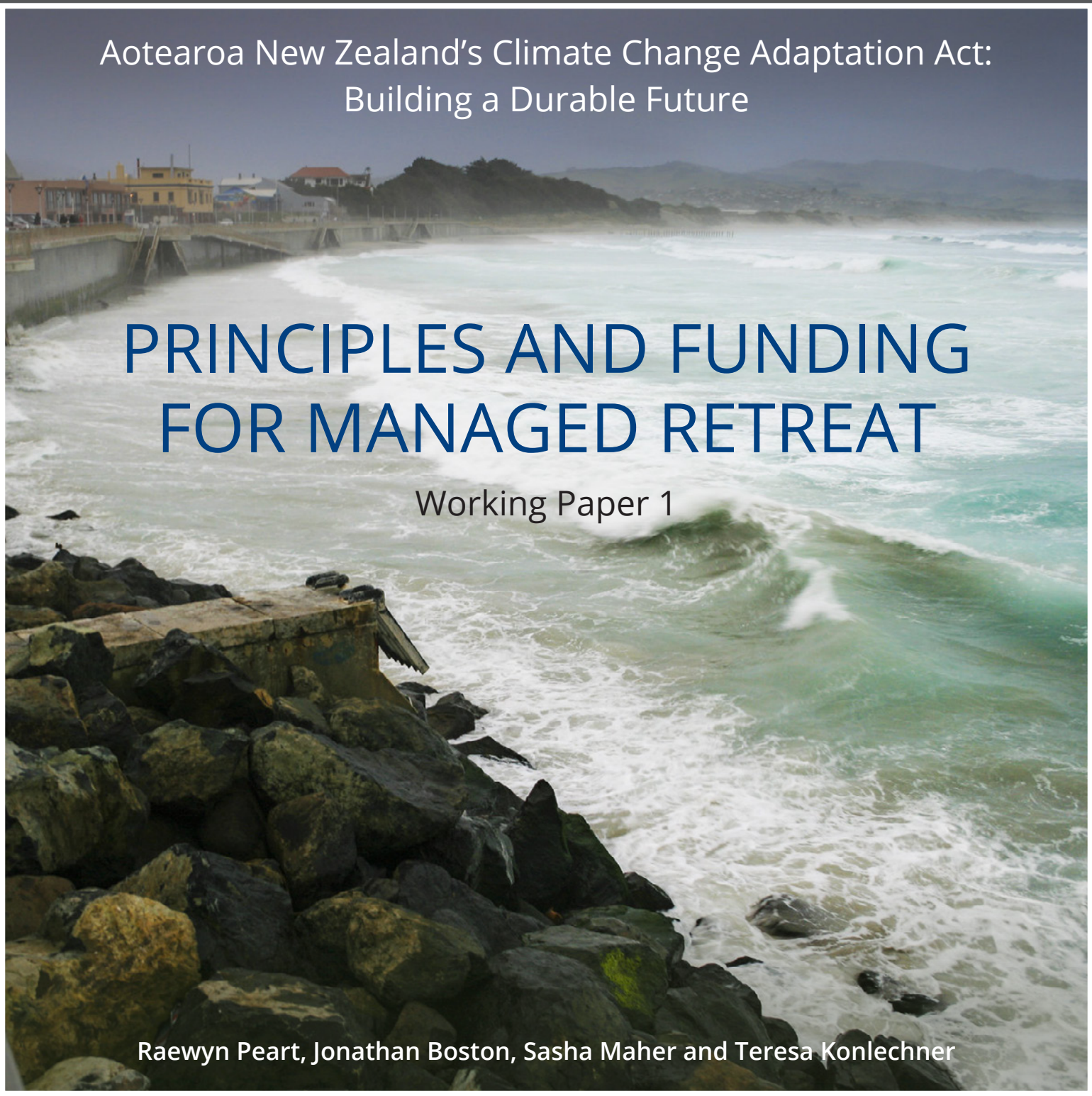
Aotearoa New Zealand's Climate Change Adaptation Act:
Building a Durable Future



PRINCIPLES AND FUNDING FOR MANAGED RETREAT

Working Paper 1

Raewyn Peart, Jonathan Boston, Sasha Maher and Teresa Konlechner

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Abbreviations

EDS	Environmental Defence Society
EQC	Earthquake Commission
GDP	Gross domestic product
IPCC	Intergovernmental Panel on Climate Change
MFE	Ministry for the Environment
RMA	Resource Management Act 1991

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EXECUTIVE SUMMARY

1. Introduction

We live in a climate changing world. Weather-related disasters are becoming increasingly commonplace. We know that such events will increase over time. These changes in the climate place more and more humans and other species in harm's way. Māori are particularly susceptible to a climate changing world which threatens their connections to land and ecosystems.

To address this unprecedented challenge the Government proposed a new piece of legislation in 2020 called the Climate Adaptation Act. This Act is intended to address the complex and distinctive issues associated with managed retreat such as funding, compensation, land acquisition, liability and insurance. It is considered necessary because other proposed legislation, such as the new Natural and Built Environment Act and Spatial Planning Act, and the existing Public Works Act, are inadequately tooled to enable people and infrastructure to be moved out of harm's way.

The Ministry for the Environment (MFE) produced a consultation document on managed retreat in April 2022. Government is expecting to introduce a Climate Adaptation Bill into Parliament by the end of 2023. The Environmental Defence Society's (EDS) *Aotearoa New Zealand's Climate Change Adaptation Act: Building a Durable Future Project* is developing recommendations for the content of the new Climate Adaptation Act. The project commenced in June 2022 and will produce three working papers followed by a final synthesis report in December 2023. This working paper is the first in the series. It focuses on conceptualising managed retreat, exploring what principles might underpin a new system, and considering how it might be funded.

The project working papers are designed to seek feedback on work in progress as we develop up ideas for incorporation into the final synthesis report. In particular, through this working paper we are seeking feedback on what the purpose of managed retreat should be, what principles should underpin it, and what funding support (if any) should be provided to those affected by it.

Part one: Context for managed retreat

In Part One of this Working Paper we explore the concept of managed retreat, why we might need to contemplate it in Aotearoa New Zealand, what it might cost and the experience of managed retreat in the country to date.

2. What is managed retreat?

Retreat is one of a range of possible adaptation responses in the face of known risk. Other responses include: avoiding the risk in the first place by preventing new development in risk prone areas; reducing the risk (at least in the short term) by creating soft or hard defences; and accommodating erosion/flooding events through such measures as raising building floor levels and constructing floodwater detention facilities.

'Managed' retreat involves the purposeful, coordinated movement of people and assets out of harm's way. Ideally it is pre-emptive, taking place before damage occurs. Alternatively, retreat can be 'unmanaged' when it is allowed to unfold in an ad hoc manner over time, with people gradually relocating in the face of increased damage and risk. Such an unmanaged approach can result in considerable inequities, including effectively trapping those who cannot afford to move in a high-risk environment. 'Transformational' retreat actively seeks positive societal and environmental outcomes as part of a managed retreat process.

Over recent decades, Aotearoa New Zealand has witnessed increasing instances of managed retreat. Most cases have been relatively small and involved only a few properties following a disaster. By far the largest example of managed retreat in the country occurred in Christchurch following the major earthquakes in 2010-11. The risk-based delineation of 'red-zones' affected close to 8,000 properties and involved the relocation of more than 20,000 people.

In almost all cases, public authorities have sought to acquire affected properties on a voluntary basis. Owners have usually been compensated based on their properties' current market value, pre-disaster rateable value or similar. Some communities which have been severely affected by river flooding and/or coastal inundation, and for which impacts are predicted to significantly increase in the future, have been unable to agree on managed retreat as part of a wider process of adaptation.

Overall, this experience indicates that *post-disaster* managed retreat has been difficult, and that *proactive* managed retreat will likely be even harder to implement. It will require skilled and dedicated personnel, and excellent co-ordination between public agencies, iwi/hapū and affected parties.

Questions for discussion:

1. How should Aotearoa New Zealand's managed retreat framework be linked to other adaptation responses?
2. When does climate risk become intolerable and to whom?
3. When is managed retreat an appropriate response to risk as opposed to unmanaged retreat?
4. When should the public interest in pre-emptive retreat override individual preferences?
5. Should Aotearoa New Zealand's managed retreat framework focus only on reducing risk or should it be more transformative?
6. What opportunities are there to improve environmental, social and cultural outcomes through managed retreat?
7. What can we learn from Aotearoa New Zealand's experience with managed retreat to date?

3 Why we need managed retreat and what it will cost

Global greenhouse gas emissions are increasing. Extreme temperatures are becoming more frequent and intense, along with storm events causing flooding. For a coastal nation like Aotearoa New Zealand, projections for sea level rise are also cause for considerable concern. Moreover, the tectonic sinking of land along many parts of the country's coastline means that many settlements and much infrastructure will be at increasing risk.

The adverse impacts of climate change, specifically sea level rise, has significant implications for Māori and the many rights and interests of iwi/hapū. Similarly exposed are many recreational, heritage, cultural and ecological assets. In many cases, the only effective and affordable long-term response to climate risks will be to move people and structures out of harm's way.

Estimating the likely scale of potential managed retreat is extremely difficult. There are numerous uncertainties. One estimate is that annual costs will be under 1 per cent of the country's GDP (which was around NZ$350 billion in 2022) over the next few decades.[1] Later in the century, the annual costs may exceed this, depending on the pace of economic growth, the success of adaptive responses, and the success of global mitigation efforts.

Managed retreat will involve the loss of land, buildings and infrastructure. Few such losses will likely be covered by insurance where retreat occurs before property damage. Managed retreat will also result in many other costs for those relocating, as well as for public bodies involved in planning and managing the movement of people and structures. There are also the costs of clearing and rehabilitating vacated land. However, in many cases managed retreat is likely to be the cheapest response option to climate risk in the long term.

Questions for discussion:

1. In what circumstances is managed retreat the best response to growing climate risks?
2. How can the rights and interests of iwi/hapū best be protected during managed retreat processes?
3. What costs of managed retreat need to be considered?
4. To what extent can insurance cover part of the costs?
5. Who should be responsible for which costs?
6. How do we value non-tangible values such as amenity and cultural sites of significance?
7. When is managed retreat the most cost effective approach in the long term?

Part two: Key principles underpinning managed retreat

In this Part of the Working Paper we consider what worldviews might underpin Aotearoa New Zealand's approach to managed retreat, and what principles might be applied to its policy design. In doing so we reflect on the set of objectives and principles for managed retreat legislation and funding proposed by MFE in its recent Consultation Document.[2]

EDS will be developing a purpose statement for managed retreat as part of this project. Some directions for such purpose statement can be drawn from the worldviews and principles discussed in the following chapters. We welcome input into what such a purpose statement should contain.

Question for discussion:

1. What should be the purpose(s) of managed retreat in Aotearoa New Zealand?

4 Worldviews underpinning approach to managed retreat

Worldviews are a system of meanings that help people make sense of their relations with the human and non-human worlds. Legal and ethical principles are underpinned by worldviews and have built in assumptions about what is right and wrong. Before discussing potential principles to underpin managed retreat law and policy, we explore different worldviews that can help inform these; market liberalism, te ao Māori, eco-centrism and a hybrid worldview formed by drawing elements from each of the three other approaches.

Market liberalism is an anthropocentric approach based on the principles of personal liberty, private property and limited government interference. Individual choice and action are prioritised ahead of government intervention. Such an approach would favour 'unmanaged' as opposed to 'managed' retreat because this would leave the individual property owner in the driving seat of response to risk.

Te ao Māori emphasises the importance of relationships between nature and people. Through the lens of te ao Māori the collection of 'things' that comprise managed retreat have their own whakapapa and wairua and are critical to expressions of mana and kaitiakitanga. Managed retreat informed by a te ao Māori worldview would see its objectives and principles developed from a place of rangatiratanga, with tikanga as the guide. Māori would have a strong governance and stewardship role.

Eco-centrism sees nature as holding interests and rights that should be recognised and defended. From an eco-centric lens, managed retreat would recognise the right of nature to exist and co-evolve with humans in shared habitats. For example, humans would relinquish land to make room for habitats and species to move inland as sea level rises.

A hybrid approach in which aspects of te ao Māori, market liberalism and eco-centrism underpin a managed retreat approach for Aoteaora New Zealand could potentially be developed. However, there are tensions between the three approaches as they reflect different priorities. It may be less useful to ask which worldview should be adopted or rejected than to determine what direction to head in so that complementarities can evolve along the way. Combining elements of different worldviews will always create some tensions, but it is important that these are rendered visible, so policy can fairly and equitably address them.

Questions for discussion:

1. What worldviews should underpin Aotearoa New Zealand's approach to managed retreat?
2. Should we seek to combine elements of different worldviews?
3. How should we best manage tensions between different worldviews?

5 Principles which could be applied to managed retreat policy

Worldviews or 'cognitive maps' are operationalised through legal and ethical principles. In this chapter we explore different principles that a future managed retreat system could adopt (which are summarised below). They include both substantive and procedural principles.

Transformative Principle	Social power and constraints should be transformed to deliver improved outcomes for people and nature
Solidarity Principle	Members of a group should support each other to fulfil mutual rights and obligations
Remedial Responsibility Principle	People who need help should be given assistance
Fair Opportunity Principle	People should not be penalised due to circumstances beyond their control

Least Advantaged Principle	It is important to protect the interests of those who are the least advantaged or have the greatest need
Needs Satisfaction Principle	It is important to meet basic human needs
Intergenerational Equity Principle	Those currently alive have a moral obligation to protect the interests of future generations
Compensatory Justice Principle	Unjustified loss, damage or disruption should be compensated for
Restorative Justice Principle	It is important to repair the relationship between those who have been wronged and those who have caused the harm
Comparative Justice Principle	Alike cases should be treated alike
Recognition Justice Principle	It is important to address the underlying causes of inequities
Te ao Māori Principles (Tino Rangatiratanga)	Māori should retain self-autonomy in decision-making over their land and resources
Ecological Justice Principles	Nature should be included in the human community of justice
Conservation Principle	There is a need to protect the ecological integrity and ecological health of natural systems
Ability to Pay Principle	Those who are wealthier have a greater duty to pay than those who are poorer
Beneficiary Pays Principle	Those who receive private benefits from public policy should provide compensation for them
Polluter-pays Principle	Those responsible for causing harm should pay to remedy it
Subsidiarity Principle	Decisions should be made closest to those most affected by them
Procedural Justice Principle	People should have the right to participate in decisions that affect them
Voluntarism Principle	Voluntary action is to be preferred over compulsion
Precautionary Principle	Lack of scientific certainty should not be used as a reason to avoid taking action
Avoid Maladaption Principle	It is important to avoid unintended negative consequences from decisions

These principles provide a general touchstone for the development of a managed retreat policy that provides a 'just transition', where the impacts and opportunities created by change are more evenly distributed. The principles indicate a need to look after the more vulnerable members of the community, as well as nature and future generations, when planning retreat strategies. They also emphasise the need to face the challenge of climate change adaptation as a collective, rather than leaving individuals to suffer the consequences alone. Importantly, the principles emphasise the importance of empowering Māori to be key decision-makers, particularly where Māori-owned land, resources and communities are affected. The ability of communities to actively participate in decisions that affect them is also highlighted, as well as the importance of supporting voluntary action in the first instance before compelling people to adapt.

Questions for discussion:

1. Which principles should be applied to Aotearoa New Zealand's managed retreat system?
2. Which principles should be prioritised or have greater weight?
3. What are the trade-offs between principles?
4. What are the key elements of a just transition in the context of managed retreat?
5. What do the principles indicate regarding the role of Māori in managed retreat?
6. What do the principles suggest regarding the design of appropriate funding policy?

Part three: Compensation for loss of residential property

In this Part of the Working Paper we discuss the potential provision of public compensation for the loss of residential property in managed retreat. We examine why public compensation might be needed in Aotearoa New Zealand, how it has been provided in other countries, how it might be designed for this country and how such a scheme might be funded. In Part Four we consider the implications of managed retreat for other sectors.

6 Why public compensation might be needed

Many of the principles described in Chapter 5 indicate the need for, and desirability of, some form of public compensation for the impacts of managed retreat on residential property. These include upholding the tradition of social solidarity (including collective risk-pooling), upholding the principle of remedial responsibility (where people in need are given assistance), incentivising voluntary relocation and upholding the principles of compensatory and restorative justice. Also important is the long-established legal principle that public compensation should be provided when the state acquires private property on a compulsory basis.

Overall, it seems unlikely that a long-term programme of relocation would secure the required level of cooperation from those directly affected without some measure of public support or compensation. Many residential property owners, along with many tenants, will simply lack the resources to move. In addition, compulsory acquisition of private properties without compensation would likely be subject to lengthy litigation.

Questions for discussion:

1. Is a public compensation scheme for residential property needed and/or desirable to support managed retreat in Aotearoa New Zealand?
2. Could managed retreat of residential areas realistically be undertaken without some form of public compensation?

7 Experience in other countries

Relatively few countries have comprehensive national-level policy frameworks to address the many and varied costs of climate change adaptation. Current funding responses tend to be ad hoc. In addition, we found no examples of governments pre-funding some of the expected long-term costs of climate change adaptation.

Most examples of managed retreat have been modest in scale, typically involving only several dozen to a few hundred properties. In most cases where publicly-mandated relocations have been undertaken, some form of public assistance was provided to the affected residents. Funding typically comes from either the central government, sub-national governments, or some combination of both.

There are lessons from international experience that can help inform the consideration of a public compensation scheme in Aotearoa New Zealand. These include that managed retreat is often controversial, voluntary measures are generally preferred and public acceptance of managed retreat is affected by multiple factors. Further lessons are that managed retreat tends to exacerbate inequalities, the needs of renters are often neglected, indigenous peoples may end up being the most disadvantaged, and co-funding across different levels of government can be problematic.

Despite its many difficulties, international experience indicates that managed retreat will often constitute the most cost-effective and perhaps only technically feasible solution to climate-induced flooding and sea level rise. If undertaken sufficiently early, a well planned and executed managed retreat programme will reduce long-term risks, enhance a community's resilience, and generate other positive outcomes and opportunities including benefits for nature.

Additionally, international research highlights that the ability of societies to adapt to sea level rise, and enhance their resilience to climate change impacts, is less about their technical prowess and more about social and political factors such as the quality of governance. Adaptive capacity is reliant on having the necessary policy frameworks and decision-making processes in place that can resolve (or at least manage) the inevitable societal conflicts that will arise. They also need to enable informed and prudent decision-making and mobilisation of the required financial and other resources.

Question for discussion:

1. What can we learn from overseas experience to help design an effective managed retreat system in Aotearoa New Zealand?

8 Designing public compensation for Aotearoa New Zealand

In this chapter we develop a series of options for how a public compensation scheme could be designed for Aotearoa New Zealand. We then turn, in Chapter 9, to how the scheme might be funded and administered and what other regulatory and policy changes might be required to support such a scheme.

When considering the design of a public compensation scheme for residential property there are a number of important considerations. These include what the goals of the scheme should be, what principles should underpin it, who should be eligible for compensation, and how properties should be valued. Ultimately there is no *optimal* way to design a public compensation scheme for managed retreat.

We identify 12 *possible* options along with a brief assessment of their respective advantages and disadvantages. They include compensation based on replacement cost or the value of a comparable property; the imposition of a fixed cap or requirement for a fixed percentage contribution from property owners; compensation based on a flat-rate or on the estimated remaining life of the building; adjustment of compensation to reflect knowledge of climate risk; differentiation based on principal place of residence, on the means of the owner or on whether the sale is voluntary or compulsory; and annual caps on the total amount paid out or a fixed future date after which compensation would not be payable. We also note that it will be important, both in the interests of distributive justice and to protect the wellbeing of affected tenants including Māori, for any strategy of managed retreat to incorporate specific provisions to assist tenants.

In this chapter we also identify several ways in which funding could be provided to assist managed retreat within Māori communities. Central government funding in this area is currently focussed on research and more funding could be provided for undertaking community-based managed retreat trials to test various approaches. Funds to improve resilience of Māori communities could also be incorporated into other projects such as when infrastructure is rebuilt or relocated. Councils could provide funding support to iwi and hapū embarking on their own climate risk and adaptation work. Māori representation on council climate change committees will also be important.

Managing a compensation scheme and/or funding support for managed retreat will be complex and may require strengthened institutions. There are a range of options for institutional re-design including adding new functions to an existing public entity or creating a distinctive, special-purpose body with unique governance arrangements, perhaps with representatives of the Crown, councils and mana whenua all serving on the governing body.

Questions for discussion:
1. What options for the design of a public compensation scheme for residential property owners are worthy of further investigation and development?
2. How should tenants be supported in managed retreat?
3. How should funding be made available to Māori to support managed retreat?
4. What institutions might be needed to manage compensation/ funding schemes?

9 Funding public compensation

It is difficult to estimate the cost of a public compensation scheme due to a large number of unknown factors. In this chapter we pose a scenario where 50,000 residential properties are affected by managed retreat, with compensation of $1 million per dwelling offered by government. The result is an overall cost of $50 billion or $1 billion per annum. This is less than 1 per cent of the current annual expenditure of government.

There are multiple ways to obtain the revenue necessary for a public compensation fund for managed retreat. In no order of importance, these sources could include:

1. General taxation (central government)
2. Property taxes (local authorities)
3. An additional levy on home insurance policies (and perhaps other insurance)
4. An additional levy on fossil fuels (eg petrol and diesel)
5. Drawing revenue from the Climate Emergency Response Fund – which recycles proceeds from the emissions trading scheme
6. Revenue from renting purchased properties until removal or demolition

7. Revenue from relocating dwellings and other structures that can be moved cost-effectively, and re-selling them

8. New taxes, such as a comprehensive capital gains tax

There is no reason, in principle, why a public compensation scheme could not be funded simultaneously from multiple sources. Additionally, along with central government, costs could be co-funded by property owners and/or local government. However, the 'ability to pay' principle indicates that a significant proportion of the costs might best be sourced from general taxation revenue. Such an approach could also minimise administration and compliance issues. Pre-funding could also be achieved by establishing a Climate Adaptation or Managed Retreat Fund.

Questions for discussion:

1. To what extent should a public compensation scheme be funded by general taxation as opposed to specific levies?
2. Should property owners and/or local government cover part of the costs of a compensation scheme?
3. Should some of the costs of managed retreat be pre-funded?
4. Should a Climate Change Adaptation or Managed Retreat Fund be established?

Part four: Addressing impacts on other sectors

In this Part we consider how managed retreat might impact other sectors and how costs might be addressed. We first focus on nature, then infrastructure, before turning to a range of business sectors.

10 Providing for nature in managed retreat

Loss and change to natural ecosystems is an unavoidable consequence of climate change. Impacts of sea level rise will be most profound on estuaries, coastal lagoons and dune communities.[3] 'Coastal squeeze', where the migration of coastal habitats is constrained by natural or constructed barriers, is expected to affect many estuaries and lagoons in Aotearoa New Zealand. Prolonged beach and dune erosion will lead to the loss of habitat for species that occupy the dynamic coastal margin. Vulnerability of species to the impacts of climate change is in many cases heightened by the already degraded state of many ecosystems due to human activity.

