Ministry for the Environment
Manatū Mō Te Taiao

Arotakenga Huringa Āhuarangi

A FRAMEWORK FOR THE NATIONAL CLIMATE CHANGE RISK ASSESSMENT FOR AOTEAROA NEW ZEALAND

New Zealand Government

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Making Aotearoa New Zealand the most liveable place in the world

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Foreword

Aotearoa New Zealand is already experiencing the impacts from a changing climate, and, due to past emissions, the climate will continue to change well into the future. However, the rate of change is intricately tied to what we do now to reduce emissions. In the absence of worldwide concerted effort to mitigate emissions in accord with the Paris Agreement, risks need to be assessed for the most extreme scenarios. These future changes will affect all New Zealanders, and we need to plan how we will respond and adapt, hand-in-hand with reducing our emissions.

Central government has an important role in this planning. It sets the direction so New Zealand's people, environment, infrastructure and economy are more resilient to the impacts of climate change. Central government's role in contributing to this direction is to:

- provide the legislative and policy framework
- provide information and guidance to support local government and businesses to make effective adaptive decisions
- fund research and publish information on climate change impacts
- prepare for and respond to major natural hazard events.

In recognising the critical importance of adapting to climate change, the Government has outlined a framework for enhanced leadership on adaptation that consists of:

- a National Climate Change Risk Assessment (NCCRA), to improve our understanding of the climate risks Aotearoa New Zealand faces
- a National Adaptation Plan that will outline the Government's approach to improving New Zealand's resilience to the effects of climate change
- monitoring and reporting on implementation of the National Adaptation Plan, to ensure accountability.

This document describes the framework and methods to be used for the first NCCRA, which will help to inform priorities for action in the forthcoming National Adaptation Plan by central government.

A values-based approach is taken in the framework, weaving in Te Ao Māori and engagement principles throughout, to produce a more comprehensive knowledge and skill base for understanding climate risks. The process combines scientific, technical and expert information with Mātauranga Māori, local knowledge and experience.

The framework aims to produce a risk assessment that will:

- improve the ability of decision-makers to make informed decisions in the presence of inevitable and, in some cases, substantial and irreducible uncertainty
- improve other stakeholders' understanding and foster and support the broader public interests in the quality of the decision-making process (for example, fairness, transparency, efficiency and preparedness).

The focus of the framework (and thus the NCCRA) is primarily on climate change risks at the national scale. It also aims to cover significant regional risks that would influence national priorities and budget processes, including rohe-based risks for iwi (eg, emergence of sub-tropical pests and diseases and fish species into Northland or receding snowlines and glaciers). Aotearoa New Zealand will also be affected by international influences arising from climate change policies or responses (eg, the re-insurance market, economic market signals from global reductions in greenhouse gases, climate-related migration and disruptive technology to reduce emissions), so the NCCRA and National Adaptation Plan will, over time, need to adapt to these influences. The first NCCRA will not consider transition risks or socio-economic projections, but these may be included in future iterations.

The framework recognises that the first national assessment will comprise mostly qualitative assessment and will integrate quantitative risk or exposure information where possible, ensuring sufficient flexibility to handle both types of information in a consistent manner. The qualitative assessment will include narrative kōrero (discourse) on values and aspirations, quality of life, wellbeing, and co-production of shared knowledge around impacts and implications. It will consider both tangible and intangible benefits and risks, and thereby take a holistic approach towards the wellbeing of Aotearoa New Zealand.

Expert panel members

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Central government agencies

Te Puni Kōkiri
Department of the Prime Minister and Cabinet
Treasury
Ministry of Transport
Ministry for the Environment
Ministry for Primary Industries
Ministry for Culture and Heritage

Department of Conservation
Ministry of Business, Innovation and Employment
New Zealand Transport Agency
New Zealand Defence Force
The Office for Māori Crown Relations – Te Arawhiti
Land Information New Zealand
Ministry of Civil Defence and Emergency Management

Local government

Local Government New Zealand
Auckland Council
Otago Regional Council
Whakatāne District Council
Hawke's Bay Regional Council
Gisborne District Council
Northland Regional Council
Nelson City Council
Environment Canterbury
Horizons Regional Council

He tirohanga Māori

Karakia (recitation)

Ko Rangi
Ko Papa
Ka puta, ko Rongo
Ko Tānemahuta
Ko Tangaroa
Ko Tūmatauenga
Ko Haumiatiketike
Ko Tāwhirimātea
Tokona a Rangi ki runga
Ko Papa ki raro
Ka puta te ira tangata ki te whai ao ki te ao mārama
E rongo whakairi ake ki runga kia tīna, tīna!
Haumi e, hui e, tāiki e!

A Māori worldview describes the interconnectedness of the environment and people and that the health and wellbeing of both are intertwined and deeply connected. Whakapapa (genealogy) is reflected in our environment, connecting people to place through ancestral connections, heritage and bloodlines. People draw sustenance from the natural environment in order to thrive, and the environment in turn must be taken care of by the people; the environment and people are both connected and co-dependent.

This karakia speaks of the orokohangahanga or creation narrative of Ranginui (Sky Father) and Papatūānuku (Earth Mother) and their children – ngā atua Māori (Māori deities). Through these atua, the various realms of our natural world and taiao (environment) and of tāngata (men and women) are represented. The karakia recites the whakapapa of these atua, beginning with Ranginui and Papatūānuku and their separation bringing forth te ao mārama (the world of light and enlightenment). It is through this process of seeking te ao mārama that the human form was created from the red ochre of the land, making both taiao (environment)and tangata (people) inextricably connected (Barlow and Wineti, 1991; Buck, 1950; Mead, 2016). The significance of this karakia and narrative in the context of te huringa āhuarangi (climate change) represents the deep connection and relationship between environment and people. The wellbeing and health of the environment and people are paramount – one must look after the other and vice versa.

Ki te kore te tangata e manaaki i tōna taiao, ka kore te tangata e whai oranga
If people do not take care of the environment, we are not taking care of our own health and wellbeing.

A holistic approach to understanding the impacts of climate change on the environment and people is required, to identify ways to adapt and prepare for change, and to change our practices to reduce the impacts. This framework recognises the importance of values as part of the holistic approach to a Te Ao Māori lens and perspective. To understand the implicit connections between taiao and tangata, we have developed a set of mātāpono (guiding principles and broad values) that contextualise the creation narrative in practical ways and that

represent the connection between taiao and tangata. These mātāpono underpin the entire framework, as well as the risk assessment process.

Ngā mātāpono (guiding principles)

The framework presented here for the Arotakenga Huringa Āhuarangi – the first National Climate Change Risk Assessment – is underpinned by a set of mātāpono that ensure the notion of taiao and tangata remain an important focal point when considering and undertaking the risk assessment.

The mātāpono, which are additional to Te Tiriti o Waitangi principles, are shown in box 1. These are based on the principles presented in the *National Disaster Resilience Strategy* (NDRS) (Ministry of Civil Defence and Emergency Management, 2019), with the addition of ōhanga (prosperity), which is informed by the Treasury's Living Standards Framework (LSF) (New Zealand Treasury, 2018). Both are discussed further in chapter A3.

The principles are framed so each is offered in te reo Māori and followed by a translation. The three points that follow each principle are not an exhaustive list but give examples of what the principle could look like in practice. This framework will be most successful when these principles are used to guide practice (both in the risk assessment process and in engagement) and, essentially, are lived.

Box 1: Ngā Mātāpono o Te Arotakenga Huringa Āhuarangi (Guiding Principles for the National Climate Change Risk Assessment Framework)

Manaakitanga (Care and reciprocity)

- Respect and care for others and the environment.
- Responsibility to prioritise wellbeing and health for both.
- Recognition that people and the environment are inextricable and connected.

Kaitiakitanga (Intergenerational sustainability)

- Protect and guard our taonga (environmental assets).
- Recognise the mauri (life force and essence) of the environment (ie, personification of landmarks and waterways).
- Guardianship of the environment for future generations.

Whanaungatanga (Connectedness and relationships)

- Recognition of Crown–Māori partnership through Te Tiriti o Waitangi.
- Engagement, communication and shared experiences.
- Collaboration and collective action with marae, hapū and iwi and communities.

Ōhanga (Prosperity)

- Recognition of intergenerational equity.
- Promotion of secure, stable and diverse livelihoods.
- Minimising negative externalities to our taonga from economic activities.

Rangatiratanga (Leadership and autonomy)

- Recognise, interweave and live Te Tiriti o Waitangi and its principles.
- Respect the notions of mana whenua, mana moana, mana taiao.
- Be guided by scientific, historic, local and traditional mātauranga.

Kia mahi ngātahi (Engagement and participation)

- National, regional and local agencies, including pan Māori, Māori, iwi and hapū representatives affected by the risk assessment and its outcomes, will be involved in the risk assessment process.
- Contributors to the risk assessment will have the opportunity to contribute to the development of the National Adaptation Plan (which will undergo a consultation process).
- The engagement process will seek input from participants in designing how they participate.

Kia āwhina (Support)

- Participation in the risk assessment will recognise the needs and interests of all participants, including decision-makers.
- Participants will be provided with the information they need to participate in a meaningful way; their views will be respected and given due consideration.
- The outcomes will be communicated to participants along with how their input affected decisions.

Part A: Background, context and methods

Wāhanga A: Te tuaroa, te horopaki me ngā tikanga mahi

Chapter A1: Introduction

A1.1 Climate change and the need for adaptation action

Climate change is not a future phenomenon. Its effects have already been observed around the world (IPCC, 2013) and will continue to be for decades, even if aggressive mitigation strategies are undertaken to reduce greenhouse gas emissions. This is because of the lag effects on atmospheric (and subsequently ocean) warming from long-lived gases present in the atmosphere from previous and ongoing activities. In addition to modifying our actions to curb emissions, we need to understand the present and future impacts, so we can plan for how to adapt to the inevitable environmental changes we will face. This will involve not only specific adaptation actions but enhancing our adaptive capacity and resilience to reduce, adjust to and take advantage of the consequences of change.

New Zealand is a signatory to the Paris Climate Agreement of 2015. Article 8 of the agreement stipulates the need for parties to:

> recognize the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage.

Article 8 also highlights the need to enhance understanding and action on "events that may involve irreversible and permanent loss and damage" and to consider non-economic loss (UNFCCC, 2015).

In New Zealand, some sectors have data on current and potential impacts and have considered adaptation options, but no comprehensive national assessment has been undertaken and no national adaptation strategy has been developed.

The proposed Climate Change Response (Zero Carbon) Amendment Bill submitted to Parliament on 8 May 2019 (the 'Zero Carbon Bill') sets a framework for New Zealand to develop and implement clear and stable climate change policies, and includes a mandate for undertaking a National Climate Change Risk Assessment (NCCRA) (New Zealand Government, 2019). The Bill, while provisional, provides for a planned approach to climate change adaptation based on the best available evidence, information and assessment of risks (see box A1-1).

Box A1-1: Adaptation – measures to increase New Zealand's resilience to changing climate

Understanding the risks, and what action is being taken to address them, will help New Zealand to coordinate efforts to adapt appropriately. This Bill will provide a framework for enhanced action on adaptation. This will consist of a national climate change risk assessment, a national adaptation plan, regular progress reporting on the implementation of the national adaptation plan, and an adaptation information-gathering power.

The national climate change risk assessment will be regularly prepared to improve understanding and prioritisation of the climate change risks that New Zealand faces. The national adaptation plan will outline the Government's planned approach to addressing risks highlighted in the national climate change risk assessment.

Climate Change Response (Zero Carbon) Amendment Bill (New Zealand Government, 2019)

The framework must consider the core elements of the NCCRA as proposed in section 5ZN (preparation of national climate change risk assessment) of the Zero Carbon Bill (New Zealand Government, 2019):

> …
>
> (2) In preparing a national climate change risk assessment, the Commission must take into account the following:
>
> (a) economic, social, health, environmental, ecological, and cultural effects of climate change:
>
> (b) the distribution of the effects of climate change across society, taking particular account of vulnerable groups or sectors:
>
> (c) New Zealand's relevant obligations under international agreements:
>
> (d) how the assessment aligns or links with any other relevant national risk assessments produced by central government entities:
>
> (e) long-term climate change trends:
>
> (f) any information received as a result of requests made under section 5ZV:[1]
>
> (g) scientific and technical advice.
>
> (3) The Commission may also take into account—
>
> (a) opportunities arising for New Zealand's economy, society, and environment as a result of the effects of climate change; and
>
> (b) any other factor that it thinks is relevant or appropriate.

A1.2 Assessing climate change risks for Aotearoa New Zealand

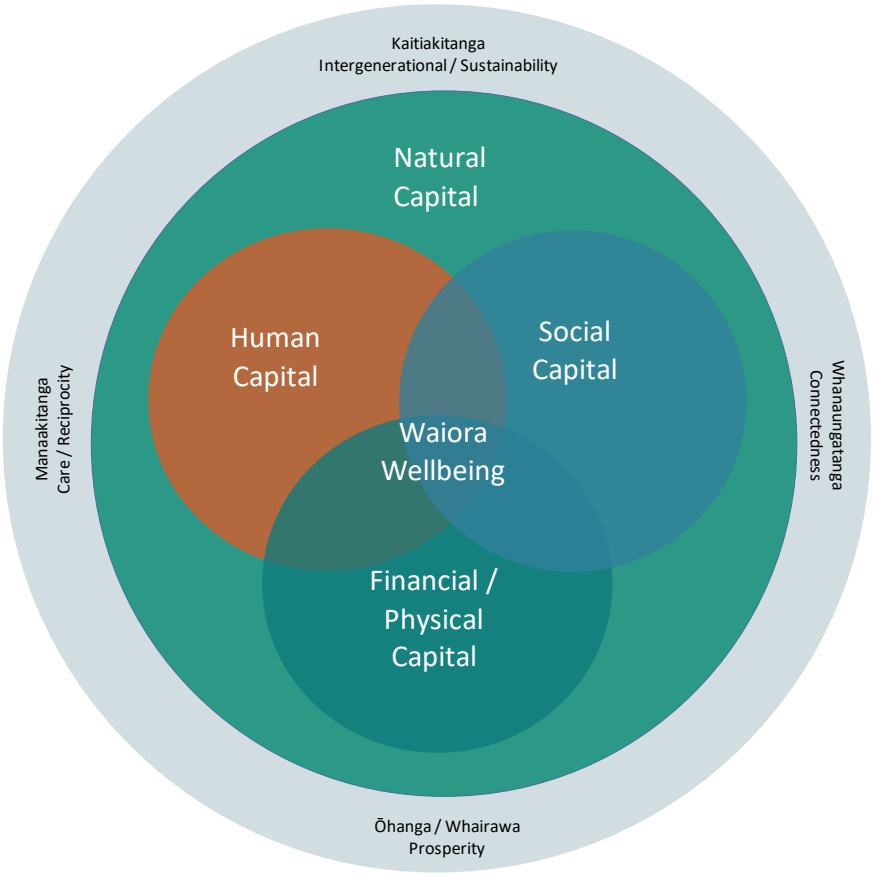
In responding to the imperatives discussed above, this document outlines a framework for the first NCCRA for Aotearoa New Zealand.

The opening karakia (page 10) portrays a Māori worldview and unique Aotearoa New Zealand lens to help frame our thinking about and approach to climate change. It emphasises the critical connections of people to the natural world and each generation to those before and after. This includes the connectedness of ecosystems, and society with them, as well as interdependencies of actions and consequences across domains. These interconnections are also reflected in the Treasury's Living Standards Framework (LSF) for wellbeing, based on four capitals – natural, human, social, and financial and physical – and particularly its proposed 'He Ara Waiora' framework (see figure A1-1):

> Waiora speaks to a broad conception of human wellbeing, grounded in water (wai) as the source of all life. The foundations for wellbeing come through kaitiakitanga (stewardship of all our resources), manaakitanga (care for others), ōhanga (prosperity) and whanaungatanga (the connections between us) (O'Connell et al, 2018, p ii).

[1] Section 5ZV: Minister may request certain organisations to provide information on climate change adaptation.

