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Creating Flood Disasters

New Zealand's oscillating history

Abstract

Using a three-part framework to evaluate choices for adjusting to floods in New Zealand, factors influencing floodplain policies and practices since 1950 are identified. Each change came after severe regional flooding. Early emphasis was on enlarging channels and raising stopbanks, and on post-disaster relief. These responses enhanced urban floodplain development, and disasters when systems failed. Periodically, attempts to improve land use planning and building management, including requirements for flood hazard maps, met stiff resistance from developers, property owners and growth-oriented local politicians, resulting in changed legislation. Policy and practice thereby oscillated several times in response to prescriptive/coercive and devolved/co-operative mandates. Underpinning all has been poor understanding of flood frequency statements on the part of at-risk people.

Keywords flood hazard, disaster potential, coercive–prescriptive, cooperative–devolved, policies and practices

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Flood hazard and types of adjustment to floods

Flooding of settlements in New Zealand has for decades been a serious problem (Cowie, 1957). In the past 70 years, scores of floods have damaged urban areas. All regions have been affected by floods, most multiple times. They have caused severe socio-economic disruptions and cost billions of dollars in losses.

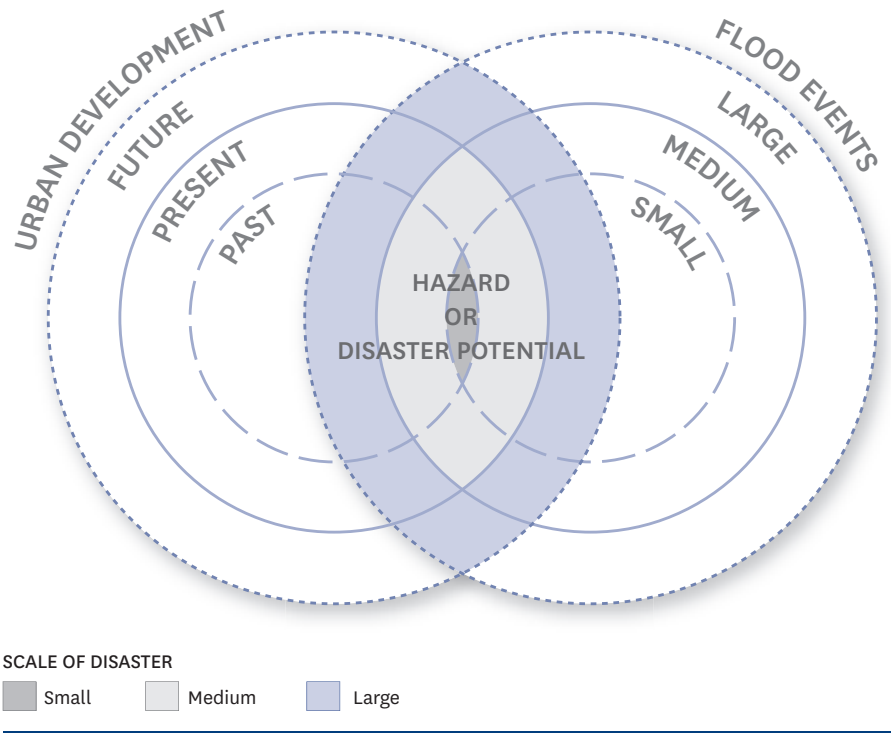
Flood hazard is defined by size of flood event and extent of human use in a flood-prone area. Continued encroachment into these areas characterises 'flood hazard creation' and 'disaster potential' (Figure 1).

Policies and practices for dealing with flood problems can be categorised into the three types shown in the chart in Figure 2. It shows that by the mid-1980s, New Zealand relied mostly on the first and third options (darkest shading), downplaying modifying flood-loss potential through measures for managing land use and buildings. The consequences of this bias for disaster creation are considered in this article.

