility food and beverage activity industrial activities integrated retail activity large format retail activity major sports facility offices and retail activities retirement village; and rural industry	Accessory buildings used for non-habitable purposes Park management activity Buildings and structures associated with temporary activities.

Upper Hutt District Council has also developed a weighting process whereby the degree of Sensitivity was correlated with the hazard rating and then linked this to rules where activities were either permitted, discretionary, or prohibited.

Table 4 Activity status for Different Sensitivity Activities across the Hazard Zones (Source: Table 18 Upper Hutt District Council Plan Change 47).

	Hazard Ranking		
	High	Medium	Low
Hazard Sensitive Activity			
Potentially Hazard Sensitive Activity			
Less Hazard Sensitive Activity			

Key

Colour	Activity Status
	Permitted
	Restricted Discretionary
	Non-Complying

Natural Hazards, climate change and Infrastructure

The review showed that approximately 18% (14) councils deemed Emergency Services/Facilities or Lifeline Facilities within policies or rules or definitions as a vulnerable activity that should be avoided in natural hazard areas, or that mitigation is undertaken to protect the facility due to its necessity in an emergency. Similarly, 15% (12) District and Regional Councils has formed policies or rules to avoid new critical infrastructure in areas that may be subject to natural hazard risks, unless mitigation can overcome this. Critical infrastructure was considered to be hospitals and emergency services; and lifeline utilities, roading and utilities like power, water and sewage. A limited number of councils have also defined areas where certain activities can or cannot occur i.e. Coastal Hazard Sensitive Activities, Flood Vulnerable Activities, Tsunami Hazards Zones and Flood Tolerant Activities.

The review of the plans and policies identified that very few councils (6%) had either highlighted climate change as a natural hazard in its own right, and that only 11% of councils have rules or policies in place to mitigate the impacts of climate change. Auckland Council, Wellington Regional Council, Thames Coromandel and Wairoa District Councils all highlighted adopting a risk-based approach over a 100-year period to assess consequences of subdivision/developments from natural hazard and climate change impacts (like inundation and coastal erosion) avoidance of vulnerable activities in areas effected by Climate change, which is in line with the NZ Coastal Policy Statement (MfE, 2016).

Policies and Rules in relation to defined Sensitive and Vulnerable Activities

The majority of the Councils (27 out of 30) that had defined sensitive and vulnerable activities had developed policies/rules to manage these activities in natural hazard area, but for some Councils only policies were in place rather than rules. In addition, 13 Councils had policies or rules but had no upfront definitions for sensitive or vulnerable activities in relation to natural hazards. Interestingly there was not always a strong link between the policies in the Regional Policy Statement and the District plans but this may in part relate to the plans being out of sync in terms of when they were written, correlation was definitely an exception rather than the norm.

Discussion

Introduction

The aim of this research project is to explore how defining and classifying sensitive or vulnerable activities in relation to natural hazards in local and regional government land use plans and policies can contribute to risk reduction and increasing resilience to natural hazards and disasters, with specific reference to SDG11 Sustainable Cities and SDG13 Climate Change and Sendai Framework (UN, 2015). Against a background of legislative change in New Zealand, and recent natural disasters this is a critical time in New Zealand to be assessing whether current land use planning tools are effective for risk reduction as envisaged by SDGs and the Sendai Framework. The contribution of land use planning to risk reduction is discussed below in the context of local and national disaster risk reduction strategies and initiatives.

Vulnerable Activities, Land Use Control and Risk Reduction

Policy and Plan Implementation

Separating sensitive or vulnerable activities from natural hazards through land use controls in theory is one of the most effective ways of reducing exposure and hazard risks (Beban & Gunnell, 2019). However, to have a positive impact on risk reduction you need a high level of participation at a local level and need policies and rules to be implemented on the ground, which also necessitates strong leadership and coordination from above (Saunders et al., 2014). At this mid-point with the SDGs and Sendai frameworks progress in New Zealand has been slow, only 38% plans/policies having defined sensitive and vulnerable activities, of which most have put (or proposed) rules or policies in place to manage these activities). Alarming only 16 councils actually have rules in place to prohibit or restrict vulnerable activities in the natural hazard area. Rules are critical if risk reduction polices are to be achieved, and back up decision making (Saunders, et al., 2014; Sullivan-Taylor et al., 2022). The lack of rules means that new developments will continue to be established in natural hazard areas, alongside existing developments, and vulnerabilities will continue to increase.

Definition of Sensitive and Vulnerability Activities

In relation to terminology the term ‘sensitive’ rather than ‘vulnerable’ has been used more frequently by Councils to define activities that should be excluded from natural hazard areas. However, in relation to natural hazards and risk reduction ‘vulnerability’ is the key focus, and reflects current thinking with risk management (refer Sendai and SDG frameworks). ‘Vulnerable’

activities would appear to be a better description as it does imply a sense of importance and urgency to take action, as oppose to ‘Sensitive’ which is rather non-specific. This issue was raised by Saunders et al. (2014), who identified the need for Councils to use risk management language (Risk/Consequences) rather than RMA language (avoid, remedy, mitigate adverse effects).