Figure A1-1: Treasury's Living Standards Framework (LSF) for wellbeing and the 'He Ara Waiora' framework



Source: The New Zealand Treasury (O'Connell et al, 2018, p ii)

As shown in figure A1-1, natural capital surrounds all the other capitals in the LSF. Our wellbeing is highly dependent on sustaining natural capital, or ecosystem 'services' (Roberts et al 2015),[2] which provide resources, moderate climate, absorb pollutants, cycle nutrients, and confer cultural and other benefits. These services are all supported by biodiversity: the animals, plants and micro-organisms that have adapted to, and interact in, the ecosystem. Ecosystems also include people and are shaped by cultural and social interactions. The LSF is complementary to a Māori worldview because it actively acknowledges the interconnectedness between people, natural capital and ecosystems. This complementarity of frameworks provides a useful starting point for our approach to climate change.

The LSF is applied within the context of shared societal values or principles of manaakitanga (care and reciprocity), kaitiakitanga (intergenerational sustainability), whanaungatanga (connectedness and relationships), ōhanga (prosperity), kia mahi ngātahi (engagement and participation) and kia āwhina (support). A further principle, or value, included for consideration

[2] Ecosystem services are the processes by which people obtain benefits from ecosystems, such as clean air, fresh water and the pollination of crops. These benefits are commonly classified as being one of four types: provisioning (eg, food, fibre, water, fuel, genetic resources); regulating (eg, air quality, climate, water flow, pollination, erosion control, pest and disease control); cultural (eg, spiritual, aesthetic, recreational, educational); or supporting (eg, photosynthesis, soil formation, nutrient cycling) (Roberts et al, 2015).

in the NCCRA is rangatiratanga (leadership and autonomy) (see He tirohanga Māori, box 1, for further definitions within the context of climate change).

Te Tiriti o Waitangi provides for the exercise of kāwanatanga (governance), while actively protecting tino rangatiratanga of Māori with respect to their natural, physical and cultural resources. Obligations under Te Tiriti o Waitangi involve recognising the special kaitiaki (guardian) role Māori have for natural capital and ecosystems, and the inherited responsibility to care for and protect resources and taonga (assets). As such, active partnership and resourcing of Māori, iwi and hapū within the process of implementing an NCCRA framework need to be adequately considered. Through this process, increased understanding of the future climate change impacts on taonga Māori, communities and values can be achieved. Potential considerations required when thinking about climate change and taonga Māori, in particular, will include (but are not limited to):

- the Māori economy is more reliant on natural resources than other parts of the economy, meaning it is more sensitive to climate change impacts and policies (which also means Māori businesses have a high stake in finding solutions)
- the number of Māori coastal communities and sites of significance is considerably high
- disproportionate climate change impacts on low-income families in which Māori are disproportionately represented
- the obligations of Māori to other indigenous Pacific peoples who will be affected by climate change.

Consistent with Te Tiriti o Waitangi principles (partnership, protection, participation and potential) (Environmental Protection Authority[3]) and the LSF, the recent *National Disaster Resilience Strategy* (NDRS) focuses on the resilience themes of social, cultural, economic, built and natural environments, and governance, underpinned by knowledge, data and assessment (Ministry of Civil Defence and Emergency Management, 2019). The outcomes sought are resilient homes, families and whānau; businesses and organisations; communities and hapū; cities, districts and regions; and enabling, empowering and supporting government. Together, the initiatives present an opportunity to emphasise a more connected and collaborative approach to understanding climate change risk for all of Aotearoa New Zealand, and they provide an important framework to underpin the NCCRA.

The interconnections noted above highlight the complex interdependencies of information needed to provide a complete understanding of wellbeing for Aotearoa New Zealand and how climate change will affect this. We need to understand how taonga are at risk and how climate change is affecting Māori and broader societal values, ways of doing and being. Further, we need to understand how to adapt in the face of an uncertain future to protect those values. This will require integration of information from various sources including biophysical, social and economic sciences, along with Mātauranga Māori.

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[3] Environmental Protection Authority. *He Whetū Mārama* https://www.epa.govt.nz/assets/Uploads/Documents/Te-Hautu/EPA-He-Whetu-Marama-English-poster.pdf

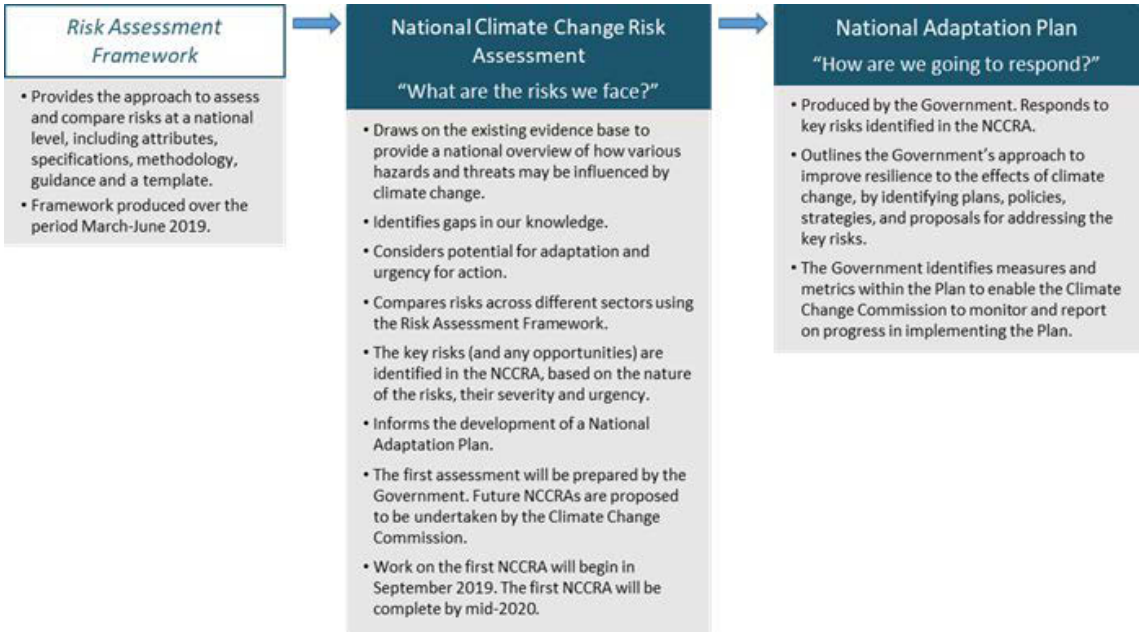
A1.3 Purpose of the National Climate Change Risk Assessment framework

The first step towards producing the NCCRA is to develop a risk assessment framework that enables a broad range of risks to be systematically compared in a manner consistent with the values of Aotearoa New Zealand (as reflected in the NDRS and LSF; see section A3.1) and the mātāpono (guiding principles) for the framework (see He tirohanga Māori, Box 1). This report presents that framework and guidance on undertaking the risk assessment to obtain a national-scale overview of New Zealand's present and future climate-related risks under different scenarios of climate change.

The objective of the risk assessment derived from applying this framework is to inform the development of a National Adaptation Plan that will be prepared following completion of the first NCCRA (and subsequent NCCRAs). This will respond to and prioritise the adaptation actions for key risks identified in the NCCRA, and outline the Government's approach to improving resilience to the effects of climate change. Figure A1-2 shows the process leading to a national adaptation plan and where the NCCRA framework sits in this process.

The framework is consistent with internationally applied risk assessment elements but seeks to place greater emphasis on engagement (including co-produced elicitation processes, eg, 'risk workshops') and the framework's mātāpono. Processes for engagement and evaluation are considered at every step.

Figure A1-2: Role of the National Climate Change Risk Assessment (NCCRA) framework in enabling development of the NCCRA and subsequent National Adaptation Plan



Chapter A2: Framework methodology

A2.1 Framing climate change risk

The term 'risk' generally concerns the loss or gain of something of value (people, assets, ecosystems, cultural taonga, infrastructure and so on) and is usually considered as a combination of the consequences of an action or event, and its likelihood. Risk assessments aim to understand the nature and determine the level of risk, and are done to inform decisions or actions to reduce risks or take advantage of opportunities associated with such events.

Climate change, however, creates cascading and gradual-onset impacts that occur when an ongoing trend (eg, sea-level rise, atmospheric temperature rise, ocean acidification and so on) reaches various thresholds or tipping points with regard to a particular system. The associated risks are not strictly event-based, so estimating the likelihood of occurrence of an event as a major component of the risk is less useful. The changing risk environment requires more emphasis on consequences (questions of 'what can happen'? and 'how bad might it be?') than on an estimation of likelihood ('how likely is it to happen?'). For example, sea-level rise is already under way. There is no question about whether a rise of 0.5 metres will occur; rather it is more a matter of when that level is reached and what the consequences will be.

For these reasons, risk in the context of climate change is best framed using the elements of **hazard**, **exposure** and **vulnerability**, with the overlap defining the risk (see figure A2-1) (IPCC, 2014b). Risk is a function of climate hazards (which can be physical *events* or *trends,* such as sea-level rise or seasonal climate changes), the degree to which things we value (people, assets, taonga) are exposed to the hazard and their vulnerability to its effects. Vulnerability is influenced by socio-economic and cultural processes (including adaptation and mitigation actions and governance), which can increase or decrease the **consequences** (and therefore the risk) resulting from exposure to a hazard.

Figure A2-1: Schematic of the interaction between the physical climate system, exposure, and vulnerability producing risk

Source: Climate Change Adaptation Technical Working Group (2017) (adapted from IPCC, 2014b)

Note: Vulnerability and exposure are determined by the cumulative result of socio-economic pathways (development) and societal conditions and the interplay with changing hazards. Changes in both the climate system (left side) and socio-economic processes (right side) will continue to be central drivers of hazards, exposure and vulnerability.

A2.2 Risk assessment process components

The risk assessment steps will be underpinned with the mātāpono (as given in box 1), which should inform how the steps of the risk assessment process will be carried out.

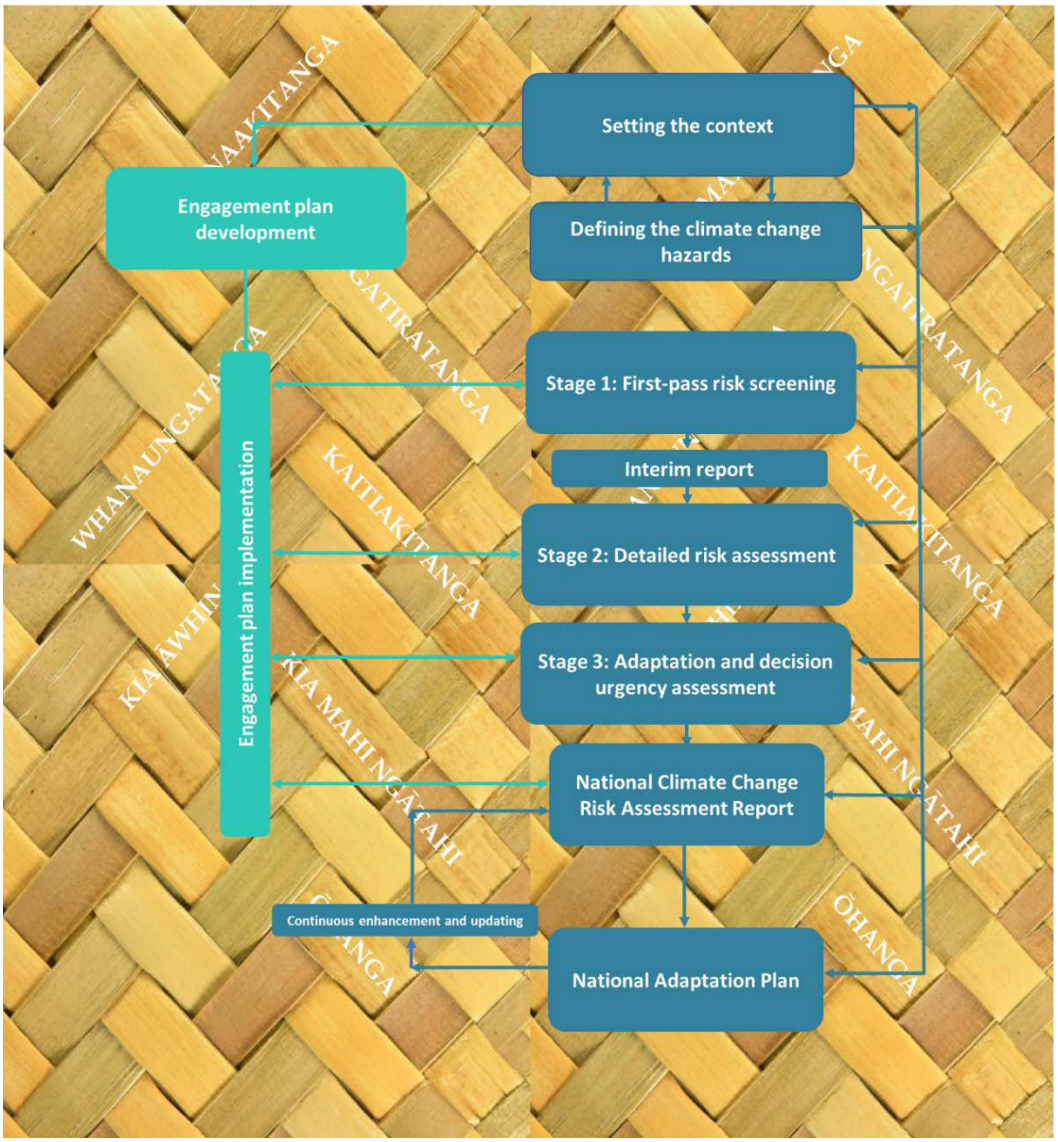
Assessing risk across domains in a meaningful way for decision-makers is challenging, especially for decisions on climate change action that intersect with other policy domains. It is critical to note that climate change risks themselves are interconnected and often arise from *compounding* hazard sources (eg, flooding from sea-level rise plus groundwater plus more intense rainfall) and *cascading* impacts that affect multiple systems and assets in complex ways. Climate change risk assessment must consider inter-related risks to ecosystems, physical assets and infrastructure systems, the economy, and society (including human health, safety and wellbeing, and cultural life and identity).

The NCCRA framework takes a three-stage assessment approach to screen for, analyse and compare risks across domains and sectors in terms of magnitude of risk and urgency for adaptation action, to inform a National Adaptation Plan. Engagement occurs at every stage. These stages recognise the iterative nature of climate change risk assessment.

The assessment starts from setting the context, which involves defining the 'elements at risk' across broad 'value domains'. It then assesses climate change hazards in relation to these elements. It does this first in a high-level screening stage, and then takes the risks identified as having moderate-to-high potential consequences through more detailed assessment. This is followed by scoring for urgency of adaptation decision-making. As noted, when proceeding through the risk assessment, consideration must be given to cross-cutting issues and impacts, that is, when an impact on one element has cascading effects on other elements or sectors, thereby increasing the overall or cumulative risk.

Figure A2-2 gives a brief outline of the risk assessment process (the framework) components, which are discussed further in subsequent chapters. Chapter A3 describes 'setting the context', and chapter A4 discusses principles of engagement (including details of engagement plan development presented in chapter C1). The process for defining climate change hazards, and the three assessment stages, are described in the technical chapters in Part B. Implementation of the engagement plan occurs at each stage.

Figure A2-2: Overview of the National Climate Change Risk Assessment framework methodology, including the three-stage assessment approach



Note: The methodology is underpinned by the mātāpono (guiding principles) for the framework.

Setting the context (chapter A3)

This step involves setting the overall objectives of the assessment process and other context elements, including:

- identifying values at risk
- identifying stakeholders and partners (who is affected and who manages the risks?)
- defining climate change projections and timeframes for the hazard component of risk
- deciding criteria to assess impacts, exposure and vulnerability
- confirming strength of evidence criteria
- confirming urgency criteria for adaptation decisions
- establishing the scale of assessment.

Engagement plan development (chapter A4 and chapter C1)

An engagement plan is to be developed (using best practice methods and underpinned by the Royal Society of New Zealand's code of ethics) during the context-setting and understanding stage.

- Best practice on engagement with Māori should be followed (eg, Office for Māori Crown Relations (2018) *Guidelines for Engagement with Māori*), involving a person with knowledge and experience of Māori engagement principles in the process.
- Engagement is needed at each stage of the assessment process.
- Expert elicitation will form the fundamental method for obtaining information from the different sectors. Because expert biases can result in perverse outcomes, it is important that structured elicitation protocols are followed and the reconciliation across experts is undertaken in a transparent and robust manner.