Modifying flood cause and effects

When natural state catchments are transformed for human uses, waters from intensive rainfalls move more quickly down the stream system, especially when urban development paves over the soil

Figure 1: Flood hazard creation caused by size of flood event and extent of human use (development) in a flood-prone area



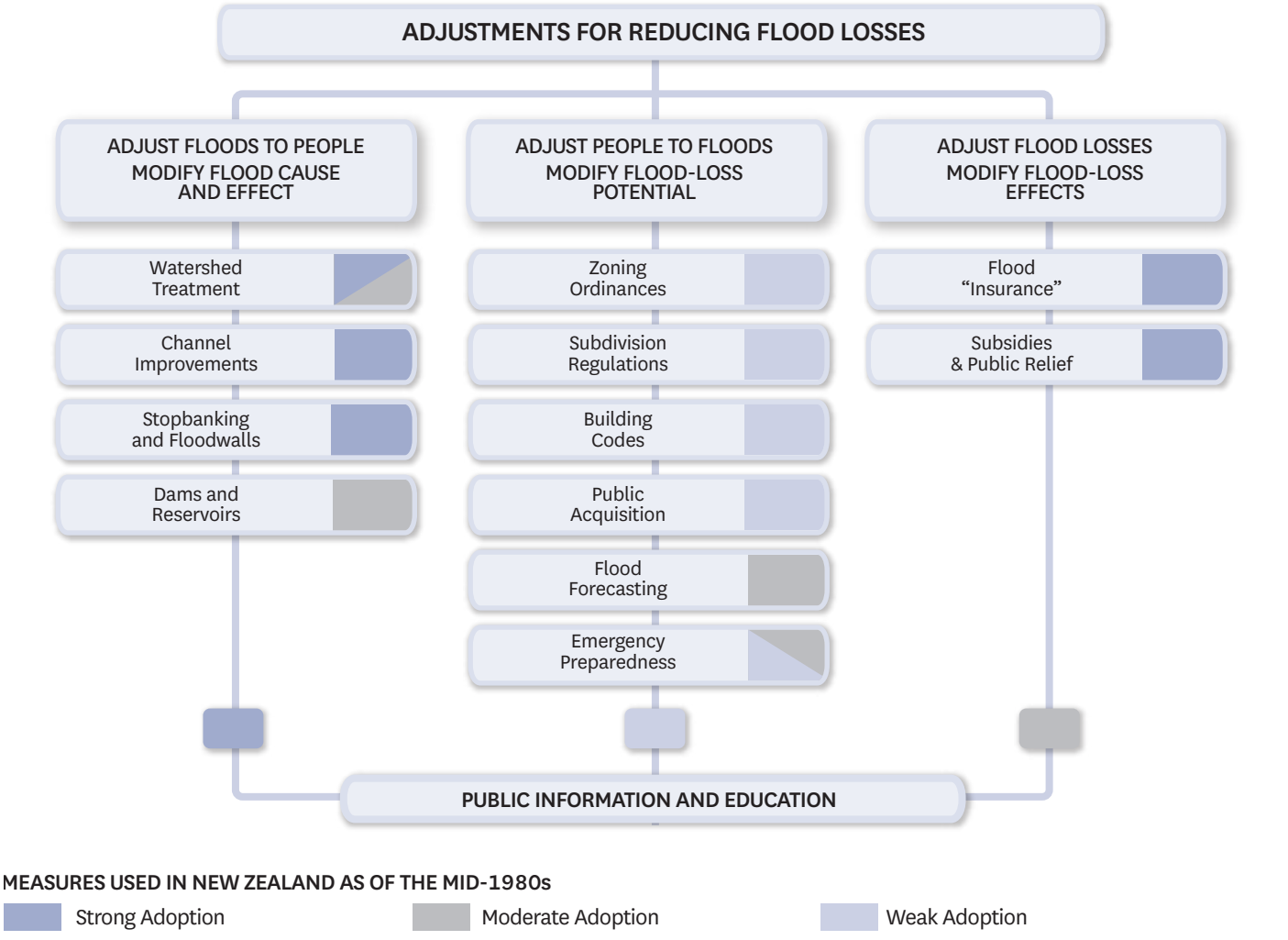
with concrete. Thus the 1-in-100-year flood may become more like a 1-in-75-year flood.

River control works

Society favoured river control works and storm water drainage, especially after the passing of the Water and Soil Conservation Act 1967. It incentivised councils by relatively strong institutional arrangements and subsidies from central government.

However, reliance on flood control and upstream catchment management increases flood hazard by encouraging intensification of development within protected areas. For example, channel widening and stopbank raising along Mangaone Stream (Palmerston North) commenced in 1920. Successive floods led to extending channels and raising stopbanks ever wider and higher five times over 50 years, each encouraging more

Figure 2: Adjustments for reducing floods losses: adjust floods to people; adjust people to floods; and adjust flood-loss effects.