Natural systems possess some innate capacity to adapt to climatic and environmental change. However, this will often be inadequate due to the legacy impacts of land use change, habitat fragmentation and ecological degradation. This means that ecological resilience in the face of climate change will require active support. Opportunities to support biodiversity adaptation in Aotearoa New Zealand include: removing physical barriers to adaption such as seawalls and stopbanks (in some cases termed 'managed realignment'); protecting and restoring natural processes and ecosystem health (such as through pest eradication and creating habitat connectivity); protecting habitat (such as creating more protected areas); and undertaking species-specific approaches (such as translocations). Actions to support the post retreat restoration of vacated lands will also be important.

Current funding is insufficient to address existing threats to New Zealand's biodiversity, let alone new initiatives that will require implementation at a national scale and across multiple ecosystems. This indicates a need for significantly increased biodiversity funding as climate change impacts on nature increase.

Questions for discussion:

1. How can nature best be factored into managed retreat policies?
2. What accommodation might need to be made for species and habitats to move?
3. To what extent should nature be prioritised when planning for managed retreat?
4. How can conflicts between the needs of nature to adapt and the desire of people to protect property be resolved?
5. How can actions to assist nature to adapt best be funded?

11 Managed retreat and infrastructure

In simple terms, infrastructure consists of structures that enable the movement and operation of services that people need. It includes telecommunications, energy, water, waste and resource recovery,

transport and social services. Ownership and operation of infrastructure spans both the public and private sectors.

Aotearoa New Zealand's geography, coupled with urban and rural development decisions, has created a network of infrastructure that is either located in floodplains or on the coast. Half a metre of sea level rise will likely affect infrastructure with a replacement value of $2.7 billion, increasing to $7.8 billion with sea level rise of 1.5 metres. Such estimates do not include other significant costs which will be incurred by infrastructure providers due to climate risks and managed retreat.

Managed retreat of infrastructure will need to occur in two specific circumstances. The first is when assets are threatened by climate risks and need to be moved out of harm's way. The second is when infrastructure needs to move alongside communities as they undertake managed retreat. Managed retreat provides the opportunity to improve the resilience of infrastructure. In relocating infrastructure, it is important to avoid mistakes of the past, such as when Māori land was taken for the establishment of infrastructure.

Current infrastructure funding comes from central government (taxpayers), general and targeted rates (ratepayers), banks and government loans, and user charges (consumers). In order to close the current $210 billion infrastructure deficit, and respond to climate change impacts and other demand and supply-side pressures, more funding options are likely needed. Potential additional funding sources include:

- Pricing: congestion charging, road user charges and water metering
- Targeted rates: on wastewater and waste volumes
- Debt: using Special Purpose Vehicles via the new Infrastructure Funding and Financing Act 2020 to accrue levies which can be borrowed against
- Private-public partnership: long-term contracts between government and the private sector for the provision of services

Key to enabling the efficient use of funding is long-term planning, timing and co-ordination across sectors. To the extent possible, the asset management cycle should align with the timing of managed retreat, and take a long-range view so that any investment is optimised and occurs at the same point that rebuild is required. Infrastructure providers may also need to align their adaptation plans.

Questions for discussion:
1. What financial sources could be utilised to fund managed retreat of infrastructure?
2. To what extent should taxes and rates be relied on as opposed to user charging?
3. How does the current infrastructure deficit impact managed retreat?
4. To what extent is it desirable and practicable to 'build back better'?
5. How can managed retreat of infrastructure best accommodate the needs of iwi and hapū?
6. How can long term planning for infrastructure better account for the timing of managed retreat?

12 Managed retreat and business

Many businesses will be adversely affected by climate change although some may benefit. Climate change can impact businesses directly and through consequential cascading risks. Climate risks can compound with other business risks including physical, regulatory, market and reputational risks.

Relocation may be forced on businesses where one or more risks makes the situation intolerable. This can occur when severe damage occurs to physical structures, productive land or crops and/or critical infrastructure. Businesses may also suffer disruption to supply chains, loss of customer base due to community or population dispersal, an increase in insurance premiums or withdrawal of insurance, and difficulty in obtaining or servicing loans.

In this chapter we explore the implications for agriculture, horticulture, fisheries, tourism, banking, insurance and Māori business (which cross cuts the other sectors). Some of these sectors support others exposed to climate risk, such as insurers covering property damage and business disruption, and lenders providing business finance.

Like communities, businesses exposed to climate change may need to relocate. Relocation is costly and there is an open question as to whether business should be assisted or compensated for loss under new managed retreat legislation. Although there is an argument for compensating

businesses, this could also be viewed as market interference. Should businesses be assisted to move because they contribute to the economy and society? Or should they be left to fail, because they are not sufficiently climate resilient, thereby freeing up resources for new enterprises which are? Further questions could also be asked such as whether size (small, medium, large), employee numbers, location and ownership structure matter if businesses were to be compensated or assisted? Also, should iconic brands with high cultural value receive greater support? Should low emitting and clean technology businesses be compensated over others?

Questions for discussion:
1. Should businesses be assisted in managed retreat and if so to what extent?
2. Should a market approach be adopted and businesses be left to fail?
3. How should Māori businesses be supported, if at all?
4. Should small enterprises receive compensation in a similar manner to homeowners (assuming they were compensated)?
5. Should some business sectors be assisted over others, and if so based on what criteria?

13 Conclusions

The impacts of climate change, and the need to move people, buildings and infrastructure out of harm's way, will be a significant challenge for Aotearoa New Zealand over coming decades. Managed retreat will be a fraught and costly process. However, costs should be significantly reduced in the longer term if a well-designed, well-funded and well-managed approach is implemented by government in a timely manner.

This working paper has highlighted some key considerations that will need to be addressed in designing a national approach to managed retreat. Our second working paper will examine the extent to which current law and policy provides an adequate framework and tools to undertake managed retreat at scale.

Endnotes

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1 Introduction

Coastal erosion damaging a house at Haumoana

We are living in a climate changing world. This was highlighted very vividly on 27 January this year when Auckland experienced its wettest day on record, by far, with more than 260 millimetres of rain falling in parts of the city.[1] An entire summer's rain fell in one day. There was extensive flooding of homes, businesses and roads. Numerous cars become stranded in the floodwaters. Land slips moved homes off their foundations and left others teetering on the edge. The domestic and international terminals at Auckland International Airport flooded bringing the airport to a standstill and stranding more than 2,000 travellers in the flooded buildings.[2] Tragically four people lost their lives. The clean-up will be extensive with more than 1,000 properties in Auckland red or yellow stickered.[3] Insurance claims are predicted to hit nearly $1 billion.[4]

This so not a one off occurrence, In August last year, another 'atmospheric river' dumped more than a meter of rain over Nelson in just four days. Over a 24 hour period more than an entire month's rain fell.[5] The heavy rain caused the Maitai River to breach its banks, causing extensive flooding and triggering over 350 landslides. More than 200 homes in Nelson were evacuated and many are still uninhabitable. In the Marlborough Sounds the same weather system damaged some 670 kilometres of road. Some roads may not be repaired. As Marlborough Mayor, John Legett observed soon after the event, "life may have to change".[6]

Such weather-related disasters are becoming more commonplace. The previous July, Westport experienced the worst flooding in decades forcing the evacuation of more than 2,000 people. More than 500 houses were damaged, over half the total number in the town.[7] The insurance payout for the weather event totalled over $97 million.[8] Such events raise the question of whether relocation should be considered for such flood-prone towns.

But it is not just flooding that is causing damage. Rising seas are threatening those on the coastal edge. In the Hawkes Bay, for example, over 100 properties are predicted to be lost over the next 20 years due to coastal erosion. The cost of moving them out of harm's way, with associated infrastructure, is estimated to be some $196 million.[9]

We know that such risks will increase over time. NIWA's recent climate change projections indicate that extreme weather events will become more frequent and intense, there will be large increases in extreme rainfall, and sea levels will likely increase by a further 0.21 metres by 2040.[10]

Such changes in the climate are placing more and more humans and other species in harm's way. The 2020 National Climate Change Risk Assessment highlighted the significant risks to social cohesion and community wellbeing from the displacement of individuals, families and communities due to climate change impacts. Coastal ecosystems are also at risk from ongoing sea-level rise and extreme weather events as are government finances and the stability of the financial system.[11]

Māori are particularly susceptible to a climate changing world which threatens their connections to land and ecosystems.[12] Through whakapapa, as well as language, stories and traditions (such as karakia, whakatauki, pūrākau, waiata and mātauranga), Māori strongly identify with landmarks such as maunga/mountains and awa/rivers. They maintain their connection with place through activities such as visiting their marae or swimming in their awa. The loss of such places can undermine a sense of identity as well as threaten the health and wellbeing of Māori communities.

In 2020, the Government proposed a new piece of legislation to address this unprecedented challenge, the Climate Adaptation Act. This Act is intended to address the complex and distinctive issues associated with managed retreat such as funding, compensation, land acquisition, liability and insurance. It is thought to be needed because other legislation, such as the proposed new Natural and Built Environment Act and Spatial Planning Act, and the existing Public Works Act, do not adequately provide the required tools to move people and infrastructure out of harm's way.

The Ministry for the Environment (MFE) produced a consultation document on managed retreat in April 2022[13] and Government is expecting to introduce a Climate Adaptation Bill into Parliament by the end of 2023. The Environmental Defence Society's (EDS) *Aotearoa New Zealand's Climate Change Adaptation Act: Building a Durable Future Project* is developing recommendations for the content of the new Climate Adaptation Act. The project commenced in June 2022 and will produce three working papers followed by a final synthesis report in December 2023.

This working paper, the first in the series, has a focus on conceptualising managed retreat and exploring what principles might underpin a new system and how it might be funded. Working Paper 2 will focus on describing and evaluating the adequacy of current law, administrative arrangements and the rights-based system applicable to managed retreat. Working Paper 3, the final in the series, will present a series of options for incorporation into the new statute to address gaps in the current system. The final report will contain concrete recommendations for the design of the Climate Adaptation Act.

Dune erosion at Pukehina Beach

The working papers are designed to seek feedback on work in progress as we develop up ideas for incorporation into the final synthesis report. This working paper seeks constructive feedback on what the purpose of managed retreat should be, what principles should underpin it, and to what extent funding support should be provided to those affected.

Some material in this paper has been drawn from a report prepared for EDS by Professor Jonathan Boston titled *Designing a Public Compensation Scheme for Private Property Losses: Policy Issues and Options*. That report has been published in full along with this Working Paper and is available on the EDS website (www.eds.org.nz). We encourage readers to refer to Professor Boston's report for a fuller account of relevant considerations when designing a public compensation scheme for the managed retreat of residential property.

The structure of this working paper is as follows:

- *Part One* sets the context for managed retreat. It explores what managed retreat is and the differences between unmanaged retreat, managed retreat and transformational retreat. It then examines why we might need to undertake managed retreat and what the potential costs might be. Finally, it reviews the country's experience with managed retreat to date.

- *Part Two* explores what the purpose of managed retreat might be in Aotearoa New Zealand as well as different worldviews and a range of principles that might underpin managed retreat policy and law.

- *Part Three* explores the issue of compensation for the loss of residential property. It examines why such compensation might be needed, how it has been provided in other countries, how a public compensation scheme might be designed for Aotearoa New Zealand and how it might be funded. It also explores how additional funding support could be provided to Māori communities.

- *Part Four* explores the impacts of climate change and managed retreat on other sectors including nature, infrastructure and business.

We have not included a separate section on the impacts of managed retreat on Māori but have sought to integrate relevant material throughout the working paper. The project team is further exploring impacts of climate change on Māori through a series of case studies, which will be reported on in subsequent working papers, and which will help inform the design of our final recommendations.

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2 What is managed retreat?

Dune erosion at Buffalo Beach, Whitianga

In Part One of this Working Paper we explore the concept of managed retreat, why we might need to contemplate it in Aotearoa New Zealand, what it might cost and what the experience of managed retreat in the country has been to date.

Managed retreat is an adaptation response to climate and other hazard risks. Simply put, it involves the "purposeful, coordinated movement of people and assets out of harm's way".[1] Managed retreat is one of a range of possible adaptation responses to known risk. Other potential responses include: avoiding the risk in the first place, such as by preventing new development in risk prone areas; reducing the risk (at least in the short term) by creating soft or hard defences to coastal erosion and flooding; and accommodating erosion/flooding events through such measures as raising the floor levels of buildings or building floodwater detention facilities (see Figure 1). Such responses are closely inter-related. For example, building seawalls may serve to delay the need for managed retreat by some decades, and avoiding development in risk prone areas in the first place may avoid the need for managed retreat entirely. It is therefore important to consider managed retreat in the context of other potential adaptation responses.

From an ecological perspective, the adaptation response which is adopted in the face of climate and other risks is particularly significant. A resort to hard protection structures such as sea walls, groynes and breakwaters will often result in 'coastal squeeze' or adverse effects on indigenous species, ecosystem functioning and associated ecosystem services. It can also serve to raise community expectations around the provision of hard protection in the future. Many effects will be irreversible in practice, as the cost of fully rehabilitating areas impacted by hard structures will likely be prohibitively high.

Protective structures like seawalls, stopbanks and groynes have adverse effects on the natural environment. The use of *nature-based methods*, also known as 'living shorelines' or 'natural flood management', that utilise the protective services of coastal and riparian vegetation and ecosystems, can provide an alternative hazard risk reduction strategy that creates biodiversity and recreational co-benefits.[2] In appropriate conditions, nature-based methods can be a cost-effective alternative to traditional hard protection structures.[3] Where protective structures cannot be avoided, biodiversity can still be supported by incorporating habitat into the structure or using hybrid protective approaches.[4]

The longer a hard structure is in place, the more costly and difficult it will be to rehabilitate the site once the structure is no longer functional. In addition, the longer adaptation is delayed, the less likely that alternative 'soft' shore protection methods or opportunities for nature will be viable. Alternative or interim protection methods, such as nature-based or living shorelines (where nature can be utilised for both biodiversity and

increased hazard mitigation services) are more likely to succeed when implemented early and where there is sufficient accommodation space.[5]

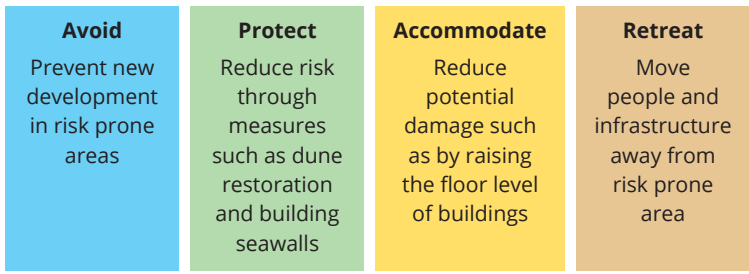

Figure 1: Types of adaptation responses

2.1 Unmanaged retreat

Retreat from risk does not necessarily need to be 'managed' as such. Episodic retreat in response to seismic events, flooding and other natural hazards has been an ongoing feature of human civilisation for millennia. People and property have typically only relocated after a significant natural disaster has occurred, rather than pre-emptively. In many such cases retreat has been unplanned, unmanaged and uncoordinated.

When public authorities take a hands-off approach to retreat, individuals are left to make their own decisions as to whether and when to move, and they bear the costs of those decisions. People will make different decisions dependent on varying personal circumstances and perception of risk. Some may voluntarily relocate early on. Some may stay put as they are attached to place and/or can't afford to move. Some may seek to construct hard engineering structures to delay relocation. Others might wait it out until the insurance industry retreats or their insurance premiums reaches an unacceptable cost threshold and/or damage to property becomes too costly. Due to the uncoordinated nature of unmanaged retreat, the process unfolds in an ad hoc manner over time. Increasing damage gradually prompts more people to move.

On the face of it, unmanaged retreat can appear an attractive option as it allows individuals and communities (including Māori communities) to make their own decisions and avoids interference with private property and Māori land rights. Unmanaged retreat also enables public authorities to avoid politically fraught decision-making processes and the considerable costs of moving people and infrastructure.

Unmanaged retreat, however, can result in considerable inequities with those who cannot afford to move being trapped in an increasingly high risk environment. Unmanaged retreat may also be coupled with a laissez faire approach towards development, allowing new houses to be built in hazard zones (on the basis of a 'buyer beware' approach), thereby increasing the amount of development and thus people and property ultimately facing risk.

2.2 Managed retreat

In contrast, managed retreat is a deliberate and intentional process. It is publicly authorised, planned and coordinated. Managed retreat is anticipatory, long-term and forward-looking. The aim is to reduce natural hazard risk permanently rather than temporarily – or, to quote MFE "to reduce or eliminate exposure to intolerable risk".[6] Managed retreat is variously referred to as 'planned relocation', 'planned resettlement', 'community-led relocation' or 'phased abandonment'.[7] Closely related is the term 'managed realignment', denoting the controlled inundation of coastal areas to create natural defences and address biodiversity loss. Setting back the line of defence does not necessarily involve the movement of people or communities, but often involves the retirement of land.[8]

> The Government's National Adaption Plan defines managed retreat as "the purposeful, co-ordinated movement of people and assets (eg, buildings and infrastructure) away from risks. This may involve the movement of a person, infrastructure (eg, building or road) or community. It can occur in response to a variety of hazards, such as flood, wildfire, or drought."[9]

Managed retreat will likely entail the movement, not only of people, buildings and infrastructure, but also of cultural and historic sites. It will almost certainly involve the relinquishing of urban and agricultural land. And importantly, it should also accommodate the needs of indigenous species, enabling them to move in response to climate change and restoring their habitat in areas vacated by humans.

Due to the high cost, significant level of disruption and political difficulties involved, managed retreat is often considered to be the last resort. But this should not necessarily be the case. If done well, managed retreat can offer many positive outcomes. These include enabling the construction of new, better and more resilient communities – with energy efficient homes and buildings and more robust, climate-proof infrastructure. The relocation of rural Māori to more productive and lower risk land and housing, for example, could improve health and well-being for whanau.

Managed retreat will likely be costly, complex and controversial. Many residents and communities in vulnerable locations will be reluctant to relocate, not least because of limited financial means and strong attachments to place. However, relocating people prior to damage occurring is likely to be financially cheaper, less risky, less disruptive and less socially harmful than relocating people following a major damaging event.

Managed retreat can also provide benefits for the natural environment, particularly if the needs of non-human species are recognised as an integral consideration in planning for human relocation and resettlement. Moving people and structures can create more space for nature. In turn, creating more space for nature can reduce the ongoing risk for those who remain. In a broader sense, managed retreat could help reconfigure the relationship between humans and nature. Siders et al note "it is possible that surrendering to nature could inspire a positive reconnection with nature in new ways".[10]

Making room for the rivers, the Netherlands

The Room for the River Programme in the Netherlands has focused on partially restoring the natural floodplain of rivers to better protect other settlement areas downstream. The programme involved buying up agricultural land to convert to floodplain areas as well as building new infrastructure (such as houses for those moved from floodplains) and riverfront developments for affected communities. As well as reducing flood risk it has improved the overall environmental quality of the river areas.[11]

Expanding wetland areas, New Jersey, USA

The Blue Acres Programme in New Jersey, USA, which was developed in response to repeated flooding events, offers to buy back properties at risk of flooding. The scheme prioritises groups of properties that are located close to existing wetland areas or that could provide significant flood storage for the remaining community. It requires clusters of homes to be purchased at the same time, rather than individual properties, in order to create interconnected restoration areas.[12]

2.2 Transformational retreat

'Transformational retreat' is a term used when positive societal and environmental outcomes are actively sought as part of a managed retreat process. It recognises that climate change adaptation should not only improve the resiliency of critical systems (such as housing and infrastructure), but also address the socio-economic factors that affect how climate-related hazards impact individuals and communities. This frame on managed retreat also seeks out opportunities to achieve biodiversity gains. There is growing international consensus that climate change is interconnected with biodiversity loss and that adaptive responses such as managed retreat should consider how best to address both crises at the same time.

Under a transformational retreat approach, the purpose would go beyond relocation of people, assets and activities to also address social inequalities,[13] enhance and restore ecosystems[14] and strengthen democracy.[15] Dundon and Abkowitz note that there are positive co-benefits that can be generated such as restoring fragile coastal ecosystems.[16] A transformational retreat approach places these matters at the forefront of the planning process, rather than being treated as incidental benefits.[17]

2.3 Components of managed retreat

Managed retreat can be viewed as a linear process with at least seven identifiable stages (see Figure 2). The actual staging, timing and sequencing will differ according to geographical, social-cultural and political dynamics as well as the availability of funding.

Transformational retreat includes a focus on the restoration of coastal and floodplain habitats, including dune systems as shown here at Piha

Stage	Groupings	Elements
Iwi/hapū and Community Engagement	Engagement	Provision of data and information Participation and/or consultation on managed retreat process and outcome
Planning and Preparation	Planning	Risk assessments Environmental, ecological, cultural and social opportunities identified Option analysis Plan/rule change Planning for relocation Planning for realignment of ecosystems/nature Placing restrictions on rebuilding and development Planning to optimise co-benefits and opportunities
	Monitoring	Developing a monitoring framework Establishing thresholds and triggers
Enabling Investment	Property acquisition and investment (buy outs and lease backs)	Property acquisition offers and negotiations
	New community investment	Acquisition of alternative land for relocation Development of new community facilities
	Public infrastructure level of service reduction	Reduction in maintenance of public infrastructure
Active retreat	Public infrastructure and structure relocations	Replacement/redevelopment of public infrastructure elsewhere Relocation of critical facility structures (schools, hospitals) Relocation/replacement of community facilities (halls, parks)
	Privately owned infrastructure	Private companies begin to reduce/remove/relocate their infrastructure
	Private property relocation/abandonment	Relocation of/abandonment of residential and commercial property Provision of temporary housing
	Removal of protective structures	Removal of seawalls, floodbanks, groynes etc
	Ecosystems and nature	Realignment or relocation of species, habitats and associated ecological and biophysical processes
Clean up	Clean up	Demolition and removal of buildings and infrastructure Decommissioning of hazardous sites and landfills
Resettlement	Resettlement	Provision of social services to ensure communities have adjusted Job transition funding
Post-retreat land management and repurposing	Retreat land	Land rehabilitation Land maintenance Habitat restoration and enhancement Ongoing monitoring, reporting and evaluation

Figure 2: Components of managed retreat[18]

Managed retreat may also be required for reasons unrelated to climate change such as when major seismic events or volcanic eruptions occur. Accordingly, any policy framework for managed retreat should be designed with a range of possible applications and contexts in view.