Defining the climate change hazards (chapter B1)

This step develops descriptors of present-day hazards (including ongoing climate-related stressors – see box A2-1) that have been observed and the projected changes in their magnitude and frequency for two future timeframes and two different global emissions scenarios. The hazards are to be developed for seven climate zones that represent broad, sub-national climatologies in Aotearoa New Zealand. This step includes:

- examining a pre-selected list of hazards (table B1-1) and confirming they are the main climate change hazards (effects) that could impact each value domain and sector
- obtaining or determining projections of the magnitude and direction of change, or changes in the frequency of occurrence of each hazard for two different global emissions scenarios (RCP8.5 and RCP4.5 – see section A3.3), and at two timeframes of around 30 years, for example, a decade around 2050 and 100-plus years (by 2100) – see section A3.3. Note that coastal hazard risks should also be appraised for 2150, to highlight the continuing rising risks and pathway dependencies for consideration later in the National Adaptation Plan
- agreeing on the present state of change in these hazards (as the baseline) and determining and agreeing on the changes in hazards from knowledge, modelling, projections and elicitation processes
- carrying forward a summary table of hazard descriptors to be used in the three-stage assessment process.

Box A2-1: Defining hazards

'Hazard' is defined according to the Intergovernmental Panel on Climate Change (IPCC) definition, as:

> the potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources (IPCC, 2012, pp 555–564).

In this report, the term hazard usually refers broadly not only to climate-related hazard events (as conventionally understood) but also evolving trends or their gradual onset physical impacts (eg, change in summer temperature or pH decrease in the ocean).

Assessment Stage 1: First pass risk screening (chapter B2)

This stage is a high-level desktop exercise using expert input. Risks are assessed for the timeframes indicated in chapter A3, comparing the present day to the RCP8.5 projection.

- **Step 1: Establish context, scope and parties involved:**
  - confirm parties and elicitation processes for each value domain
  - confirm qualitative criteria (strength of evidence, consequences)
  - define aggregation of risks from sub-national climate zones.
- **Step 2: Identify the existing climate risks** (for present day, eg, the past two decades) for the sectors and elements defined in the context-setting phase. This answers questions of: 'What can happen?' and 'To what extent is the asset, taonga, sector already affected?'.
- **Step 3: Analyse risks** for future climate change impacts and opportunities for the recommended timeframes and RCP8.5 climate change projection only at this stage.
- **Step 4: Evaluate risks** to determine the need for detailed risk assessment or exploration of opportunities. Highlight significant gaps requiring dedicated future effort. Evaluate against consequences criteria and identify risks that rank 'moderate' or 'high' to carry forward to the next stage to assess in more detail. Prepare an interim report explaining high-level findings of the key risks from the Stage 1 screening.

Assessment Stage 2: Detailed risk assessment (chapter B3)

For risks identified in Stage 1 risk screening (chapter B2), analyse and evaluate future risks and opportunities based on the two selected climate change projections and timeframes (chapter B1).

- **Step 1: Establish context, scope and parties involved:**
  - confirm list of risks from Stage 1 to explore in detail
  - confirm parties and elicitation processes based on Stage 1 identified risks
  - **hazards:** use additional sources and knowledge, and in-depth stakeholder and expert engagement, to gain more detailed information on the hazards shown to affect the identified key elements at risk and their projected changes. This includes the additional extended timeframe to 2150 only for coastal hazard risks related to flooding.
- **Step 2: Exposure assessment:** Assess the current and potential future exposure of the assets, taonga, sectors (those already identified as being exposed and/or at risk in Stage 1)
- **Step 3: Vulnerability assessment:** For assets, sectors and taonga identified as being significantly exposed in Step 2, assess the sensitivity and overall adaptive capacity of the assets, taonga and sector to the hazard, to derive a measure of vulnerability.
- **Step 4: Consequence assessment:** From results of steps 2 and 3, evaluate the potential severity of consequences under the prescribed climate change projections and timeframes (chapter B1). Consider the implications of cross-cutting risks affecting multiple domains or sectors.
- **Step 5: Risk scoring:** Assign risk rating based on consequences at the national scale and carry forward to Stage 3.

Assessment Stage 3: Adaptation and decision urgency assessment (chapter B4)

Taking risks from Stage 2, analyse the current and planned adaptation to highlight risks for which adaptation decisions need to be made most urgently, to inform a National Adaptation Plan.

- **Step 1: Assess current and planned adaptation:** Are these actions sufficient to manage the evolving risk? Are they sufficiently flexible to account for uncertain future changes?
- **Step 2: Assess decision urgency:**
  - consider actions that have long lead times
  - consider where action is required early to avoid current pathway dependency (maladaptation) or irreversible negative consequences
  - identify research gaps where strength of evidence is low for the higher perceived risks or where there is deep uncertainty
  - identify monitoring gaps.
- **Step 3: Report on key risks** based on severity and urgency for adaptation decisions and action, highlighting where more action is needed or there is a research priority.

This climate risk assessment will be completed through analysis of existing data and literature, and collaborative elicitation with experts, Māori, iwi, hapū, and key stakeholders including government departments and other custodians of those risks. Guidance is given for engaging with and consulting stakeholders, Māori, iwi, hapū, experts and sector adaptation leaders to gather information and produce agreed risk rankings and to evaluate the key risks to be addressed.

The result of the risk assessment will inform the National Adaptation Plan. Monitoring and review of the National Adaptation Plan is proposed as being the mandate of the Climate Change Commission.

Chapter A3: Setting the context for the National Climate Change Risk Assessment

A3.1 Background

The first step in a risk assessment is to set the context. This includes establishing objectives, identifying key elements at risk, identifying stakeholders, determining criteria against which risks will be rated, and, in the case of climate change risk assessments, describing the climate scenarios to be used.

The objective of the NCCRA and subsequent National Adaptation Plan is to safeguard the wellbeing of Aotearoa New Zealand into the future in the face of uncertain climate change risks. It is about ensuring the protection and enhancing the resilience of significant environmental, cultural and societal values and resources, the built environment and the economy.

The following sections describe the elements involved in setting the context for the NCCRA.

A3.2 Defining what we value

To identify risks, we need to understand what is at stake: what we value and want to protect. For the NCCRA, this means defining national values and taonga that may be at risk from the observed and potential impacts of climate change. In risk management terminology, these are often referred to as 'assets', or elements at risk, but they are not just physical things; both tangible and intangible values are included.

The approach chosen to identify at-risk elements for the first NCCRA draws on and aligns with the Treasury's LSF, which provides a means for organising indicators of sustainable intergenerational wellbeing, and the NDRS, which details priorities and objectives for increasing New Zealand's resilience to disasters.

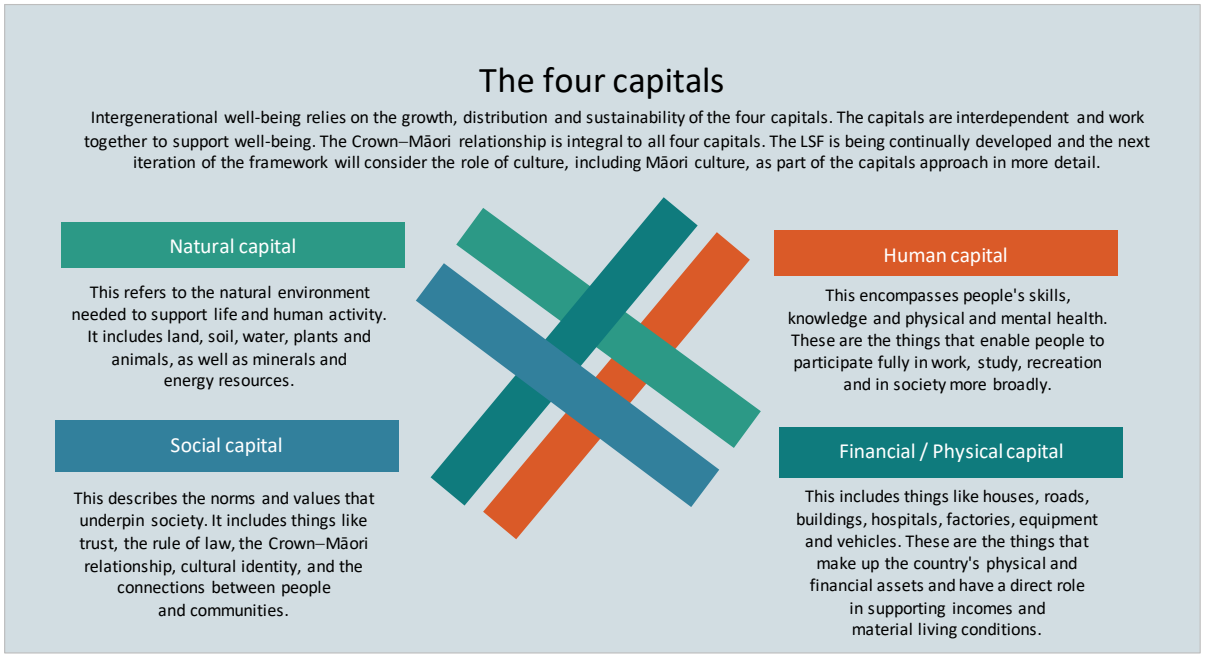
The LSF's four capitals – natural, human, social, and financial and physical – represent broad categories of values and assets that contribute to wellbeing. These can be applied at the individual, community or national level. Similarly, the NDRS categorises elements and assets (also termed capitals) under broad categories of social, cultural, economic, built environment, natural environment, and governance. This provides a structure for the NCCRA framework to gain an understanding of risk in terms of 'value domains' – groups of things we value as a society – that align with the NDRS and LSF.

As discussed in chapter A1, from a Māori perspective, the intertwining of people (tangata) and environment (taio) underpins wellbeing and forms the basis for all other interactions, because we rely on natural resources for sustaining life. Natural resources are also critical for all other capitals. For example, physical capital (built environment and infrastructure) relies on the integrity of the natural environment (land use, soils, water, coastal) and human capital to

maintain it. Natural capital is also important for cultural and social capital (cultural life, community), and financial capital (eg, for primary industries, tourism, fisheries).

Figures A3-1 and A3-2 show the four capitals of the LSF and six domains (capitals) of the NDRS respectively.

Figure A3-1: Four capitals of the Living Standards Framework



Source: The New Zealand Treasury

Figure A3-2: Framework for the National Disaster Resilience Strategy

Source: Department of the Prime Minister and Cabinet, 2019

Table A3-1 describes how these frameworks overlap and how sectors and 'elements at risk' can be conceptualised and assessed in the NCCRA framework. It also establishes and explains 'value domains' for assessing risk, which align with the domains and capitals of the NDRS. The descriptions in table A3-1 recognise the interconnectedness of these domains and their impact on the capitals of the LSF, as highlighted by the colour coding in the table.

Table A3-1: Value domains based on the National Disaster Resilience Strategy (NDRS) and Treasury's Living Standards Framework (LSF)

Value domain	Description
Human	The LSF defines **human capital** as people's skills, knowledge and physical and mental health. The two last aspects are likely to be the most affected by climate change, though access to education and knowledge networks may also be compromised. The human domain encompasses both **social** and **cultural** elements, so these themes are not distinct. Human health and wellbeing are intertwined with the wellbeing of the **natural environment**.
Society	As defined in the LSF, **social capital** encompasses both **social** and **cultural** domains of the NDRS and also relates to and affects **human capital**. The LSF defines social capital as the norms, rules and institutions that influence how people live and work together and experience a sense of belonging (social cohesion). It includes trust, reciprocity, the rule of law, cultural and community identity, traditions and customs. Similarly, the NDRS includes social capital, health, education, welfare, justice and protection as the main factors of social resilience. **Cultural** values, identity and life, heritage, taonga and Mātauranga Māori are identified as the main cultural resilience factors.
Culture	**Culture** is commonly defined as "that complex whole which includes knowledge, beliefs, arts, morals, laws, customs, and any other capabilities and habits acquired by [a human] as a member of society". All people have culture; it is not limited to specific categories or geographical boundaries. All culture is subject to reinterpretation and therefore can change through time and space. The term '**cultural life**' has a more formal definition in international conventions. Within this value domain, the term 'cultural life' includes how people access, participate, experience, enjoy, develop and share their culture within their communities. **Cultural heritage** can be seen as 'ngā taonga tuku iho nō ngā tūpuna', something from our culture that can be acquired or inherited from the past, that we value today and wish to pass on to future generations. Cultural heritage can be divided into two main categories: tangible and intangible cultural heritage. The **natural environment** can also be regarded as having a cultural aspect, along with cultural landscapes and physical, biological or geological formations. Social identity can be derived from natural capital like land, mountains, rivers and lakes.
Natural environment	**Natural capital** encompasses all aspects of the natural environment that support life and human activity. This includes: • land, land use and soils • freshwater • biodiversity – plants and animals • coastal and marine ecosystems • He Kura Taiao – living treasures. Biosecurity (against pests and diseases) is important in maintaining natural capital. The natural environment sustains **human** wellbeing and all other domains.
Economy	In the NDRS, **economic** resilience relates to the resilience of businesses, livelihoods, financial management (banking) and insurance sectors. The LSF categorises economic wellbeing in terms of **financial capital**, but the economy is also dependent on both **human** and **natural** capital.

Value domain	Description
Built environment	The **built environment** encompasses infrastructure, transport, buildings and housing, and urban areas. The LSF indicator of wellbeing in this domain is **physical capital**.

A3.3 Identifying key elements, partners and stakeholders

The framework outlined in table A3-1 can be used to identify elements at risk, including sectors (eg, primary industries or infrastructure) and subsectors (eg, agriculture, energy infrastructure) as well as tangible and intangible assets and taonga (eg, things like community wellbeing and cultural values).

This process involves:

- using the value domain framework to identify sectors, systems, taonga and assets ('elements') at risk in each domain, noting that many elements cross domains and impacts on one may affect several others in the same domain or different domains. All four capitals (LSF) should be considered within the six domains (NDRS) to ensure coverage of all key value areas for Aotearoa New Zealand
- identifying the key agencies, partners, stakeholders and organisations concerned with risk management of these sectors, systems, taonga and assets. From a national governance perspective, these will be ministries and government agencies, and iwi and pan-Māori groups, as well as stakeholders for whom the identified element at risk has particular value. These parties should be engaged in the process of identifying assets at risk (see chapters A4 and C1).

Table A3-2 lists examples that can be used as a template to identify potential elements at risk via an engagement process for analysis in the NCCRA. It should be noted the list of stakeholders is not complete and may change over time. It will need to be fully scoped during the engagement planning stage. The NCCRA assessor may refine this further (ie, add or modify subsectors). For use by sub-national agencies, these may also be modified as appropriate.