Source: Ericksen, 1986, p. 240

intensive agriculture, then urban development. By mid-1970, stopbanks had grown level with eaves of adjacent houses – all at risk from the greater-than-designed-for flood; and none, it is assumed, flood-proofed (Ericksen, 1986, p.134).

Stopbanks are quite prominent landscape features, but studies show many people living nearby fail to realise their function. Those who do simply take for granted they won't fail due to breaching, overtopping or both. But they can fail, as happened along the Tūtaekurī and Ngaruroro rivers in Hawke's Bay during flooding in February 2023. A recent study compared people's awareness of flood schemes and risks, using survey data and EQC (Earthquake Commission) damage claims, to flood hazard maps. It found notable areas where they don't align (Walsh, Paulik and Robertson, 2020).

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Emphasis on funding flood control works changed in response to evidence presented in *Creating Flood Disasters: New Zealand's need for a new approach to flood hazard* (Ericksen, 1986), and neoliberal reforms in the mid-1980s which curtailed government subsidies (Bewick, 1988; Campbell, 1988; National Water and Soil Conservation Authority, 1987).

Severe regional flooding in 2002 and 2004 led the Ministry for the Environment to investigate flood risk management, including funding, affordability and governmental roles. Its 17 case studies found 'river management ... highly reliant on physical works, and this may not be the most appropriate approach to mitigate flood risk in future' (Ministry for the Environment, 2008, p.29).

The worrying scale of historical stopbanking and its ongoing maintenance by councils is shown in recent inventories, leading to calls for 'provisions to restrict inappropriate development in flood-prone areas, including those behind protective structures' and 'resources and support … to allow local councils to compile more rigorous and consistent (residual) flood risk information and to actively engage with the public for better flood risk awareness and outreach' (Fu et al., 2023).

Prior to the 2023 flood disasters, Local Government New Zealand petitioned government for $197 million in support of 80 ready-to-go flood management infrastructures for upgrading flood protection, and to augment $215 million given in 2020 for a joint-venture programme aimed at completing 55 flood protection projects (Local Government New Zealand, 2019). The proposals don't highlight other flood-loss mitigating measures, such as land use and building management.

Daylighting storm water systems

In recent years programmes like Auckland's Making Space for Water have aimed to create a sponge city (Mercier, 2023). This programme started because tens of thousands of flood-prone homes across Auckland were severely stressing storm water and waste water systems. Thus, Auckland Council has been daylighting some storm water drainage systems in order to increase green space and decrease hard surfaces. Some were shown to have averted damage to nearby buildings in the 2023 floods. But others failed badly, as in Wairau Valley on the North Shore, where several multi-purpose wet and dry detention ponds were overwhelmed. The Sunnynook 30-year plan says much about the multi-functions of these ponding areas, but nothing of their flood-retention function, nor what citizens should do if ponds are overwhelmed (Auckland Council, 2018).

Planning decisions for creating sponge cities will be conditioned by past land use decisions and increases in rainfall intensity from climate change, and strong drivers for intensification or infill housing in urban areas that increase run-off and reduce permeability.

Modifying flood-loss effects

At the right of Figure 2 are measures for modifying flood-loss effects, including insurance and relief funds. By the mid-1980s they were being strongly adopted, and since then have been refined in their expansion.

Insurance

Historically, because few people insured against natural hazards, the government created the Earthquake and War Damage Commission in 1945 to provide affordable insurance, funded by a levy placed on all fire insurance policies of private insurance companies (Earthquake Commission, 2023). Significant natural disasters subsequently led to the Earthquake Commission Act 1993, with the commission being renamed the Earthquake Commission (EQC) and given control of the Natural Disaster Fund. Cover for commercial properties was removed from the fund in 1994 to encourage better uptake with private insurers. Soon after, household contents cover was also removed.

In the past 20 years, the private insurance industry has trended towards risk-based pricing for residential dwelling insurance, where premiums are tailored to specific risks faced. Increasingly, insurance

companies consult council flood maps in order to reassess risks. They also now take account of property-specific mitigation efforts (for example, building elevation) in risk assessment. This is reflected in premiums charged.