2.4 Aotearoa New Zealand's experience with managed retreat

Aotearoa New Zealand has witnessed increasing instances of managed retreat over recent decades.[19] Most cases have been relatively small, involving only a few properties, but some have involved over a hundred properties including Twin Streams in West Auckland[20] and the RiverLink Project in the Hutt Valley.[21] By far, the largest example of managed retreat in the country occured in Christchurch following the major 2010-11 earthquakes. Significant areas of the city were 'red-zoned' indicating that houses could not be rebuilt, with red-zoning affecting close to 8,000 properties. More than 20,000 people were relocated.[22]

Most cases of managed retreat in Aotearoa New Zealand have occurred after a disaster, with pre-emptive retreat being much less common. In some cases, retreat can be both post-event and pre-emptive. For example, in Matatā managed retreat was undertaken after property damage had occurred, but was designed to remove people from an area where there was future flooding risk.[23] In almost all cases, public authorities have sought to acquire affected properties on a voluntary basis, although there has been an implicit threat of compulsory acquisition in some cases. Where properties have been acquired, the owners have usually been compensated based on their properties' current market value, pre-disaster rateable value or similar.

Some communities severely affected by river flooding or coastal erosion/inundation have been unable to agree on managed retreat as part of a wider process of adaptation. Examples include the Hawkes Bay coastal settlement of Haumoana,[24] the coastal settlement of Mākara (near Wellington),[25] the small riverine settlements of Waitōtara and Whangaehu (near Whanganui),[26] and a riverside suburb in Whanganui.[27]

Questions for discussion:

1. How should Aotearoa New Zealand's managed retreat framework be linked to other adaptation responses?
2. When does climate risk become intolerable and to whom?
3. When is managed retreat an appropriate response to risk as opposed to unmanaged retreat?
4. When should the public interest in pre-emptive retreat override individual preferences?
5. Should Aotearoa New Zealand's managed retreat framework focus only on reducing risk or should it be more transformative?
6. What opportunities are there to improve environmental, social and cultural outcomes through managed retreat?
7. What can we learn for Aotearoa New Zealand's experience with managed retreat to date?

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3 Why we need managed retreat and what it will cost

Flooding in Westport July 2021 *(NZ Defence Force)*

3.1 Climate risks

Global greenhouse gas emissions are increasing. Atmospheric concentrations of CO_2 are higher now than at any time during the past two million years.[1] Concentrations of methane are also rapidly rising. Global mean surface temperatures are currently around 1.1°C higher than during the latter half of the 19th century and are set to further increase.[2] Extreme temperatures are more frequent and intense, increasing storm events which cause flooding.[3]

For a coastal nation like Aotearoa New Zealand, projections for sea level rise are of considerable concern. The average rate of global mean sea level rise almost tripled between 1901-1971 and 2006-2018 to around 3.7 millimetres per annum.[4] By 2150, the projected rise is 0.37-0.86 metres under a very low emissions scenario, and as much as 0.98-1.88 metres under a very high emissions scenario.[5] A much larger rise in sea level, approaching 5 metres by 2150, cannot be ruled out due to considerable scientific uncertainty about ice-sheet processes.

There will also be changes in wind and wave regimes, as well as storm frequencies and magnitudes, as a result of climate change.[6] Subtle shifts in these coastal drivers, in tandem with sea level rise, may lead to substantial changes in shoreline erosion and inundation.[7]

On a global scale "extreme sea level events that occurred once per century in the recent past are projected to occur at least annually at more than half of all tide gauge locations by 2100 (*high confidence*)".[8] To compound matters, "the combination of more frequent extreme sea level events (due to sea level rise and storm surge) and extreme rainfall/riverflow events will make flooding more probable (*high confidence*)", especially in coastal cities.[9] In short, climate change will generate many compounding and cascading risks.

Aotearoa New Zealand has the 9th longest coastline in the world, at around 15,000 kilometres, and will therefore likely be disproportionately affected by sea level rise.[10] Many people live within a few metres of high spring tide, with significant amounts of public infrastructure (including roads, railway lines and water services) located on the coast.

Many coastal areas are also subject to vertical movement due to tectonic plate activity, impacting the extent of sea level rise.[11] In some areas, where the land is rising, the impacts will be moderated. But in other areas, sinking of the land will make things much worse. About 40 per cent of Aotearoa New Zealand's coastline is subsiding, particularly along the lower North Island and upper South Island[12]. For example, the Wairarapa coastal settlements of Castlepoint and Riversdale are sinking at a rate of around 3.77 and 4.67 millimetres per year respectively, which is likely to lead to a net one-metre rise in sea level by 2100.[13]

The cumulative impacts of climate change mean that major flooding, mud flow and coastal erosion events in Aotearoa New Zealand will increase in frequency and intensity. The country is particularly vulnerable due to most major cities, as well as numerous towns and other settlements, being built on floodplains or on the coast.[14]

Currently a 1-in-100 year flood could affect close to 20,000 km^2 of land and over 675,000 people and 400,000 buildings. Also at risk are some 20 airports, including the Auckland and Christchurch international airports; major industrial developments such as the Tiwai Point Aluminium smelter, Marsden Point Oil Refinery and Taranaki Methanex methanol production facilities; and major roads, railway lines and electricity transmission lines.[15] With a changing climate, what are currently 1-in-100-year events will become much more common.

Many recreational, heritage, cultural and ecological assets are also at risk from climate change impacts. For example, 4,149 archaeological sites, 300 of the Department of Conservation's coastal assets (including campgrounds and bridges), and more than 350 sites where the Department manages ecosystems or specific indigenous species, are threatened with coastal flooding due to sea level rise.[16] Coastal ecosystems are particularly vulnerable to climate change impacts due to the legacy of habitat degradation caused by coastal development.

3.2 Risks for Māori

The adverse impacts of climate change, especially sea level rise, have significant implications for Māori land and the many rights and interests of iwi/hapū.[17] In some cases, the impacts will affect land transferred to iwi/hapū via settlements negotiated under Te Tiriti o Waitangi. Much of the whenua returned to iwi under Treaty settlements has land title, settlement acts and other encumbrances which restricts the ability to move marae complexes and associated assets to new sites.

Of the almost 800 marae in the country, around 80 percent are located in low-lying coastal areas or near flood-prone rivers.[18] Of these, almost 200 are within one kilometre of the coast, and several dozen are likely to be vulnerable to sea level rise during the remainder of this century. In addition, a range of other valuable cultural assets will be at risk from climate change including Māori burial sites, mahinga kai, hunting sites and places of historical significance. Losing access to such sites can threaten important cultural and spiritual linkages.

Climate change will also create risks for the Māori business economy as Māori are heavily invested in the primary sector including forestry, fishing, agriculture, horticulture and farming.[19]

3.3 Potential costs

Climate change will undoubtedly impose significant direct and indirect costs on society. These costs are slated to escalate significantly as the century advances, and they will fall unevenly geographically and socially.

In terms of Aotearoa New Zealand's vulnerability to sea level rise, it has been estimated that each 10 centimetre rise in sea level will put at risk an additional 7,000 buildings (with a replacement cost of around $2.4 billion), 133 kilometres of roads and 10 kilometres of railway line.[20] With half a metre of sea level rise, around 36,000 buildings, 350 km^2 of land and close to 50,000 people will be put at risk of flooding during extreme events.[21] Sea level rise of a metre will have significantly greater impacts, exposing buildings valued at around NZ$25 billion to coastal inundation.[22] These estimates exclude the wider costs of climate change arising from more severe droughts, floods, fires and storms, along with the costs of consequential global supply-chain disruption, increased geopolitical tensions and large-scale internal and external migration.

Estimating the likely scale of managed retreat in the face of such risks is extremely difficult as there are numerous uncertainties. They include the path of global greenhouse gas emissions over the next 50 to 100 years, the pace of sea level rise, and the extent of vertical land movement in vulnerable coastal areas. In addition, it is unclear the extent to which councils will be successful in adopting an 'avoid' strategy, by preventing further development in potentially hazardous areas. Also uncertain is the level of investment in new or improved protective structures (through a 'protect' strategy) and their effectiveness in limiting coastal erosion, inundation and flood damage.

Given these uncertainties, it is challenging to estimate the likely *annual* costs of managed retreat in future decades, let alone the possible *cumulative* costs by specific dates. One estimate concluded that annual costs should be under 1 per cent of the country's GDP (which was around NZ$350 billion in 2022) over the next few decades. Later in the century, they may exceed this level, depending on the pace of economic growth, the success of adaptive responses, and global mitigation efforts.[23] Such

costs associated with managed retreat are but one of the many costs that climate change will generate.

The most significant financial impacts will almost certainly be experienced by property owners. Many of these will be homeowners, with a home ownership rate in Aotearoa New Zealand of around 65 percent.[24] Owner-occupied dwellings, and other privately-owned real estate, account for 43 per cent of total household assets.[25] This means that the loss of a home due to managed retreat could have a profound impact on the net worth of many households.

Aside from the direct loss of land, buildings and infrastructure, many other costs will be incurred as a result of managed retreat. These include:

- Renters having to move
- Disruption to businesses activities
- Negative impacts on the activities and assets of iwi/hapū, community and religious organisations and the providers of childcare, education, health care and social services
- The loss of many cultural and historical treasures, along with places of spiritual, aesthetic and recreational value
- The loss of neighbourly and community relationships
- The loss of indigenous species, ecologically significant habitats and associated ecosystem services.

Few losses associated with managed retreat are likely to be covered by insurance. Under current insurance arrangements, property owners are generally not covered for losses consequential to managed retreat, unless retreat is undertaken after property damage occurs (such as with the Christchurch red zone properties). Costs faced by those in rental accommodation (who will face moving costs as well as potentially steeper rentals and greater transport costs in their new location) are not covered by insurance. A proportion of affected commercial enterprises may have business interruption insurance but this may not cover disruption due to managed retreat.

There will also be many other costs that will be borne by public authorities. They include the costs of planning and administering large-scale relocations (including undertaking risk assessments, evaluating options, planning new settlements, conducting extensive public consultations, negotiating with property owners and covering legal fees). Demolishing and removing at-risk buildings and infrastructure will also be expensive (noting that the cost of demolishing buildings in the Christchurch red-zones is estimated to have exceeded NZ$1 billion).[26] There is also the cost of rehabilitating the abandoned land and replacing or enhancing the resilience of public infrastructure.

Losses will occur, in any event, if things are left to take their course in the absence of a managed retreat strategy. Managed retreat is effectively a cost or loss mitigation strategy.

In Australia it was estimated that $1 spent on risk reduction was likely to save at least $3 on future disaster costs by avoiding losses and disruption.[27] Other international estimates of the likely savings are substantially higher.[28]

Questions for discussion:

1. In what circumstances is managed retreat the best response to growing climate risks?
2. How can the rights and interests of iwi/hapū best be protected during managed retreat processes?
3. What costs of managed retreat need to be considered?
4. To what extent can insurance cover part of the costs?
5. Who should be responsible for which costs?
6. How do we value non-tangible values such as amenity and cultural sites of significance?
7. When is managed retreat the most cost effective approach in the long term?

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Part 2: Key principles underpinning managed retreat

4 Worldviews underpinning approach to managed retreat

Waka taua, Ngāti Paoa

In this part of the Working Paper we consider what worldviews might underpin Aotearoa New Zealand's approach to managed retreat and what principles might be applied to its policy design. In doing so we reflect on the set of objectives and principles for managed retreat legislation and funding proposed by MFE in its Consultation Document (see Figure 3 below).

MFE's proposals beg the question: what is the overall purpose of managed retreat in Aotearoa New Zealand? What outcomes should managed retreat be trying to achieve? MFE's Consultation Document does not propose a purpose or any objectives for managed retreat per se, but it does propose objectives for managed retreat legislation and funding respectively. The legislation objectives focus on providing clarity and tools rather than seeking any specific outcomes. The funding objectives indicate a minimalist approach where hardship to those affected by climate change is to be "reduced" while also reducing the liabilities of the Crown (thereby potentially placing more of the considerable costs of managed retreat onto other parties). It is somewhat unclear how these two (and at least partially conflicting) imperatives will be achieved at the same time.

Others have proposed explicit purposes for managed retreat. For example, Hanna et al suggest that its purpose is to "remedy unsustainable land use patterns that expose people, ecosystems, and assets to significant natural (and socio-natural) hazard and climate induced risks."[1] The Georgetown Climate Center has proposed that "The aim of managed retreat is to proactively move people, structures, and infrastructure out of harm's way before disasters or other threats occur to avoid damage, maximize benefits, and minimize costs for communities and ecosystems."[2]

As part of this project EDS will be developing a purpose statement for managed retreat. Some directions for such a purpose statement can be drawn from the worldviews and principles discussed in the following chapters. We welcome input into what such a statement should contain.

Question for discussion:

1. What should be the purpose(s) of managed retreat in Aotearoa New Zealand?

Managed retreat legislation	Funding responsibilities
OBJECTIVES	
• To set clear roles, responsibilities and processes for managed retreat from areas of intolerable risk • To provide stronger tools for councils to modify or extinguish existing uses of land • To provide clarity on tools and processes for acquiring land and related compensation • To clarify local government liability for decision-making on managed retreat, and the role of the courts • To provide clear criteria for when central government will intervene (or not) in a managed retreat process	• To reduce hardship due to the impacts of climate change • To incentivise better long-term investment decisions concerning climate change risk • To reduce liabilities, including contingent liabilities of the Crown • To support the role of banking and insurance in facilitating risk management
PRINCIPLES	
• Managed retreat processes are efficient, fair, open and transparent • Communities are actively engaged in conversations about risk and in determining and implementing options for risk management • Social and cultural connections to community and place are maintained as much as possible • There is flexibility as to how managed retreat processes play out in different contexts • Iwi/Māori are represented in governance and management and have direct input and influence in managed retreat processes, and outcomes for Iwi/Māori are supported • Protection of the natural environment and the use of nature-based solutions are prioritised	• Limit Crown's fiscal exposure • Minimize moral hazard • Solutions are designed to be a simple as possible • Ensure fairness and equity for and between communities, including across generations • Minimize cost over time by providing as much advance notice as possible • Solutions support system coherence and the overall adaptive system response • Risks and responsibilities are appropriately shared across parties including property owners, local government, central government, and banks and insurance industries

Figure 3: MFE's proposed objectives and principles for managed retreat[3]

Worldviews are a system of meanings that help us make sense of our relations with the human and non-human world. It is through worldviews that we can orient ourselves. Legal and ethical principles are underpinned by worldviews and have implicit moral assumptions. Before discussing potential principles to underpin managed retreat law and policy, we explore different worldviews that can help inform these; market liberalism, te ao Māori, eco-centrism and a hybrid worldview drawing elements from each of the other three approaches.

4.1 Market liberalism

Market liberalism is an anthropocentric approach based on the principles of personal liberty, private property and limited government interference. Classical liberalism emphasises liberty from government regulation and asserts that self-interest is a basic component of human nature. It claims that by each individual pursuing his or her own interests, the best interests of society are served overall. Classical liberalism posits that government is not able to improve on a free market so should confine itself to protecting property rights, enforcing contracts, providing public goods and maintaining internal and external security. Government intervention should only occur in specific instances of market failure or where market imperfections create barriers to private investment.

A focus on the primacy of the market is reflected in a recent International Monetary Fund document on economic principles for climate adaptation which states, "in perfectly competitive markets (complete structure of property rights, atomistic participants, complete information, and no transaction costs), individuals and firms are expected to adapt efficiently … these markets are hypothetical constructs, but they provide a useful benchmark to develop a theory of government intervention".[4]

Market imperfections can occur when risk is not reflected in returns which can lead to private sector under-investment in the provision of public goods. For example, an insurance company may decline to provide cover for properties threatened by sea level rise because the level of premium that property owners can afford does not cover the risk to the company. In such situations, government could step in to subside insurance premiums so insurance cover remained available.

Another example of a market imperfection is where companies fail to undertake long-term investments in risk reduction measures because only short-term finance is available from lenders. This might prompt government to intervene in the lending market. Such an approach is reflected in MFE's proposed objectives for funding responsibilities which include "to incentivise long-term investment decisions concerning climate change risk" and "to support the role of banking and insurance in facilitating risk management".[5]

Market imperfections also occur when critical information is unavailable to market players. In such cases, government might seek to raise the knowledge and awareness of private actors. The assumption here is that if information about risks is freely available, property prices will adjust, and individuals will voluntarily move rather than invest sub-optimally in protective structures. This approach is reflected in an additional principle proposed by MFE for funding responsibilities which is to "minimise cost over time by providing as much advance notice as possible".[6]

Adopting a market liberalism approach to climate adaptation would favour 'unmanaged' as opposed to 'managed' retreat as the preferred option. This is because it would leave the individual property owner in the driving seat. Elements of a market liberalism approach can be seen in MFE's proposals which position central government as not *leading* managed retreat but *sharing* responsibility with a range of other actors including local government, iwi/Māori, affected communities, individuals and businesses.[7] MFE's Consultation Document states that "central government may need to be involved, for example where a large area is facing a particular urgency, or there is significant hardship". However, it goes onto emphasise that "this does not mean that it is appropriate for central government to fund managed retreat processes or local infrastructure".[8]

The main drawbacks of a market liberalism worldview are its many assumptions that do not reflect real world circumstances. These include that market efficiency leads to optimal social and environmental outcomes and economic motivations solely guide human behaviour. Humans are reduced to market participants and nature is reduced to a service or 'solution' for humans. The individualistic approach of market liberalism is also at odds with a te ao Māori worldview and the principle of social solidarity or risk pooling.

> A future managed retreat system could be based on market liberalism where individual choice and action is prioritised as the optimum response ahead of government intervention.

4.2 Te ao Māori

Te ao Māori emphasises the importance of relationships between nature and people. It is a holistic worldview that is focused on interconnections. Te ao Māori is grounded in mātauranga Māori and Māori principles such as tikanga (ethics), he tāngata (wellbeing), mana whakahaere (empowerment),

kaitiakitanga (guardianship), manaakitanga (care for persons), mahitahitatanga (treat others as equals) and wairuatanga (spirituality).

Through the lens of te ao Māori, the material and physical elements of managed retreat have their own whakapapa and wairua; they are valuable beyond the economic dimension and are critical to expressions of mana and kaitiakitanga. Such elements are centred in place and specific sites. They carry strong associations and significance that cannot be disentangled from the context in which they are given expression.

A maataapono (principle) in the Ngaa Rauru Kiitahi climate change strategy *Whakatupuria te Kawa Ora* "acknowledges our cultural values embedded in our ancient teaching as a way forward into the anticipated climate future".[9] The Strategy outlines the interconnectedness between physical and spiritual domains in that all life forms are related (as defined through whakapapa) and must be balanced. When this balance is disrupted the wellbeing of land and the wellbeing of people fall into decline.[10]

The current approach to managed retreat is not informed by a te ao Māori worldview,[11] which would see its objectives and principles redrafted from a place of rangatiratanga, with tikanga as the guide.[12] Adopting a te ao Māori worldview would mean moving from an approach where Māori interests are narrowly confined to 'cultural' concerns, to a situation where collaborative governance occurs on an equal footing with the Crown from the outset.

Such an approach is partly reflected in the proposed principle for managed retreat set out in MFE's Consultation Document that "Iwi/Māori are represented in governance and management and have direct input and influence in managed retreat processes, and outcomes for Iwi/Māori are supported".[13] A prerequisite to such a 'tika' approach[14] is the availability of funding to build capacity in the rangatiratanga 'sphere', so it becomes of equal strength to kawanatanga in decision-making, and so that Māori have adequate resources to fulfil their kaitiaki obligations.

A future managed retreat system could be based on te ao Māori where nature and humans are recognised as interconnected and Māori have a strong governance and stewardship role.

4.3 Eco-centrism

Eco-centrism sees nature as holding interests and rights that should be recognised and defended. Humans are just one species amongst many and their role is to speak for and guard the rights of other species. Broader nature-focused approaches extend rights and dignity to non-living aspects such as geological features.

Eco-centrism can be criticised on a number of grounds. Inherently it reflects human values rather than the value of nature itself; after all, rivers cannot speak so humans must attribute words to them. Additionally, nature's rights often conflict with human desires for progress and development, and the approach fails to recognise human relationships with nature.

From an eco-centric lens, managed retreat would recognise the right of nature to exist and co-evolve with humans in shared habitats. This would require humans to relinquish some land to create room for habitats and species to move inland as sea level rises. In the planning and design phase of managed retreat, the needs of nature would be considered alongside human needs, and opportunities to provide benefits to nature would be identified up front.

The current system of managed retreat does not reflect an eco-centric worldview. MFE's Consultation Document has one principle that mentions nature, stating that "protection of the natural environment and the use of nature-based solutions are prioritised."[15] This echoes an anthropocentric view where nature is used to provide 'solutions' for humans, rather than being seen as having rights and interests on its own account.

A future managed retreat system could be based on eco-centrism where nature is recognised as having intrinsic value alongside humans, not just as serving human needs to reduce risk.

4.4 Hybrid worldview

A hybrid approach in which aspects of te ao Māori, market liberalism and eco-centrism underpin a managed retreat approach for Aoteaora New Zealand could potentially be developed. However there are tensions between these approaches that warrant further thought.

To start with, elements of market liberalism appear inherently incompatible with te ao Māori. A liberalist worldview is based on objectifying and separating things which are priced by the market. In

contrast, under te ao Māori, whakapapa frames the world as "an all-embracing network in which all life is included".[16] In a managed retreat system based on strong market liberal principles, risks are priced, and short-term imperatives placed ahead of long-term concerns. This can be at odds with a worldview that sees people and nature connected genealogically and intergenerationally. Market liberalism is also poor at capturing non-economic risks, such as risks to wāhi tapu or sites of significance that have complex cultural and spiritual values.

In turn, the anthropocentric aspects of both te ao Māori and market liberalism could create tensions with an eco-centric worldview. Te ao Māori is more compatible because the environment is seen as interconnected with the wellbeing of people, whereas market liberalism is only interested in improving human development. The difference between eco-centrism and te Ao Māori lies in the hierarchy. The intrinsic value of nature is put first in eco-centrism whereas te ao Māori sees human wellbeing as the central nodal point that is connected to the health and wellbeing of other species.

As a result of such tensions, adherence to all three worldviews may not be feasible or beneficial. For example, maximising financial benefits under a liberal market approach might prevent the social and ecological goals of a transformative, just managed retreat to be achieved. Therefore, rather than determining which worldview to adopt or reject, it may be more useful to contemplate which direction we should head in and how complementarities between the different worldviews can evolve along that pathway. Combining elements of different worldviews can still create tensions, but it is important that these are rendered visible, so policy can fairly and equitably address them.

The normative basis of a future managed retreat system could be one in which complementarities are found among market liberalism, te ao Māori and eco-centrism.

Questions for discussion:

1. What worldviews should underpin Aotearoa New Zealand's approach to managed retreat?
2. Should we seek to combine elements of different worldviews?
3. How should we best manage tensions between different worldviews?