Table A3-2: Sectors and potential elements at risk, according to domains in the National Disaster Resilience Strategy

Value domain		Sectors, assets, taonga (elements at risk)	Agencies, partners and stakeholders
Human	**Society**	Community wellbeing, social cohesion and social welfare: • urban communities • rural communities • coastal communities	MSD, local councils, SOLGM, LGNZ, MPI, Federated Farmers
		Health	MOH, DHBs, PHOs
		Education	MOE, TEC
		Sports, recreation	MCH, DOC
	Culture	Cultural heritage: • archaeological sites • museums, arts, theatre	MCH, MPP… others DOC
		Ahurea Māori, tikanga Māori – Māori culture, Māori values and principles	TPK, iwi, pan-Māori, Iwi Chairs Forum, Māori Women's Welfare League, New Zealand

Value domain	Sectors, assets, taonga (elements at risk)	Agencies, partners and stakeholders
		Māori Council, Māori Climate Change Commission
	Cultural taonga	TPK, iwi, pan-Māori, DOC
Natural environment	He Kura Taiao – Living treasures	TPK, iwi, pan-Māori, DOC, Iwi Chairs Forum, Māori Women's Welfare League, New Zealand Māori Council, Office of the Māori Climate Commissioner
	Freshwater	MfE, MPI, DOC, regional councils, PCE
	Coastal, estuarine and marine ecosystems	MfE, MPI, DOC, regional councils, EPA, Hauraki Gulf Forum, PCE
	Biosecurity – safety from pests and diseases	MPI
	Land use	LINZ, LGNZ, regional councils, local authorities, DOC, MPI, MfE, PCE
	Biodiversity	MfE, MPI, DOC, regional councils, PCE
Economy	Primary industries: • fisheries • aquaculture and marine farming • forestry • agriculture • horticulture and viticulture	MPI MPI, DOC, MfE, Aquaculture New Zealand MPI, DOC, MfE MPI, DOC, MfE, Beef + Lamb New Zealand, Dairy NZ, Horticulture New Zealand, New Zealand Winegrowers
	Tourism	MBIE, DOC, Tourism New Zealand
	Technology and business	MBIE
	Whakatipu rawa – Māori enterprise	TPK, iwi, pan-Māori, Iwi Chairs Forum, Māori Women's Welfare League, New Zealand Māori Council, Māori Climate Change Commission, FOMA, Te Tumu Paeroa
	Insurance and banking	Treasury, New Zealand Insurance Council, banks
Built environment	Infrastructure and services	Local councils, specific sector organisations, New Zealand Lifelines Council, Infrastructure Commission, Treasury, SOLGM, LGNZ, Engineering New Zealand
	• Water	Water New Zealand, MOH, MfE, DIA
	• Energy	MBIE, Electricity Authority, Transpower, lines companies, electricity generators, GIC, Refining New Zealand, EECA, Commerce Commission
	• Transport	MOT, New Zealand Transport Agency, KiwiRail, CAA, lifeline utility airports, lifeline utility ports
	• Information communication technology and communications	MBIE, Vodafone, Spark, 2degrees
	• Waste management	WasteMINZ, MfE

Value domain	Sectors, assets, taonga (elements at risk)	Agencies, partners and stakeholders
	• Buildings and housing	MBIE, BRANZ, Housing New Zealand, local councils, MHUD, Engineering New Zealand
	Urban spaces	Local councils, MHUD
	Te Whare Āhuru He Oranga Tāngata – Safe homes, healthy people	Housing New Zealand, MBIE, TPK, iwi, pan-Māori, Iwi Chairs Forum, Māori Women's Welfare League, New Zealand Māori Council, Office of the Māori Climate Commissioner, Te Aranga
Governance	Natural hazards	MCDEM, MfE, regional council special interest group on natural hazards, regional and local councils, DOC (coastal)
	Defence	MOD, NZDF
	National security and justice	DPMC, MOD, MOJ, NSS, MFAT
	Treaty partnerships	Office of Māori–Crown Relations, MOJ, iwi, pan-Māori, Iwi Chairs Forum, Māori Women's Welfare League, New Zealand Māori Council, Office of the Māori Climate Commissioner, DOC
	Fiscal	Treasury, Reserve Bank of New Zealand, Office of the Auditor-General

Note: These domains and elements should be assessed against impacts on all four LSF wellbeing capitals. Not all agencies, partners and stakeholders have been identified, and those listed are meant as a guide only. The assessor will need to map out these elements. Refer to the Abbreviations for the full names of agencies, partners and stakeholders.

A3.4 Selection of timeframes and climate change projections to assess risks

Selection of timeframes

The NCCRA framework considers three timeframes for assessing risks (and opportunities) from climate change. A fourth timeframe is considered in Stage 2 assessments for coastal hazard risks arising from ongoing rising sea level.

1. **Present day (past 10–20 years)**, it is important to isolate impacts that are already occurring from climate change as a starting point for considering urgency on the higher risks identified through the three-stage assessment process. Canvassing the present situation was seen as a strength of the second NCCRA in the United Kingdom (Warren et al, 2018). This is also a useful starting point in engagement and elicitation processes before considering future impacts.
2. **Thirty years**, which is nominally around 2050 (or the decade 2040–2050). This covers the next few cycles of council long-term plans, and 30 years is the planning timeframe for local government infrastructure strategies (Local Government Act 2002, s101B) and asset management plans. It is also aligned with the longer terms granted for resource consents (up to 35 years), to better highlight climate risks at that juncture.
3. **By 2100 (around 60–80 years)**, which is typically used as the juncture for detailed climate change projections up until now (this timeframe enables projections for a wide range of climate variables to be used without the need for extrapolation). The 2080–2100 period

will suffice, even though some decisions require at least 100-year timeframes, because the main objective of the national risk assessment is to prioritise actions for the higher risks on a comparative basis.

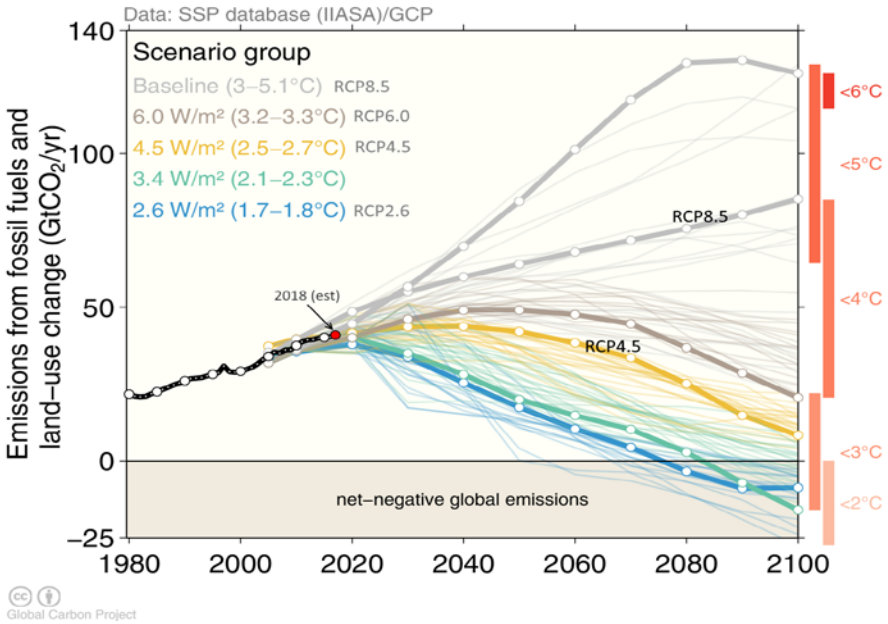
4. For **coastal hazard risks** related to sea-level rise, also appraise the risks out to **2150** in the Stage 2 assessment, given:
    i. that the mandate to assess coastal hazard risks (including climate change) out to "at least 100 years" is present in the *New Zealand Coastal Policy Statement 2010* (Department of Conservation, 2010);
    ii. a set of New Zealand-specific projections for sea-level rise is available out to 2150 in the Coastal Hazards and Climate Change Guidance (Ministry for the Environment, 2017, p 105, figure 27), and
    iii. coastal flooding risk exposure mapping for coastal areas up three-metre rises already exists at the national scale (Parliamentary Commissioner for the Environment, 2015; Paulik et al, 2019; LGNZ, 2019).

Iwi and hapū are often mindful of and concerned with the longer-term view beyond 100 years around coastal areas that are facing ongoing impacts of sea-level rise on taonga and cultural sites. Consideration of this 2150 timeframe will highlight any potential lock-in or pathway dependency issues with the suggested actions at Stage 3.

Selection of climate change projections

The climate change projections recommended in the NCCRA framework are derived from four representative concentration pathways (RCPs) that were used by the Intergovernmental Panel on Climate Change (IPCC) in its fifth Assessment Report (2013–2014) (IPCC, 2014a). RCPs represent and describe a limited number of possible climate futures (figure A3-3) to work with in assessments. These few RCPs globally represent various scenarios in terms of the additional radiative forcing or heating (Watts) per square metre area of the Earth since pre-industrial conditions in 1750. The RCP emissions pathways also incorporate land use change, population projections and social and economic changes that could occur on a global scale.

Figure A3-3: Range of possible global pathways for carbon dioxide (CO_2) emissions from fossil fuels and land use change with projected global temperature ranges by 2100



Source: Adapted from the Global Carbon Project: www.globalcarbonproject.org/carbonbudget/18/presentation.htm (Slide 40)

Note: The representative concentration pathways (RCPs) used by the IPCC are annotated in the legend and the two RCPs selected for the NCCRA are annotated on the graph. The black line shows the trend in global carbon dioxide emissions up to 2018. GCP = Global Carbon Project; $GtCO_2/yr$ = gigatonnes carbon dioxide per year; IIASA = International Institute for Applied Systems Analysis; SSP = shared socio-economic pathways; W/m^2 = Watts per square metre.

The two RCP projections selected for the overall risk assessment, with the median (50-percentile) projections of mean annual temperature rise relative to a 1986–2005 baseline (Ministry for the Environment, 2018; tables 5 and 6, pp 38–39), are:

- **RCP 4.5** – with a range of mean annual temperature projected across Aotearoa New Zealand of 0.7–0.9 degrees Celsius by 2031–2050 and 1.3–1.4 degrees Celsius by 2081–2100
- **RCP 8.5** – with a range of mean annual temperature projected across Aotearoa New Zealand of 0.9–1.1 degrees Celsius by 2031–2050 and 2.8–3.1 degrees Celsius by 2081–2100.

For the initial risk screening stage (Stage 1, chapter B2), only the higher RCP 8.5 projection is needed, because the purpose of the screening is to compare and determine the major climate-related risks to analyse during the detailed risk assessment. It also reduces the effort required and enables a wider breadth of impacts to be appraised and compared, under a single high scenario of continuing global emissions at the present rate. The use of two climate change projections is, however, recommended for the detailed risk assessment stage (Stage 2, chapter B3) to encapsulate uncertainty surrounding the future trajectory of global greenhouse gas emissions (figure A3-3) and associated climate responses.

A3.5 Risk and urgency criteria

Decision-making criteria flow from the objective of the NCCRA, which is to inform the development of the National Adaptation Plan (see section A1.3). This means a focus on

national-level risks and an assessment that allows central government to prioritise actions that will have the greatest benefit on a national scale.

Risks will be rated based on:

- the severity and magnitude of their consequences
- the strength of evidence for the estimates of events occurring (hazards) or thresholds being crossed (stressors and trends) with respect to the selected climate change projections over the selected timeframes (see section A3.4 and chapter B1)
- the urgency of decision-making for adaptation to address the most significant risks.

The criteria to select risks include:

- strength of evidence for describing hazards, and assigning risk scores (see table C2-1 in chapter C2)
- magnitude of consequences (exposure and vulnerability) across all four LSF capitals (see table C2-2 in chapter C2)
- urgency with which decisions need to be made (chapter B4).

For each element and asset, risks are rated by combining the consequence scores for each of the affected LSF capitals. It should be noted that the first NCCRA will not incorporate socio-economic projections into the rating of consequence magnitude and severity. This may be used in future iterations of the framework, incorporating techniques to assess the influence of (uncertain) socio-economic changes.

The framework does account for current and planned adaptation and the effect that existing government policy or actions already have on influencing the level of risks.

A3.6 Scale of assessment

The NCCRA is a national-scale assessment of climate change risks. A challenge for national-level assessments is how to deal with different geographical responses and differing levels of exposure to climate stressors so risk measures are not diluted when aggregating to a national scale. This can result in missing significant impacts that affect only some regions (eg, primary production, tourism or metropolitan infrastructure) or result from different frequencies of extreme hazard events at the regional scale but that contribute to cumulative impacts.

To consider climate-related changes that will manifest in different impacts across geographical regions, the assessment will be carried out in the six sub-national regions used by the National Institute of Water and Atmospheric Research (NIWA) for assessing seasonal climate outlook (NIWA, 2019b), plus a seventh zone for the Chatham Islands.

Chapter B1.1 describes the regions. Risks deemed to be high or extreme at these regional scales are considered to be national risks. Similarly, where a risk rates as moderate or high in multiple regions, it is also considered a national risk.

The methodology for this assessment is explained in detail in chapter A2 and Part B. Information about using the framework at different scales is presented in chapter C5.

Chapter A4: Risk assessment engagement

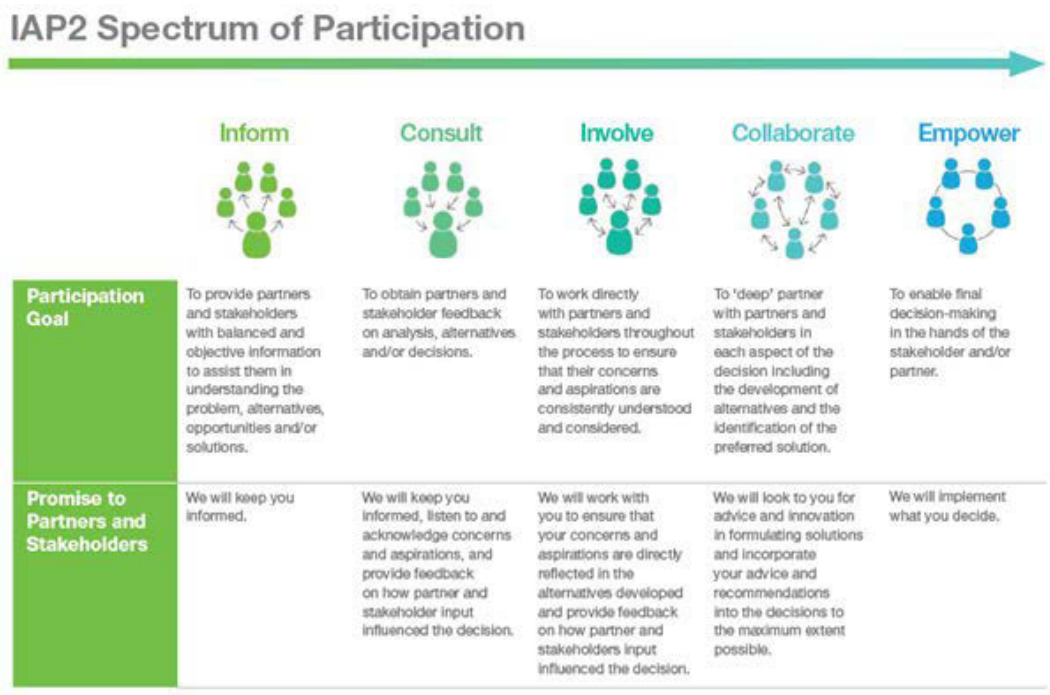
A4.1 General considerations

Engagement is an important element in this climate change risk assessment framework. It should take place at each stage of the risk management process with pan-iwi organisations and both internal and external stakeholders. The engagement activities and prompts for each stage, for both the development of an engagement strategy to undertake the NCCRA and for implementing it, are outlined in chapter C1, with reminders at the end of each assessment stage chapter (chapters B2, B3 and B4).

In this framework, the word 'stakeholder' defines individuals, groups of individuals, organisations or a political entity with a specific stake in the outcome of a decision to the impact of a policy, project or proposition. The word 'community' may also be used, which defines individuals and groups of people, stakeholders, interest groups and citizen groups. A community may be a geographical location (community of place), a community of similar interest (community of practice) or a community of affiliation or identity (such as industry). 'Partner' refers to specific engagement with Māori, iwi and hapū, reflecting the partnership principles of Te Tiriti o Waitangi.

For this risk assessment, engagement is required to contribute to each stage of the assessment process. Many methods and forms of engagement may be needed at different stages of the process, and a spectrum of engagement activities may be required (ie, informing, consultation, involving, collaborating, as shown in figure A4-1). This risk assessment will not require or enable 'empowerment', because no adaptation decisions are made within the risk assessment that actively enable empowerment.

Figure A4-1: Adapted International Association of Public Participation (IAP2) spectrum of participation



Source: International Association of Public Participation www.iap2.org

Engagement is a planned process with the purpose of working across organisations, partners, stakeholders and communities to shape decisions or actions in relation to a problem, opportunity or outcome. Not all those with a vested interested may want to be actively involved in the risk assessment process; some may prefer regular updates while others may need to be fully involved.

Several sources of guidance are available on engagement principles, process and design, including in the Coastal Hazards and Climate Change Guidance (Ministry for the Environment, 2017); the International Association of Public Participation (IAP2); Standards Australia/New Zealand (2010) and the Commonwealth Scientific and Industrial Research Organisation (Gardner et al, 2009).

A4.2 Specific considerations for engaging with Māori

When planning for engagement with Māori, iwi and hapū, we need to factor in the capacity and capability of those we engage with, including their skills, knowledge, competing priorities, resources and the time they need to effectively respond to our participation request (Waikato Regional Council, 2017). When undertaking the NCCRA, established best practice on engagement with Māori should be used (eg, Office for Māori Crown Relations (2018) *Guidelines for engagement with Māori*), and a person with knowledge and experience of Māori engagement principles and tikanga should be involved in the process.