The Canterbury earthquakes of 2010 and 2011 led to a public inquiry into the Earthquake Commission, and thence to the Natural Hazards Insurance Act 2023 (Earthquake Commission, 2023). Its primary objective is to clarify the role of EQC in reducing the impact of natural hazards on people, property and the community.

The government has been considering residential flood insurance issues in the context of increasing risk-based pricing and exacerbation of underlying risks by climate change. In April 2022, Cabinet invited the Treasury to consult on these issues and examine options to intervene in the insurance market (Reserve Bank, 2022; Treasury, 2022).

Over a decade ago, Smart and McKercher (2010) found no historically significant trend in the occurrence of river floods. Rather, floods tended to cluster in certain decades, and this varied across the country. The reported increase in insurance claims at that time therefore reflected increased population in at-risk areas.

The Insurance Council of New Zealand expects insurers to pay out $3.5 billion for property damage caused by the 2023 storms; and that insurers may restrict or refuse new cover for homeowners in highest-risk areas and consider risk-based pricing for commercial businesses (Gallagher Brokers, 2023).

Relief funds

Over decades, relief for individuals, communities and businesses affected by extreme climatic events has broadened to involve many government agencies. In response to the 2023 disasters, the Department of the Prime Minister and Cabinet has listed grants available for three main entities: local authorities (five types of grants); businesses (four types of grants and loans); and communities (three types of grants). The lead agencies include: the Department of Internal Affairs, the National Emergency Management Agency (NEMA), Civil Defence Emergency Management (CDEM), the Department of the Prime Minister and Cabinet, Treasury and the Ministry of Business, Innovation and Employment, the Ministry for Primary Industries, the Ministry of Social Development and Te Puni Kōkiri (Department of the Prime Minister and Cabinet, 2024). In addition, upon application the government can make contributions to a mayoral or disaster relief fund in order to quickly help communities recover from emergencies. For years, much relief funding enabled reinstatement of homes and businesses within the same vulnerable locations, although increasingly with building elevation and, more recently, buy-outs of worst-affected homes.

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Modifying flood-loss potential

After 1950, incremental shifts towards better uptake of land use planning and building practice came in response to several disastrous regional floods. But by the mid-1980s their adoption was still relatively weak. This led to the Resource Management Act 1991 (RMA). Links between the RMA and the Building Act 1991 were examined and amendments made to remove inconsistencies (Cashin, 1993). In the decade following the passing of the RMA, several conferences and workshops were held to explain and explore its application and emerging issues (e.g., Blakely, 1994; Hull and Coory, 1994, 1995; Centre for Advanced Engineering, 2002).

When serious regional flooding occurred in 2002, the Climate Change Office in the Ministry for the Environment had the means for evaluating economic losses from the community flooding analysed (Walton et al., 2004). A regional flood in 2004 led to a workshop involving professional and council planners to review emergency responses and reasons for flood hazard creation (Ministry of Civil Defence and Emergency Management, 2009). Meanwhile, the Ministry for the Environment was researching the state of play in 17 flood-prone communities and had the dozen statutes dealing with flooding reviewed (McSweeney, 2006; Ministry for the Environment 2008). This led to the ministry providing local councils with guidelines for better preparing for future flooding (Ministry for the Environment, 2010). With this background, measures for modifying flood-loss potential are outlined below.

Flood forecasting

New Zealand has long been favoured with a centralised weather forecasting service which has grown in sophistication through computer modelling linking local, regional and global climate systems. This is important for short-term localised emergencies and longer-term forecasts for farmers.

Forecasting is essential for providing information in a form of use to emergency planners and ought to come from one authoritative source. In turn, emergency planners must speedily provide pertinent information to relevant council personnel and floodplain dwellers when declaring an emergency.

Emergency preparedness

Emergency planning grew from the 1950s. Each legislative change for improving effectiveness came in response to a major disaster, especially flooding. Early on, local politicians objected to the term

'disaster' declaration, so it was changed to 'emergency' declaration. When over 10% of councils had failed to develop a civil defence plan, it was made mandatory in 1968. Eventually, declaring an emergency passed from civil defence personnel to local politicians, who generally had little enthusiasm for civil defence and land use planning (Ericksen, 1986, p.178–9).