An eco-centric worldview would extend rights to nature and natural systems such as the Whangapoua estuary shown here

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5 Principles which could be applied to managed retreat policy

Living on the edge at Clarks Beach

Worldviews are operationalised through legal and ethical principles. In the following we explore different principles that could underpin a future managed retreat system. These draw on what is reflected in current legislation, proposed reforms, international and local case studies and managed retreat literature. It is not possible here to delve into every approach, or to consider all their implications for managed retreat. What follows is a selective and summary account of the principals we consider to be the most relevant in the context of managed retreat, and their various strengths and weaknesses (see Figure 4 for summary). Each is variously underpinned by the worldviews previously discussed.

There is a wide spectrum of principles from substantive to procedural, all of which interact with one another. Substantive principles seek to guide the outcome or are goal orientated. They can address social, cultural, environmental and/or justice outcomes. Procedural or process-based principles address how decisions are made and implemented. There are no ideal packages of principles for managed retreat. Like worldviews, specific principles have their pros and cons, and some might be given greater weight than others. The collection of principles in Figure 4 set out the kind of approaches which will need to be considered when crafting managed retreat policy.

Coastal erosion impacting the Clifton Motor Camp

Transformative Principle	Social power and constraints should be transformed to deliver improved outcomes for people and nature
Solidarity Principle	Members of a group should support each other to fulfil mutual rights and obligations
Remedial Responsibility Principle	People who need help should be given assistance
Fair Opportunity Principle	People should not be penalised due to circumstances beyond their control
Least Advantaged Principle	It is important to protect the interests of those who are the least advantaged or have the greatest need
Needs Satisfaction Principle	It is important to meet basic human needs
Intergenerational Equity Principle	Those currently alive have a moral obligation to protect the interests of future generations
Compensatory Justice Principle	Unjustified loss, damage or disruption should be compensated for
Restorative Justice Principle	It is important to repair the relationship between those who have been wronged and those who caused the harm
Comparative Justice Principle	Alike cases should be treated alike
Recognition Justice Principle	It is important to address the underlying causes of inequities
Te ao Māori Principles (Tino Rangatiratanga)	Māori should retain self-autonomy in decision-making over their land and resources
Ecological Justice Principles	Nature should be included in the human community of justice
Conservation Principle	There is a need to protect the ecological integrity and ecological health of natural systems
Ability to Pay Principle	Those who are wealthier have a greater duty to pay than those who are poorer
Beneficiary Pays Principle	Those who receive private benefits from public policy should provide compensation for them
Polluter-pays Principle	Those responsible for causing harm should pay to remedy it
Subsidiarity Principle	Decisions should be made closest to those most affected by them
Procedural Justice Principle	People should have the right to participate in decisions that affect them
Voluntarism Principle	Voluntary action is to be preferred over compulsion
Precautionary Principle	Lack of scientific certainty should not be used as a reason to avoid taking action
Avoid Maladaption Principle	It is important to avoid unintended negative consequences from decisions

Figure 4 Principles which could be applied to managed retreat policy

5.1 Transformative Principle

The transformative principle focuses on the opportunity to fundamentally shift power relations and socio-cultural constraints that deepen vulnerability to stressors such as climate change. Applied to managed retreat, it recognises the opportunity to achieve deeper social and environmental change ('transformational retreat'). It is closely related to the recognition justice principle in seeking to redress the underlying causes of structural injustices. Such a transformative approach is currently lacking within the existing system and managed retreat proposals put forward by MFE.

A future managed retreat policy could be based on the transformation principle which seeks to deliver improved outcomes for people and nature.

5.2 Solidarity Principle

Solidarity is tied to an 'imagined' community or group, whose members are expected to support each other, in order to fulfil the mutual rights and obligations associated with group membership.[1] It can be expressed vertically, as the 'strong' helping the 'weak', and/or horizontally as the

'strong' and the 'weak' jointly risk-pooling. The relevant community can be local or global, and span time and space, depending on how it is framed. [2]

In Aotearoa New Zealand a wide concept of solidarity has been incorporated into institutions and law. It can be seen in how we have responded to natural disasters, conflicts and pandemics. It is reflected in the establishment of the Natural Disaster Fund which provides natural disaster insurance for residential properties which are privately insured. In managed retreat, a principle based on solidarity would imply that property loss due to climate impacts should be viewed primarily as a collective responsibility to be addressed by the state.

There are challenges with adopting a solidarity principle. Arguably the collective may overshadow individual autonomy and intervention by the state on behalf of the collective may exacerbate 'moral hazard'.

The risk of moral hazard

Moral hazard refers to situations where individuals and organisations increase their exposure to a risk because they do not bear the full costs of the risk. For example, providing public compensation to private property owners affected by managed retreat may increase incentives to build or develop further in high hazard zones. Moral hazard can also occur where there is no state intervention. For example, when individuals bear the full costs of retreating, there is a strong incentive to remain in place and build protective structures, thereby increasing exposure to harm.

A future managed retreat system could be based on a principle of solidarity with government acting as the lead entity on behalf of the collective.

5.3 Remedial Responsibility Principle

Remedial responsibility refers to the widely accepted moral responsibility to assist people who need help because they are seriously deprived, suffering or in danger.[3] In the first instance, responsibility to meet a need resides with those who have caused or contributed significantly to the problem. However, where those directly responsible cannot be readily identified, or are unable to help, the principle places the moral duty to act on those most capable of addressing the problem.

The principle of remedial responsibility is highly relevant to the impacts of anthropogenic climate change. The problem has been caused by the actions of multiple people over many decades. Many of those partly responsible are no longer alive. While some individuals and organizations have contributed disproportionately to the problem, seeking effective redress from them is not likely possible. Given this situation, the principle would oblige the state to provide assistance to those without the financial resources to move out of risky areas.

Some of the problems with applying a remedial responsibility principle to managed retreat arise from its framing of the state as the primary entity to plan, fund and deliver managed retreat. This may subvert individual action and responsibility. It may also undermine the autonomy of Māori communities.

A future managed retreat system could reflect the remedial responsibility principle by placing on government the primary duty to assist those who lack the financial resources to relocate out of harm's way.

5.4 Fair Opportunity Principle

This principle states that people should not be penalised, discriminated against, or suffer disadvantage because of circumstances or conditions over which they have no realistic control. It would mean, in the context of designing a public compensation policy for managed retreat, that knowledge of the impacts of climate change, ability to pay, need for compensation, and any responsibility for losses could be taken into account but not extraneous and irrelevant matters.

A future managed retreat system could reflect the fair opportunity principle by ensuring that the criteria applying to any provision of public compensation is fair and reasonable.

5.5 Least Advantaged Principle

This principle suggests that it is vital to protect the interests of the least advantaged members of society and/or those who have the greatest needs. Applying this principle to managed retreat would mean providing the greatest support to those with the lowest incomes and/or least net wealth. The principle could extend to the natural environment. Nature is unable to advocate for itself, yet ecosystems are also impacted by natural

hazards leading to their loss.[4] Applied to nature, the principle means that managed retreat should incorporate specific provisions to support ecosystem resilience to natural hazards, such as supporting improved ecosystem health, assisting recovery and supporting climate change adaptation.

A future managed retreat system could reflect the least advantaged principle by providing more generous support for those with the least wealth as well as for nature.

5.6 Needs Satisfaction Principle

Most approaches to social justice place significant weight on meeting various basic human needs including adequate food, clothing, shelter, education and health care. However, there are many different approaches to needs satisfaction. Some approaches emphasise the moral obligation to meet only a limited range of basic needs such as addressing severe poverty. Others set a higher benchmark such as ensuring that every citizen can 'participate and belong' in the life of their community, enjoy an adequate level of wellbeing and live as social equals.

The needs satisfaction principle has several implications for managed retreat. First, many property owners may be at risk of losing their homes or significant savings. Renters may find it difficult to afford the rent of a suitable home in a nearby location. Given that adequate housing is recognised as a basic human need, applying this principle implies that it would be unjust for the state to undertake managed retreat without a proper housing policy. The state would need to ensure that all those required to relocate, including renters, are able to secure affordable and adequate housing.

A future managed retreat system could reflect the need satisfaction principle by ensuring that those needing to move are provided with adequate housing options.

5.7 Intergenerational Equity Principle

This principle is about the relative value given to the interests of current and future generations. It posits that those currently alive have a moral obligation to protect the interests of future generations. This requires acting prudently in the present, considering the long-term effects of decisions, and living off the dividends of natural capital rather than eroding its base.

The intergenerational equity principle assumes that the market cannot be relied on to provide for the interests of future generations because its participants may not be born yet. It is highly compatible with the te ao Māori principle of kaitiakitanga and other principles such as remedial responsibility, compensatory justice and restorative justice. MFE's proposed managed retreat principles signal the importance of inter-generational equity by stating "ensure fairness and equity for and between communities, including across generations".

This approach has limitations. It has been criticised as being anthropocentric because it focuses on fulfilling human needs rather than those of other species. Additionally, the needs of future generations is an amorphous concept and extremely hard to predict. For example, do current generations have an express obligation to preserve (as best they can) resources or 'untouched wilderness' for the future or simply to provide future generations with the same opportunities to exploit those resources?

A future managed retreat system could apply the intergenerational equity principle by institutionalising long time frames and adopting a future focus in planning processes.

5.8 Compensatory Justice Principle

This principle seeks to recompense unjustified losses, damage or disruption. The aim is to right a wrong or rectify an injustice. Where possible, the goal is to make people 'whole again'. In Aotearoa New Zealand the idea of compensatory justice has informed the design of public compensation for historical injustices to iwi/hapū under Te Tiriti o Waitangi and establishment of a no-fault compensation scheme for accidents. To the extent that managed retreat directly affects land owned by iwi/hapū, including land transferred under a Treaty settlement, the principle would indicate that compensation for resultant losses would need to be provided.

A future managed retreat system could provide for compensatory justice by providing public compensation for losses arising from managed retreat including losses to Treaty settlement land.

5.9 Restorative Justice Principle

The restorative justice principle is about restoring the relationship between those who have caused an injustice and those who have been wronged. From a substantive managed retreat policy perspective, the principle suggests that redress of some kind should be provided to those who lose their homes and businesses. From a procedural perspective it highlights the importance of processes being 'person-centred' so they are as humane, open, respectful, collaborative and supportive as possible. [5]

The restorative justice principle focuses on injustices to people, but it could be expanded to include nature. As well as deliberately making room for at-risk ecosystems to move inland in the face of sea level rise, an eco-centric framing would focus on repairing damage caused to ecosystems by human activities.

A managed retreat system could provide for restorative justice by providing public compensation for the loss of houses and businesses and repairing damage to the natural environment.

5.10 Comparative Justice Principle

The comparative justice principle requires alike cases to be treated in the same way. Conversely, cases that are not alike should be treated differently. Further, any differences in treatment should reflect the extent to which there are relevant differences between the cases. For managed retreat, this could mean that property owners should be treated consistently within communities, across the country and, ideally, over time.

A managed retreat system could provide for comparative justice by ensuring that all property owners and residents are treated consistently.

5.11 Recognition Justice Principle

The recognition justice principle looks to redress the underlying reasons for maldistribution. In the context of climate change, the principle aims to redress the structural causes of the disproportionate burden of climate harms borne by some people. It could also apply to harm borne by ecosystems and non-human species if an eco-centric lens was cast over the principle.

Application to managed retreat policy would mean recognising differences between individuals and groups, including in the cultures, values and situations of affected parties. It would require active acknowledgement of who people are, where they are coming from, and what they are saying about their situation.

A managed retreat system could provide for recognition justice by acknowledging the social and cultural differences between affected people.

5.12 Te ao Māori Principles

Māori worldviews incorporate not just ethical and relational understandings but also values and principles embedded in tikanga. A central Māori principle is tino rangatiratanga which is included in Article 2 of Te Tiriti (with the English version referring to "possession", a very different concept). Tino rangatiratanga is a principle "rooted in a Māori worldview, and there is no one English term which fully encapsulates its meaning." It refers to chiefly authority, "Māori control over Māori lives, and the centrality of mātauranga Māori".[6] It drives a number of other values in a cascading sense.

Tino rangatiratanga brings into focus the important Māori principle of kaitiakitanga as well as concepts such as mauri (life-force or essence) and mātauranga Māori. The latter is more than just the knowledge of scientific facts. It encompasses broader ideas like wisdom (knowing what *ought* to be done), science and systems of knowing. Coupled with the more recently emerged "Principles of Te Tiriti" discussed below, these concepts help set the framework for Māori communities to respond to climate change.

Many traditional narratives hold mātauranga about risk and customary or historical practices including informing ideas around adaptation. For example, the whakatauki "Ka mate kāinga tahi, ka ora kāinga rua" refers to resilience, perseverance and preparedness and suggests that when one's home is no longer habitable, another can be found.[7]

Approaching climate change adaptation from a tino rangitiratanga perspective would empower Māori communities to drive processes for themselves. This would help ensure that Māori cultural sites and whakapapa connections with the environment remain protected. It would also see that mātauranga Māori was respected and that tangata whenua were able to fully participate in decision-making and power sharing. This

voice would be expressed in a joint sphere between rangatiratanga and kawanatanga (the Crown).[8]

Other important Māori values include[9] whanaungatanga ("the centrality of relationships to Māori life"), manaakitanga and kaitiakitanga ("nurturing relationships, looking after people, and being very careful how others are treated"), mana ("the importance of spiritually sanctioned authority and the limits on Māori leadership"), mana whakahaere ("a set of processes, customs, policies, laws and institutions affecting the way a group is directed, administered or controlled")[10], tapu/noa ("respect for the spiritual character of all things") and utu ("the principle of balance and reciprocity"). Robert Joseph also highlights the importance of the concepts of koha (gift exchange), aroha (charity and generosity) and hau (respect for the vital essence of a person, place or object).[11] These values are intertwined with spiritual relationships to provide the foundation for Māori society as well as the key institutions of te ao Māori.[12]

Alongside these principles are those under te Tiriti o Waitangi. These are constantly evolving and are being defined through Waitangi Tribunal reports and case law. While there is no definitive list, there are some well-established principles that are now widely accepted. Following the *New Zealand Māori Council v Attorney-General* decision in 1989[13] government identified the following principles to help guide government policy and action:

- The Principle of Government (the government's right to govern and make laws)
- The Principle of Self-Management (the right of iwi to organise and control their resources)
- The Principle of Equality (all New Zealander's are equal before the law)
- The Principle of Reasonable Cooperation (between government and iwi on matters of common concern); and
- The Principle of Redress (effective resolution of Māori grievances).

In modern jurisprudence, and out of respect for the Māori version of Te Tiriti, the Principle of Government is also now often referred to (and used interchangeably with) the Principles of Kāwanatanga, Self-Management and Rangatiratanga. Additional principles are now well established by the Waitangi Tribunal and courts including the Principle of Partnership, the Principle of Active Protection, the Principle of Reciprocity and the Principle of Mutual Benefit (the needs of both cultures are provided for). [14]

All these principles are interconnected and underpinned by a number of established duties on each party including a duty to act reasonably, honourably and in good faith, and a duty to make informed decisions which is linked to a duty to consult. There is also emerging jurisprudence around a "Right to" or "Principle of" Development.[15] This encompasses a general right for tangata whenua to develop as a people, rather than be locked into an historical context. The Right to Development Principle has been endorsed by the Waitangi Tribunal but not as yet by the courts.[16]

MFE's proposed principles for managed retreat cover te Tiriti obligations in the legislative but not funding list. Arguably they should be included in both, as governance implies the ability to participate in decisions about funding (not only legislation) in order that the implication of funding options for Māori are fully considered. In addition, te ao Māori principles do not feature in the proposals. The principles inherent in Te Mana o te Wai offer a model which could be adapted for a managed retreat system.

Tohu, Tapapakanga

Exploring the principles inherent in Te Mana o te Wai

The application of principles underpinning Te Mana o te Wai, a term which is included in the National Policy Statement for Freshwater Policy, are only starting to be explored. Such principles include mana whakahaere, kaitiakitanga and manaakitanga which are to be recognised and expressed through full engagement with iwi and hapū. "Mana" is a broad concept. It has been defined as "prestige, authority, control, power, influence, status, spiritual power, charisma – mana is a supernatural force in a person, place or object. Mana goes hand in hand with tapu, one affecting the other".[17]

Water has its own mauri or life force. It is considered by Māori to be the tears of both Ranginui and Papatūānuku, and is shed by rain and mist to become the lifeblood to support koiora or living communities. Almost every activity has a link with the maintenance and enhancement of mana and tapu. Animate and inanimate objects can also have mana, as they derive from the atua. In addition, mana can be derived from association with people imbued with mana or because objects are used in significant events.[18]

There is much to explore in the concepts of mana and tapu but one example is the Treaty settlement for the Whanganui people – the many tribes that reside near and along the Whanganui River. The river was returned to iwi Māori with all the legal rights of a person, so the river carried mana, and this sets a tone for that mana to be applied to the water. This highlights the importance of water to Māori and managed retreat from land should be viewed in a similar way. The land that is retreated from, or retreated to, has mana in the same way as the awa was recognised as having mana in the Whanganui case. If these concepts were applied in the context of managed retreat then respect for the land would be paramount.

Canada's National Adaptation Strategy discussion document explicitly states as one of its principles that indigenous peoples should have the right to "choose and advance their own self-determined actions on adaptation".[19] A similar principle could be adopted for Aotearoa New Zealand's managed retreat policy.

5.13 Ecological Justice Principle

Ecological justice sees nature as an actor, not an object, within the human community of justice. Such a principle is recognised in the concept of giving legal personhood to nature, such as achieved through the Treaty settlement processes for Te Urewera and Te Awa Tupua/Whanganui River. Application of the ecological justice principle could see rights extended to natural systems affected by climate change.

There could be express recognition of ecological justice in future managed retreat legislation, embracing an eco-centric ethic, and welcoming nature into the human system of justice.

5.14 Conservation Principle

The conservation principle recognises the need to protect ecological integrity, including supporting the full potential of indigenous biotic and abiotic features and natural processes, functioning in sustainable communities, habitats and landscapes, and the ecological health of natural systems. In this sense, the conservation principle resembles the public trust doctrine, where the state has a responsibility to act as the guardian of ecological values of public areas. The principle is reflected in MFE's Consultation Document as the "protection of the natural environment". However, under the conservation principle protection is not always enough, with nature often requiring assistance to restore ecological integrity and health.

The conservation principle could be made explicit in a future managed retreat system and extend beyond protection to include regeneration and restoration of the natural environment.

5.15 Ability to Pay Principle

The widely applied ability to pay principle recognises that duties to pay vary with ability, so that the more able (ie wealthier) have greater duties than the less able (ie poorer). When applied to managed retreat it implies that those with the greatest means should contribute disproportionately to costs. It also follows that a high-net-worth person should receive less public assistance than those on lower incomes and/or with lower net worth.

A managed retreat system could recognise the principle of ability to pay by providing greater assistance to those with lower incomes and/or net worth.

5.16 Beneficiary Pays Principle

The beneficiary pays principle holds that private benefits arising from a public managed retreat policy should be either surrendered or compensated for. Thus, the greater the benefit received, the greater the amount owed back. This principle is reflected in MFE's proposed principle that "beneficiaries of risk mitigation should contribute to costs."[20]

In practice, the principle may be hard to implement due to difficulties in identifying all the benefits received and calculating their precise value. For example, when constructing a protective seawall, it is highly likely that some people will benefit more than others. A seawall might be designed to protect not only at-risk residents living nearby, but also a vital transport corridor to other communities. The barrier may also encroach on ecosystems. Consequentially, there may potentially be large numbers of beneficiaries, who profit to different extents from the wall, as well as unrepresented non-human species who bear the cost.

In addition, risk mitigation policies may bring important benefits to society as a whole such as lower long-term economic and social costs because fewer people, properties and public infrastructure will be harmed by repeated flooding and inundation. On this basis, the 'beneficiaries of risk mitigation' could be seen as all the citizens of the country, both now and in the future.

A managed retreat system could recognise the beneficiary pays principle through requiring those that directly benefit to contribute to the cost.

5.17 Polluter-pays Principle

The polluter-pays principle holds that the party responsible for causing harm should pay to remedy the harm or right the wrong caused. Applied to climate change impacts, it suggests that those who have contributed disproportionately to the emission of greenhouse gas emissions should contribute accordingly to adaptation responses. This concept has been applied at the global level with expectations that developed countries compensate developing countries for historical emissions and help fund adaptation measures. In the domestic context this could require entities deemed disproportionally responsible for historical and current emissions to pay for managed retreat and transitional adaptation measures. These funds could be targeted to vulnerable communities and ecosystems at risk.

A managed retreat system could recognise the polluter-pays principle by funding some of the costs of managed retreat through a charge on greenhouse gas emitters.

5.18 Subsidiarity Principle

Subsidiarity holds that decisions should be made closest to, and in line with, the values of those most affected by them. It is focused on placing authority in the relevant community of interest so it can shape the results. It is compatible with liberalism and te ao Māori principles of rangatiratanga, mana whakahaere and kaitiakitanga.

The key challenge in applying the subsidiarity principle is how to identify and classify those who are most affected by managed retreat decisions. Further, questions on the workability of the subsidiary principles include how decision-makers at different-scales (central/local/community/iwi) would interact, what the role of the private sector would be, how decisions would be made, how tensions between conflicting interests would be resolved, and how equal participation in local decisions would be ensured.

A future managed retreat system could include the subsidiarity principle and locate decision-making responsibilities close to those most affected by policies.

5.19 Procedural Justice Principle

Public participation is a procedural cornerstone of law. Internationally, the procedural justice principle is often focused on access to information, the ability to be involved in decision-making processes, and access to judicial redress. The law generally aims for all relevant views to be considered, choices to be informed by local knowledge, and a balance to be achieved between use and protection which reflects the wider values of communities.

The principle has generally operated on the assumption that people should be able to participate to the extent that their interests are affected. As such, broad participatory rights are provided when producing plans, policy statements and regulations under the Resource Management Act 1991 (RMA) (and plans under the Local Government Act 2002) where objectives, policies, rules/regulations and other provisions can affect a wide range of people. It implies that Māori should have relatively strong participatory rights because of their status as Treaty partners. Access to information, transparency of process and access to justice are also important.

The procedural justice principle could be reflected more strongly in a managed retreat system to ensure processes are transparent and fair including for mana whenua.

5.20 Voluntarism Principle

The voluntarism principle emphasises the importance of voluntary action. Compulsory movement of people should only occur if necessary to protect the public interest. A focus on voluntary action can serve to increase social licence for managed retreat and reduce the risk of active public resistance, including protracted legal action. However, it can have limitations when some people refuse to move despite compounding risks, undermining co-ordinated action.

The voluntarism principle could be applied to managed retreat to the extent that compulsory movement of people was not required to protect the broader public interest.

5.21 Precautionary Principle

The underpinning idea behind the precautionary principle is that a lack of scientific uncertainty should not be used to avoid taking action to prevent the risk of serious harm. In a managed retreat context it means that even if the science on a hazard is not definitive, if there is a serious risk of harm, then action should still be undertaken to move people out of harm's way.