Effective engagement with Māori is essential for producing better quality outcomes and realising Māori–Crown partnerships. It will let you gather on-the-ground information, views and reactions, and it strengthens the legitimacy of outcomes. Engaging effectively with Māori contributes to the development of effective policy options, helps agencies provide robust advice to ministers and to deliver improved outcomes. The process of genuine engagement with Māori by the Government is (Office for Māori Crown Relations, 2018):

- an acknowledgement of their rangatiratanga and status as Te Tiriti o Waitangi partners
- an acknowledgement that Mātauranga Māori makes an important contribution to solving policy and practical problems
- an acknowledgement that Māori have the resources and capability to contribute
- an acknowledgement that some issues affect Māori disproportionately and Māori are therefore better placed to develop solutions.

Engagement is fundamentally about building effective relationships; this is particularly important with Māori. Wherever possible, pick up the phone or make kanohi ki te kanohi (face-to-face) contact, rather than sending emails.

Māori, iwi and hapū organisations often have limited capacity for engagement and other competing priorities. Māori groups are under pressure to respond and react to requests from multiple agencies. Māori, iwi and hapū representatives may not be paid for their time, often have limited resources, and much of their workforce is voluntary or part-time. Māori organisations and representatives must be involved in the planning of engagement, so an achievable and appropriate process is designed that suits both parties. Considerations include:

- checking if iwi, hapū or Māori organisations have organisational environmental or climate change management plans. If so, check the requirements within them before any engagement, because they may contain a preferred method for engagement, associated

costs, and identified issues and priorities around climate change. These plans can inform the development of the engagement strategy

- checking on the location of engagement activities and what Māori would prefer (eg, at a marae, and who will book this, eg, the consultant or the Māori, iwi or hapū representative). Make sure you are aware of any particular protocols for that marae
- ensuring costs for the hui, Māori, iwi or hapū time, and any cultural support, have been included in the budget
- ensuring the timeframes for engagement are suitable to both parties
- before the collection of any mātauranga Māori for this risk assessment, the level of sensitivity, protection, dissemination, use and 'ownership' will be discussed and agreed upon by those offering the mātauranga.

When engaging with Māori at a national level, we recommend the risk assessor considers, as an initial step, a process to engage with Māori who represent interests in the various domains and themes (eg, built environment, human (social, cultural and governance), natural environment and economy). These types of national scale and pan-Māori collectives could include: the Iwi Chairs Forum (Pou Taiao Committee); New Zealand Māori Council; New Zealand Māori Women's Welfare League; Office of the Māori Climate Commission; and National Māori Climate Network. Relevant Māori engagement expertise and well-established and connected networks are preferred for successfully engaging with these institutions.

Some climate change risks may be specific to certain areas, such as increased drought severity in eastern areas, therefore engagement with tangata whenua (Māori, iwi, hapū mandated organisations and institutions) in the specific area at risk would be recommended. Once again, relevant expertise and well-established and connected networks are preferred for successfully engaging with these institutions. Adequate resourcing of the engagement process should also be considered, for example, paid time and travel for iwi and hapū representatives, koha, and cultural advisors, if required.

Guidance for developing and engagement plan is given in chapter C1.

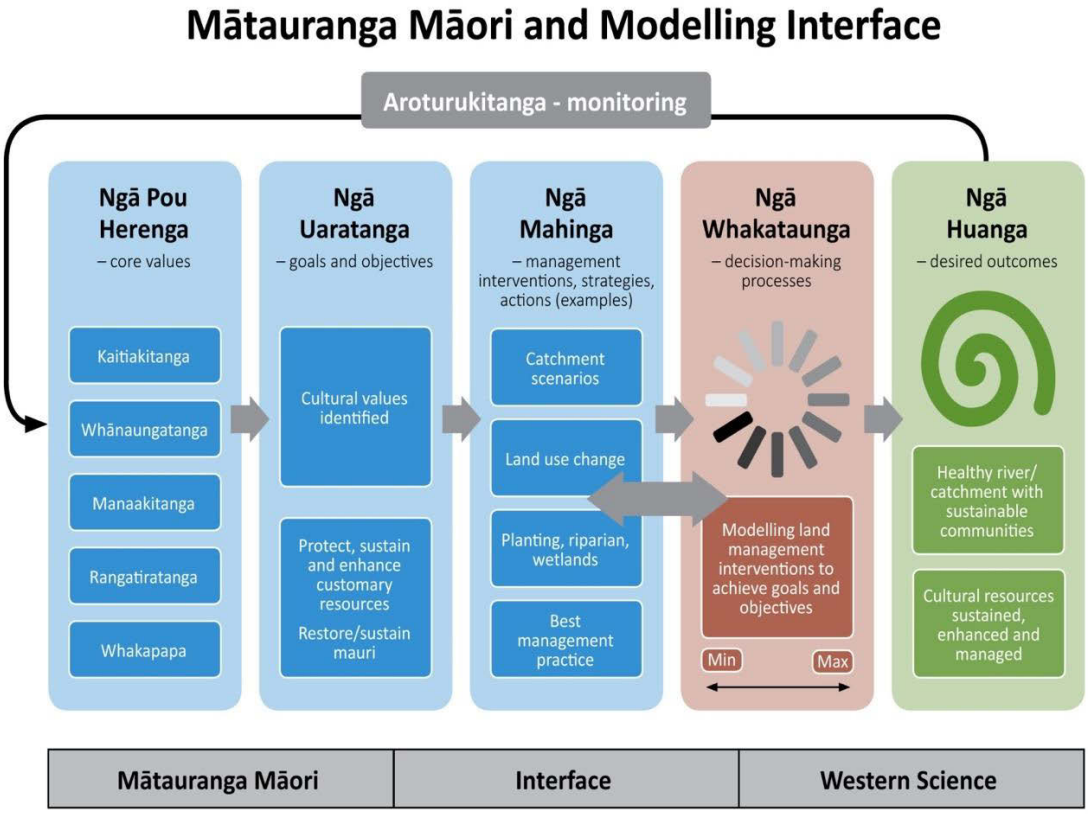
A4.3 Consideration of Mātauranga Māori in the risk assessment process

Throughout the risk assessment stages, collaborative processes can be applied for identifying risks with Māori, iwi and hapū to specific taonga and assets across the value domains of this framework. Figure A4-2 shows how modelling, quantitative assessment and Mātauranga Māori can be used to generate land-management scenarios and mitigations to meet outcomes and aspirational targets of iwi and hapū for their cultural assets and taonga.

In the figure A4-2 model, cultural and science monitoring are being used to observe trends towards or away from aspirational targets. This model was used by Harmsworth et al (2014) in the Manawatū and Kaipara catchments with continuous refinement and modification through 'proof of concept' and use of catchment-modelling tools. The tools included, for example, spatial analysis, the Catchment Land Use for Environmental Sustainability (CLUES) model (NIWA, 2019a) and SedNetNZ (Dymond and Basher, 2019) and were used to develop mitigation scenarios for freshwater contaminants, such as sediment, nitrogen, phosphorus, and pathogens. This approach can help inform risk management decisions to improve risk

management strategies, sustain or protect cultural values and increase iwi and hapū participation in climate change adaptation.

Figure A4-2. Modelling towards Māori aspirations and outcomes



Source: Harmsworth et al, 2014

Part B: Technical chapters

Wāhanga B: Upoko Mātauranga Whāiti

Chapter B1: Defining the changing hazards for risk assessment

B1.1 Defining hazards

Chapter A3 described the conceptual basis for defining values, assets and systems that may be at risk from exposure to climate-related hazards and the selection of climate change projections and timeframes to consider.

This chapter defines sub-national climate zones. It outlines the process for developing descriptors to represent the climate-related hazards for different emission scenarios and timeframes as input to the climate change risk assessment stages. The 'hazard component' of risk (left-hand part of figure A2-1 in chapter A2) can be related to either:

- a worsening of natural hazard events (magnitude, persistence and changing frequency with time), conventionally seen as a 'hazard' (eg, more intense short-duration rainfall)
- a gradual onset 'stressor' or 'trend' (eg, change in seasonal rainfall patterns or receding snowlines, decreasing ocean pH or international climate-related influences).

The term 'hazard' is used in this framework to describe the component or driver of the 'increased or accelerated' risks arising from climate change. This follows IPCC terminology, with the term 'hazard' referring to hazards, stressors and trends. This step's main task is to develop concise 'descriptors' of the main hazards. These should include the magnitude of change and/or change in frequency of occurrence by around 2050 (30 years) and 2100 (60–80 years), plus 2150 for coastal hazard risks only, for two climate projections and variations in geographical influence across defined sub-national climate zones (figure B1-1).

A useful starting point for assessing future risk is to appraise the present situation of climate change effects, but remembering that future effects may accelerate, rendering past trends and occurrences as an unreliable guide to the future.

Defining hazard components is not intended to be extensive or time consuming but should develop a concise narrative of the expected hazard range, gleaned from current information and expert knowledge. This can then inform the risk assessments as to the nature of changes (relative to present-day) over the relevant timeframes.

Managing the heightened risks caused by climate change requires:

- an understanding of the climate hazards that will exacerbate climate-sensitive risks imposed on the domain elements and systems being assessed
- identifying thresholds (where available) for emerging climate-related hazards. These thresholds relate to, when agreed (through elicitation), future objectives associated with a domain element or sector that would no longer be met (eg, a rise of X degrees Celsius in mean air temperature could render a type of horticulture or viticulture unviable; or an X metre sea-level rise could lead to a significant national exposure of buildings and infrastructure).

This framework presents a suite of key hazards (table B1-2) that are most likely to contribute to substantial climate-related risks, driven by primary and secondary climate variables that contribute to the hazard, to be input into the risk assessment as the hazard component. In most cases, the degree of change in the variables and, hence, the change in the hazard through time, can be informed by:

1. the assessor applying recommended climate change projections for climate variables (or the hazards themselves, if available) at national and sub-national scales directly from available credible information sources or previous assessments and reports using those projections (see section C4 for information sources)
2. expert elicitation processes involving recognised researchers, practitioners, climate and policy analysts in local and central government, and Māori experts to determine or confirm the relevant suite of hazards and their descriptors for each value domain or sector.

To keep this task manageable, it is envisaged the assessor will compile descriptors for the suite of hazards (based on the set list), in conjunction with researchers and practitioners with climate and hazard expertise in the relevant sub-domain or sector.

In addition, at the start of the elicitation or risk workshops for the first-pass risk screening (assessment Stage 1), it would be pertinent to confirm the suite of hazards are the main ones to consider, or if any are missing, for the specific domain element or sector and across all sub-national climate zones.

B1.1 Sub-national climate zones

For the national-scale risk assessment, it is recommended hazards are developed for seven climate zones to represent broad sub-national climatologies that may show significant differences in climate change impacts. Figure B1-1 shows the sub-national climate zones.

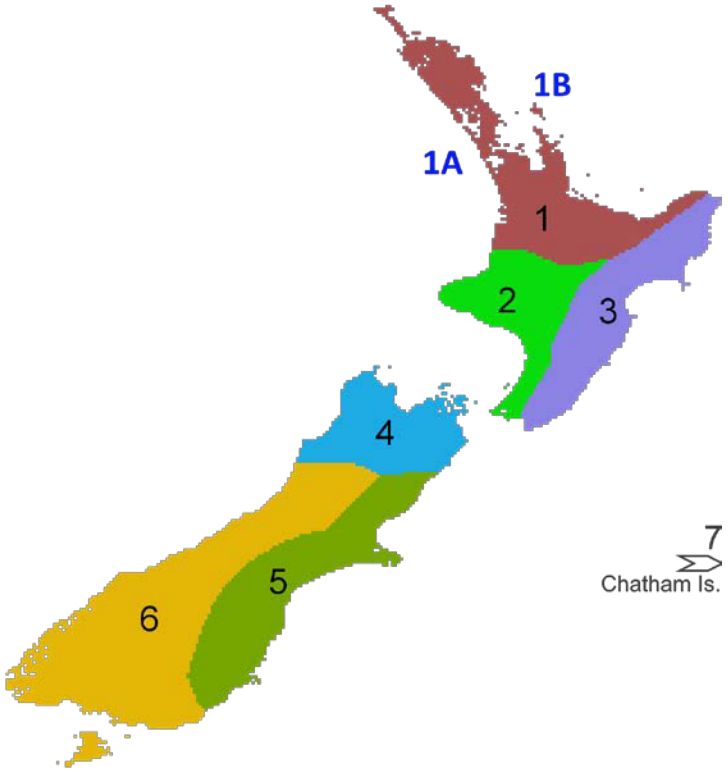
Within each risk assessment stage, the risks identified will need to be aggregated to the national scale, while still retaining those risks that might be rated high in one or two climate zones that have significant national impact (see chapters B2 and B3).

The extent of the sub-national climate zones is defined as follows.

1. **Region 1:** Upper North Island (Te Ika ā Māui) – extends to Mōkau on the west coast and Lottin Point (Wakatiri) in eastern Bay of Plenty, and covers the northern part of Lake Taupō. For assessing climate impacts on coastal and marine activities or elements, split the west coast and Tasman Sea (zone 1A) from the east coast, Pacific Ocean and Hauraki Gulf (zone 1B). Includes the regions of Northland, Auckland, Waikato and Bay of Plenty.
2. **Region 2:** Western lower North Island (Te Ika ā Māui) – covers Taranaki to Wellington (Te Whanga-nui-a-Tara) and includes National Park and southern Lake Taupō. Includes the regions of Taranaki, Manawatū–Whanganui (Horizons) and Wellington.
3. **Region 3:** Eastern lower North Island (Te Ika ā Māui) extends from Hicks Bay (Wharekahika) to Palliser Bay (Te Waha o te Ika ā Māui) and back to the Ruahine and Kaweka ranges. Includes Gisborne, Hawke's Bay and the Wairarapa catchment of Wellington.
4. **Region 4:** Northern South Island (Te Wai Pounamu) – covers Marlborough (from Kaikōura north), Nelson (Whakatū) and around to Punakaiki on the West Coast. Includes Tasman, Nelson, Marlborough and Buller District.

5. **Region 5:** Eastern South Island (Te Wai Pounamu) from Kaikōura to Owaka (South Otago) and includes Central Otago and the MacKenzie Basin including Lakes Tekapo to Ōhau to the east of the Southern Alps. Includes the West Coast, inland Otago and Southland.
6. **Region 6:** Western and southern South Island (Te Wai Pounamu) – covers the West Coast, Fiordland, Southland and Stewart Island (Te Punga o Te Waka ā Māui) and includes the Southern Alps and southern lakes. Includes Canterbury and Otago.
7. **Region 7**: Chatham Islands (Wharekauri – Rēkohu) and Pitt Island (Rangiauria –Rangiaotea) at longitude 183–184°E.

Figure B1-1: Spatial coverage of the sub-national climate zones based on broad zones of rainfall climatologies



Note: The spatial coverage of the sub-national climate zones are based on broad zones of rainfall climatologies that NIWA uses for seasonal forecasting (Kidson and Renwick, 2002). An additional seventh zone has been added for the Chatham Islands. Coastal and marine climate change risks should consider separately the west (1A) and east (1B) coasts in zone 1, due to their different ocean and climate conditions.

B1.2 Method for determining climate hazards

The hazard component of risk (figure A2-1) comprises both changing hazard profiles and gradual onset trends or shifts through time, driven by single or multiple climate variables (eg, heating and associated changes). The steps for defining the hazard component are outlined in figure B1–2, which shows how various primary and secondary climate variables combine to cause the climate-related hazards. These hazards can be examined in the risk assessment stages for all value domains and associated sectors.

Changes or trends in climate-related variables at the sub-national scale (seven climate zones; figure B1-1) should be determined from recommended climate change projections (see section

B1.3), where available, or from credible information sources (examples in chapter C4) and/or elicitation processes. To reduce the workload at the first-pass risk screening stage (Stage 1, chapter B2) and to focus on the higher emerging risks, only hazards for the higher projection RCP8.5 are needed initially. Those higher risks transferred to the detailed risk assessment stage should then be further examined using hazards derived from both RCP4.5 and RCP8.5 projections in Stage 2 (chapter B3).