Since 2000 there have been 61 local and 17 regional emergency declarations in response to flooding, seven caused by tropical or ex-tropical cyclones. One might assume that this led to refinements and improvements in the emergency preparedness system. However, a government inquiry into emergency responses to Cyclone Hale (8–12 January 2023) and Cyclone Gabrielle (12–16 February 2023) found that 'The emergency management system is not fit-for-purpose' and that 'There is a major disconnect between communities and CDEM agencies'. Therefore 'Urgent system change is required', and must 'recognise the role of iwi Māori throughout the system' (Ombler et al., 2024, pp.13–14, 16).

These findings and recommendations reflect those given in independent reports prepared for Auckland and Hawke's Bay (Bush, 2023, 2024). The latter showed that CDEM did not plan for worst-case scenarios. Yet a very similar climatic event and disaster had occurred in 1938 (Grayland, 1963). It was recommended that iwi/Māori involvement in CDEM structures be formalised, reflecting similar recommendations made in prior disaster responses and which had informed the 2023 Emergency Management Bill.

An internal evaluation of the NEMA in Wellington found that it was not only unprepared for the extreme events, but also lacked leadership, experience and depth to deal with them (NEMA, 2024).

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Land use planning

In the long run, neither flood-protection works nor emergency preparedness, flood insurance and relief funds will lessen 'disaster creation'. Instead, councils need to better adjust use of flood-prone land through land use and building measures aimed at reducing the flood hazard. Like other adjustments, changes to legislation aimed at measures for reducing catastrophe potential were stimulated by damaging floods.

Requiring land use plans

Poor uptake of land use plans by councils under the 1926 Town-planning Act led to them being made mandatory in 1953, a year when widespread regional flooding occurred twice. In the 1960s councils were required to map and disclose natural hazards in their district plans and 'provide as far as practicable against land being used for purposes for which it was not suitable … unless otherwise mitigated'. By 1970, only 70% of councils had an operative district plan (Ericksen, 1986, p.148).

A year after major flooding in Wellington, the government made the Town and Country Planning Act 1977 more prescriptive. Serious regional flooding happened in Southland and Otago in 1978 and again in 1980. By the time new legislation was being considered in the mid-1980s,

> developers and local councils had blunted legislative gains for regulating subdivision and building in hazard-prone areas by successfully lobbying government to make amendments to the planning acts. Local councils had little to fear from central government for not complying with its regulatory prescriptions. And developers could expect minimal penalties for violating development consents (May et al., 1996, pp.46–7).

Consequently, one third of 103 flood-prone communities with more than 1,000 people identified in a 1967 study did not have flood maps in their district plans in 1983, making land use management to reduce flood exposure intractable (Ericksen, 1974). Thus, flood hazard and disaster creation grew.

Adjustments to flooding require flood-prone area maps. By the mid-1980s there were three obstacles to uptake by councils, apart from technical difficulties in producing maps: perceived legal implications; lack of subsidies to councils from central government for mapping (which the RMA had the potential to address); and perceived adverse effects on land values, which case studies in the 1990s showed to be something of a myth (Ericksen, 2005; Montz, 1992, 1993).

Implementing the RMA

Following Cyclone Bola in 1988, the parliamentary commissioner for the environment recommended to government legislative changes aimed at sustainable management of natural and physical resources. Persistent flood disasters indicated unsustainable development.

The resource management law reform process (1988–90) integrated many statutes into the RMA. It emphasised an integrated planning approach to natural resources and hazards. For floods this meant relying less

on engineering controls and more on reducing loss-susceptibility through land use and building management. Indeed, the 13 recently established regional councils would no longer receive subsidies supporting new flood control works or amending existing ones. It was for the local councils to solve local problems without being coerced or monitored by government agencies.

The co-operative and devolved RMA sought to encourage a flexible approach to adopting flood loss-reducing measures within local councils (Berke, Dixon and Ericksen, 1997). However, optimism of staff soon waned because the government did not provide for councils the promised national policy statement, national environment standards and guidance, technical assistance, or funding needed to encourage them to boldly adopt.