Applying the precautionary principle to managed retreat would mean that action would be taken in the absence of definitive science establishing the nature of the risk.

5.22 Avoid Maladaptation Principle

The avoid maladaptation principle seeks to avoid any unintended negative consequences of decisions. It requires a joined-up approach to policy formation and awareness of how solutions in one sphere can exacerbate those in other areas or in the future. For example, planning for removal of settlements under managed retreat should account for where people will be relocated to and whether this will increase the vulnerability of other systems, sectors or social groups. It will be particularly important to consider iwi/Māori interests, because land near coastal communities may be iwi settlement land.

Careful consideration of the potential for adverse ecological effects from new subdivisions or buildings constructed to provide for relocated people will also be required under this principle. There is a risk that the pressure to move people will result in a lowering of environmental protections and increase in the acceptability of ecological harm. It will be important in applying this principle to recognise that biodiversity loss and climate

Intensified development on the shoreline at Arkles Bay

mitigation are interconnected. Avoiding maladaptation means ensuring that climate mitigation solutions do not inadvertently increase carbon emissions or loss of nature.[21]

An avoid maladaptive principle could be applied to managed retreat through considering and addressing broader consequences that might arise from taking specific actions.

5.23 Bringing the principles together

The principles discussed above provide a touchstone for the development of a managed retreat policy which supports a 'just transition' where impacts and opportunities are more evenly distributed.[22] The principles indicate a need to look after the more vulnerable members of the community, as well as nature and future generations, when planning retreat strategies. They also emphasise the need to face the challenge of climate change adaptation as a collective, rather than leaving individuals to suffer the consequences alone. Importantly, they emphasise the importance of empowering Māori to be key decision-makers, particularly where Māori-owned land, resources and communities are affected. The ability of communities to actively participate in decisions that affect them is also highlighted as well as the importance of supporting voluntary action in the first instance before compelling people to adapt.

Questions for discussion:

1. Which principles should be applied to Aotearoa New Zealand's managed retreat system?
2. Which principles should be prioritised or have greater weight?
3. What are the trade-offs between principles?
4. What are the key elements of a just transition in the context of managed retreat?
5. What do the principles indicate regarding the role of Māori in managed retreat?
6. What do the principles suggest regarding the design of appropriate funding policy?

Endnotes

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6 Why public compensation might be needed

Severe coastal erosion at Haumoana

In this Part of the Working Paper we examine what might need to be considered when designing a public compensation scheme for the loss of residential property in managed retreat. We consider why public compensation might be needed in Aotearoa New Zealand, how it has been provided in other countries, how a compensation scheme might be designed for this country and how it might be funded. In Part Four we consider funding issues for other sectors.

In broad terms 'compensation' is designed to address an unjustified and/or unintended harm.[1] 'Public' compensation is that provided by an entity that is, at least in part, publicly funded to deliver a public or government service. It usually has three main goals: to rectify a loss or right a wrong; to support rehabilitation; and to provide incentives to minimize harm, thereby promoting public welfare and overall efficiency.

Many of the principles described in Chapter 5 indicate the need for and desirability of some form of public compensation scheme for managed retreat in Aotearoa New Zealand. These include upholding the tradition of social solidarity (including collective risk-pooling), upholding the principle of remedial responsibility (where people in need are given assistance), incentivising voluntary relocation; and upholding the principles of compensatory and restorative justice.

It is also important to consider legal precedents when it comes to private property. It is highly likely that managed retreat will require the compulsory acquisition of some private properties as there will inevitably be some owners who will refuse to cooperate with a voluntary programme of property acquisition. In this respect there is a long-established legal principle that public compensation should be provided when the state acquires private property on a compulsory basis, as reflected in the provisions of the Public Works Act 1981.

A managed retreat system will also need to consider the mix of public incentives for protection rather than relocation. If the government provides funds to support community protection measures (such as seawalls or floodbanks), it will arguably need to provide more generous funding to assist with managed retreat. Otherwise communities will likely seek to rely on protective structures when managed retreat is the more socially optimal long-term response.

Contemplating a public compensation scheme for managed retreat raises significant challenges. Foremost, it will be fiscally expensive for the government. Costs would escalate substantially during the second half of the century and beyond. That said, substantial costs will be incurred in any event, irrespective of whether retreat is managed or unmanaged, and whether public compensation is provided or not. It is really a matter of determining who should bear the costs and to what extent they might be minimised. By shifting some costs from individuals onto the taxpayer collective, public funding of proactive adaptation measures has the potential to reduce the overall long-term societal costs of climate change adaptation.

In a democracy such as Aotearoa New Zealand, it seems unlikely that a long-term programme of relocation will secure the required level of cooperation from those directly affected, or the necessary degree of public confidence and support, without some form of public compensation. Otherwise a significant proportion of residential property owners, along with many tenants, will simply lack the resources to move, and property owners will likely engage in protracted legal action.

Questions for discussion:

1. Is a public compensation scheme for loss of residential property needed and/or desirable to support managed retreat in Aotearoa New Zealand?

2. Could managed retreat of residential areas realistically be undertaken without some form of public compensation?

Endnotes

1 Note that compensation differs from *restitution*. Whereas restitution involves returning an object that has been lost or stolen to its rightful owner, compensation does not involve the "restoration of the object itself, but rather the provision of something else altogether", Goodin R, 1989, 'Theories of compensation', *Oxford Journal of Legal Studies*, 9(1), 56-75, at 59

7 Experience in other countries

Double Bay, Sydney

Relatively few countries have comprehensive national-level policy frameworks to address the many and varied costs of climate change adaptation. Current funding responses tend to be ad hoc.[1] We could identify no examples of governments pre-funding some of the expected long-term costs of climate change adaptation. However, some vulnerable countries (such as Singapore)[2] and coastal cities have developed plans to invest heavily in adaptation initiatives over the next few decades.

Most examples of managed retreat have been modest in scale, typically involving only several dozen to a few hundred properties. But there are some examples of large-scale relocations. For instance, the massive 2011 earthquake and tsunami in Japan displaced hundreds of thousands of people, many of whom were resettled in safer locations.[3] In most cases where publicly-mandated relocations are undertaken, some form of public assistance is provided to the affected residents. Funding typically comes from either the central government, sub-national governments, or some combination of both (see Figure 5).

There are lessons from international reviews which should inform the discussion of a public compensation scheme in Aotearoa New Zealand. These include:

(a) *There is variable practice across countries:* In some cases property owners are fully compensated based on a (pre-disaster) fair market value; in other cases compensation provides for full replacement in a similar but low risk neighbourhood; and in yet other cases there is only partial compensation and/or caps on the size of payouts. Some compensation packages (eg in the United States) include relocation assistance and help for renters.

(b) *Voluntary measures are generally preferred:* Property buyouts are generally voluntary rather than compulsory[4] and the utilization of voluntary buyouts is generally low until a major flood or coastal inundation occurs. For instance, in Nashville, Tennessee the take-up of a long-standing voluntary buyout programme increased dramatically after a major flood in 2010.[5]

(c) *Managed retreat is controversial:* Public compensation for property losses due to managed retreat remains politically and socially controversial in many countries. Community opposition to property buyouts and relocation is relatively common.

(d) *Public acceptance of managed retreat is affected by multiple factors:* The level of support among affected private property owners and the wider public for buy-out policies depends on a range of factors[6] including perceptions of risk; attachment to 'place'; the level of trust in local officials; and financial factors. Other considerations include: procedural issues (eg whether property owners believe that the policy process has been open, transparent, and fair); perceptions of fairness (ie are the owners being offered a fair price for their property); the varied goals and values of affected residents; and the way the objectives of, and principles underpinning, the policy of retreat are framed and communicated to residents.[7]

Country	Examples of compensation
Australia	Following major floods in the Brisbane area in early 2022, the federal and Queensland state governments agreed to fund an estimated 500 residential property buyouts at an average cost of A$750K per property. Similarly significant buyouts are planned in parts of New South Wales.
Austria	Since the 1970s, both national and sub-national governments in Austria have undertaken managed retreat along various sections of the Danube River in the interests of flood risk management. Over 500 residential and commercial properties have been purchased on a voluntary basis at their market value, based on independent assessments.[8] Compensation arrangements have varied. In some cases landowners were required to contribute a share of the relocation costs, such as the costs of demolition.
Canada	Compensation arrangements and criteria vary between the different provinces, but there is an expectation that compensation for property losses will be provided.[9] For instance, the province of Quebec funds property buyouts where homes have repeatedly flooded or are highly vulnerable. Under policy settings announced in mid-2022, a 'departure allowance' is available, with a maximum of C$325,000 for a standard residence. Homeowners choosing to rebuild rather than sell their properties following a flood are entitled to a lifetime maximum recovery allowance of C$100,000. Once the limit is reached, no further disaster assistance will be available.
China	Around 1.3 million people living along the banks of the Yangtze River were forced to relocate in the 1990s to make way for the reservoir behind the giant Three Gorges hydro dam. Those displaced along the affected section of the river (almost 200 kilometres) were offered compensation by public authorities of 30,000 yuan (or about US$4,600) per person. Decades later, however, many of those evicted had not received compensation.
Fiji	A growing number of at-risk coastal villages have been relocated with modest financial assistance from the government.
India	The state of Orissa has relocated several at-risk villages by providing housing for affected residents in safer locations nearby.
Netherlands	Public compensation has been provided over the past few decades to property owners in around 30 locations affected by the 'Make Room for the River' programme which can involve moving protective barriers to create larger flood plains and thus reduce flood risk.
United Kingdom	Only limited central and local government funding is currently available for residents whose properties are threatened by sea level rise and coastal erosion. Managed retreat has been undertaken in various locations over recent decades but a transparent and nationally consistent approach for compensating affected property owners has been lacking.[10] In some cases, the level of compensation has been related to the level of risk and the availability of information regarding the risks in question. Some of those living in flood-prone areas receive subsidised household insurance via the Flood Reinsurance scheme.
United States	The Federal Emergency Management Agency and other federal agencies have undertaken well over 40,000 residential property buyouts since the 1980s to relocate residents affected by significant and/or repeated flooding and coastal inundation. Property owners receive payments based on the pre-disaster value of their properties and assistance with removal expenses. Many states also have additional programmes.

Figure 5: International examples of public compensation for managed retreat

(e) *Managed retreat tends to exacerbate inequalities:* Income and wealth inequality, along with other social divisions, are often exacerbated by the impacts of climate change as well as the policy responses to those impacts such as managed retreat.[11] Worse outcomes are experienced by a variety of disadvantaged groups, and in particular indigenous peoples, ethnic minorities, those renting properties in at-risk locations, those on low incomes, those with significant health issues, and those with limited borrowing options.

(f) *The needs of renters are often neglected:* Those renting properties in areas zoned for retreat are often given only limited public assistance. For instance, in the United States there is reliable evidence that both the direct impacts of climate change and governmental property buy-out programmes often leave renters significantly worse off.[12]

(g) *Indigenous peoples may be the most disadvantaged:* The available international evidence, albeit limited, suggests that indigenous peoples may suffer disproportionately from both the impacts of climate change and the policies designed to mitigate those impacts[13] Indigenous peoples tend to live in more vulnerable areas and have fewer resources than other groups to cope with the impacts of climate change. Such factors are particularly relevant for Aotearoa New Zealand given that Māori are disadvantaged relative to Pākehā on most of the relevant measures of wellbeing.

(h) *Co-funding across different levels of government can be problematic:* Co-funding by national and sub-national agencies can add to policy complexity, contribute to delays and raise equity issues, not least because of the unequal resources and capabilities of sub-national governments. Moreover, local authorities are typically reluctant to fund or co-fund property buyouts. This is because their financial resources are limited; providing compensation to property owners raises politically sensitive issues; and the loss of properties can impact on their revenue from property rates/taxes.

Overall international experience indicates that, despite its many difficulties, managed retreat will often constitute the most cost-effective and perhaps the only technically feasible solution to climate-induced flooding and sea level rise. If well planned and executed, and undertaken sufficiently early, it will reduce long-term risks, enhance a community's resilience, and generate other positive outcomes and opportunities including benefits for nature.[14] Equally, unlike protective structures which will probably require periodic enhancements, each instance of retreat should ideally constitute a one-off (and thus non-repeated) investment.

International research also highlights that societies' ability to adapt to sea level rise, and enhance their resilience to the impacts of climate change, is less about their technical prowess and more about social and political factors such as the quality of governance.[15] In other words, adaptive capacity depends on having the necessary decision-making processes and policy frameworks in place to resolve (or at least manage) inevitable societal conflicts, enable informed and prudent decision-making, and mobilise the required financial and other resources.

Question for discussion:

1. What can we learn from overseas experience to help design an effective managed retreat system in Aotearoa New Zealand?

Endnotes

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8 Designing public compensation for Aotearoa New Zealand

Homes at Kaiaua flooded during the January 2018 storm

In this chapter we set out a series of options for how a public compensation scheme could be designed. We then turn, in Chapter 9, to how the scheme might be funded and administered and what other regulatory and policy changes might be required to support it.

8.1 Design considerations

When considering the design of a public compensation scheme there are a number of important considerations including what the goals of the scheme should be, what principles should underpin it, who should be eligible for compensation, and how properties should be valued.

We set out a wide range of principles that could be applied to managed retreat in Chapter 5. Any principles applied to a public compensation scheme will need to accommodate a diverse range of contexts and circumstances. Moreover, somewhat different principles may need to be applied depending on the types of property loss being considered. For example, the loss of Māori land will likely require specific procedures and distinctive compensatory arrangements potentially tailored to the specific hapū or whanau affected.

Importantly, there is no *optimal* way to design a public compensation scheme for managed retreat. Nor is there a simple or ideal formula for sharing the burden of adjustment equitably. Any public compensation scheme will raise complex issues of eligibility. These include factors such as the location of the property; the type of property; when the property was built; the financial circumstances of the owners; the occupancy type; whether the property is insured; whether the property has been damaged; whether there is a mortgage; and whether there is specific hazard information on the property's Land Information Memorandum and, if so, what this says and when it was included.

A critical question in designing any public compensation scheme will be how to value the properties zoned for managed retreat and how to relate any compensation to such valuations. There are various ways of valuing residential and commercial properties and these can produce markedly different results. Commonly employed methods include market value, sales comparison value, investment value, use value (or value-in-use), liquidation value, insurable value, rateable value, and replacement or rebuild value. Each of the options has various drawbacks, such as the likely fiscal cost, challenges of determining comparability or equivalence, potential assessment and administrative costs, and the impact on the value of neighbouring properties.

8.2 Compensation for residential property owners

There are numerous ways in which the *amount* of public compensation provided for property losses due to managed retreat could be determined. Figure 6 summarises 12 *possible* options along with a brief assessment of their respective advantages and disadvantages. They reflect various suggestions made over the years in Aotearoa New Zealand along with some approaches adopted in other jurisdictions. They are further described in Boston 2023.[1] They are designed primarily for residential properties and there is a need to develop a parallel set of options for compensating the owners of non-residential properties and for Māori land.

	Option	Advantages	Disadvantages
1	**Compensation based on the replacement cost of the buildings plus the land value, with the land value based on comparable land in a safer nearby location**	• Broadly consistent with the principles of community responsibility, comprehensive entitlement and effective compensation • Broadly fair to affected property owners • Likely to secure a relatively high rate of voluntary sales • Likely to secure the needed social license for proactive managed retreat • Lower administrative and compliance costs than most other options	• High fiscal costs • High risk of moral hazard • Likely to be regarded as unfair by some taxpayers and/or ratepayers • May result in over-compensation • May inflate property prices in at-risk areas generating unwarranted capital gains for owners
2	**Compensation based on the value of a comparable or equivalent property in a safer nearby location (ie one of a reasonably equivalent size and standard)**	• Broadly consistent with the principles of community responsibility, comprehensive entitlement and effective compensation • Broadly fair to affected property owners • Likely to secure a relatively high rate of voluntary sales • Lower administration and compliance costs than most other options • Likely to secure the needed social license for proactive managed retreat • Consistent with existing criteria in the Public Works Act where the market value of the affected property is insufficient or not appropriate	• High fiscal costs • High risk of moral hazard • Likely to be regarded as unfair by some taxpayers and/or ratepayers • May result in over-compensation • May inflate property prices in at-risk areas generating unwarranted capital gains for owners • There may be no equivalent properties in safer nearby locations – which would risk driving up property prices in the surrounding areas, depending on the scale of the retreat and investment in new housing stock
3	**Compensation would be similar to that provided under either option 1 or 2, but with a fixed cap (eg based on the average house price nationally or regionally in the recent past)**	• Depending on the level of the cap, this option could be broadly consistent with the principles of community responsibility, comprehensive entitlement and effective compensation • A low cap is likely to be considered unfair by many affected property owners, resulting in litigation, delays and refusal to sell voluntarily	• Relatively high fiscal costs (depending in part on where the cap is set) • Any reduction in fiscal costs relative to options 1 and 2 will depend on the level of the cap and the associated behavioural responses • The lower the cap, the greater the losses experienced by owners; some owners may be left with negative equity which could disproportionately affect first-home buyers with large mortgages

	Option	Advantages	Disadvantages
4	**Compensation would be similar to that provided under either option 1 or 2, but with a fixed percentage contribution from property owners (eg 20%)**	• Depending on the proposed percentage contribution and whether this is applied uniformly, this option could be broadly consistent with the principles of community responsibility, comprehensive entitlement and effective compensation • A high percentage contribution is likely to be considered unfair by many affected property owners, resulting in litigation, delays and refusal to sell voluntarily	• Relatively high fiscal costs (depending on the percentage contribution by property owners) • Any reduction in fiscal costs relative to options 1 and 2 will depend on the percentage contribution and the associated behavioural responses • The higher the percentage contribution, the greater the losses experienced by owners. Some owners may be left with negative equity which could disproportionately affect first-home buyers with large mortgages • May not secure the necessary social license for proactive managed retreat
5	**Compensation would be flat-rate, with fixed amounts for each dwelling and land**	• Much will depend on the level of the flat-rate compensation, whether it is applied uniformly across the country, and whether it is differentiated by property types • The direct fiscal costs of the scheme are likely to be lower than options 1 and 2, but there could be indirect fiscal costs if owners refuse to sell and/or if there are strong demands for better protection • Avoids providing proportionately greater compensation to the wealthy	• Broadly speaking, such an approach will disadvantage those with more expensive properties and advantage those with cheaper properties; it may thus be seen as unfair by many affected property owners • Some owners may be left with negative equity, thereby exposing lenders • Unlikely to secure a high rate of voluntary sales, resulting in the need for greater coercion • Unlikely to secure the social license required for proactive managed retreat

	Option	Advantages	Disadvantages
6	**Compensation would be based on the estimated remaining habitable life of the property – the shorter the estimated life, the larger the compensation payment. Freehold properties would be converted to leasehold, with time-bound leases based on the period during which occupancy is considered safe; leaseholders would have a right to sell their lease or rent the property**	• The long-term fiscal costs of such a scheme are likely to be lower than many other options (depending on their specifications) • May be considered fair by many taxpayers and some owners	• Some owners may be left with negative equity, thereby exposing lenders • May not be regarded as fair or reasonable by some owners • Likely to generate significant implementation issues, including the risk of time inconsistency • May generate significant litigation • Probably not a stand-alone policy option, thus needs to be coupled with another option, which may cause problems • May not secure the social license required for proactive managed retreat • Likely to require legislative change and the creation of a new form of tenure
7	**Compensation would be adjusted to reflect the knowledge of climate change-related risks by the owners at the time of purchase or construction**	• The direct fiscal costs of such a scheme are likely to be lower than some other options (depending on their specifications) • May be considered fair and reasonable by some people (eg taxpayers)	• Unlikely to be regarded as fair or reasonable by many owners • Likely to generate significant implementation issues and be very difficult to apply in practice • Likely to generate significant litigation, with risks to councils • Likely to increase political pressure for better protection • Unlikely to secure the social license required for proactive managed retreat

Protective works and redevelopment on the shoreline at Milford, Auckland

	Option	Advantages	Disadvantages
8	**Compensation would be differentiated depending on whether the property is the principal place of residence or not**	• The direct fiscal costs of such a scheme are likely to be lower than some other options (depending on their specifications), but the indirect costs could be greater • Likely to be considered fair and reasonable by many people (eg taxpayers) • If well designed, will help protect the least advantaged property owners	• Probably inconsistent with the principles of community responsibility, comprehensive entitlement and effective compensation • Unlikely to be regarded as fair or reasonable by many owners of two or more properties • Highly likely to generate gaming and other behavioural responses which will reduce the expected fiscal savings • May generate significant administrative costs and implementation issues • May generate additional problems for tenants • May have impacts on overall investment in the residential property market with implications for the availability and affordability of residential housing • May not secure the social license required for proactive managed retreat
9	**Compensation would be differentiated according to the means of the owners (eg their net worth and/or income)**	• The direct fiscal costs of such a scheme are likely to be lower than some other options (depending on their specifications), but the indirect costs could be greater • Likely to be considered fair and reasonable by many people (eg taxpayers) • If well designed, will help protect the least advantaged property owners	• Very likely inconsistent with the principles of community responsibility, comprehensive entitlement and effective compensation • Many owners likely to be left with negative equity • Unlikely to be regarded as fair or reasonable by many owners, especially those who fail to meet the eligibility criteria for compensation • Likely to generate gaming and other behavioural responses which will reduce the expected fiscal savings • May generate significant implementation issues • Unlikely to secure the social license required for proactive managed retreat

	Option	Advantages	Disadvantages
10	**Compensation would be differentiated according to whether the property sale is voluntary or compulsory**	• Provides an incentive for owners to move on • Reflects additional costs of taxpayers if compulsory acquisition is required • Favouring voluntary purchases will likely reduce the need for compulsory purchases, but the likelihood of voluntary sales will depend on the overall design of the compensation scheme (ie which of other options are selected), along with the size of the incentive	• The disadvantages will depend on which option(s) this is combined with.
11	**Total compensation for property losses due to managed retreat would be capped annually or for specified periods of time (ie via a fiscal envelope)**	• If successfully implemented, this option would limit the direct fiscal costs of the scheme over time (but may result in significant indirect costs) • The advantages will depend on which option(s) this is combined with	• Highly vulnerable to time inconsistency; hence, an unstable policy option • Potential risk of clustering near temporal boundaries • The disadvantages will depend on which option(s) this is combined with • Unlikely to secure the social license required for proactive managed retreat, especially as the need for such retreat increases
12	**There would be no compensation beyond a fixed date in the future; prior to that compensation could be based on one or more of the options above**	• If successfully implemented, this option would limit the direct fiscal costs of the compensation scheme over time, but is highly likely to result in significant indirect costs • The advantages will depend on which option(s) this is combined with until the scheme is terminated	• Highly vulnerable to time inconsistency; hence, an unstable policy option • The disadvantages will depend on which option(s) this is combined with • Unlikely to secure the social license required for proactive managed retreat, certainly beyond any cut-off date for compensation

Figure 6: Options for public compensation for loss of residential properties

Each option has evident strengths and weaknesses – with some having serious drawbacks. Options 1 and 2 are the two most likely to ensure that proactive managed retreat can be implemented when deemed necessary. They are also those most consistent with the principles outlined earlier. In addition, given the (relatively) generous level of compensation they involve, many, if not most of the property owners affected by managed retreat can be expected to sell voluntarily. Such options are also scalable and applicable to multiple locations and contexts. Accordingly, they should stand the test of time as the adverse impacts of climate change intensify. Against this, both options would be expensive to implement, and the fiscal costs would likely increase substantially as the century progresses. If such costs are deemed to be unacceptable politically, then it will be necessary to consider another option or perhaps a combination of options.