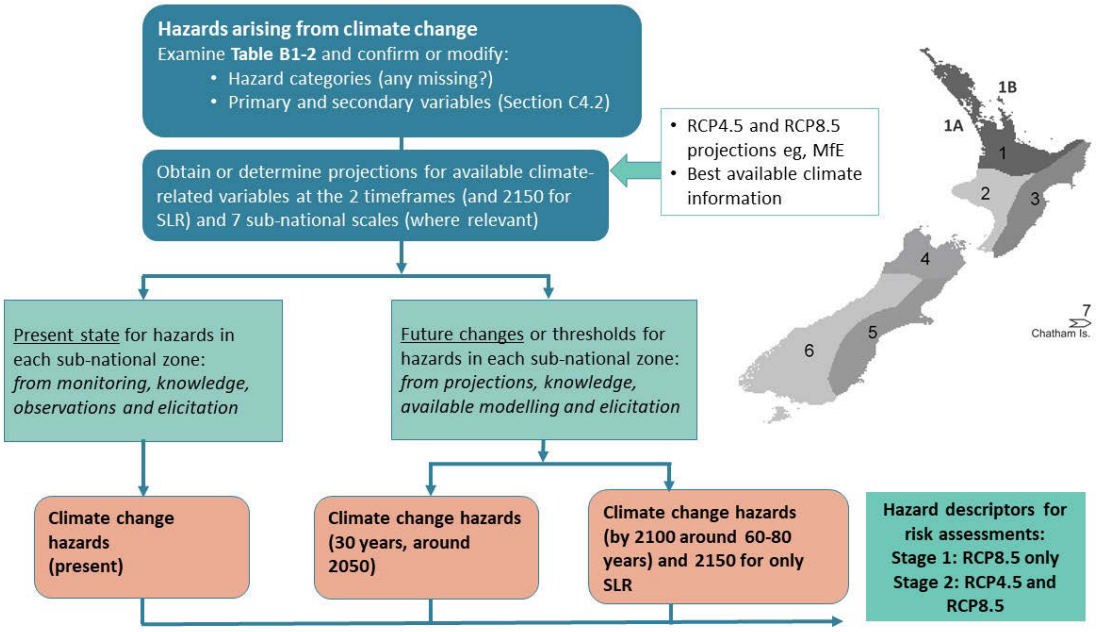
Hazard descriptors should be developed for the present day (eg, past one-to-two decades) to appraise the climate-related changes presently being experienced, then at two selected future timeframes, plus by 2150 for coastal hazard risks only (section A3.3).

The aim is to determine a credible suite of hazard descriptors applicable to the seven sub-national climate zones (or generically across Aotearoa New Zealand, eg, sea-level rise) to populate the hazard component for the risk assessments in chapters B2 and B3.

The assessor can augment the derivation of the suite of hazards and their descriptors through expert input. This can include how changes in primary and secondary climate variables influence changes in the hazard over time (from the present day), including changes in magnitude (severity), persistence and changing frequency with time. Hazard descriptors should also be confirmed at the outset of the first-pass risk screening stage during risk elicitation or workshops for each sector.

If the magnitudes and uncertainties or changes in climate hazards are largely unknown (ie, strength of evidence is low), this aspect should be carried into the risk assessment stages and noted as a gap and, hence, a potential research priority, particularly if the potential risk is perceived to be moderate or high (chapter B4).

Figure B1-2: Steps in translating climate change variables to hazards in each sub-national climate zone, applicable to specified timeframes for two climate change projections



Note: The starting point in the elicitation and engagement processes is the list of suggested hazards in table B1-1. The outputs are the descriptors of hazards due to climate change that input to the risk assessment stages (chapters B2 and B3). Inset map shows the sub-national climate zones (figure B1-1), with zones 1A and 1B applying to marine and coastal risks in northern Aotearoa New Zealand. MfE = Ministry for the Environment; SLR = sea-level rise.

Table B1-1 provides an exemplar for recording the hazard descriptors for transferring to the risk assessments, with a useful starting point being table 1 in the 2018 Climate Change Projections for New Zealand (Ministry for the Environment, 2018).

Table B1-1: Example table for recording descriptors of the present state and future changes of hazards (including stressors and trends) for the two projections RCP4.5 (moderate emissions mitigation) and RCP8.5 (continuing high global emissions)

Hazard	Recent and past effects or changes	Projected changes by ~2050 (30 years) *Direction and magnitude of change*	Projected changes by ~2100 (60–80 years) *Direction and magnitude of change*
Rising mean temperature: air and water	Average air temperature has increased by 1.0°C over the past 100 years. The five warmest years since 1909 are: 2016, 2018, 1998, 1999 and 2013 (0.84–0.72°C above 1981–2010 average) (MfE, Stats NZ and NIWA 7-station series) River and lake temperatures have risen by ... Sea-surface temperatures have risen by …. over period … with Tasman Sea marine heatwaves in the previous two summers	**RCP4.5**: ensemble average increase for period **2031–50**, eg, zones 1, 4, 5 and 6 (+ 0.9°C, + 0.9°C, + 0.7–0.8°C) (MfE, 2018) Freshwater temperatures for likely to rise by … Sea-surface temperatures likely to rise by ... ?	**RCP4.5**: ensemble average increase for period **2081–2100**, eg, zones 1, 4, 5 and 6 (+1.4°C, +1.4°C, +1.3–1.4°C) (MfE, 2018) Freshwater temperatures for likely to rise by … Sea-surface temperatures likely to rise by ... ?
		RCP8.5: ensemble average increase for period **2031–50**, eg, zones 1, 4, 5 and 6 (+ 1.1°C, + 1.0°C, + 0.9–1.0°C) (MfE, 2018) Rivers, lakes, sea-surface temperatures will rise by ... ?	**RCP8.5**: ensemble average increase for period **2081–2100**, eg, zones 1, 4, 5 and 6 (+ 3.1°C, + 3.0°C, + 2.8–3.0°C) (MfE, 2018) Rivers, lakes, sea-surface temperatures will rise by ... ?
Climate sub-national zones affected	All	All (slightly smaller increase in south)	All (slightly smaller increase in south)
Reduced snow cover and glaciers	Total ice volume of the Southern Alps for the small and medium glaciers has decreased by 33% from 1977–2018 (Salinger et al, 2019). Snow pack or snowlines have changed by ...	**RCP4.5**:	**RCP4.5**:
		RCP8.5:	**RCP8.5**: Snow days per year reduce by 30 days or more by 2090 (MfE, 2018). By 2120, …
Climate sub-national zones affected	2, 4, 6	2 (Central Plateau), 4, 6	2 (Central Plateau), 4, 6

Hazard	Recent and past effects or changes	Projected changes by ~2050 (30 years) *Direction and magnitude of change*	Projected changes by ~2100 (60–80 years) *Direction and magnitude of change*
Hazard X		RCP4.5:	RCP4.5
		RCP8.5:	RCP8.5:
Climate sub-national zones affected			

Note: The baseline (zero) for Ministry for the Environment (2018) and IPCC projections is the average over 1986–2005. MfE = Ministry for the Environment; NIWA = National Institute of Water and Atmospheric Research; Stats NZ = Statistics New Zealand.

B1.3 Climate-related changes: Defining hazards

Based on the expected climate changes for Aotearoa New Zealand, table B1-2 provides the key categories (17) of hazards (which may be events or trends and stressors, or a mix of both) arising from climate change that are most likely to result in substantial risks to the nation's wellbeing (ie, Treasury's Living Standard Framework as outlined in chapter A3). The second and third columns outline the associated primary and secondary climate change variables that contribute to each of the hazards. A 'long list' of these climate-related variables is available in chapter C4 (table C4-1), if amendments to table B1-2 are necessary.

The risk screening assessment (chapter B2) provides an initial appraisal of whether these hazards pose a threat (and how significant), are minor or not applicable for the climate sensitive elements of each value domain and associated sectors. Other compound hazards (combinations of the listed hazards) could also pose a risk for a particular sector and could be added at the initial step (figure B1-2).

Table B1-2: Key categories (17) of hazards (blue shading) arising from climate change most likely to result in substantial risks to include in the NCCRA (this is not an exhaustive list)

Hazard (arising from climate change)	Primary climate-related variables	Secondary climate-related variables
Higher mean temperatures: air and water	• Higher day and night temperatures • Higher mean water (freshwater and marine) temperatures	• More heatwaves and warm spells • Fewer frosts or cold days
Heatwaves: increasing persistence, frequency and magnitude	• Higher day and night temperatures • Increase in persistence of maximum daily temperatures above 25°C	• Changes in seasonal winds • Humidity changes from changes in cloudiness
More and longer dry spells and drought	• Low seasonal rainfall • Change in seasonal wind patterns • Interannual variability (eg, ENSO)	• Higher day and night temperatures
Changes in climate seasonality with longer summers and shorter winters	• Fewer frosts or cold days • Higher day and night temperatures • Changes in seasonal rainfall	• Changes in seasonal wind

Hazard (arising from climate change)	Primary climate-related variables	Secondary climate-related variables
Increasing **fire–weather** conditions: harsher, prolonged season	• Low seasonal rainfall • Change in seasonal wind patterns • Increase in persistence of maximum daily temperatures above 25°C • Humidity changes from changes in cloudiness	• Higher day and night temperatures • Interannual variability (eg, ENSO)
Increased **storminess and extreme winds**	• Increase in storminess (frequency, intensity) including tropical cyclones • Changes in extreme wind speed	• Changes in wind seasonality • Interannual variability (eg, ENSO) • Increase in convective weather events (tornadoes, lightning)
Change in **mean annual rainfall**	• Higher or lower mean annual rainfall in sub-national climate zones • Changes in seasonal winds	• Humidity changes from changes in cloudiness
Reducing **snow and ice cover**	• Higher day and night temperatures • Changes in rainfall seasonality • Change in seasonal wind patterns • Receding snowline • Reduced snow and glacier cover • Earlier snow melt	• Increase in avalanches • Interannual variability (eg, ENSO)
Increasing **hail** severity or frequency	• Increase in hail severity or frequency • Increase in convective weather events (tornadoes, lightning)	• Humidity changes from changes in cloudiness
River and pluvial flooding: changes in frequency and magnitude in rural and urban areas	• Changes in extremes: high intensity and persistence of rainfall • Increase in hail severity or frequency • Interannual variability (eg, ENSO) • Increased storminess and wind • Relative sea-level rise (including land movement) • Rising groundwater from sea-level rise	• Humidity changes from changes in cloudiness • Changes in rainfall seasonality • Change in seasonal wind patterns • More and longer dry spells and droughts (antecedent conditions)
Coastal and estuarine flooding: increasing persistence, frequency and magnitude	• Relative sea-level rise (including land movement) • Change in tidal range or increased water depth • Permanent increase in spring high-tide inundation • Rising groundwater from sea-level rise • Changes in extremes: high intensity and persistence of rainfall	• Changes in waves and swell • Changes in extreme wind speed • Changes in sedimentation (estuaries and harbours)

Hazard (arising from climate change)	Primary climate-related variables	Secondary climate-related variables
	• Increase in storminess (frequency, intensity) including tropical cyclones	
Sea-level rise and salinity stresses on brackish and aquifer systems and coastal lowland rivers	• Relative sea-level rise (including land movement) • Permanent and episodic (low river flow) saline intrusion • Low seasonal rainfall • Rising groundwater from sea-level rise • Permanent increase in spring high-tide inundation	• Changes in sedimentation (estuaries and harbours) • Interannual variability (eg, ENSO)
Increasing **coastal erosion:** cliffs and beaches	• Relative sea-level rise (including land movement) • Changes in waves and swell • Changes in extreme rainfall: high intensity and persistence • Changes in sedimentation from catchment run-off • Increased storminess and extreme winds • Interannual variability (eg, ENSO)	• Rising groundwater from sea-level rise • Changes in rainfall seasonality • Change in seasonal wind patterns
Increasing **landslides and soil erosion**	• Changes in extreme rainfall: high intensity and persistence • Changes in rainfall seasonality • More and longer dry spells and droughts (antecedent conditions)	• Interannual variability (eg, ENSO)
Marine heatwaves: more persistent high summer sea temperatures	• Higher mean ocean temperatures • Increase in persistence of maximum daily temperatures eg, above 25°C • Change in seasonal wind patterns • Ocean circulation changes	• Interannual variability (eg, ENSO) • Changes in waves and swell
Ocean chemistry changes: nutrient cycling and pH changes	• Changes in ocean nutrient cycling – upwelling and carbon • Ocean acidification (pH decreasing) • Higher mean surface-water temperatures • Change in seasonal wind patterns	• Ocean circulation changes • Interannual variability (eg, ENSO)
International influences from climate change and greenhouse gas mitigation preferences	• Immigration • Markets (pricing, preferences) • Pacific Island countries (disaster responses, development)	
Other?	• • •	• • •

Note: This is not an exhaustive list. The second and third columns outline the associated primary and secondary climate change variables that contribute to each of the hazards, which should be confirmed before developing the

'hazard component' descriptors at the recommended timeframes and projections (extra space is provided in the table). The long-list of variables is in chapter C4.2 (table C4-1). ENSO = 2–4 year El Niño–Southern Oscillation.

B1.4 Guidance on alignment of information with Representative Concentration Pathway projections and timeframes

Figure B1-3 gives an outline of approaches for mapping information, where possible, to align consistently with the recommended RCP4.5 and RCP8.5 projections for Aotearoa New Zealand at the recommended timeframes: present day; 30 years (around 2050); by 2100; and for sea-level rise and coastal flooding impacts only, by 2150 during Stage 2. An initial list of information sources and tools is given in chapter C2.

Types of information on climate change projections include the following.

a) Projections of the core group of primary climate variables that contribute to the key hazards. These are available for RCP4.5 and RCP8.5 projections, particularly temperature, rainfall, drought, wind and sea-level rise. The main sources for these primary variables are the Climate Change Projections for New Zealand (Ministry for the Environment, 2018), the Coastal Hazards and Climate Change Guidance (for sea-level rise to 2150) (Ministry for the Environment, 2017), the Australasian IPCC chapter from Working Group II to the IPCC's Fifth Assessment Report (Reisinger et al, 2014), and various papers and reports.

b) Information derived from analysis of increments in climate change variables.

   For example, high-intensity rainfall increases for various event durations (one hour to three days) are available in the High Intensity Rainfall Design System (HIRDS) version 4 (or the Climate Change Projections for New Zealand report (Ministry for the Environment, 2018)) for 1 degree Celsius increments in rising air temperature or coastal risk exposure nationally in terms of 0.1 metre increments in sea-level rise (eg, Parliamentary Commissioner for the Environment, 2015; Paulik et al, 2019).

   For the recommended timeframes, determine the magnitude of the relevant climate hazard or contributing climate variables from the RCP4.5 and RCP8.5 projections (see point a) above) and interpolate the available magnitude and frequency in the information sources or tools from the nearest increments. For example, if the temperature were to rise by 2.8 degrees Celsius in 100 years for the RCP8.5 projection, then the high-intensity rainfall increase can be interpolated from the increases for 2 degrees Celsius and 3 degrees Celsius in the HIRDS tool.

c) Past reports or journal papers may have previously assessed climate change effects with past scenarios from the IPCC Special Report on Emission Scenarios (SRES) that were used in the third and fourth IPCC Assessment Reports. These scenarios are now superseded by the RCP projections.

   In this case, map the equivalent SRES scenarios to RCP4.5 and RCP8.5 projections:

   – equivalent to RCP8.5 – use an average of A1FI (highest scenario) and A1B SRES scenarios for 30 years and by 2100

   – equivalent to RCP4.5 – use the B1 SRES scenarios for 30 years and by 2100 (Ministry for the Environment, 2017, appendix C).