There were also budget cuts, including to the new Ministry for the Environment and Department of Conservation slated to provide policy guides and technical assistance to councils (May et al., 1996). Thus, a decade after implementation of the RMA, research on the quality of sampled district council plans found that too many good policies in plans were poorly implemented, leading to poor outcomes, due in part to the 'managerialism' (i.e., private enterprise practices aimed at measuring outcomes) that accompanied government reforms in the mid-1980s (Ericksen et al., 2003).

Moves to increase transparency and accountability in councils further entrenched functional splits, making it difficult to deal with issues (e.g., storm water and flooding and catchment management) in a 'comprehensive' and 'integrated' manner. Policy and regulatory aspects of planning were typically separated and unproductive rivalry often occurred. As well, both policy and regulatory units were separated from the engineering units managing storm water and flooding, which were separate from the emergency management unit. This silo effect still prevails.

All this meant differing views on flood management. Engineers still sought asset solutions to flood problems, while planners sought land use management and avoidance solutions. In general, local politicians working to shorter time frames tended towards the former, thereby avoiding conflict with property owners and developers.

Nevertheless, regional councils responded well to the RMA by developing long-term plans for areas at threat from riverine flooding, which included the range of adjustments for relevant local councils to consider (e.g., Wellington Regional Council, 1997). The extent of adoption by local councils overall is unknown.

The Ministry for the Environment reviews and recommendations of 2008 and its guidelines of 2010 influenced councils through plan changes and reviews, which were required to be done every ten years. Improving mapping of flood spread and depth therefore became increasingly important for councils.

Building codes

The Building Act 1991 introduced a uniform performance-based New Zealand Building Code, replacing individual by-laws of local government. It aimed to protect life, rather than property. The local government codes were extended to include performance requirements for 10% (1-in-10-year) floods. The Building Act 2004 repealed the earlier legislation, but not the intent of the natural hazard provisions.

These provisions are contained in sections 71–74 of the Building Act 2004, which outline: a natural hazard; when building permits must be refused if land is subject to hazard; when consents can be granted, with a condition requiring notification of the consent; and steps needed to be taken after notification, such as entering details of natural hazards on the record of title for the land and when they can be removed.

The Building Code requires residential buildings and community care facilities to be built at a higher elevation than the flood level of a 1-in-50-year event. But it does not require a flood protection standard for commercial buildings (Ministry for the Environment, 2010, p.23).

In a recent critique of the Building Act 2004, Brook says:

> Within the act, hazards are not necessarily something to be too concerned about … Section 72 accepts that an existing risk of natural hazard … should not prevent building work going ahead, as long as the work will not make the situation worse. The clear implication is that Section 72 allows land developers and lawyers, who will push the law to its limits in court if necessary, to build a house on land subject to natural hazards, and sell it, often to unsuspecting buyers. The law really can be an ass, and if we are to learn from the tragic events of 2023, some of it, particularly pertaining to building consents, needs to change. (Brook, 2023)

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In late 2023, the Ministry of Business, Innovation and Employment issued guidance to councils on sections 71–74. Using section 73, councils should endorse the title to show a building is on hazardous land (Ministry of Business, Innovation and Employment, 2023).

Land information memorandums

The Local Government Official Information and Meetings Act 1987 required councils to provide identifiable natural hazards information, such as the likelihood of

flooding and its potential severity, in a land information memorandum (LIM) for intending property owners. But some councils had yet to comply by 2022.

Using the return period statement in LIM reports (e.g., 100-year flood) misleads property owners. For example, a resident in West Auckland said that when he bought his house 'the LIM mentioned flood risk was 1 in 100 years so it was acceptable, but flooding happened nearly every month' (*New Zealand Herald*, 12 May 2023). Research 50 years ago in 23 countries showed that 90% of people sampled thought a 100-year flood would not come again for 100 years, even though its annual exceedance probability (AEP) in a single year is 1%. When given the probability statement, 75% of those sampled understood its meaning (White, 1974). It was later suggested that a 10-year time horizon for property owners would provide a better signal, such as the 100-year or 1% flood having an almost '10 percent chance of being equalled or exceeded in a 10-year planning period' (Ericksen, 1986, ch.3).

A 2023 amendment to the Local Government Official Information and Meetings Act is more prescriptive of what constitutes a LIM. It should contain understandable information and identify hazards and impacts (including potential ones) affecting land in a district, and their cumulative or combined effects. But councils do not have to create new information for each LIM. The Act also amends the definition of natural hazards to include effects of climate change.