Many of the other 10 options would be difficult and/or expensive to implement, and/or likely to generate significant opposition from affected property owners, and/or hard to sustain politically for various reasons. This includes Options 5, 7, 9, 11 and 12. Having said this, the devil is often in the detail. For instance, it is one thing to draw a line in the temporal sand, as for Option 12, but it is another thing to determine when this line should be drawn. If it were applied from 2050, for instance, its impacts would be radically different from delaying its application to, say, 2100. But even if the earlier date were chosen, for all practical purposes the main policy question would be which of the other options (or combination of options) Option 12 should be coupled with.

Each of the remaining five options deserve further analysis and consideration. This certainly applies to Option 6 (involving precautionary property buyouts with relatively long-term tradable leases). Also, Option 3 (which entails a fixed cap on the total level of compensation per property) may be easier to implement and secure a greater level of public support than Option 4 (which requires all property owners to shoulder a proportion of the estimated losses). But such an assumption will need to be tested. Potentially, a proportional contribution may be preferred by many people to a fixed cap.

Both Option 8 (which involves differentiating, for the purposes of compensation, between principal and non-principal places of residence) and Option 10 (which involves giving extra public assistance to those who choose to sell their properties on a voluntary basis) are also likely to find a measure of public acceptance.

It would be possible to combine several options, such as Options 3 and 8 – or perhaps 3, 8 and 10. It might also be feasible to have several options available simultaneously, thus giving affected residents a choice over which 'deal' they preferred.

But in every case the parameters and specifications of each aspect of the proposed policy framework would need very careful analysis and deliberation. For example, it is one thing to have a cap on the total amount of public compensation per property (or type of property), it is quite another to determine where to set the cap – and, also, to decide whether there should be separate caps for different kinds of residential properties and for properties which serve different purposes and, if so, what differentiation is justified. Such matters are potentially complex and controversial.

Equally, while making a distinction between principal and non-principal places of residence for compensatory purposes has intuitive appeal, perhaps mostly based on principles of distributive justice (not least the basic human need for shelter), such an approach may be difficult to implement in practice. There is also the question of whether it would facilitate voluntary property buy-outs, especially if combined with a cap on the amount of available compensation.

Of course, even if a distinction is made between principal and non-principal places of residence for compensatory purposes, there is no requirement for the cap on the latter to be zero. The cap could, instead, be set at a lower level than the cap for principal places of residence – say at 50 or 75 percent of the higher rate. The challenge for policymakers is to determine in advance what specific policy parameters are likely to achieve the desired long-term results, and which parameters can be expected to prove durable.

Finally, there is the question of whether – and how – any preferred approach might be applied to vulnerable Māori land, including land provided to iwi/hapū by the Crown as part of a Treaty settlement. There will probably need to be special compensatory arrangements to accommodate such situations. But any distinctive provisions for Māori/iwi/hapū will need to be justifiable, including being broadly consistent with the principle of comparative justice. Otherwise, they are likely to provoke public criticism on the grounds that the kind of special treatment being instituted is not justified. The impact of climate change (and related policy responses) on Māori land, as noted earlier, requires comprehensive and contextualised investigation.

8.3 Compensation for residential tenants

The discussion so far has focused almost exclusively on the interests of private property owners – and mostly residential rather than non-residential. But, as noted earlier, a significant proportion of privately-owned residential properties are rented and tenants often fare badly in cases of managed retreat.[2] It is also important to note that current and growing housing inequities in Aotearoa New Zealand disproportionately affect Māori communities. The *Maihi Ka Ora National Māori Housing Strategy* states that "Māori make up just 16.7% of the population but represent 50% of those on the housing register, 37% of public housing tenants and are three times more likely to experience severe housing deprivation than Pākehā or New Zealand Europeans. Only 31% of Māori own their own home, compared to 51% of the general population".[3] This serves to highlight that tenants who are Māori will be disproportionately affected by climate change and managed retreat.

Accordingly, it will be important, both in the interests of distributive justice and the wellbeing of affected tenants including Māori, for any strategy of managed retreat to incorporate specific provisions to assist tenants. With this in mind, it is worth noting that the Public Works Act 1981 provides for (discretionary) compensation to be made available by the relevant authority to tenants affected by the sale of a property.[4]

8.4 Funding for Māori

There are a range of ways in which funding could be provided to assist with managed retreat in Māori communities at both the central and local government levels. Central government funding in this area is currently focussed on research. More funding is needed for running actual trials with communities to test various managed retreat processes and consolidate learnings. There would be opportunities to use Māori communities as a pilot for managed retreat given that the community structure of whānau, hapū and iwi well lends itself well to testing different scales of retreat. More research funds could also be deployed into funding marae level planning (reflecting the key te ao Māori principle of Rangatiratanga – self-determination).

Ōnuku Marae

Funding resilience of Māori communities could also be built into other projects. For example, when Waka Kotahi relocates state highways that provide protection to marae, the projects could include funding to assist retreat of the marae. Other funds could be better configured to support managed retreat, such as Oranga Marae which is managed by Te Puni Kokiri. This provides funding for the physical and cultural revitalisation of marae.[5] However, the current funding available ($100k) is not sufficient to support the implementation of large-scale actions like managed retreat, and would need to be increased.

In terms of local government, it will be important to include Māori representation on council climate change committees. Council funding support could also be provided to iwi and hapū embarking on their own climate risk and adaptation work. There are currently some small funds available at regional council level for Māori communities (eg $15,000 in the Bay of Plenty) but these are very insufficient for the task at hand.

Some iwi are well organised and may only need financial support to help implement their plans. Some may not need funding at all. Other iwi and hapū organisations may require support to get started, including embarking on adaptation planning. It can be a complex institutional environment to navigate as some hapū may not want iwi to speak for them and prefer to do their own planning.

It will be important to ask iwi and hapū how they wish to proceed with long term adaptive planning and for funding to be well targeted to their activities. Funding will need to be more accessible to communities who need it. For example, access to Māori researchers is often needed to complete research application proposals (eg Deep South Challenge Te Taura Fund) but there is a very limited number of Māori researchers in Aotearoa New Zealand and many of them are too busy to assist.

8.5 Implications for institutional design

Effective implementation of managed retreat, including any public compensation scheme, will require specialist institutional arrangements, robust governance, highly competent staff and adequate funding to cover the inevitable administrative costs. New institutional arrangements will be likely required. Such matters are not considered in any detail here, but will be considered in later stages of the EDS project. There are a range of options for institutional design including adding new functions to an existing public entity (such as the Earthquake Commission) or establishing one or more new public entities, such as a Climate Change Adaptation Commission or a Managed Retreat Commission.

There may be a case for creating a distinctive, special-purpose entity with unique governance arrangements, perhaps with representatives of the Crown, councils and mana whenua all serving on the governing body. This would enable regional councils, territorial authorities and/or mana whenua to be directly involved in the decision-making surrounding where, when and how to undertake managed retreat in specific communities.

Questions for discussion:

1. What options for the design of a public compensation scheme for residential property owners are worthy of further investigation and development?
2. How should tenants be supported in managed retreat?
3. How could funding be made available to Māori to support managed retreat?
4. What institutions might be needed to manage a compensation scheme?

Endnotes

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9 Funding public compensation

Much of Auckland's CBD is built on low lying reclaimed land

9.1 Potential costs of public compensation

It is difficult to estimate what the cost of a public compensation scheme might be. At the outset, it is unclear how many private properties will be affected by managed retreat over a specified period, as this will depend on a wide range of things including: the path of emissions and the impact this has on the climate and pace of sea level rise; the extent of vertical land movement; the extent to which public authorities are successful in preventing further development in hazardous areas; and the level of investment in new or improved protective structures. Also, the number of affected properties that will be eligible for public compensation, and the average amount of compensation per property and/or type of property, will depend on the overall specifications of any compensation scheme.

Houses were built on the flattened frontal dunes at Omaha

A scenario for costing a managed retreat public compensation scheme

Suppose that by the year 2100 the sea level around Aotearoa New Zealand has risen by about a metre, and there has been continuing vertical land movement, including ongoing subsidence in a number of significant population centres (eg Auckland, Napier, Nelson and Wellington). Suppose that, as a result, the relevant public authorities have created zones for managed retreat which affect 50,000 residential properties directly (and many thousands indirectly). And suppose further, for the sake of argument, that the public compensation scheme provides financial assistance per dwelling averaging about NZ$1 million. Leaving aside all other related costs (such as for planning, administration, litigation, social assistance, demolition and removal and land remediation) the cost of the scheme for the period in question would be around NZ$50 billion, with the bulk of this falling during the latter part of the century. On an annual basis, this would be less than NZ$1 billion on average, or less than 1 per cent of current expenditure by the central government.[1]

A fiscal cost of around $1 billion per annum might seem relatively manageable in the overall scheme of things. But the figure excludes a range of other costs associated with managed retreat including the loss of non-residential properties, public infrastructure and social infrastructure and the cost of establishing new communities, all which are likely to be

substantial. There are also the various other costs associated with the climate change.

9.2 Raising revenue for compensation

There are multiple ways that the revenue necessary for a public compensation fund for managed retreat could be raised. Potential sources include:

- General taxation (central government)
- Property taxes (local authorities)
- An additional levy on home insurance policies (and perhaps other insurance)
- An additional levy on fossil fuels (eg petrol and diesel)
- Drawing revenue from the Climate Emergency Response Fund – which recycles proceeds from the emissions trading scheme
- Revenue from renting purchased properties until removal or demolition
- Revenue from relocating dwellings and other structures that can be moved cost-effectively, and re-selling them
- New taxes, such as a comprehensive capital gains tax

There is no reason, in principle, why a public compensation scheme could not be funded simultaneously from multiple sources. For instance, the Accident Compensation Corporation draws its funding from a combination of levies on employers, employees and the self-employed; government contributions from the general taxation pool; returns on the Corporation's investment fund (of around NZ$50 billion in June 2021); and levies included in the price of petrol and motor vehicle license fees.

By contrast, the Earthquake Commission (EQC) is funded largely by levies paid as part of home insurance policies, together with investment returns on the Natural Disaster Fund. Currently, these levies are charged at the rate of 20 cents per $100 of cover. The maximum premium per dwelling is $345 (including GST). The levies are designed to reflect the expected long-term costs of earthquakes and the other natural disasters covered by the EQC scheme, along with the scheme's administration costs. In 2022 the fund had around $7 billion in reinsurance cover. It also has a Crown guarantee.

There is a strong case for seeking to apply the polluter-pays principle, at least to the extent that this can be achieved in a cost-effective manner, and while greenhouse gas emissions remain significant. The most obvious option would be to draw from the Climate Emergency Response Fund which was established in 2021. Currently, the initial NZ$4.5 billion is being employed almost exclusively for climate mitigation purposes (ie to reduce greenhouse gas emissions). But there is no reason in principle why it could not also be employed in future years for adaptation purposes, including helping to fund managed retreat. However, the main costs of adaptation are likely to fall after greenhouse gas emissions fall to low levels. Hence, the emissions trading scheme or other greenhouse gas-related price mechanisms will not provide a long-term funding source for managed retreat or other adaptation costs.

Another option would be to apply an additional levy to home insurance policies. The logic for this approach would be similar in part to the logic for the EQC levy: that such a levy would help meet the costs of private *property* losses, in this case losses mostly due to climate change. Applying an additional levy at a fixed rate per $100 of cover, in a similar manner to the EQC levy, would be more equitable than a flat-rate levy per dwelling. However, distributional implications of increasing the cost of insurance would need to be carefully considered.

Interestingly, in France loss and damage to properties due to natural disasters and shoreline management are funded via the Barnier Fund. This is financed by an additional premium that is applied uniformly to all home insurance contracts (at a rate of 12%) and vehicle insurance (at the rate of 6% per vehicle).[2]

Modest amounts of funding could be generated from lease-back arrangements for purchased properties (as described in Chapter 8). Similarly, in some cases, it may be cost-effective to move dwellings and other structures to safer locations and then re-sell them to interested buyers. In all likelihood, however, the total revenue from such sources will cover only a modest proportion of the costs of a compensation scheme.

From the perspective of the ability to pay principle, funding a significant proportion of the costs of a compensation scheme from general taxation revenue may be the best approach. It also minimizes administration and compliance costs.

9.3 Co-funding compensation

In some countries, the funding of property purchases in the context of managed retreat involves contributions from state governments, local authorities and/or the affected property owners. Likewise, several instances of successful managed retreat in Aotearoa New Zealand have involved sub-national governments contributing a share of the costs (such as at Matatā). Additionally, there are other examples of compensatory arrangements, such as that for the 'leaky homes' crisis, where councils and affected property owners have been expected to contribute a share of the costs.[3]

Requiring co-funding from property owners may increase the incentive to resist a strategy of retreat, thus complicating the ability to undertake a co-ordinated and timely relocation process. It may also trap poorer owners, who lack the funds to contribute their share, in high-risk areas. Thus any proposal to require co-funding by property owners will need careful design.

The issue of whether local authorities should be asked to pay part of the costs of a public compensation scheme for managed retreat raises different issues. In Aotearoa New Zealand local authorities have relatively modest statutory functions when compared to many similar-sized democracies (such as the Nordic countries and Switzerland). Partly because of this, they have limited revenue raising powers. Hence, their capacity to cover new and additional costs is heavily constrained, raising the issue of whether local government, as it is currently configured, could afford to contribute significant funds to public compensation for large managed retreat exercises.

9.4 Pre-funding compensation

Thus far, no country has established a dedicated long-term funding instrument to pre-fund some of the future costs of climate change adaptation, such as managed retreat. Fiscally, governments face multiple and never-ending demands on the public purse, all the more so given the continuing global pandemic. Politically, too, most governments find it hard to gain electoral support for significant non-simultaneous exchanges (ie inter-generational transfers), no matter how justified they may be.[4]

Other factors are also likely to weaken the case for pre-funding. To start with, the costs of climate change adaptation remain uncertain. In addition, future technological innovations may reduce some of the costs of adaptation substantially, and if future generations are better off than current generations, then the costs of adaptation will be more affordable. Hence, the case for current taxpayers contributing significantly to a climate change adaptation fund may seem both unjustified and unnecessary.

However, current generations are causing climate change and this will impose significant costs on future generations. On this basis, it would be morally justifiable to tax current citizens to create a public fund (or funds) which could be drawn down in the future to help cover climate change-related loss and damage. Moreover, future generations may not in fact be better off.[5]

Pre-funding could be achieved through establishing a fund similar in concept and design to the New Zealand Superannuation Fund. Revenue for such a fund could be derived from a range of sources, with the pooled funds invested domestically and internationally, and then drawn down later in the century to help meet the costs of managed retreat.

Questions for discussion:

1. To what extent should a public compensation scheme be funded by general taxation as opposed to specific levies?
2. Should property owners and/or local government cover part of the costs of a compensation scheme?
3. Should some of the costs of managed retreat be pre-funded?
4. Should a Climate Change Adaptation or Managed Retreat Fund be established?

Coastal erosion damage at Haumoana

Endnotes

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10 Providing for nature in managed retreat

Coastal forest affected by erosion at McNeills Beach, Westland

In this Part we consider how managed retreat might impact other sectors and how the costs they incur might be addressed. We focus first on nature and then infrastructure before turning to a range of business sectors.

Climate adaptation discussions often give little consideration to what managed retreat may mean for nature; or any recognition of the need for species to retreat from climate hazards alongside humans. This is despite Aotearoa New Zealand's coastal, river and floodplain ecosystems supporting a wide range of indigenous flora and fauna that will be unable to survive outside such habitats. These ecosystems also provide critical services to humans; coastal and floodplain ecosystems regulate floods while saltmarshes, mangrove forests and seagrass meadows store carbon and contribute to climate change mitigation and adaptation.[1]

Despite their evident importance, coastal, river and floodplain ecosystems in Aotearoa New Zealand have experienced some of the greatest rates of historic loss. This has been through the development of land for agriculture and settlements, and the modification of river systems for such things as water abstraction, flood protection schemes and land conversion. Functionally intact remnants are often fragmented, modified and vulnerable to further loss due to threats such as non-native pests, pollution and ongoing habitat loss. The species that live in these places are some of the most vulnerable and threatened within the country.

10.1 Effects of climate change on nature

The main biophysical impacts of climate change on Aotearoa New Zealand's coastal systems will result from sea level rise and (to a lesser extent) changes in waves, storms and rainfall.[2] Marine areas will also be strongly affected by shifts in temperature and water acidity.[3] Sea level rise will exacerbate coastal erosion and inundation, and worsen salinisation of groundwater, compromising coastal ecosystems and the species that depend on them.[4] The most vulnerable ecosystems will likely be those associated with low-lying soft sediments, intertidal areas, estuaries, lagoons, beaches, sand dunes and mud/sand flats.[5] Rocky coasts have greater resilience to the effects of sea level rise, but their ecology will be vulnerable to changes in temperature, wave forces and ocean acidity.[6]

In estuaries and coastal lagoons, sea level rise is predicted to extend the upstream limit of saline water, alter tidal ranges and extend submergence patterns for intertidal habitats such as salt marshes, mangroves, seagrasses and sand/mud flats.[7] In the absence of physical barriers, habitats will move inland and upstream as the seaward margins of existing habitats become increasingly submerged. New areas of estuary habitat will naturally form to replace the inundated areas. However, where migration is constrained by infrastructure, topography or other environmental features, or where deliberate actions are taken to prevent migration (such as through infilling encroaching wetlands and installing new drainage), the most likely response to sea level rise will be the constriction and then loss of intertidal habitats.

'Coastal squeeze', where the migration of coastal habitats is constrained by natural or constructed barriers, is expected to affect many estuaries and lagoons in Aotearoa New Zealand.[8] The extent of habitat loss may be large and could occur rapidly. For example, recent work on 11 estuaries suggest a 27 to 94 percent loss of intertidal area with a 1.4 m increase in sea level.[9] The loss of intertidal flats could begin as early as the 2020s if rates of sea level rise exceed 5 mm a year and sediment supply is limited.[10] Estuaries with gently sloping intertidal areas are projected to experience the earliest and largest losses of intertidal area, while habitats at higher intertidal elevations are expected to maintain themselves for longer periods.

Climate change impacts on the hydrology and submergence patterns of estuaries will likely alter community structures and ecosystem functioning.[11] Increased submergence will favour more salt and submergence tolerant species and will eventually lead to the loss of the most sensitive species of plants and animals. In some cases, such changes will favour the spread of exotic invasive species. Additionally, changing salinity and submergence patterns decreases the ability of shoreline vegetation to trap sediment, reducing accretion rates and increasing the vulnerability of estuarine shorelines to erosion.[12]

The predicted effects of sea level rise on beach and dune ecosystems is similar to that for estuaries. Coastal squeeze will result in the loss of beach and dune habitats, along with the specialist species that live within them, and lead to changes in community composition and ecosystem function.[13] Other predicted effects include increased wave driven erosion and undercutting of dunes. The resulting dune scarps can act as physical barriers to species crossing the land-sea boundary, such as hoiho (yellow-eyed penguin) and rāpoka/whakahao (New Zealand sea lion). They also limit the transportation of sand inland which is critical to maintaining high quality sand dune habitats.

Prolonged beach and dune erosion will lead to the loss of habitat for species that occupy the dynamic coastal margin, including pīngao, the iconic sand dune sedge which grows only on the seaward faces of coastal dunes or on active dunes. Beaches and intertidal flats are important nesting and feeding sites for shorebirds, and the loss of habitat and increased disturbance due to sea level rise and wave erosion will be key threats to these species.[14]

Increased inundation and squeezing of intertidal habitats will reduce macroinvertebrate and shellfish abundance, with associated effects on coastal food webs, ecosystem functioning and service provision.[15] Groundwater salinisation is expected to alter the hydrology of dune slacks, a type of wetland found only in sand dunes. In addition, as for estuary and lagoon systems, sea level rise may alter the ability of dune building plants to trap sediment, while also decreasing beach volumes, thus increasing the vulnerability of sandy coastlines to sea level rise and flooding.

Shorebirds (also known as waders) are particularly vulnerable to climate change, as they will be impacted by the range of predicted changes at the land sea interface, particularly in terms of nesting.[16] Many of the forty-seven shorebird species recorded in Aotearoa New Zealand are in decline.[17] Certain estuaries such as the Kaipara, Manukau, Firth of Thames, Farewell Spit and Tasman Bay are key breeding and wintering regions for shorebirds.[18] Changes in estuary condition at these sites, due to sea level rise, may have critical implications for these important species.

Sea level rise will also affect terrestrial ecosystems and species on low-lying land adjacent to the coast. This is vividly demonstrated by the 'ghost forests' which feature prominently along the Atlantic coast of North America and which were created by the submergence of formally forested low-lying land.[19] Examples of vulnerable coastal forests in Aotearoa New Zealand include the pōhutukawa forests of the northern North Island, the podocarp forests of the Tautuku and Tahakopa barriers in the Catlins, and the kahikatea forests of Westland. Similarly, habitat fragmentation will mean that key refugia for some threatened terrestrial species will be vulnerable to sea level rise flooding and erosion.

Increased sea water and air temperatures will result in terrestrial and aquatic species moving southwards and/or upwards.[20] In coastal waters, for example, mangroves are predicted to increase their range southwards while the range of kelp is expected to contract to the south.[21] More extreme heat waves will likely affect temperature sensitive species such as kelp, and some rocky shore intertidal species, leading to changes in community structure. In severe cases, where keystone species are lost, fundamental shifts in ecosystem state are likely to occur.

Changes in seasons may disrupt predator-prey relationships, and affect the flowering of some trees, when birds lay their eggs and when species migrate.[22] Increased rainfall will increase soil erosion, worsening sedimentation and turbidity in some rivers, estuaries and coastal waters.[23] For regions that are likely to experience decreased rainfall, disruption of aquatic ecosystems through low flows or drying up of stream and rivers

will impact aquatic fauna and flora.[24] More acidic seawater will affect carbonate species like shellfish and coralline algae.[25]

Vulnerability of species to the impacts of climate change will, in many cases, be heighted by the already degraded state of many ecosystems as the result of human impacts.[26] Fragmented, degraded and isolated populations will likely be less resilient to climate change impacts.[27]

Loss and change to natural ecosystems will be an unavoidable consequence of climate change. The question is, how much loss is acceptable and in which situations, and what can be done to minimise it? It will be important to consider options to reduce impacts on natural systems during climate change adaptation and managed retreat, such as designing greener hazard protection mechanisms or undertaking ecological restoration of vacated lands.