In Councils classifying vulnerable/sensitive activities these activities generally relate to where people spend a considerable amount of time/sleep overnight or where people are more at risk due to disability/poor health or socio economic circumstances (Beban & Gunnell, 2019; Mason et al 2019). For some councils’ vulnerability definitions were very generic so not adapted for local conditions. Ideally a risk assessment needs to be undertaken, involving community consultation to avoid bias decision making by policymakers (Hofmann, 2021). Vulnerable activities could be assessed by Accessibility, mobility, evacuation routes, mass gathering, duration in building, type of building/exposure to specific natural hazard.

Social Vulnerability and Point Source Activity Definitions

In general, Councils seem to have used point source activities to define vulnerability possibly as it follows a similar approach to that used to define reverse sensitivity or National grid sensitivity. However, Vulnerability in reality is a complex concept, and a one size fits all approach is unlikely to be effective in reducing risks of natural hazards to local communities, towns or cites (Cutter et al., 2008). The narrow lens that has been taken with point source activity locations means that localized issues, like economic livelihoods/unemployment/access to transport/language barriers/poor housing/rented or temporary housing/overcrowding are ignored. Best practice would be to define location specific vulnerability using a Vulnerability index or Resilience indexes (Mason et al., 2019) so that the Vulnerable activities more closely reflected those of the district. This would achieve greater gains in localized risk reduction. For example, in Hurricane Katrina lack of public transport for low socio economic groups who lived in the low lying swamps meant they could not escape (Yarnal, 2007). Similarly, there are many examples of where when populations have been relocated from coastal areas following a Tsunami that resulted in their fishing livelihoods been destroyed (Ueda & Torigoe, 2012). Ignoring Environmental vulnerabilities means that the impacts of natural hazards can be exacerbated, for example, by draining wetlands that provide sinks for stormwater, or establishing pine forests on unstable soils which increases sediment and forestry slash in flood flows.

Point source activity controls are really only triggered when a new development such as a subdivision or infrastructure or a change in use occurs, which inevitably means that risk reduction through this process takes too long. Furthermore, as point source activities are static in time, they do not take account of dynamic changes in risk profiles (say due to climate change), and vulnerability (Cutter et al., 2008). Social vulnerability will vary due to factors such as unemployment or rises in bank loan interest rates or closure of transport networks, or increase in renters in an area or an influx of migrants. This land use planning approach using point source activity has oversimplified vulnerability making it one dimensional, so limiting its effectiveness. Ideally an assessment of vulnerability needs to include engagement with stakeholders to get them involved in decision making policy development (Hofmann, 2021). Otherwise the risk is that vulnerable communities may continue to occupy the natural hazard zone, and/or informal squatting may occupy in red zoned buildings, or in buildings not designed for overnight stays (Wyndham et al., 2020).

Existing Uses and Managed Retreat

Existing uses in natural hazards areas seem to receive surprisingly little attention in District Plans/Policy Statements, and there appears to be a lack of National guidance for what Councils should do where hazard sensitive or vulnerable activities like daycares or retirement villages are already present in high hazard areas, and how this should be managed or addressed through the District or Unitary plans. There is some urgency to address this, as inevitably with climate change there will be an increase in the risk of flooding, coastal erosion, and inundation.

In effect by defining sensitive and vulnerable uses councils are perhaps unknowingly enforcing managed retreat of existing uses perhaps with no idea of the scale of the issue or with whom the liability lies. This will be exacerbated when broad descriptions have been adopted without looking at the vulnerabilities within a specific district. For example, in a study undertaken by Internal Affairs (2002) it was highlighted that 44 communities had a high level of socio-economic vulnerability (occupying the bottom 10% of the deprivation index) and were exposed to flood hazard, and were located in districts that have limited rate payer funds to implement mitigation which include South Waikato, Waitomo, Buller, Gisborne, Opotiki, Rotorua, and the Far North. This illustrates how further research needs to be done to quantify vulnerability and how it is going to be managed within communities, and to explore how ratepayer funds will be used to ensure equitable outcomes (Ellis, 2021). In a similar exercise but on a larger scale Iglesias et al. (2021) did

a mass scale review of the US and found that 57% of buildings (including home, hospitals, and offices) are located in natural hazards areas, which was attributed to uncontrolled urbanisation. The limitations of land use planning for managing some risks for example low probability but high potential impact (e.g. volcanic activity, tsunamis and earthquakes) also need to be fully explored.

The planning process of excluding activities or further development also leads to socio spatial exclusion of local communities (Fuentelba, 2020), and has an enormous impact on well-being. Strong political will is needed to address the challenges of those that are vulnerable in terms of being poor and marginalised, meaning that good governance is a critical aspect in disaster risk reduction (UNDRR, 2019). Having said that preventative land use planning is going to be critical to avoid managed retreat on huge scale in New Zealand with climate change. The protracted managed retreat at Matata that took 17 years highlights how problematic and time consuming this process is due to established livelihoods in an area, ties with the community and family, and indigenous māori culture (RNZ. 2022, May 26).



WHAKATANE BEACON

The 2005 debris flow dumped silt, debris and boulders on Matatā.

Figure 4 Matata – Managed Retreat
Source: Stuff 31 March 2021

A key consideration is that when policies or rules exclude vulnerable activities or people from natural hazards areas, like low lying flood areas, their options are often more limited compared to

the privileged. Often vulnerable people are living in rented accommodation or live in lower value properties, so their options for relocation are reduced (Ellis, 2021). So what often happened is that informal squatting or voluntary living occurs (Wyndham et al., 2020). Political issues also get in the way of managed retreat so elected officials often support short term fixes rather than long term sustainable solutions (Lawrence et al., 2020). So it is critical that outcomes are equitable for all when managed retreat or mitigations are adopted and that democratic process are followed (Ellis, 2021). Managed retreat timeframes also extend beyond normal electoral and planning cycles, and necessitates much more flexible policy and planning processes to accommodate the uncertainty particularly with climate change and varying impacts.