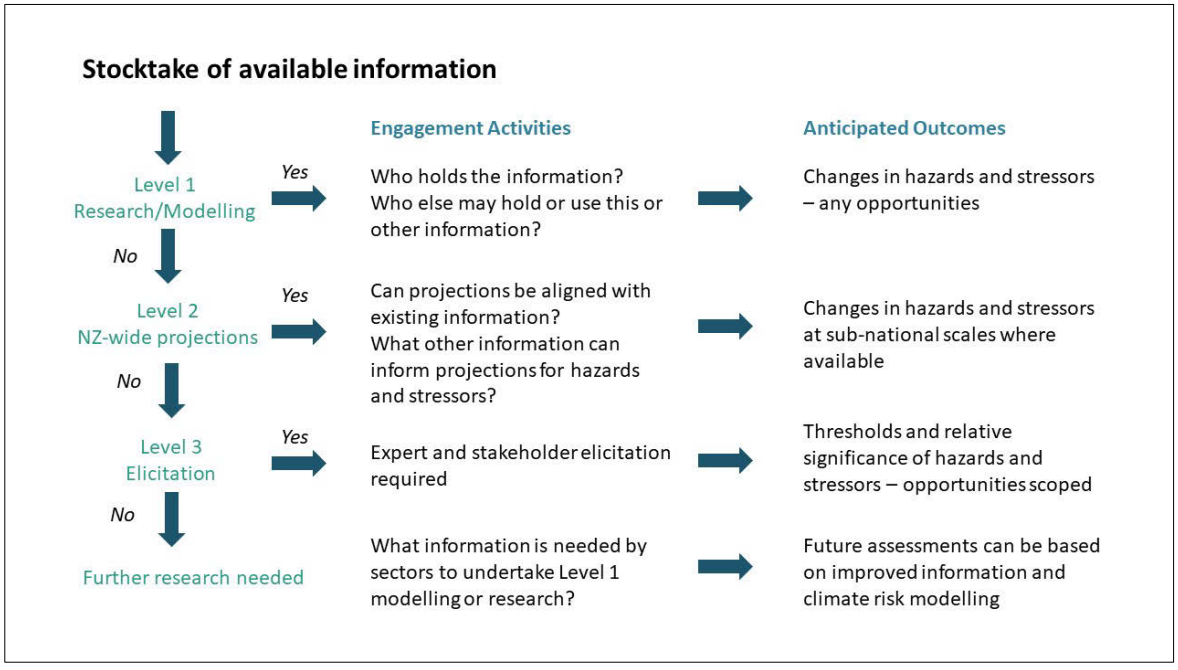
d) Expert or Mātauranga Māori findings from stakeholder elicitation processes that may be able to express the hazard in terms of potential thresholds, where agreed future objectives or levels of service may no longer be met.

   Such mixed quantitative–qualitative information on thresholds should be aligned or mapped to the recommended RCPs and timeframes by the assessor, where possible. (For example: a) a regional aquaculture activity may not be viable once the mean summer sea temperature is 1 degree Celsius higher, or b) a sea-level rise threshold is agreed when more than [X] number of buildings nationally are at risk of more frequent flooding from available risk exposure assessments). From these deliberations, the assessor should align such thresholds with the recommended projections, where possible (eg, timing for the emergence of the threshold under different projections). This then provides consistency when assessing and evaluating the risks.

e) Where information on the changes in climate is unclear (has not emerged), little known or is unlikely to be significant in terms of exposure or vulnerability.

   In this case, the findings can be transferred from the risk screening stage (Stage 1, chapter B2) and assessed to see if further action or research is needed in Stage 3 (chapter B4) when evaluating the urgency rating.

Figure B1-3: Mapping for producing mixed quantitative and qualitative information and knowledge on hazards and risk exposure for consistency and relativity between risks



Chapter B2: Assessment Stage 1: First-pass risk screening

B2.1 Scope and purpose for first-pass risk screening

Once the context of the climate change risk assessment has been set (by identifying the important assets, taonga and elements at risk (chapter A3)), and descriptors identified for the climate change hazards to which these elements may be exposed and vulnerable (chapter B1), the next step is assessing how and where these components interact, to identify the risks. This assessment starts with a first-pass screening stage. The purpose is to provide a transparent process that encompasses a broad exploration of climate change risks to identify those that require a more detailed risk assessment (chapter B3).

First-pass climate change risk screening is primarily a qualitative process that can be co-produced without detailed data to develop a preliminary understanding of the extent and relativity of climate change risks to a value domain, sector or at the regional or local level (CoastAdapt, 2016). It helps users assess the broad risk spectrum qualitatively using existing and available information, and through elicitation processes or risk workshops and engagement with expert and sector adaptation leaders, and Mātauranga Māori in the context of values (chapter A3) and agreed objectives or thresholds of change.

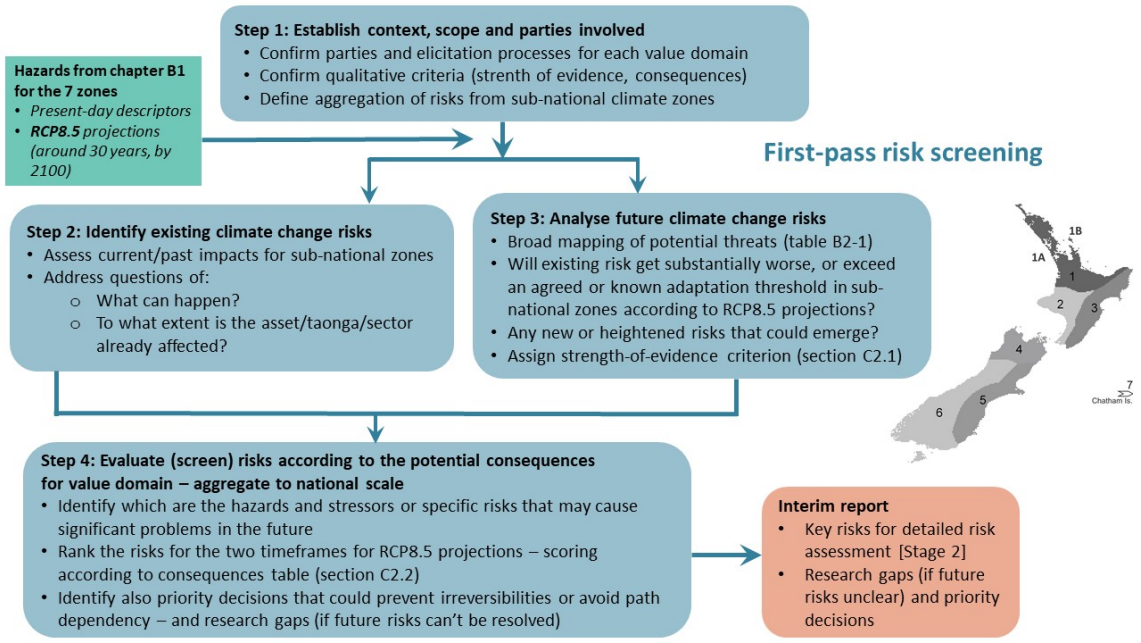
Acknowledging the primarily qualitative nature of information gathered, this stage still requires grounding by canvassing the present day risk exposure and appraising future risks arising from the hazards based on the higher RCP8.5 climate projections and two future timeframes (chapter B1). A first-pass screening process should not be relied on to make initial or early adaptation decisions, but the actual process and engagement is an important step for overlaying values, objectives and potential threats from climate change. It is also important for identifying opportunities arising from a warmer climate, quick wins for adaptation or research gaps that can be picked up in Stage 3 (chapter B4).

To start the process, ensure all key partners and stakeholders have been identified for engagement purposes and participation in the elicitation or risk workshop process, to co-produce the first-pass risk screening. This stage will:

- provide participants with a rapid starting point for understanding broader climate change impacts and implications
- leverage existing national, regional or local information and expert knowledge. This includes accessing and identifying Māori aspirations and values along with mātauranga ā iwi/hapū (iwi and hapū knowledge) and hītori (histories)
- shortlist potential future climate risks (or exposure, if risk is not well described) from the broad categories of potential hazards (table B1-1) for the relevant value domain, decision area or system to be assessed in detail in Stage 2.

Figure B2-1 outlines the process for the Stage 1 first-pass risk screening.

Figure B2-1: Stage 1 first-pass risk screening process



B2.2 Method for the first-pass risk screening

The four steps and various prompts covering the first-pass risk screening are outlined below (adapted from CoastAdapt, 2016).

- **Step 1: Establish the context and define the scope and parties involved in the first-pass screening for each value domain or sector**
  - Set objectives and scope of the domain or sector risk screening and allotted time period.
  - Confirm and set up the elicitation (risk workshops) and engagement processes (see section A4).
  - Confirm the applicability of the qualitative criteria (domain or sectoral consequence criteria and strength of evidence) for which risks are carried forward into the detailed risk assessment.
  - Reconfirm that hazard descriptors from chapter B1 together cover the main hazard component for the value domain or sector – noting that only RCP8.5 projections out to 2100 are used for this risk screening stage.
  - Define how the spatial scale (for the sub-national climate zones) of the first-pass assessment is handled, to aggregate to national-scale risk ratings.
- **Step 2: Identify the existing climate risks (both past and present day)**
  - Using hazards from table B1-2, complete table B1-1 on the impacts observed for the present day or recent past, assess the broad impacts on sectors and elements across the value domains. Include any available records or accounts of trends or changes in climate or weather-related hazards in recent times, relative to the past.
- **Step 3: Analyse future climate change risks for the RCP8.5 projections out to 2100 and rate the evidence base**

- Using hazards from table B1-2, complete table B1-1 for the RCP8.5 projections for the recommended timeframes (around 30 years and by 2100). Then explore the degree of climate change impacts on the climate-sensitive elements or activities for the relevant value domain or sector using available information and co-production through elicitation processes. This can be undertaken using a precursory mapping exercise (as shown in table B2-1) to map the potential threats or where the impact of the hazard is minor, neutral or not applicable.
- Can any existing risk get substantially worse, or exceed an agreed or known adaptation threshold, under the projected climate change?
- Could any new or heightened risks emerge under the future projected change?
- How confident are we in the pedigree or strength of the initial evidence collated (information, knowledge from elicitation) for assessing the risk in this screening process? Apply a strength-of-evidence rating from table C2-1 (chapter C2).

- **Step 4: Evaluate (screen) risks according to the potential consequences to determine need for a detailed risk assessment for the more at-risk elements or activities**
  - Identify which hazards or specific risks (if well described or known) may cause problems in the future for the value domain or sector.
  - Rank the risks for the two timeframes, applicable to RCP8.5 projections, by scoring according to the five-level, risk-rating scale from the consequences table (table C2-2, chapter C2) for the relevant value domain. Outline and document how the national-scale risk rating has been aggregated from the sub-national climate zones (eg, if any sub-national zone score is high, then a national score is high, or if there are two, three or more medium ratings, then the national rating may be set to high and so on). Note: for marine or coastal activities or sectors, use sub-national climate zones 1A and 1B separately instead of just zone 1 (upper North Island).
  - Are opportunities available for beneficial effects arising from climate change that could prompt transformational change with low regrets?

Following these steps, select the high risks, and any moderate risks with associated high uncertainty (eg, strength of initial evidence is low to medium, or it is unknown how the sector may adapt or cope), to transfer through the detailed risk assessment stage (chapter B3). The four-step process for the first-pass screening is not necessarily a linear progression. Previous steps may need to be revisited if new information or knowledge arises or earlier findings need readjusting to establish a consistent set of priority risks.

B2.3 Guidance on the screening steps

Guidance on Step 1: Establish the context and scope, set up engagement processes

Step 1 has several components.

Understand the scope and purpose of the exercise. This should be established at the start of any level of risk assessment to clarify what is included or excluded in the assessment. Guidance on the context and underpinning values for the NCCRA is discussed in chapter A3.

Develop an engagement plan. Involve parties who should be part of the first-pass risk assessment in co-producing value domain or sector risk priorities to be further evaluated in the detailed risk assessment. The levels of engagement and methods should be defined (see chapter A4 and chapter C1).

Define the qualitative criteria. At the outset, define the criteria used to decide which risks are carried forward to the detailed risk assessment. This may be by consensus, a majority, via review of a reference group, or significant consistent evidence for indicators, such as potential national impact, maximum number of risks for each domain or sector, or whether the risks are amenable to being addressed in a National Adaptation Plan.

Define how the spatial scale of the first-pass screening assessment is handled. The NCCRA assessment is primarily intended to be applied nationally to feed into the National Adaptation Plan (chapter A1). It also needs to identify significant regional-scale risks that would be of major concern to central and local government, industry, services, infrastructure providers, business and the insurance and banking sector.

Incorporate the recommended timeframes to consider (chapter B1) covering present-day changes or trends (and the recent past) in Step 2. In Step 3, use the 30-year (around 2050) and 2100 timeframes (leaving the additional long-term appraisal for coastal flood risk to 2150 to be undertaken in Stage 2).

Incorporate the RCP8.5 climate change projection from chapter B1 (the completed table B1-1). Include this where possible, to provide a consistent grounding for deliberations and establish relative priorities. An example is that participants in the risk screening could be given summary factsheets (derived from table B1-1) outlining the main categories of climate change effects nationally and regionally. The effects could include temperature rise, rainfall intensity, sea-level rise, pH change and rainfall, wind and drought patterns, and so on, for the relevant projection at the two future timeframes. It would also be useful to include increments of change and by decade for these climate change effects for the relevant projection, to align thresholds that emerge from elicitation processes.

Example: if nationally a threshold sea-level rise of say around 0.3 metres was deemed to lead to a significant loss of estuarine wetlands and salt-marsh environments, tables like table 10 (decadal increments) and table 11 (0.1 metre sea-level rise increments) in the Coastal Hazards and Climate Change Guidance would indicate this would occur around 2050 for RCP8.5 (or earlier, if polar ice sheet response was greater than expected using a higher RCP8.5 H^+ sea-level scenario) (Ministry for the Environment, 2017).

The types of information and sources of climate change projections are outlined in chapter C4.

Guidance on Step 2: Identify the existing climate risks

Table B1-1 (chapter B1), once completed, should outline a range of hazards exacerbated by climate change (look-up list in table B1-2). The same hazard set can be used as a starting point for identifying and reviewing recent or past changes or trends of these hazards for the 'present day' situational analysis. Many of the listed hazards that were induced by changes to the climate and oceans may not yet have emerged, but several changes in extremes (eg, flooding, intense rainfall) or seasonal changes in temperature or precipitation (eg, droughts) have become evident in recent decades.

At this step, **identify any records**, **accounts**, **reports or other sources** (see chapter C4) that discuss trends or changes in climate or weather-related hazards (eg, drought occurrence or persistence, flooding) in recent times (one-to-two decades) relative to the past.[4] Elicitation with experts (climate scientists, social scientists, Māori experts and so on) and stakeholders, including and especially those who could be considered 'custodians' of the risk, will be required at this stage and could be combined with step 3 engagement requirements.

For a national assessment, these experts and knowledgeable practitioners would first be identified by mapping the sectors or elements at risk (described in chapter A3) against the climate drivers and impact chains (the 'hazards', described in chapter B1). This would be done according to the scope of the risk assessment (ie, regional or local assessments may use different criteria to decide on sectors or elements to be screened).

Expert elicitation will include relevant representatives such as:

- pan-Māori organisations
- researchers (ie, Crown research institutes, universities, private research companies)
- policy analysts (ie, climate, hazard, risk and climate policy) in central and local government (including quasi-government organisations and state-owned enterprises)
- practitioners (ie, planners, engineers, economists, social, cultural) with experience in climate matters
- professional bodies (ie, Society of Local Government Managers, Engineering New Zealand, New Zealand Planning Institute, New Zealand Sustainability Council) and representatives well versed in climate change issues.

Guidance on Step 3: Identify future climate change risks and opportunities

Once the source of your climate change projection data or information for the recommended timeframes is finalised (completed table B1-1), start exploring the degree of climate change impacts that will affect the relevant value domain. Sector or domain climate impact scenarios may already have been developed and analysed that would be useful to introduce to the first-pass screening assessment. These could be, for example, the pastoral sector scenarios in various SLMACC (Sustainable Land Management and Climate Change) research or review reports collated and assessed by the Ministry for Primary Industries (2019).

Some national-scale, risk exposure assessments have been completed, especially for coastal areas affected by sea-level rise and associated hazards (Bell et al, 2016; LGNZ, 2019; Parliamentary Commissioner for the Environment, 2015; Paulik et al, 2019; Tait, 2019). These provide a regional and aggregated national-scale analysis of the exposure to sea-level rise and coastal flooding, and a high-level assessment for riverine flood plains (Paulik et al, 2019).

Questions to ask during this stage of the assessment follow.

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[4] Note: a useful starting reference on the attribution of the influence of climate change on recent flood and rainfall events and droughts over the past decade can be found in Frame et al (2018b). Another helpful reference on changes in severe weather is Bell (2018a, 2018b).

Can any existing risk get worse under projected climate changes?

Qualitative understanding of the change in direction (increase, decrease or no change) of future climate hazards, as well as other risk-related information (eg, erodibility of the coastline or catchment soils), should provide a qualitative understanding of how existing risks, identified in Step 2, may change in future at the nominated timeframes.

As an example, with projected sea-level rise, those parts of the coast nationally that have previously experienced coastal flooding or erosion-related problems, or that exhibit a tidal signal in groundwater levels (existing risk), will clearly face increasing risks from these hazards in future.