About sections 44B and 44C, the Insurance Council of New Zealand chief executive observed: 'New Zealand has a real and ongoing problem with building and maintaining assets in dumb places … Beyond the enhanced provision of hazard information [in the Bill], it is also long past time that councils do more to simply stop development in high hazard zones, particularly those identified around our coast and in known flood zones' (Orlano, 2022).

Flood-proofing buildings

Making foundations of buildings watertight against groundwater is long practiced. But above ground, houses, businesses and utilities were not until more recent times made waterproof against flooding. Permanent flood-proofing includes: sealing foundations and walls against seepage; strengthening walls to resist hydrostatic pressure; installing drain sumps and pumps; locating electrical switches and points above flood elevations; and elevation of buildings. Contingent measures are those taken upon receipt of adequate flood warning, including: installation of watertight windows and door closures; provision for moving content out of reach; and provision for emergency operation of electricity and water services (Shaeffer, 1960).

In 2010, the Ministry for the Environment provided six options to councils for managing future flood risk, including use of non-regulatory methods such as 'siting and designing buildings to minimise risk' (Ministry for the Environment, 2010, p.30). Soon after, the Business Research Association of New Zealand (BRANZ) provided for councils (and others) a building protection decision framework with a range of adaptation options for flood-prone buildings under different flood risk conditions (Roberti, 2012).

Elevated buildings, especially houses, are increasingly common, but in the absence of contingent measures they fail, as happened in several suburbs of Auckland in the 2023 floods.

Managed retreat

In towns experiencing repeated floods, some existing and intending property owners either elevated their building or relocated to higher ground. After a large flood affected Ōpōtiki in 1964 (population c.2,750), calls were made to move the town onto the adjacent Hukutaia hills to the west. Instead, the government recommended enlarging stopbanks and allowing moving to higher ground already underway to evolve naturally (Ericksen, 1974). Currently, Ōpōtiki District Council plans to use proposed new fast-track consenting legislation for a plan change to expand and intensify housing on the hills (*Ōpōtiki News*, 13 June 2024).

On the other hand, when the small township of Kelso, Otago (population c.300) was hit by large floods in 1978 and 1980, early calls for rebuilding and providing new river protection eventually gave way to the government facilitating relocation in 1982 (MacKenzie, Bond and Stephenson, 2022).

In the last few years, calls for managed retreat as an adaptation option have heightened due to the observed increase in the frequency of large flood events and anticipation of sea level rise. An Expert Working Group on Managed Retreat was established by the government in 2022 to help inform its review of relevant planning legislation. It showed how predetermined plans for relocating buildings and people to safer areas could be implemented (Ministry for the Environment, 2023). Recently, consideration has been given to relocating 12,000 people in South Dunedin away from flood-risk land (de Pont and Wong, 2023).

Adjusting to climate change

In 2019, the government established an independent Climate Change Commission under the Climate Change Response (Zero Carbon) Amendment Act 2019

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to monitor the progress of national adaptation plans and to advise on barriers to implementation and the effectiveness in addressing the most significant risks from climate change and to recommend how barriers may be overcome. The Act had multi-party political support, as well as support from across the business, NGO and other communities.

While much of government's agenda focused on emissions controls, other programmes were pursued. Specialists mapped the spatial effects on the country's floodplains and coasts while allowing for climate change. For example, NIWA has been updating its rainfall and flood-forecasting models in order to produce new riverine and coastal flood maps for use by regional councils. They in turn can better identify flood-prone properties and coping strategies (NIWA, 2023). Thus, the Northland Regional Council's updates showed over 17,000 additional flood-affected properties under a warming climate, increasing the total to 40,000. Maps show the extent for 10%, 2% and 1% annual exceedance probability floods (Northland Regional Council, 2021).

To help achieve its national adaptation plan for climate change, the last Labour-led government proposed new legislation. It intended having a national planning framework to help guide councils into better land use practices vis-à-vis climate change and natural hazards, including riverine and coastal flooding. This is not unlike what was proposed for natural hazards under the RMA.