Motivators for Land Use Planning for Risk Reduction

The observation is often made that we learn from disasters, and that in the post recovery period the opportunity to make rules changes becomes more critical out of necessity to prevent it happening again (Glavovic et al., 2010). Communities not unexpectedly tend to be very reluctant to embrace managed retreat and often willing to tolerate huge risks, but after a disaster they become more aware of risks (Lawrence et al., 2020). Also, as Saunders et al. (2014) highlights it is often easier to change rules post event when political and public pressure compels action. For example, post Christchurch earthquake investigations it was identified that red zoned houses in the Port Hills should never have been built in these areas of land instability (Saunders et al., 2013). Similarly, Saunders et al. reports that when widespread flooding occurred in Thames in 2002 many houses had been cited too close to rivers or the coast where risks were intolerable, and managed retreat had to be initiated.

Bolezan et al. (2022) believes the focus in land use planning should be on developing policies to support vulnerable communities, and taking the opportunity to learn from previous disasters where land use planning has failed. The fact that urban vulnerability has increased over time suggests that there should be a broader use of tools to assess risk and impacts on vulnerable communities, which will help prioritise action for increasing resilience (Bolezan et al., 2022). Decision making also needs to incorporate the cost benefit analysis of mitigation options and take into account long term sustainability, as in some cases managed retreat may provide a more viable option for places like Westport that experience repeated flooding (Internal Affairs, 2022).

Conflicting Interests in Relation to Land Use Planning

As Eriksen (1986) highlighted local authorities have historically avoided land use planning for risk reduction due to perceived negative effect it may have on the growth of the economy, land values and rateable values. With this preoccupation with the economy Eriksen observed that there was limited financial incentive to pursue risk reduction through land use planning, but noted finance was always available for short term structural fixes. There is degree of frustration as local and central government are still seemingly extremely reluctant to take a long term view, and invest in risk reduction through avoiding development of natural hazard zones, and are now faced with relocation of existing vulnerable activities. As Ellis (2021, p. 27) alludes to the 'current status quo in development of at-risk areas transfers the burdens of responsibility to future generations of ratepayers'. This situation has also been exacerbated by the Housing Enabling Bill/Act which started as a well-meaning land use planning project to overcome a housing shortage, but indirectly resulted in exposing more people to natural hazards, and unequitable outcomes. This type of intervention reflects the dominant interests of the government and their vision (Pelling, 2011), and ignores the fact it increases risk exposure. For example, during an extreme rainfall event in Auckland (27-29th January, 2023) the local roading, and stormwater/wastewater infrastructure couldn't cope with the increased stormwater flows (due to reduced soakage) as result of housing intensification, and the worst effected were the lower socio-economic areas occupying low-lying areas of west and south Auckland (Newshub, 2023).

The flexible and permissive approach (and lack of enforcement) that land use planners have taken in the past has resulted in developments (incl infrastructure) being located in high risk natural hazard areas (UNDRR, 2022). As Berke et al. (2015) emphasizes it is critical to evaluate how policies in local and national plans work together to reduce natural hazard vulnerability. Berke et al. suggests reviewing policy areas for growth/strategic plans, land purchases, financial incentives or penalties, land classification/consenting, and community infrastructure/facilities at outset to determine if they will increase or decrease vulnerability, and then responding appropriately.

When natural disasters happen in New Zealand the burden of loss is relieved through insurance, relief funds and rehabilitation through government agencies such as EQC, MBIE and private insurers. This can then indirectly exacerbate the problem through facilitating people rebuilding on the floodplain or area where a landslide occurring without addressing the real issues of ongoing exposure to the natural hazards. Disaster funding can develop a culture of reliance of the

government to fix this, rather than helping communities to stop the disasters happening in the first place (McClelland, 2013). For example, in the recent extreme rainfall event (27 January, 2023) in Auckland landslides occurred along Shore Road destroying homes, some of these homes had been rebuilt two decades earlier when a previous landslide had occurred. The insurance sector can also certainly influence land use decision making, as inevitably as the frequency of the disasters and associated claims increases premiums will rise or become unaffordable (or unavailable) which indirectly long term will encourage methods to be adopted to increase resilience and reduce vulnerability (IOC, 2022).