10.2 How nature can adapt to climate change

Natural systems possess innate capacity to adapt to climatic and environmental change.[28] For example, coastal wetlands, mangrove forests and sand dunes can adapt to sea level rise by trapping sediment to increase their vertical height, as well as migrating inland.[29] Shorebirds can alter feeding patterns in response to changing storm cycles. However, in many situations, the adaptive capacity of habitats and species to respond to climate change will be inadequate.

The predicted rates of sea level rise are unprecedented; and are expected to be too fast for many coastal habitats and species to fully adapt.[30] Similarly, the magnitude and frequency of other climate change stressors, such as increased temperature and extreme flood events, are expected to overwhelm the innate adaptive capacity of many ecosystems and species.[31]

Many species live on the coastal frontline, Flaxmill Bay

Such effects are even greater when the adaptive capacity of ecosystems has already been undermined through other anthropogenic impacts.

Global-scale projections indicate that between 20 and 90 per cent of coastal wetland areas may be lost to sea level rise, based on low and high sea level rise scenarios, respectively. However, such losses may be avoided if wetlands are able to move inland, and wetland areas might actually increase in some cases. One modelling exercise indicated that wetland gains of up to 60 per cent of current area would be achievable if wetlands were given sufficient space to move.[32]

In many situations, human modification of the coast has removed or decreased the effectiveness of natural adaptive mechanisms. Hard structures and drainage protect against flooding, but also prevent the inland transfer of sediment which is required for natural habitats to increase their elevation and migrate inland.[33] Changes in vegetation cover, due to shifts from native to exotic species, can also alter sediment transport processes in coastal habitats with implications for adaptation. Biological interactions, such as competition from introduced species, can further undermine the ability of indigenous species to move into new areas.[34]

Other examples of decreased adaptive mechanisms include habitat fragmentation, and the loss of dispersal mechanisms, which prevent regeneration after a stress event. For example, the management of river systems to decrease flooding can be at the expense of species reliant on flood events for habitat creation or reproduction. In addition, there can be decreased seedling recruitment due to browsing pressure from non-native mammals.

Along with the physical and ecological barriers that limit climate change adaptation by nature, there are institutional and societal barriers. Poor perception of some habitats or species (ie mangroves in northern New Zealand), a failure to protect biodiversity values at the expense of development and/or knowledge gaps regarding requirements for successful adaption, can lead to inadequate protection and planning for habitats and species when faced with climate change and sea level rise.

In many cases, institutional and social barriers can be more of a threat to nature than climate change impacts. There remains poor recognition of the need to allow for dynamic coastal process in order to increase the adaptive capacity of nature, particularly by private property owners (and in some cases regulators), as allowing for dynamic coastal processes can increase hazard risks to adjoining properties.

The adaptive capacity of natural systems to environmental change has been significantly reduced due to land use change, habitat fragmentation and ecological degradation. Building ecological resilience in species and ecosystems, in the face of climate change, will require active support.

10.3 Supporting the adaptive capacity of nature

The adaptation of nature to climate change will, in most cases, require human assistance to overcome innate and induced barriers. There is a growing set of tools that can be used to help achieve this. For example, the IPCC reports on terrestrial and freshwater ecosystems[35] and oceans and coastal ecosystems[36] identify a range of possible actions to support climate change adaptation, and there is an increasing body of international literature on this topic.[37] However, much of this material is conceptual, and there has been little empirical testing to determine which approaches work best on the ground.[38] Despite this, it is possible to identify several opportunities to support biodiversity adaptation in Aotearoa New Zealand, based on current knowledge. They include:

(a) *Managing in place to support migration*: This focuses on removing physical barriers to adaption or reinstating natural mechanisms or processes that support adaptation. For example, sediments can be added to habitats to help them keep pace with sea level rise, and water and sediment flows can be restored to facilitate accretion.[39] The removal of built barriers to increase accommodation space is another approach which is receiving considerable international attention for its potential to mitigate sea level rise effects on nature.[40]

Often termed '*managed realignment*', the removal or breaching of protection structures to increase accommodation space for coastal wetlands has been successfully undertaken in Europe and the UK.[41] While untested in the context of sea level rise adaptation, there are positive indications that providing accommodation space may offset wetland loss from sea level rise.[42] In fact, it is likely that the removal of structures will be critical to ensuring wetland survival under future sea level rise scenarios. Successful implementation will require careful planning as restored habitats may not necessarily attain the physical and biological attributes of natural habitats without additional restoration actions.[43]

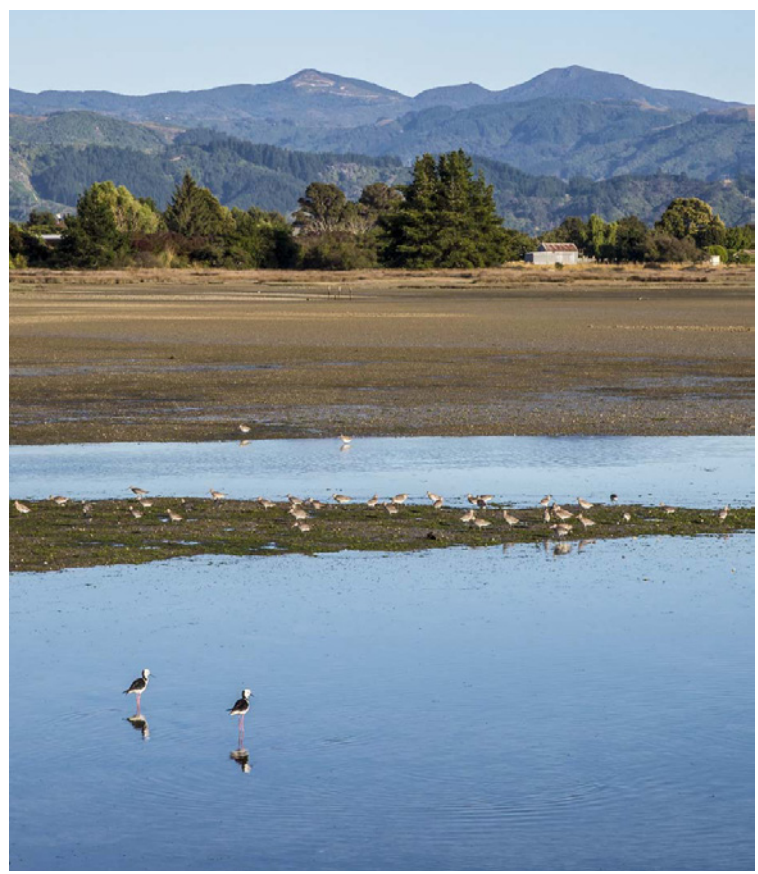
(b) *Ecological restoration*: Protecting and restoring natural processes and ecosystem health is a general underlying principle for maintaining and building biodiversity resilience to climate change.[44] Such approaches include species rehabilitation, restoring hydrological or geomorphic processes, restoring natural vegetation dynamics, improving connectivity between habitat patches, and reducing non-climatic stressors such as pests or habitat fragmentation.[45] In some situations, it may also be appropriate to create new habitats, such as new wetlands to offset historical wetland loss. This approach recognises that climate change will act synergistically with other existing threats to increase risks to indigenous biodiversity. As such, minimising other impacts will help improve resilience in the face of climate change induced shifts.[46]

(c) *Protecting habitats*: This approach involves increasing the amount of land in protected areas and maintaining large areas of resilient landscapes free from development. It also includes protecting sufficient accommodation space and climate change refugia. It is based on the considerable evidence indicating that the extinction risk to species from disturbances (including climate change) is reduced by having large, connected populations. Biodiverse systems are more resilient, and provide higher levels of ecosystem services, than those that are degraded and have lost species.[47] The approach highlights the need for climate change threats to be incorporated into resource management decision-making to ensure that human use and infrastructure will not reduce the resilience of core habitats to climate change.[48]

(d) *Other strategies:* There are many other strategies that can be adopted to support the ability of species to adapt. They include assisted translocations and migration of species, intensive management of specific species, ex situ conservation strategies (such as seedbanks/genetic stores) and assisted evolution (such as manipulating the genes of organisms in order to enhance their climate change resilience).[49] The long-term effectiveness of such strategies for climate change adaptation is unknown, and given the intensive nature of such interventions, they will likely only be suitable for application at a species level.[50] One potential exception is assisted colonisation when undertaken to restore ecosystem function (such as through the translocation of keystone species).[51]

Christie has developed a framework for the management of climate change threats on Aotearoa New Zealand's terrestrial native biodiversity,[52] and this could equally be applied to freshwater and coastal biodiversity. It comprises five broad national-level strategies that cover a range of conservation management actions, from research and development, through to management and awareness raising. The strategies are:

- Improve knowledge of the impacts of climate change on species and ecosystems
- Develop decision support tools and adaptation methods
- Incorporate climate change adaptation strategies into existing management and research programmes, planning and policy
- Improve management and restoration of existing species and ecosystems to facilitate resilience to climate change



Estuarine communities are particularly threatened by sea level rise, Motueka Estuary

- Raise awareness and understanding of the impacts of climate change on biodiversity.

McGlone and Walker note that the best defences against biodiversity loss due to climate change are those actions being undertaken now to prevent biodiversity loss due to ongoing pressures of pests, weeds and land use change.[53] However, within coastal ecosystems, purchase of land for coastal reserves ahead of need, removing inappropriate anthropogenic hard structures, and preventing further hardening of the coastal area are also priorities.

Allowing indigenous species and habitats to adapt to climate change hazards will require a reframing of how nature is viewed and valued, especially when the adaptation of nature conflicts with the protection of property. How this might be achieved remains a central question in climate change environmental management, and one for which there is no simple answer.

10.4 Funding managed retreat of nature

Actions to support the managed retreat of nature, or the post retreat restoration of vacated lands, will need to be properly funded. McGlone and Walker note that current funding is insufficient to address existing threats to New Zealand's biodiversity, let alone new initiatives that will require implementation at a national scale and across multiple ecosystems. It is important that initiatives to support nature within a managed retreat framework do not occur at the expense of addressing current threats to biodiversity. This indicates a need to significantly increase biodiversity funding in response to a climate changing world.

Questions for discussion:
How can nature best be factored into managed retreat policies?
What accommodation might need to be made for species and habitats to move?
To what extent should nature be prioritised when planning for managed retreat?
How can conflicts between the needs of nature to adapt and the desire of people to protect property be resolved?
How can actions to assist nature to adapt best be funded?

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11 Managed retreat and infrastructure

Northern motorway, Auckland

In simple terms infrastructure consists of structures that enable the movement and operation of services that people need. At its core, infrastructure is about interconnection. Figure 7 illustrates how infrastructure draws on different strands of social, financial, human and natural capital to create six categories of services that people rely on:[1]

- Telecommunications: broadband, fixed line and mobile
- Energy: electricity, oil, gas, hydrogen and other fuels
- Water: drinking water, waste water, stormwater, flood protection, water storage and irrigation
- Waste and Resource Recovery: landfill and recycling facilities
- Transport: land, aviation and maritime
- Social: housing, health, aged care, education, skills and research

A fuller picture in Figure 7 would bend the arrow back around to the strands to show how infrastructure in turn acts on the four capitals. For example, 'optimised' human capital depends on services such as clean and safe drinking water, functioning schools and hospitals, transportation and efficient modes of communicating.

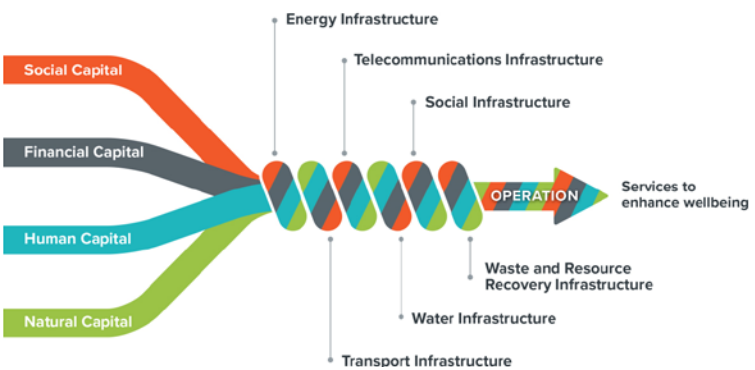

Figure 7: The components of infrastructure *(Source: Infrastructure Commission Te Waihanga)*[2]

Ownership and operation of infrastructure spans the public and private sectors. Energy and telecommunications are provided by private entities. Local and central government generally own and operate water, waste, transport and social infrastructure. At an asset level there is a nexus of inter-sectoral contracts and different models of ownership. For example, waste depots and landfills are generally owned by councils, but waste services can be contracted to private providers. Responsibility for municipal waste lies with local government but farm waste is the responsibility of private land holders. The complexity in the provision of infrastructure is further illustrated by the complex arrangements involved in the provision of airport services.

Airports are partially owned by local government but with private sector and central government investment. For example, the airports at Whanganui, Taupō, Whakatāne, Westport and Whangarei are 50 per cent owned by the relevant local council with central government owning the remaining share. Auckland Airport is a publicly listed company with Auckland Council as a major shareholder (22%). Wellington is 66 per cent privately-owned and 34 per cent owned by Wellington City Council. Christchurch Airport is 75 per cent owned by Christchurch City Council and 25 per cent owned by central government.

There are numerous independent infrastructure-related companies and agencies operating at airports. Some of the independent bodies operating there include the Civil Aviation Authority which provides security, Airways NZ which undertakes air traffic control, ground handling contractors which undertake baggage handling for airlines, border control agencies such as Customs, Biosecurity and Immigration, and the private sector OCS Group which cleans the airport lounges, food courts and washrooms. The airport company does not directly control all such operations but facilitates collaboration and co-operation to ensure efficient airline operations and passenger travel. Funding comes from a mix of central government, private equity and user charges.

11.1 Infrastructure climate risks

Climate change will expose infrastructure to ongoing sea level rise, more frequent and extreme storm events and surges, and temperature increases. Risks includes higher groundwater, saltwater intrusion, coastal and inland flooding, landslides and droughts. Aotearoa New Zealand's geography, coupled with urban and rural development decisions, has created a network of infrastructure that is largely located on floodplains and/or the coast. Analysis of coastal flooding from 1 metre of sea level rise reveals that by 2100 over 1,441 kilometres of roads, 101 kilometres of railways, 72 kilometres of electricity transmission lines, 141 electricity structures, 14 airports and over 4,000 kilometres of three-water pipelines will be exposed and require some form of intervention from protection through to relocation.[3]

A study commissioned by Local Government New Zealand estimated that half a metre of sea level rise would affect infrastructure with a replacement value of $2.7 billion, increasing to $7.8 billion with sea level rise of 1.5 metres. Three waters infrastructure is at greatest risk with 6,000 kilometres of pipe exposed to a 1.5 metre rise.[4] Such estimates do not include the other significant costs that will be incurred from climate risks and resultant managed retreat such as:

- Increased operational and maintenance costs

Wellington airport

- Costs of damage to infrastructure
- Planning costs for purchase and rezoning of land for new infrastructure corridors
- Interim interventions such as flood protection prior to managed retreat
- Costs of providing ongoing services to residents that do not choose to voluntarily retreat
- Forced abandonment of assets before projected (and costed) end of life
- Demolition and infrastructure removal costs and site and habitat restoration.
- Ongoing community engagement and consultation

Such costs need to be seen in light of the current substantial deficit in infrastructure investment. The Infrastructure Commission Te Waihanga recently outlined the severity of the deficit problem which will cost 0.7 per cent of GDP every year over a 30-year period to address.[5] The impact of such deficit, in association with climate-related pressures, means that infrastructure in some areas is already failing.

When wastewater infrastructure fails, resulting in wastewater spills and overflows, the impact on Māori communities is felt far and wide. Freshwater and mahinga kai sources are degraded affecting the ability of the community to collect food. Cultural values can be negatively impacted when human waste considered to be tapu is mixed with special and sacred areas like urupā, marae and mahinga kai. Contamination of land or cultural sites can lead to declining mental, spiritual and physical health for Māori as well as impacting their connection to the land and sea.[6]

The extent of infrastructure exposed to climate risk varies by location. Napier, Lower Hutt and Christchurch are highly exposed, but the challenges are also high in niche locations such as South Dunedin and Thames. For example, in South Dunedin water infrastructure (along with houses) is coming under significant pressure due to a confluence of factors such as tidal range, land subsidence and climate induced sea level rise, storms surges and rainfall.

Climate change impacts on stormwater and wastewater infrastructure can result in the corrosion of pipes and machinery from saltwater and sewage overflows through breakages and flooding. It can also disrupt the biological processes critical for treating wastewater. Connectivity of transportation networks can be disrupted by flooding, landslides and erosion of roads, leading to communities being isolated and transportation flows being blocked and/or delayed. Roading along with other lifelines utilities (gas, telecommunications, water, rail and electricity)[7] are considered to be critical infrastructure essential for community well-bring.[8]

11.2 Managed retreat of infrastructure

There are two different circumstances under which managed retreat of infrastructure might occur. The first concerns assets threatened by climate risks that need to be moved out of harm's way. The second is when infrastructure needs to move alongside communities undertaking managed retreat. An example of the first scenario is Transpower's national grid of transmission lines and substations, which are being impacted by coastal flooding, increased frequency of high impact (flood/wind) events and accelerated erosion.[9] Transpower has identified the need to relocate some transmission lines into surrounding areas. However, such an exercise is not necessarily straightforward, as adjacent land may be subject to development restrictions such as those designed to protect outstanding natural landscapes.

Managed retreat provides the opportunity to improve the resilience of infrastructure through 'building back better'. However, in relocating infrastructure it is important to avoid mistakes of the past. For example, Māori have experienced confiscation and dispossession of land in the name of infrastructure. Roads (including those built by imprisoned Māori for military use during the New Zealand Land Wars) paved over extensive areas of land without consideration of its cultural importance.[10]

In Māori tradition, wai (water) was formed by the tears of both Ranginui and Papatūānuku in lamenting their separation (the Creation Story). That gift of water from these ancestors, that are connected to each person through whakapapa, is the lifeblood that sustains life and reminds Māori of their connection to whenua through whakapapa. Upholding and respecting Papatūānuku means that the connectedness of water bodies, both above and below ground, needs to be respected. Groundwater for Māori transcends denoted artesian systems that separate bodies of water. A particular location may sit outside a contamination zone in an artesian sense but for Māori the lifeblood is still affected. Similarly, infrastructure that interrupts the connectivity of water impedes the lifeblood. For Māori it is important to respect and maintain the ability for water to flow where it needs to flow.

When a community relocates, services will need to follow. However, voluntary relocation may also lead to some residents remaining in place, with local government having to provide services to both the new and old (risky) locations. There is also the issue of who is responsible for removing old infrastructure and remediating the land. For example, structures containing small amounts of hazardous material along the estuary edge of red-zoned land in Southshore, Christchurch were left for the council to deal with, despite central government (through the Canterbury Earthquake Recovery Authority) leading the managed retreat process. Another issue is the removal of roads after managed retreat. Under existing statutory provisions roads cannot be stopped if they are still required for access. If they are stopped, it is unclear who is responsible for removing tar and other hazardous material contained in the old roads.

Hauraki Plains drainage system, Waihou River

11.3 Funding managed retreat of infrastructure

Current infrastructure funding comes from central government (taxpayers), general and targeted rates (ratepayers), bank and government loans, and user charges (consumers). However as identified by Te Waihanga and Treasury in their recent 2022 Investment Statement, in order to close the current $210 billion infrastructure deficit and respond with resilience to climate change and other demand and supply-side pressures, more options than the current funding sources are needed.

Rates will not be sufficient on their own to close the gap and have limitations due to local government politics, concerns about rate rises and affordability. New or enhanced funding avenues will be required to ensure infrastructure is effectively retreated. They could include:[11]

- Pricing: congestion charging, road user charges and water metering
- Targeted rates: on wastewater and waste volumes
- Debt: using Special Purpose Vehicles via the new Infrastructure Funding and Financing Act 2020 which enables borrowing against accrued levies
- Private-public partnership: long-term contracts between government and the private sector for the provision of services

Many of the options may also have significant benefits for the environment by driving lower emissions, and water and resource use, while promoting the transition to a circular economy. Key to enabling the efficient use of funding is long-term planning, timing and co-ordination across the sectors. To the extent possible, the asset management cycle should take a long-range view, and align with the timing of managed retreat, to ensure that any investment is optimised and occurs at the same point that rebuild is required. Various infrastructure providers in the same area may also need to align their adaptation plans.

Questions for discussion:

1. What financial sources could be utilised to fund managed retreat of infrastructure?
2. To what extent should taxes and rates be relied on as opposed to user charging?
3. How does the current infrastructure deficit impact managed retreat?
4. To what extent is it desirable and practicable to 'build back better'?
5. How can long term planning for infrastructure better account for the need for managed retreat?

Endnotes

1 In this paper we focus on physical structures rather than social and cultural infrastructures. We have added 'green infrastructure' into the categories. We see green infrastructure as meriting special mention because of its potential to restore nature after retreat. Green infrastructure also brings co-benefits for humans such as health benefits, carbon sequestration, ecosystem services, landscape protection and enhancement, recreation and enhanced social/cultural connections

2 https://www.tewaihanga.govt.nz/assets/Uploads/Te-Waihanga-Infrastructure-Under-One-Roof-2020.pdf

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4 Simonson T and G Hall, 2019, *Vulnerable: The quantum of local government infrastructure exposed to sea level rise*, Local Government New Zealand, Wellington, at 12

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8 Critical infrastructure is defined as "Physical and digital assets, services, and supply chains, the disruption (loss, compromise) of which would severely impact the maintenance of national security, public safety, fundamental rights, and well-being of all New Zealanders", see https://dpmc.govt.nz/sites/default/files/2019-07/Cyber%20Security%20Strategy.pdf

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11 https://strategy.tewaihanga.govt.nz/strategy

12 Managed retreat and business

The Canterbury Plains are subject to drought which will likely increase under global warming *(Rob Suisted)*

12.1 Climate risks affecting business

Many businesses will be adversely affected by climate change although some may benefit. Climate change can impact businesses directly and through consequential cascading risks. In addition, climate risks can compound with other business risks to significantly impact business operations. Key risks facing businesses due to climate change include:

(a). Physical risks: the forestry, fisheries, agriculture, energy, transport and tourism sectors are exposed to flooding, droughts, fires and storms. There are also risks from pests and diseases.