The new, but short-lived, legislation, the Natural and Built Environment Act and Spatial Planning Act, were to replace the RMA, together with a proposed Climate Change Adaptation Act (Ministry for the Environment, 2021, 2022). It had a modicum of prescription and coercion, encouraging councils to achieve better outcomes in managing flood risks by moving away from decades of minimising land use and building management measures.

The damaging storms of 2023 led to amending the RMA emergency and recovery provisions to give councils flexibility in assisting community recovery. And, mid-year, the government supported councils in buying out and better protecting cyclone and flood affected risk category 3 properties.

A recent study highlights two main needs:

> First, a clearer national directive of how flood risk and residual risk should be managed is urgently needed, particularly for guidance on the regulatory provisions to restrict inappropriate development in flood-prone areas, including those behind protective structures. Second, more dedicated resources and support are necessary to allow local councils to compile more rigorous and consistent (residual) flood risk information and to actively engage with the public for better flood risk awareness and outreach. (Fu et al., 2023)

In early 2024, the newly elected National-led coalition government quickly repealed the new legislation in favour of developing a 'fast-track' approach for infrastructure projects and quicker development decisions, with no clear way forward for how to avoid flood catastrophes and any replacement of the RMA likely to move closer to protecting private property rights. And so, the pendulum swings.

Conclusion

Since 1950, three types of adjustment to floods have been variously used in New Zealand. Changes in emphasis typically followed major flood disasters and government reviews of legislation.

Reliance on measures that modify flood causes and effects (i.e., adjust floods to people) waned by 1990 after research showed that stopbanking encouraged hazardous floodplain development and neo-liberal reforms curtailed government subsidies for their construction. Prospects under the current National-led coalition suggest a swing back to fast-tracked stopbanking developments.

Repeated regional floods over decades ensured that measures that modify flood-loss effects (i.e., adjust flood losses) increased. Insurance became better targeted to risks and public relief funds deepened and structures broadened.

Efforts by government to legislate for measures aimed at modifying flood-loss potential (i.e., adjust people to floods) through land use and building management have oscillated between: somewhat coercive and prescriptive (1970s); somewhat devolved and co-operative (1990s); more coercive and prescriptive (2022); and likely somewhat laissez faire (2024).

> … catastrophe potentials will continue to grow unless more effective land use and building measures are adopted in urban New Zealand that can reduce and avoid further exposure to floods.

Flood protection works, emergency preparedness, flood insurance and relief funds do lessen the flood-loss burden for communities and individuals. But they do not resolve the issue of disaster creation. Indeed, catastrophe potentials will continue to grow unless more effective land use and building measures are adopted in urban New Zealand that can reduce and avoid further exposure to floods.

In the book *Creating Flood Disasters* (Ericksen, 1986), 18 cases showed how urban development had encroached onto historic flood-prone land by the mid-1980s. It would be instructive to update those cases, in order to show not only the extent of continued encroachment, but also the nature of land and building management.

The main lessons from this overview are that while the integrity of existing river protection systems must be maintained, building on the most vulnerable flood-prone land ought to stop. Where building occurs on less vulnerable land, it ought to be permanently and contingently flood-proofed. For this to be effective, a high-quality flood warning and emergency system is required. In support, floodplain mapping should continue apace and, as for LIM reports, the planning flood should reflect the planning horizon of ordinary citizens. If this is taken to be ten years, then the 100-year or 1% flood has an almost 10% chance of being equalled or exceeded in their ten-year planning period.

Over many years, staff in the Ministry for the Environment and its partner agencies have toiled long and hard to have legislation moved in the direction of encouraging local government into better land use and building practices in natural hazard areas. In order to move beyond entrenched local attitudes, a well-tailored community flood hazard education programme is needed aimed at civil defence and council staff, councillors, renters, property owners and developers.

An education programme could include: 1) understanding floods and their frequencies; 2) understanding flood hazard creation; 3) interpreting flood hazard maps and LIMs; 4) understanding their implications for land values; 5) enhancing alternative measures for reducing flood losses, such as permanent and contingent flood-proofing of buildings and utilities; 6) developing past prophesies for at-risk communities to illustrate how disaster potential and flood losses change over time in response to each adjustment type; and 7) developing scenarios of future losses and savings under the adjustment types (Ericksen, 1975a, 1975b). Any education programme has to be salient and ongoing to be effective, and, while costly to develop and maintain, should be resourced to be long lasting.

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