Figure 5 Landslide on Shore road following severe flooding on 27 January, 2023 in Auckland. (Photo Hannah Peters / Getty Images/)

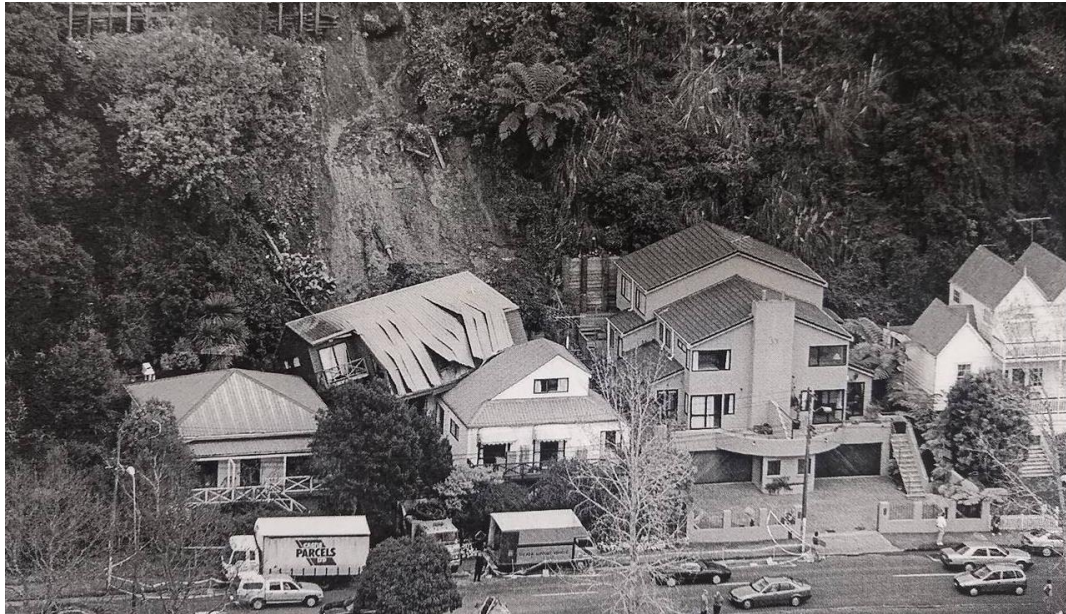


Figure 6 Former Landslide on Shore Road in 1997 (House on RHS slipped in 2023) (Source NZ Herald, 4 March, 2023)

Timeframes and Inflexibility in Land Use Planning for Natural Hazards

The timeframes under which impacts of natural hazards and vulnerability are to be considered is very relevant to the discussion, and presents a further challenge to land use planning for risk reduction. For example, Local authority long-term plans have a 10-year timeframe, and infrastructure strategies consider a 30-year timeframe. This makes it problematic when considering natural hazards as allowing a subdivision or infrastructure to proceed (and establish existing use rights) might limit future managed retreat options when looking at 100 years plus timeframe for example with climate change.

Current land use planning timeframes may also not offer enough short term flexibility when trying to manage exposure to natural hazards when there is uncertainty and when the risk profile may change rapidly due to climate change. Great flexibility is needed in District plans to enable rules to be changed as new or increasing risks emerge and vulnerability increases (Lawrence et al., 2020). With the increasing frequency and intensity of storms and increased urbanisation there is also a need to look at resilience with infrastructure as what was once a 1:100-year flood may now a 1:70-year flood ((Smart & Mckerchar, 2010). Given the observed delays in updating district plans it is imperative that councils become more proactive with managing and implementing risk reduction. Adaptive plans need to be developed to overcome uncertainties and increasing vulnerabilities.

Alternative Methods of Managing Natural Hazards

On balance it would seem that a more integrated approach is needed to risk reduction. Ideally an overall risk reduction (or resilience) plan needs to be developed for each district/region/catchment that looks at all natural hazards risks and works out zones where vulnerable activities should be avoided, and ensuring that adjacent land uses do not exacerbate natural hazard risks. An alternative approach would be to define activities that can happen in natural hazard zones rather than those that are excluded. For some councils the exhaustive list of activities that are to be avoided in the natural hazard zones suggests that in reality that risks are intolerable and that these areas should be developed into buffer areas including soft uses like recreation or natural environment area (provided this is safe). Taking into account long term sustainability, protection of the natural environment, and learning from indigenous knowledge are the key to addressing natural hazards and reducing exposure (Kousky, 2010). For example, wildfires have become a recent problem as the urban rural interface has encroached natural habitats (Australian Roundtable, 2016).

Berke et al. (2015) also outlines mechanisms whereby incentives can be offered like density bonus fees for land that is surrendered in natural hazard areas, and tax breaks are given to land owners or developers for incorporating mitigation, but with fees imposed to cover structural improvements or infrastructure upgrades. However, it is important that incentives do not disadvantage the underprivileged and further reinforce underlying vulnerabilities. Taking account of direct and indirect costs of natural disasters is also important when looking at risk reduction. As the Australian Roundtable (2016) suggests disaster recovery funds should be linked to the amount invested in risk reduction, and insurance premiums are reduced where risk reduction has been undertaken.

Building Capacity across all Stakeholders

Great integration of scientific institutions, civil defence groups, NEMA, territorial and regional authorities, central government and the community is needed for risk reduction, and mitigation (Pielke, 2007; Crawford et al., 2017). The Sendai framework gives a clear directive that Disaster Risk Reduction needs to be integrated across sectors and levels and utilise bottom up and top down approaches, and fully utilise scientific and technical knowledge (UNDRR, 2017). In New Zealand there appears to be a lack of connection between national government strategies and what is going on at the local level (UNDRR, 2022). The resource limitations of local authorities in terms of technical knowledge, time and funding and their influence on decision making needs to be

recognised (Saunders et al., 2014a). Local and regional authorities need to urgently work alongside the natural hazard scientists, the developers, the community and indigenous people to increase resilience within a town or city or region and ensuring that infrastructure and critical facilities become resilient. New Zealand research institutions like GNS and NIWA hold an enormous amount of data on natural hazards risks, but this data needs to be made more user friendly, easily accessible and available to policymakers and local authorities (Crawford et al., 2017). There is definitely an increasing need for urban governance to be horizontal and coordinated rather than top down (Fuentelba et al., 2020). However, there is still a need for a centrally governing body (such as NEMA) for risk reduction to bring organisations and the communities together to work together.