(b). Regulatory risks: climate-related changes in legislative provisions and policies can affect businesses through impacting industry structures, competition dynamics, cost and pricing structures, property rights and access to natural resources.

(c). Market risks: competitors main gain an advantage or investors may divest resulting in financial loss for businesses. This risk is particularly acute for financial services that are exposed to climate risk disclosure legislation but may also affect other businesses that appear as 'risks' on disclosure statements.

(d). Reputational risks: such risks occurs when a business fails to meet societal expectations. Damages often expand beyond the immediate affected parties or location. For example, Aotearoa New Zealand's reputation could be at risk if an extreme flooding event leads to industrial pollution.

Relocation may be forced on businesses where more than one risk manifests and makes the situation intolerable. This can occur when severe damage occurs to physical structures (such as retail outlets or distribution warehouses), productive land or crops, and/or critical infrastructure. In addition, supply chain disruption, loss of customer base due to community or population dispersal, an increase in insurance premiums or withdrawal of insurance, and difficulty obtaining or servicing loans may also impact a business.

If not managed well in advance, such factors could lead to loss of profitability, unemployment, decreased savings, increased debt and loss of livelihoods. The knock-on effects from unmanaged retreat could be a depressed regional economy, reduced exports, trade disruptions and a stressed financial system.[1] Some businesses may be able to adapt in an unmanaged retreat system, but they would fare better under a carefully, planned, well signalled retreat.

In the sections below we explore these risks in specific sectors before turning our attention to how such losses might be recompensed.

12.2 Agriculture

Primary industries may have to relocate parts (or the entirety) of their operations if either their building facilities, infrastructure, supply chain access (including export or regional ports) and/or suppliers' lands and operations are adversely affected by climate change. Suppliers include not only farms contracted to supply meat, wool or dairy products, but also those providing feed, fertiliser suppliers, transport companies, veterinarians and meat processing plants.

Often overlooked is the full agricultural supply chain from the perspective of the animal. Animals are exposed to weather and rely on humans for food, water and shelter throughout their life cycle. Poor animal welfare and health leads to lower productivity in herds. Bobby calf mortality rates increase if long haul is undertaken in hot conditions, and if there is a road closure, this could lengthen the time taken to transport stock.

Fonterra provides a good example of such impacts. Its manufacturing sites at Edgecumbe and Brightwater are located in low lying areas near rivers and have in the past been impacted by flooding events. Other sites in Northland are susceptible to drought including at Kauri and Maungaturoto. Fonterra needs water for its plants to operate, and has at times had to transport water, which is costly. Beyond its plants, Fonterra's supplier farmers are exposed to inland flooding in Westland and Manuwatu and to drought in the northern part of the North Island and on the Canterbury plains. Irrigation may not be a financially viable solution for existing drought-prone farms. Stock can also risk being stranded or cut off from feed sources. If this occurs during the calving season, or winter, then stock may be lost. Heat stress reduces milk production. Farms are also increasingly exposed to new pests and diseases.

Beef and sheep farms, and associated companies, face similar risks to the dairy industry. Many farms are located in areas with low population density and are not easily accessible. They are highly dependent on infrastructure (roads, power, internet and flood protection works) and some farmers contribute to maintaining roads. The costs of this could increase significantly if local councils reduce or cease funding. Likewise, water access and availability could be at risk in some areas already prone to drought. This could severely curtail the productivity and profitability of some farms.

Aside from the direct physical and financial risks, there are reputational risks that could further push farms to relocate or cease operating. Animal welfare and unchecked biosecurity outbreaks could affect consumer perception and market access, leading to reputational damage. A knock-on effect could be consumer boycotts, negative media and unwanted civil society attention. Reputational damage often leads to new regulations and compliance requirements, which in turn increases operational costs. In such situations, managed retreat may be forced on farms and businesses as a result of compounding impacts.

12.3 Horticulture

Horticulture is heavily reliant on access to highly productive land and infrastructure (including roads and buildings), which in coastal and flood prone areas is vulnerable to extreme weather events and sea level rise.[2] Horticulture crops are generally grown on flat land which can be particularly vulnerable to flooding from adjacent waterways and sea and storm surge.

Only 15 per cent of the country's total land area is classified as highly productive (Land Use Capability Classes 1, 2 and 3) and significant areas of this land are situated in coastal and flood prone areas. Unlike buildings, highly productive land cannot be relocated. Once degraded, it is very hard to recover. Using land that is not highly productive for horticulture results in lower yields unless more intensive land management approaches are adopted. Intensive land management can mean greater inputs of fertiliser and water to get the same yield per hectare as that of highly productive land, risking the quality and health of soil and waterways.[3]

Not all fruit and vegetables can be grown on the same highly productive land. Different fruit crops require different climates and soils. For example, kumara are grown in Kaipara, avocados in Northland, citrus in Gisborne, kiwifruit in Bay of Plenty, apples in Hawkes Bay and Nelson, and apricots in Central Otago. Eighty per cent of vegetables grown throughout the country make up the year-round supply of fresh vegetables for the domestic market. Aotearoa New Zealand's national food supply and domestic food security will become more important with population growth, requiring greater protection and availability of highly productive land.

Extreme weather events that destroy food crops are expected to become more frequent and intense in the coming years. Climate change impacts will mean that some growing operations will cease to operate which will reduce the domestic and export supply of fruit and vegetables. This will, in turn, cause financial impacts throughout the supply chain and result in higher prices for consumers.

Horticulture in the Hawke's Bay region is particularly susceptible to climate change impacts, including flooding risk, due to its location on flood plains.[4] Rivers already flood every winter when a storm brings more rainwater than can soak into the soil. The region is an important food growing hub and managed retreat from flood prone areas could have an extreme effect on the regional economy and people because:

- 16,800 hectares of commercial fruit and vegetable production are located on the Heretaunga Plains
- Food production in Hawke's Bay accounts for 52.5 per cent of the region's GDP
- Hawke's Bay produces 61 per cent of the country's apple and pear crops, 70 per cent of summer fruit and 50 per cent of the squash crop.
- Heinz Watties and McCains, two of the large post-harvest facilities located within the region, employ over 1,800 people

While horticulture buildings (such as processing centres and post-harvest facilities) are covered by insurance, growers do not generally have insurance for crops due to lack of affordability and/or cover by insurance companies. The land is the basis of the grower's income source, and is treated as an investment, similar to residential housing. With advances in technology and growing systems, covered cropping (greenhouses) are becoming more prevalent, and may be an alternative for growers. But not all horticulture is suitable for covered cropping such as kiwifruit, citrus, avocados, cherries and broad acre vegetables. In addition, many crops cannot be grown at the same scale and therefore generate the same returns as achieved in outdoor production.

12.4 Fisheries

The ocean has absorbed about 90 per cent of the excess heat humans have generated since the 1970s.[5] This has resulted in sea level rise, heatwaves and ocean acidification. Marine biodiversity, and the lives and livelihoods of coastal communities, will be severely affected as the climate nears 1.5 degrees. Increased temperatures will continue to impact marine species even if emissions are stabilized.

It is expected that with warming waters invasive species will displace existing species, aquaculture production will be reduced, and fisheries operations and supply chains will be disrupted.[6] Seawater acidification is likely to adversely impact a range of harvested species including kina, paua and mussels where acidity can stunt shells and weaken growth. It is also likely to affect other species such as snapper, which may be smaller as a result and have physical deformities.[7] More intense storms will also put the health and safety of employees at risk. It is likely that some aquaculture operations will have to relocate. These dynamics are acute for Māori who rely on economic and cultural connections to kaimoana.

The salmon aquaculture industry is already having to contemplate relocation. Salmon cannot survive in temperatures over 18 degrees. Seawater temperatures have been rising above this level in the Marlborough Sounds over the summer. In 2021, a marine heatwave led to over 1,000 tonnes of salmon dying in New Zealand King Salmon's Marlborough farming operations. The company reported a $73 million loss for the year ending January 2022[8] and is currently constructing a farm in the Cook Strait where the temperature is cooler.

Ngāi Tahu's Hananui Aquaculture and Sanford also intend to farm salmon in deeper, cooler waters offshore.[9] These shifts may affect local communities that are reliant on existing aquaculture operations for incomes and jobs. Some jobs may be lost as a response to reduced profit and productivity. For example, New Zealand King Salmon reduced its workforce by 139 to absorb the financial impact of fish deaths.[10]

12.5 Tourism

Climate risks to tourism includes floods, droughts, increasing temperatures, coastal erosion and biodiversity loss. These have already led to shortened snow seasons, glacier melts and kauri dieback. These risks can be classified as primary, secondary or tertiary effects.[11] Primary effects are the direct impacts on tourism activities from climate change such as through changes in temperature and the weather. Secondary effects describe changes in the landscape or nature because of climate change. For example, coastal erosion from sea level rise, storm surges and tides could make some beaches inaccessible or dangerous to tourists. Recreational fishing in rivers may not be viable due to intense inland flooding. Tertiary effects encompass the impact of policies on tourism such as those aiming to mitigate emissions impacting travel patterns. One or more of these effects could catalyse businesses to relocate or cease trading.

In October 2022 Ruapehu Lifts Limited went into voluntary administration citing three years of disastrous ski seasons due to the lack of snow and the Covid-19 pandemic. The company had up to 700 employees and brought an economic benefit of around $100 million to the region. The company does not appear to have fully grasped the potential impacts of climate change on its business, with climate change failing to get a mention in its most recent annual report.[12]

Tourism is not unified under one industry representative body nor guided by a dedicated government agency like agriculture or fisheries. Similar to other sectors, tourism comprises many small-to-medium-size enterprises, some of which do not have the resources to invest in long-term strategic planning or risk management. They also may lack the ability to influence local or central government investment decisions on infrastructure and the natural environment.

Since 2008, the Franz Josef glacier has retreated 1.56 kilometres, the fastest rate ever recorded. About 500,000 international tourists come to the Westland District every year and Franz Joseph's resident population of about 400 reaches 1,000 with seasonal workers. The economic impact of tourism to the glaciers is estimated at $120m per year with 90 per cent of residents working in the tourist industry.

Climate change is not only impacting the glacier, but also increasing flooding, affecting access to the glacier and the financial viability of farms on the Waiho river flats. In March 2019, the road to Fox glacier was closed by the Department of Conversation following flooding and landslips from an extreme rain event. The cost to repair of $16 million was considered unsustainable given the high likelihood of a recurrence.[13] Farms and landowners on the Waiho flats are now seeking flood protection with the airport also at risk.[14]

Further compounding the risks, the town straddles the 800 kilometre Alpine Fault line,[15] and there is currently a 75 per cent probability of an earthquake during the next 50 years, with an 82 per cent chance that this will be over M~8. These combined risks, along with adverse impacts on tourism from the ongoing, slow retreat of the glacier, strongly suggest that managed retreat should be considered as an option for the town.

12.6 Banking

Aotearoa New Zealand has 27 registered banks, with four large Australian-owned banks (ANZ, ASB, BNZ and Westpac) responsible for 85 per cent of bank lending. Loans and advances account for around 80 per cent of banking system assets.[16] Two thirds of lending is in the residential market, reflecting a preference for home ownership as an investment option in Aotearoa New Zealand. As house prices have increased, so has aggregate household wealth, with housing now accounting for over 50 per cent of domestic household assets. As such, the value of the housing stock sits at around $1.5 trillion, five times the size of the country's GDP, and comparably high among OECD countries.[17] This means that the physical impacts of climate change create a significant risk to many homeowners and those banks and insurers that lend on or provide insurance over the property.

In their climate risk disclosures, the major banks which hold close to 85 per cent of the country's market share, all indicated that on average two per cent of their residential portfolios are exposed to coastal flooding. This creates a risk of credit loss to the banks, and consequent reduction in liquidity, with potential flow on effects to the wider economy. Options to mitigate this financial risk for banks include altering the loan to value ratios (thereby increasing the level of equity a homeowner has in the property) and shortening payment periods thereby reducing the loan term.

The response of banks to managed retreat has yet to be properly tested. Westport is an example of a town where residents remain in a high-risk location after repeated flooding events and where managed retreat is being contemplated in the future. After the most recent flooding event, banks followed an emergency assistance approach offering customer support including through case-by-case emergency measures, temporary suspension of home loan principal repayments and access to overdrafts at reduced interest rates. Business and rural customers were able to access working capital facilities.[18] Banks are continuing to offer mortgages in Westport. In response to the Christchurch earthquakes in 2011-2012, banks adopted a similar approach, supporting red-zone homeowners in a number of ways, including through committing new residential mortgage lending, discounting mortgages to help relocation, providing flexible repayment terms and waiving application fees.

Banks have yet to develop funding options for managed retreat but could potentially adopt a more proactive and targeted approach to supporting customers than that currently provided following an emergency. Assuming a government compensation scheme was in place to purchase

at-risk property, banks could incentivise customers to move to safer locations. For example, they might offer discounted rates on loans on the relocated property. This would be similar to sustainability-linked loans which are currently being offered and allow borrowers to access cheaper finance conditional on sustainability targets being met over a period of time. It would recognise that impacted customers need time to transition and that there is joint benefit for the bank, borrower and wider financial system in taking a longer-term view. Banks could also play a stewardship role by helping to inform customers about climate risks and options for managed retreat.

The government and Reserve Bank could support investment in adaptation by banks, through policy settings which reduce the risk or cost of bank lending, including through providing government guarantee schemes (where the government partially underwrites the risk on bank lending on targeted investments), reducing Reserve Bank capital requirements, and providing access to cheap central bank funding facilities.

Banks must currently comply with responsible lending obligations including assessing affordability. This can create a barrier to lending money to customers taking measures to make their property more resilient, or those wishing to relocate. This is particularly the case for lower income borrowers and those whose property has suffered a reduction in value.

12.7 Insurance

Aotearoa New Zealand's insurance sector includes general, life and health insurers. All three are exposed to the impacts of climate change, but only general insurers have a direct interest in managed retreat due to their exposure to property damage. The general insurance sector is made up of both private and government-owned insurers, with there being about 89 licensed insurers in New Zealand, 55 per cent of which are foreign owned. The private general insurance sector has assets of around $27 billion, which represents 7.5 percent of the country's GDP. Foreign-owned insurers account for about 85 per cent of these assets.[19]

General insurers are impacted by effects of climate change in three main ways: changes in the volume and value of *claims* made by their customers due to more frequent and extreme storms, floods and other events; changes in the value of their *investments* due to the impacts of climate change; and the direct impact of events on their *business operations*.

The economy of Franz Joseph is affected by the retreat of the glacier and the town is also at risk from flooding and seismic risk

General insurers provide two general types of insurance that are relevant to climate change:

- *Property insurance*: which protect individuals and businesses from financial losses arising from damage to their property, including damage caused by climate-related natural hazards.

- *Liability insurance*: which protects individuals and businesses from financial losses arising from their involvement in damage to other people's property.

The cost of financial losses incurred by insurance companies is met, in the first instance, from the premiums paid by policyholders. When losses are sufficiently large, they may be paid for by reinsurers (with whom insurers insure themselves), or by investors through reduced dividends or ultimately through the loss of capital. Claimant policyholders will often have to contribute a small amount in the form of their policy excess.

Over the past 10 years the total cost of climate-related insurance claims has exceeded $2 billion.[20] Two of the country's largest general insurers have recently highlighted the potential growth in these costs. IAG New Zealand expects claim costs (excluding those arising from the impact of sea-level rise on coastal hazards) to increase by between 26 and 34 per cent by 2050. It expects this increase to be "broadly manageable across our portfolio through regular pricing and underwriting reviews and through our reinsurance and capital management activities".[21] Although Suncorp has not reported on its exposure to New Zealand coastal hazards (taking a group level approach), it has stated that "over the next decade, an increase of less than 10 percent is expected in the combined, all-hazards average annual loss to the existing built environment due to climate change."[22]

Like banks, the approach of insurers to managed retreat has not been tested. However, we can gauge potential responses from three examples: Christchurch, Matatā and Westport. In Christchurch, insurers paid more than NZ$21 billion in claims arising from the 2011-2012 earthquake sequence.[23] EQC paid a further $10 billion, bringing the total insured cost of the event to more than $31 billion. A significant proportion of the cost to pay out red-zone homeowners in Christchurch was met through insurance, as most of the damage to homes and land was sufficient to warrant full payment by insurers (for the home) and EQC (for the land). Insurance is now unavailable for the 125 homes that remain in the red-zone. In Matatā, IAG continued to insure its customers throughout the retreat process, adjusting the cover provided to reflect both the valuation of homes and the transfer of ownership to the Whakatane District Council.

Following the latest flood in Westport, insurers paid $73.1 million in claims on house, contents and motor vehicle damage.[24] An additional $24.1 million was claimed in areas outside of the town. IAG proposed a managed retreat programme for the most exposed properties, where claims payments could be redirected. However, this proposal was unsuccessful, so the insurance money was used to repair affected homes in situ. Most insurers, including IAG and Suncorp, continue to provide insurance to Westport residents in much the same way as they did before the floods. But Tower Insurance has since introduced risk-based pricing for floods leading to their customers in Westport paying more than those elsewhere.

The primary role of insurers in response to the effects of climate change is to help fund recovery from natural disasters through the payment of claims to affected households and businesses. Other options could be considered, including maintaining cover through pre-emptive managed retreat processes, redirecting claim payments towards the post-event relocation of homeowners, and helping to create the right public policy and planning environment for such options to be developed. More broadly, insurers could help educate the public about the risks they face, incentivise and reward good risk decisions though their pricing and underwriting, and potentially invest in the funding of risk reduction infrastructure.

12.8 Māori business

Māori hold concentrated interests in sectors exposed to severe climate change impacts including forestry, fisheries and other primary industries. Natural resource-based sectors dominate Māori investments, with interests in agriculture, fishing and forestry totalling $23.4 billion (see Figure 7).[25] This includes $8.6 billion in sheep and beef farming; $4.9 billion in dairy farming; $4.3 billion in forestry; $2.9 billion in fishing and aquaculture; and $2.6 billion in other agriculture (including horticulture). Māori are also significant tourism operators. For example, about six million visitors engaged in activities with or related to Māori tourism in 2017, generating $1.7 billion in foreign exchange revenue and employing 14,000 people. Māori-led tourism has been identified by the government as an important area for growth in the sector.[26]

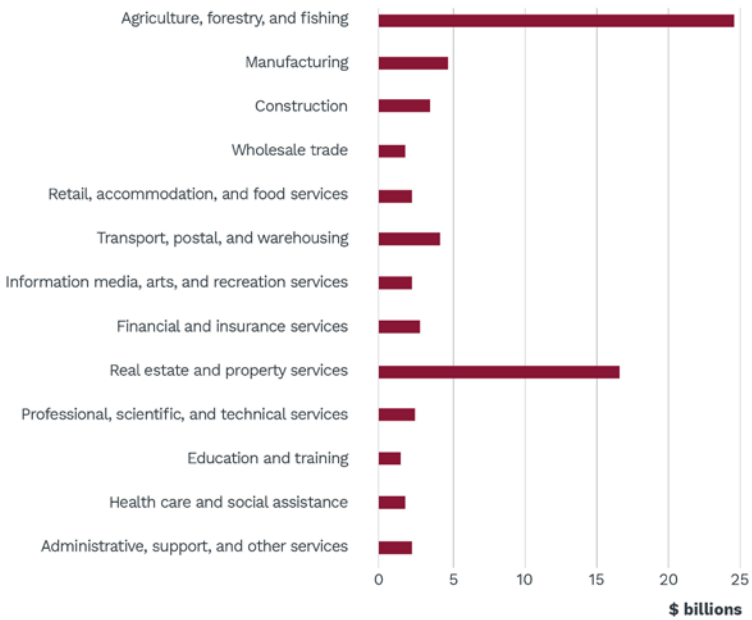

Figure 8: The value of different sectors in the Māori economy *(Source: Reserve Bank of New Zealand)*[27]

12.9 Funding managed retreat for business

Like communities, businesses exposed to climate change may need to relocate. Relocation is costly, and a decision will need to be made as to whether businesses incurring losses as a result of managed retreat should be eligible for any public compensation. If homeowners who treat houses as an investment were to compensated, should such funding similarly be extended to small business owners? After all, an individual may have chosen to invest in a business as opposed to a house.

There are many small to medium sized businesses that rely on income from land and/or landscapes that are unique and not easily substitutable. For example, crops require certain soils and climatic conditions to grow economic yields. Fish species can only grow in specific habitats and temperatures. Suitable locations for ski fields are limited. There may simply not be the waterways, landscapes or productive land available to relocate business to. There is also the issue of continued availability of supporting services, capital (human and natural) and infrastructure. Some businesses need an accessible customer base to be profitable such as supermarkets, restaurants, cafes and hotels.

All these variables mean that businesses may face issues, stemming from climate change impacts, that are not directly within their control. If roads to regional ports are damaged from landslips following an intense rain event this could impact the ability of a business to meet customer orders in export markets. Downstream this may lead to lower inventory and empty retail shelves. Consumers may decide to 'try' the other brand and permanently switch. Customers are likely to respond to shortage of supply by seeking to diversify suppliers to ensure reliable supply. These knock-on effects represent cascading risks to businesses from multiple sources.

The overriding question, in this context, is whether private enterprise is seen as separate to private asset ownership. Although there is an argument for compensating at least some businesses, this could also be viewed as market interference. Should businesses be assisted to move because they contribute to the economy and society? Or should they be left to fail, because they are not climate resilient, thereby freeing up resources for new enterprises which are? Further questions could be asked such as whether size (small, medium, large), employee numbers, location and ownership structure matter if businesses were to be compensated or assisted? Should iconic brands with high cultural value be compensated? Should low emitting and clean technology businesses be compensated over others?

Questions for discussion:
1. Should businesses be assisted in managed retreat and if so to what extent?
2. Should a market approach be adopted and businesses be left to fail?
3. How should Māori businesses be supported, if at all?
4. Should small enterprises receive compensation in a similar manner to homeowners (assuming they were compensated)?
5. Should some business sectors be assisted over others, and if so based on what criteria?
6. Should small business be supported above large business?

Endnotes

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13 Conclusions

Houses on the coastal frontline at Ocean Beach, Hastings

The impacts of climate change, and the need to move people, buildings and infrastructure out of harm's way, will be a significant challenge for Aotearoa New Zealand over coming decades. Managed retreat will be a costly process, but the overall societal costs should be significantly reduced in the longer term, if a well-designed, well-funded and well-managed approach is implemented by government in a timely manner.

This working paper has highlighted some key considerations that need to be addressed in designing such an approach. These include what the purpose of managed retreat should be, what worldview and principles might underpin policy, considerations around designing a public compensation scheme for the loss of residential property, providing for nature in managed retreat and addressing impacts on infrastructure provision and business. Throughout all these sections we have specifically considered impacts on Māori and how these might be addressed. We have posed a number of questions at the end of each chapter which we welcome constructive feedback on.

The EDS project's second working paper will examine the extent to which current law and policy provides an adequate framework and tools to undertake such managed retreat at scale.

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