Monitoring of Progress of Risk Reduction

It is a real concern that so little monitoring of risk reduction is done in New Zealand to evaluate if land use planning is being effective in reducing risks principally through separation of vulnerable activities from natural hazard areas. This is despite statutory requirements on national bodies, regional and territorial authorities to undertake monitoring. Saunders et al, concluded back in 2014 very few Councils monitored the outcomes of natural hazard objectives and policies, and cited difficulties with establishing measurable outcomes. The increasing risks and vulnerabilities is highlighted by the fact there have been 64 declared states of emergency since 2015 (NEMA 2023). Given the uncertainties with climate change it is more critical than ever that changes in hazard risks and vulnerabilities are monitored so that society can adapt (Birkmann, et al., 2010). The lack of monitoring also provides little incentive to implement risk reduction as the ineffectiveness of risk reduction isn't disclosed until a disaster occurs (Berke et al, 2015). Regular reviews of risks and methods adopted for risk reduction need to be undertaken, particularly when plans are updated (Saunders et al., 2014).

As part of the National Disaster Resilience Strategy (NEMA, 2019) some resilience indicators were developed (refer Figure 7) but are poorly thought out, for example how is “Quality of land Use planning for hazards” and “Rates of development in areas prone to disasters” actually measured. The fact that they have not been tracked to date may be indicative of this and totally overlooks natural hazard risks for existing uses. The aftermath of Cyclone Gabrielle and the extreme rainfall event of 27-29th January, 2023 that effected Auckland, Northland and Coromandel clearly demonstrate that risk reduction through land use planning has not been effective in reducing vulnerability and exposure.

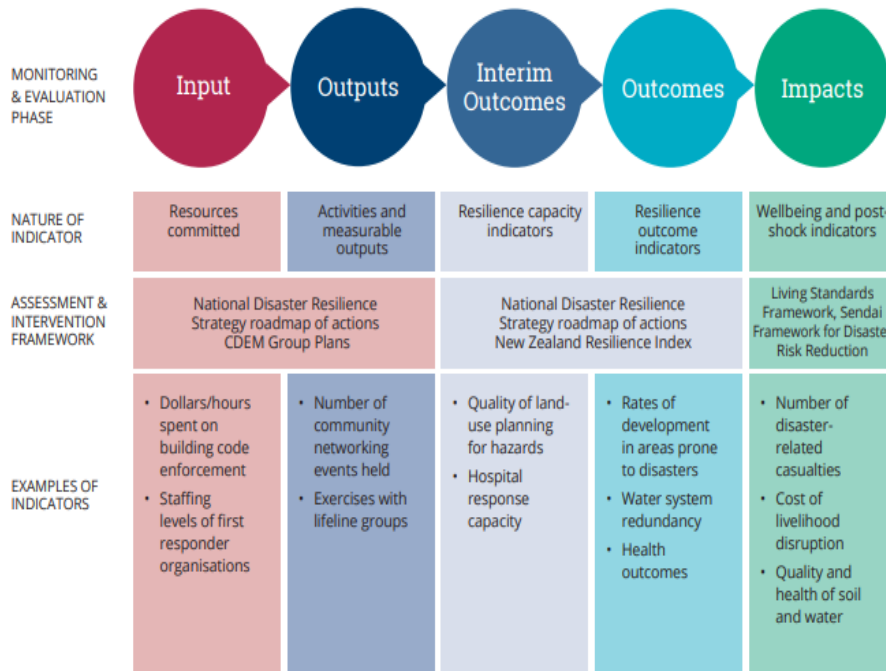


Figure 6 Logframe for resilience monitoring and evaluation

Figure 6 Logframe for resilience monitoring and evolution
(Source NEMA, 2019)

The lack of measurement of risk reduction may also reflect the need to develop indicators that more accurately monitor progress against risk reduction. As Saunders (2017) highlighted there is a challenge in monitoring natural hazard policies without an event occurring. Even the SDGs and Sendai frameworks do not directly measure risk reduction activities and instead measure negative consequences just as deaths or injuries, which given the unpredictable nature of natural hazard events (and time of impact) this data really doesn't mean much, unless this data is being used to offset costing against investment and decision making for mitigation (Selmi, 2016). Also, as Cutter (2008) highlights correlating natural hazard property losses with social vulnerability is not directly relevant as these people have less to lose in the first place. More specific indicators for disaster risk reduction strategies would provide a true reflection of government efforts to adopt local disaster risk reduction strategies (besides reducing carbon emissions) and reduce vulnerabilities.

Based on this MSDG Research project some examples of more relevant indicators to risk reduction (SDG11 and SDG13) and vulnerability have been developed (refer Table 5), which are measurable at local and national level.

Table 5 Suggested SDG Indicators for Risk Reduction (measurable over 1 to 5 year periods)

Indicator	Description
SDG 11/13	Land area (km ²) occupied by communities or businesses or infrastructure that is exposed to natural hazards such as flooding, landslides; sea level rise, inundation, or seismic and volcanic hazards. Noting that seismic and volcanic hazards may be hard to measure as they may occur along an entire fault line or relate to a new area of seismic activity.
SDG 11/13	Spatial distribution (number/ km ²) of socially vulnerable people (including numbers) living in natural hazard zones.
SDG 11/13	Managed retreat – area of land km ² that has been diverted to a buffer zone (natural ecosystem, recreation reserve)
SDG 11	Number of buildings per km ² that are protected against seismic risk
SDG11/13	Number of buildings per km ² that are protected against flooding
SDG11/13	Number of Critical buildings/per km ² – for example, emergency facilities, community centres, maraes, surf life-saving clubs and hospitals) that that are located outside natural hazard area.
SDG11/13	Number of local authorities that have an adequate number of emergency facilities and shelters for vulnerable people (incl homeless) in case of a disaster that are located outside natural hazard areas
SDG11/13	Number of people that have provision to store rainwater and have a backup energy supply
SDG11/13	Area km ² of productive agricultural land that is potentially effected by natural hazards
SDG11/13	Area of bare soil km ² exposed by forestry logging/slash or other agricultural activities that is at risk of mobilisation by natural hazards
SDG11/13	Area of land km ² planted in native bush or set aside as natural reserve within urban areas
SDG11/13	Number of people in cell phone coverage that could receive a natural risk alert or warning
SDG11/13	Number of local governments that have a resilience and adaptation plans in place that take into account local vulnerabilities, and undertake regular reviews to determine effectiveness
SDG11	Number of local governments that have strategies and plans in place to reduce natural hazards in existing use areas, and undertake regular reviews to determine effectiveness
SDG11/13	Tax Incentives offered for mitigation of natural hazards and adaptation to climate change to land owners, renters and developers
SDG11/13	Number of local governments that have used resilience scorecard or vulnerability analysis approach to assess and reduce exposure of vulnerable people to natural hazards and monitored outcomes
SDG11/13	Number of National governments that have an integrated strategy for addressing risk reduction which is led and coordinated at a National level, and actively engages (and supports) with local and regional governments, lifeline utility and infrastructure operators, Technical/ Science Research organizations, Emergency Response, Maori and local communities (included vulnerable people), and business sector

Conclusion

In conclusion, local authorities in New Zealand appear to be carrying the burden of responsibility for risk reduction, and in reality this is a shared responsibility with many stakeholders and requires joined up thinking and action. The complexity of land use planning in New Zealand with Councils having to take into account multiple national policies, plans and strategies and addressing all perspectives (Social, economic and cultural) and the long timeframes (10 to 30 years) makes implementation of risk reduction problematic. Especially when further delays occur as changes to legislation, lack of national guidance and perverse policies to increase the density of housing. A very wide lens has to be adopted to ensure that resilience and vulnerability are addressed retrospectively for existing, and for future proposed developments including infrastructure. In the immediate short term local and regional councils need to prioritize resources to ensure that critical facilities (including infrastructure) that are needed in a natural disaster are resilient, and if required relocate them out of the natural hazard zone.

For New Zealand to achieve SDGs 11 and 13 by 2030 in relation to risk reduction there is a need to look at land use planning for risk reduction with a wider lens addressing social, environmental and economic factors, as part of overall long term resilience and adaptation plans for cities, towns and catchments. Simply defining vulnerable activities, natural hazard zones and establishing new rules for developments will not achieve risk reduction. For effective risk reduction there needs to be greater integration and involvement of multiple actors (including local and regional councils, NEMA, CDEM groups, Crown Research Institutes, māori, local businesses and communities, and lifeline utility providers), and stronger leadership from central government, and enforcement of planning rules. New broader approaches to risk reduction also need to be developed that take account of long term sustainability and achieve greater integration of key stakeholders including local communities. Developers also need to absorb the true costs of natural hazard mitigations and improving infrastructure resilience. The lack of monitoring of the effectiveness of current risk reduction approaches is a concern, and new indicators have been suggested that would enable New Zealand to track more closely progress in risk reduction towards meeting SDGs 11 and 13.

The urgency with which to address Risk Reduction in New Zealand was highlighted by James Shaw Minister for Climate Change following the Cyclone Gabrielle (The Guardian, 2023), who simply stated 'We are now seeing the consequences of our inaction to climate change'.

Appendix 1: Information sheet



MASSEY UNIVERSITY
COLLEGE OF HUMANITIES
AND SOCIAL SCIENCES
TE KURA PŪKENGĀ TANGATA

Project Contacts

If you have any questions about this research please contact the following investigators:

Alison Feeney
Mobile: +64 21 374782
alisonfeeney@ix.net.nz

Committee Approval Statement

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. Ethics Notification Number: 4000022718

Appendix 2: References

- Australian Business Roundtable. (2016). *The Economic Cost of the Social Impact of Natural Disasters (2016) Australian Business Roundtable*. Deloitte. <http://australianbusinessroundtable.com.au/assets/documents/Report%20-%20Social%20costs/Report%20-%20The%20economic%20cost%20of%20the%20social%20impact%20of%20natural%20disasters>.
- Beban, J., & Gunnell, S. (2019). *Incorporating Social Vulnerability into Land Use Planning and Local Government Process for Management of Natural Hazards and Climate Change in New Zealand*. Urban Edge Planning Ltd, Wellington, New Zealand.
- Berke, P., Newman, G., Lee, J., Combs, T., Kolosna, C., & Salvesen, D. (2015). Evaluation of Networks of Plans and Vulnerability to Hazards and Climate Change: A Resilience Scorecard. *Journal of the American Planning Association*, 81(4), 287–302. <https://doi.org/10.1080/01944363.2015.1093954>
- Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N., Garschagen, M., Fernando, N., & Kropp, J. (2010). Extreme events and disasters: A window of opportunity for change? Analysis of organizational, institutional and political changes, formal and informal responses after mega-disasters. *Natural Hazards*, 55. 637-655. 10.1007/s11069-008-9319-2.
- Botezan, C.S., Radovici, A., & Ajtai, I. (2022). The Challenge of Social Vulnerability Assessment in the Context of Land Use Changes for Sustainable Urban Planning. Case Studies: Developing Cities in Romania. *Land*, 11(17). <https://doi.org/10.3390/land11010017>

- Crawford, M.H., Crowley, K., Potter, S.H., Saunders, W.S.A., & Johnston, D.M. (2018). Risk modelling as a tool to support natural hazard risk management in New Zealand local government. *International Journal of Disaster Risk Reduction*, 28 610–619. <https://doi.org/10.1016/j.ijdr.2018.01.011>
- Cutter, S. L. & Finch, C. (2008). Temporal and spatial changes in social vulnerability to natural hazards. *PNAS*, 105, (7) 2302-2306. www.pnas.org/cgi/doi/10.1073/pnas.0710375105
- Ellis, E. (2021). A just transition to Climate-resilient Coastal Communities in aotearoa New Zealand. *Policy Quarterly*, 17(5). 23 -30.
- Eriksen, N. J. (1986). Made in New Zealand – flood hazards. *Soil and Water*, 77, 3-19.
- Fuentealba, R., Verrest, H., & Gupta, J. (2020). Planning for Exclusion: The Politics of Urban Disaster Governance. *Politics and Governance*, 8(4), 244-255. DOI:10.17645/pag.v8i4.3085
- Glavovic, B. C., Saunders, W.S.A., & Becker, J.S. (2010). Land-use planning for natural hazards in New Zealand the setting, barriers, burning issues and priority actions. *Nat Hazards* 54, 679-706.
- Hofmann, S.Z., (2021). 100 Resilient Cities program and the role of the Sendai framework and disaster risk reduction for resilient cities. *Progress in Disaster Science*, 11. <https://doi.org/10.1016/j.pdisas.2021.100189>.
- Iglesias, V., Braswell, A. E., Rossi, M. W., Joseph, M. B., McShane, C., Cattau, M., et al. (2021). Risky development: Increasing exposure to natural hazards in the

United States. *Earth's Future*, 9, e2020EF001795. <https://doi.org/10.1029/2020EF001795>

ICNZ. (2021). *"The cost of natural disasters."* Insurance Council of New Zealand. <https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters>

Internal Affairs. (2022). *Vulnerable Communities exposed to flood hazards.* [https://www.dia.govt.nz/diawebsite.nsf/Files/Proactive-releases/\\$file/Vulnerable-Communities-Exposed-to-Flood-Hazard-August-2022.pdf](https://www.dia.govt.nz/diawebsite.nsf/Files/Proactive-releases/$file/Vulnerable-Communities-Exposed-to-Flood-Hazard-August-2022.pdf)

Kousky, C. (2010). Using Natural Capital to Reduce Disaster Risk. *Journal of Natural Resource Policy Research*, 2 (4), 343-356. <https://doi.org/10.1080/19390459.2010.511451>

Krippendorff, K. (2019). *Content analysis: an introduction to its methodology.* (Fourth edition). SAGE.

Lawrence, J., Boston, J., Bell, R., Olufson, S., Kool, R., Hardcastle, M., Stroombergen, A. (2020). Implementing Pre-Emptive Managed Retreat: Constraints and Novel Insights. *Current Climate Change Reports*. 6, 66-80. <https://doi.org/10.1007/s40641-020-00161-z>.

Mason, K.M., Lindberg, K., Haenfling, C., Schori, A., Thomas, K.L., Popovich, B., Faulkner, R., Beban, J.G., Gunnell, S., Marsters, H., Read, D., & Borman, B. (2019). *Social vulnerability indicators for flooding in Aotearoa New Zealand: Rationale, indicators, and potential uses.* Wellington: Environmental Health Indicators Programme. Massey University. <https://www.ehinz.ac.nz/assets/Social-Vulnerability-Indicators/Social-vulnerability-indicators-rationale-indicators-and-potential-uses.pdf>

McClelland, R. (2013), '*Enhancing Commonwealth Leadership of National Resilience Strategy*', in Clark, M. & Griffin, G. (eds), *Next Generation Disaster and Security Management*, University of Melbourne

McGregor, J., Parsons, M., & Glavac, S. (2022). Local Government Capacity and Land Use Planning for Natural Hazards: A Comparative Evaluation of Australian Local Government Areas. *Planning Practice & Research*, 37(2), 248-268. DOI: 10.1080/02697459.2021.1919431

MfE. (2010). *NZ Coastal Policy Statement*. Ministry for the Environment.
<https://environment.govt.nz/acts-and-regulations/national-policy-statements/new-zealand-coastal-policy-statement/>

MfE. (2016). *Risk based thinking for Natural Hazards under the RMA*. Prepared for Ministry for the Environment by Tonkin and Taylor.
https://environment.govt.nz/assets/Publications/Files/NPS_Natural-Hazards-Framework_FINAL-Report-TT-June-2016.pdf

NEMA. (2019). *National Disaster Resilience Strategy*.
<https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>

NEMA. (2023). *Declared States of Emergency*.
<https://www.civildefence.govt.nz/resources/previous-emergencies/declared-states-of-emergency/>

Newshub. (2023, January 28). *Auckland flooding several Kāinga Ora houses lifted off their foundation*. <https://www.newshub.co.nz/home/new->

zealand/2023/01/auckland-flooding-several-k-inga-ora-houses-lifted-off-their-foundations.html

NZ Herald. (2023, March 4). I could hear it coming after me: Are Auckland's cliffs too risky for building homes. *NZ Herald*. <https://www.nzherald.co.nz/nz/aucklands-cliffs-are-slipping-away-so-should-we-ban-building-on-dangerous-sites/LAZULYKQUBGU7L5YOF24L4ZA2U/>

Pelling, M. (2011). *Adaptation to climate change: from resilience to transformation*. Routledge.

Pielke, R Jr. (2007). *The Honest Broker: Making Sense of Science in Policy and Politics*. Cambridge University Press, 2007.

RNZ. (2022, May 26). *Matata The Town that had to retreat*. <https://www.rnz.co.nz/programmes/the-detail/story/2018843338/matata-the-town-that-had-to-retreat>

Sarantakos, S. (2013). *Social research* (4th ed). Palgrave Macmillan.

Saunders, W.S.A., Coomer, M.A., & Beban, J.G. (2014). *Analysis of natural hazard provisions in regional policy statements, territorial authority plans, and CDEM Group Plans*. GNS Science Report 2014/28.

Saunders, W.S.A., Beban, J.G., & Coomer, M.A. (2014a). *Assessment of council capability and capacity for managing natural hazards through land use planning*. GNS Science Report 2014/50.

- Saunders, W.S.A., & Ruske, M. (2014b). *Tabulated results from review of natural hazard provisions in regional policy statements, territorial authority plans, and CDEM group plans*. GNS Science Report 2014/0
- Saunders, W.S.A. (2017). A risk-based approach to land use: planning for natural hazards. *Planning Quarterly*. 205:28-33.
- Selmi, A.A., Blanchard, K., & Murray, V. (2016). *Ensuring science is useful, usable and used in global disaster risk reduction and sustainable development: a view through the Sendai framework lens*. Palgrave communications. DOI 10.1057/palcomms.2016.16.
- Smart, G.M., & Mckerchar, A.I. (2010). More flood disasters in New Zealand. *Journal of Hydrology (NZ)* 49 (2), 69-78.
- Stuff. (2021, March 31). *Sad Farewells for Matata managed retreat fighters*. <https://www.stuff.co.nz/national/128203042/sad-final-farewells-for-matat-managed-retreat-fighters>
- Sullivan-Taylor, B., Gunnell, S., Becker, J., & Johnston, D.J. (2022) Improving resilience: a longitudinal analysis of land-use policy and planning for earthquakes in Aotearoa New Zealand, 2000–16. *Australian Journal of Emergency Management*, 37 (3).
- The Guardian (2023, February, 14). New Zealand Minister delivers furious speech about lost decades spent bickering over climate crisis. *Guardian*. <https://www.theguardian.com/world/2023/feb/14/new-zealand-minister-delivers-furious-speech-about-lost-decades-spent-bickering-over-climate-crisis>

Ueda, K., & Torigoe, H. (2012). Why do Victims of the Tsunami Return to the Coast? *International Journal of Japanese Sociology*, 21(1), 21–29. <https://doi.org/10.1111/j.1475-6781.2012.01159.x>

United Nations. (2015). *Disaster Risk Reduction*. <https://sdgs.un.org/topics/disaster-risk-reduction>

United Nations. (2015) *Transforming our world. The 2030 Agenda for sustainable development*. A/RES/70/1. 21252030 Agenda for Sustainable Development web.pdf (un.org)

UNDRR. (2017). *Understanding Disaster Risk*. <https://www.preventionweb.net/understanding-disaster-risk/component-risk/exposure>

UNDRR. (2019). *Implementing the Sendai Framework to achieve the Sustainable Development Goals*. <https://www.undrr.org/implementing-sendai-framework/sf-and-sdgs>

UNDRR. (2022). *Aotearoa New Zealand's National Midterm Review of the Sendai Framework for Disaster Risk Reduction 2015-2030 Report*. <https://sendaiframework-mtr.undrr.org/publication/new-zealand-voluntary-national-report-mtr-sf>

Wyndham, K.E., Castro, C-P., & Sarmiento, J-P. (2021) From Disaster Risk Construction to Disaster Risk Reduction: Exploring the Agency of Urban Land-Use Planning in Chile, *Planning Practice & Research*, 36:1, 20-40, DOI: 10.1080/02697459.2020.1829285

Yarnal, B. (2007). Vulnerability and all that jazz: Addressing vulnerability in New Orleans after Hurricane Katrina. *Technology in Society*, 29, (2), 249-255. <https://doi.org/10.1016/j.techsoc.2007.01.011>.