Could any new risks emerge under the future projected changes?

Just because an area has no previous record of a particular hazard, this is not a guarantee it will not happen in future. The assessor should consider whether the qualitative change of a hazard in future could give rise to risk that has not yet been realised (CoastAdapt, 2016). As an example, prolonged summer heatwaves may not be an issue in some coastal urban areas, like Auckland at present, but with rapid urbanisation, combined with growth in the aged population and a rise in average temperature, the health risk to people living in these areas may increase in future heatwaves. Another example could be as sea level increases, the increased extent of semi-permanent, high-tide inundation or coastal flooding could create new challenges. For example, large tracts of coastline in Aotearoa New Zealand have not yet experienced these impacts but, with ongoing rising seas, it will only be a matter of time before such risks emerge.

List any possible future damage, losses or declines in services or primary production against each of the relevant hazards (CoastAdapt, 2016). This will help identify assets, areas, activities, environments, cultural taonga or communities that may be exposed to future climate-related hazards. In the coastal situation, the coastal risk-exposure reports above would give an indication of the emergence of those risks in different coastal regions of New Zealand, for example, number of buildings and roads exposed at different sea-level rise increments.

How confident are we in the strength of the evidence base (information, knowledge, from elicitation) for assessing the risk?

Some rating of the strength of evidence is important before evaluating the risk in Step 4 (especially if the rating is low). It is also important for transparent communication of decisions when selecting a category for action in chapter B4 (that may eventually be part of the National Adaptation Plan) or for taking the uncertain risk through to the detailed risk assessment stage. If little is known, but a climate change effect is perceived as a threat, then that risk could be a candidate for assigning it to a 'Research Priority' action (see chapter B4). It could also be analysed in the detailed risk assessment (chapter B3), if information on exposure and vulnerability can be determined through expert and stakeholder elicitation. A suggested score card of the confidence in 'strength of evidence' is shown in table C2-1 in chapter C2.

Precursory mapping of climate change threats and opportunities

In Step 3, precursory mapping of a value domain or sector's elements (where specific climate risks are known at the sector level) to the generic list of climate change hazards (table B1-2, chapter B1) will be a useful preliminary step to identify which elements could be exposed to a hazard, or are neutral (ie, not relevant or impact on that element is minor or unlikely).

Such an exercise provides a wider landscape of the impacts and can be a useful starting point for engaging with stakeholders, Māori, iwi, hāpu, sector leaders and experts on the relevancy of hazards and their potential impacts.

Table B2-1 shows an example that encapsulates this precursory mapping.

Table B2-1: Example template for precursory mapping of climate change threats and opportunities

Theme or sector: Transport sector																				
	Climate-related hazards (broad suite)																			
Map climate-related hazards that pose main threats to the value domain or sector (leave blank if neutral or N/A)	Higher mean temperatures: air and water	Heatwaves	Dry spells and drought	Changes in climate seasonality	Fire weather (harsher, prolonged season)	Storminess and extreme winds	Mean annual rainfall	Reducing snow/ice cover	Hail	River & pluvial flooding	Coastal & estuarine flooding	SLR & salinity stresses	Coastal erosion	Landslides and soil erosion	Marine heatwaves	Ocean chemistry changes	International influences	Others?
Elements or activities exposed																		
Element 1		■	■		■					■	■							
Element 2	■			■		■	■		■			■	■	■			■	
...		■		■		■	■		■									
....	■	■	■	■	■										■			■
...		■				■					■		■				■	
Activity X		■		■		■	■	■	■									
Activity Y											■							
Activity Z	■	■		■	■													
...																		
...																		
...																		

Note: This example template provides for precursory mapping of potential threats (from hazards) for each element of a value domain or sector, or where the climate change effect is not likely to be significant or relevant to that domain or sector (blank cell). SLR = sea-level rise.

This template example, which maps climate change effects (hazards) to elements of a value domain or sector, can be updated throughout the risk assessment and engagement processes (as new information is revealed), and to provide an overview of where the risks potentially lie from climate change. The relevant climate change threats for each element of a value domain or sector can then be taken through to the first-pass climate change risk screening (Step 4).

Guidance on Step 4: Analyse risks and evaluate priorities for detailed risk assessment or exploration of opportunities

Identify hazards or specific risks that may cause problems in the future

Through structured engagement and elicitation processes that address Step 2 and Step 3 questions, work through risk screening summary sheets for the elements in each value domain or sector for the key hazards identified in the precursory mapping in Step 3. An example sheet is shown in table B2-2.

The threat or opportunity would be derived from a template such as table B2-1, the strength of evidence from table B2-2, and codes used to indicate the different types of evidence (data, knowledge, reports, existing risk assessments and so on).

Defining consistent criteria across all value domains is difficult for the initial risk rating in the short term (30 years) and long term (100-plus years), given the variety of activities and elements. However, an initial step the assessment team should explore when undertaking the facilitated elicitation process ('risk workshop') for a sector or domain is co-producing qualitative descriptors of what would constitute a low, medium or high risk for the sector, to produce reasonable relativity between risks. It is important in elicitation or workshop processes to revisit the risk-screening scoring after the first round, to apply a relativity lens and ensure consistency. It is also helpful to consider input from an external review of the outputs, before proceeding to the detailed risk assessment (chapter B3).

From this first-pass risk assessment and the completed risk screening summary templates, several climate impacts can be identified for further analysis in the detailed risk assessment using criteria defined in Step 1.

Are there opportunities (beneficial effects) arising from climate change that could be explored within a National Adaptation Plan?

Collate the credible opportunities for beneficial effects (eg, reduced or negligible frost days) which could arise from a warmer climate for the relevant value domain or sector (and any potential side-effects or indirect implications) and that could be transferred to the evaluation of risks and opportunities in chapter B4 (because these types of opportunities do not readily fit the risk assessment framework in chapter B3).

Table B2-2 shows an example template for Step 4 that could be used to record findings from the risk screening process.

Table B2-2: Example template of how the climate-related risks for key elements or activities in a value domain or sector can be assessed in the first-pass screening process

Exemplar: Stage 1 Risk Screening					Example content only – for illustrating the method						
Value Domain: Economy			Sector: Primary Industries			Element: Aquaculture and marine farming					
Climate-related hazard [table B1-2]	Significant present-day impacts	Significant impact by ~2050 [RCP8.5]	Significant impact by 2100 [RCP8.5]	Main impacts for RCP8.5: due to changes in magnitude, frequency or trends (by ~2050 and 2100)	Key implications for the element or sector	Strength of evidence (1 to 4) [tableC2-1]	Current or planned adaptation under way [Short-term fix or adaptive/long-term?]	Well-beings affected?	Sub-national climate zones exposed (1–7)	Initial national risk rating: ~2050 [Consequences table C2-2]	Initial national risk rating: by 2100 [Consequences table C2-2]
River and pluvial flooding (high intensity rainfall)	?	●	●	Reduced harvest times due to *E. coli* – increases by x% by …	Loss in production time		Smart monitoring systems, catchment plans	**Economic**, Environ., Cultural	1 – 6	Moderate	Moderate
Ocean chemistry changes (pH and nutrients)	–	●	●	Shell condition degenerates (pH expected to decrease to X); Nutrients expected to …	Viability of production?			"	all	Minor	Moderate
Marine heatwaves	?	●	●	Affects spat larvae and feeding, salmon condition … Marine heatwaves will become common by …	Viability of production?			"	1A, 1B, 4	Moderate	Major
Etc											

Note: The table uses incomplete examples for the aquaculture and marine farming sector; these do not contain verified information but simply show the method. Table C2-1 lists the strength of evidence criteria and table C2-2 the criteria for consequences, which are used in the risk screening stage for initially rating the risks mapped in a template, such as figure B2-1.

Produce interim report at the end of Step 4 on preliminary risk screening assessment findings including potential opportunities arising from climate change

Rather than producing one report at the end of the NCCRA, it is recommended the Stage 1 screening exercise results are communicated in an interim report at the end of Step 4 for the general public.

Step 4 requires expert judgements to be validated because opinions gathered may not be able to be fully justified if data and information are scarce. Additional engagement activities at this point should include verifying the first screening findings with those people engaged, to ensure the findings reflect the actual risks.

Engagement activities	Prompts
Verifying Stage 1 outcomes	• Were all those with expert knowledge or information engaged in the process? • Do the results reflect perceived and actual risks? • Are there any perverse outcomes?

	• Are assessment attributes weighted for regional context, that is, population, impact? If so, why and how? • Send first screening results back to engaged stakeholders for their verification of outcome. • Does the engagement strategy need to be revised and updated?

Chapter B3: Assessment Stage 2: Detailed risk assessment

B3.1 Detailed risk assessment scope and purpose

The purpose of the detailed risk assessment is to refine our knowledge about risks rated as of potential concern in the first-pass screening (chapter B2). This process helps to identify key risks to be considered in the development of a National Adaptation Plan. The assessment will require an engagement plan, including expert elicitation, as discussed in chapters A4 and C1.

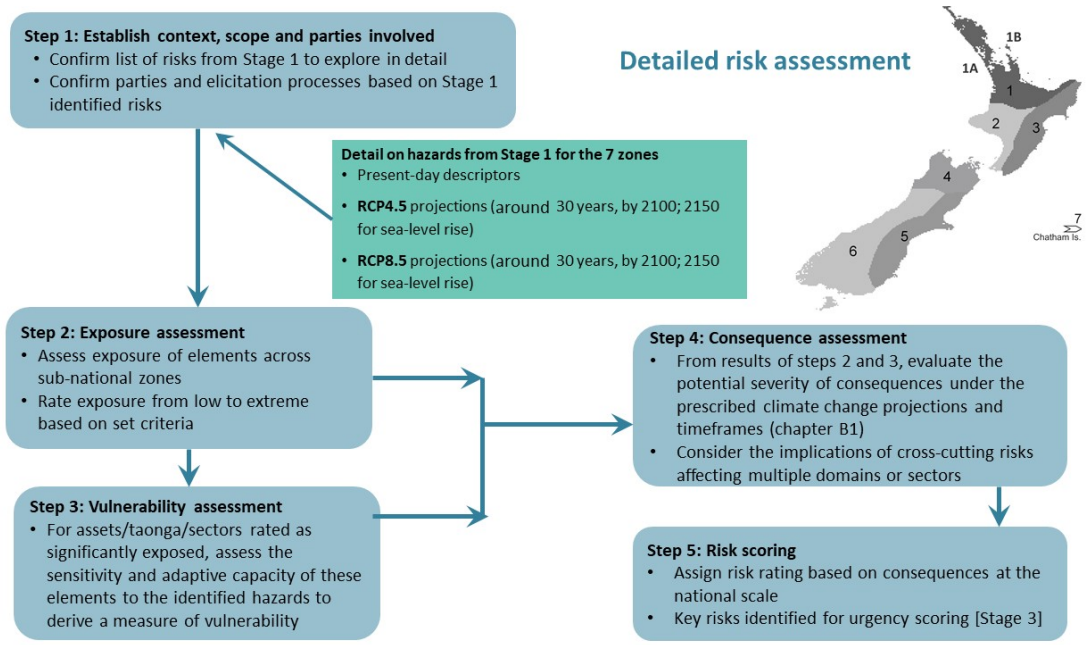
Following the first-pass assessment, a number of elements will have been identified as being at moderate or high risk due to changes in climate-related hazards associated with the RCP8.5 projection. The Stage 2 assessment will further examine the extent of exposure of the assets, sectors and taonga, and their vulnerability to the identified climate-related hazards. This helps determine the potential severity of consequences under both RCP4.5 and RCP8.5 projections, at all three recommended timeframes (chapter B1), plus out to 2150 for only coastal flood risks associated with sea-level rise (chapter B1). The latter extension highlights this long-run risk (for which risk exposure information is available out to 2150), to ensure short-term actions or long-term options that address adaptation are sufficiently flexible and adaptive to avoid locking in pathway dependency.

As summarised in chapter A2, the NCCRA framework is based on the hazard–exposure–vulnerability framing of climate change risks from the IPCC Working Group II Fifth Assessment Report (IPCC, 2014a). Risk results from the interactions of climate-related hazards (chapter B1) with exposure and vulnerability to those hazards from the changing climate. Vulnerability relates to how sensitive the elements are to changes in the climate, as well as their adaptive capacity (the ability to cope with the impacts and/or rate of change). In the detailed risk assessment, risk is rated in terms of consequences (impacts) resulting from these interactions.

Like the first-pass assessment, the detailed assessment assesses risks across the seven designated sub-regional climate zones (chapter B1) and aggregates the consequence scores to determine a national-level risk rating.

The Stage 2 detailed risk assessment process is shown in figure B3-1.

Figure B3-1: Stage 2 detailed climate-change risk assessment



B3.2 Method for detailed risk assessment

As shown in figure B3-1, this assessment stage involves five steps, as discussed below.

- **Step 1: Establish the context and define the scope and parties involved**

  Based on results of Stage 1, including further detail on hazards:

  – reconfirm the list of risks from Stage 1 to explore in detail (chapter B2)

  – confirm the parties and the elicitation (risk workshops) and engagement processes based on Stage 1 identified risks (see chapter A4 and chapter C1)

  – gather detail on hazards from Stage 1 for RCP4.5 and RCP8.5 projections and the recommended timeframes (around 30 years, by 2100, and for sea-level rise in relation to coastal flooding, out to 2150) across the seven sub-regional climate zones (from the updated and completed table B1-1, chapter B1).

- **Step 2: Exposure assessment**

  – Define elements at risk by value domain or sector (chapter A3) for the priority risks from the screening assessment (chapter B2), by sourcing relevant data and knowledge on elements from databases. For example these databases include Census, sector databases, New Zealand Landcover Database, Land Information New Zealand NZ Building Outlines, RiskScape asset and buildings databases, environment and conservation classifications, tourism hotspots, marine habitats and fisheries environment classifications.[5]

  – Quantify the value (in monetary terms, if possible) of the defined assets, taonga, environments and people exposed to the identified climate hazards.

[5] LRIS Portal (2019) LCDB v 4.1 Land Cover Database version 4.1, Mainland New Zealand, https://lris.scinfo.org.nz/layer/48423-lcdb-v41-land-cover-database-version-41-mainland-new-zealand/; Statistics New Zealand 2018 Census www.stats.govt.nz/2018-census/; NZ Building Outlines https://data.linz.govt.nz/layer/101290-nz-building-outlines/; RiskScape: https://riskscape.org.nz/.

- Assess the elements at the temporal and spatial scales of exposure (where quantifiable for the seven sub-national climate zones) for current and specified future timeframes (chapter A3 and chapter B1) for the two recommended projections (RCP4.5 and RCP8.5).
- Record the exposure quantitatively or qualitatively in geospatial maps or tabular form, and apply ratings on a four-level scale from low to extreme exposure across the sub-national climate zones using table B3-1. Except where the asset values are easily quantifiable in objective terms, it will be necessary to engage with key stakeholders, experts and sector adaptation leaders in an elicitation process to define thresholds for the key elements exposure that constitute a risk.

- **Step 3: Vulnerability assessment**
  - Through an elicitation process with key stakeholders, experts and sector adaptation leaders, decide on appropriate data and information, indicators or qualitative descriptors for the vulnerability assessment. This information should cover **sensitivity** and **adaptive capacity** relating to the elements or activities at risk in a value domain or sector.
  - Assess data and information for each value domain or sector across the seven sub-national climate zones and record a qualitative ranking using the four-level scale, from low to extreme, shown in table B3-2.
- **Step 4: Consequence assessment**
  - Confirm the criteria of relevance for assessing consequences for each value domain or sector. Chapter C2 (table C2-2) gives an example of consequence indicators for five impact levels across the NCCRA value domains.
  - Engage experts and knowledgeable practitioners to evaluate the consequences based on the agreed criteria, considering the ratings for exposure and vulnerability.
  - Where multiple consequences criteria are scored for each value domain or sector, use an agreed weighting or normalisation method to determine an aggregate score.
- **Step 5: Risk scoring**
  - Prepare a workbook for scoring risks by domain or sector. Risks will be rated based on the consequences score, aggregated across the sub-national climate zones (using criteria prepared for the aggregation of risk scores to the national scale eg, Step 1, section B2.2). Only risks falling under consequence categories of moderate to extreme from Step 4 need to be scrutinised further in Stage 3.
  - Assess strength of evidence and uncertainty using the strength of evidence criteria outlined in chapter C2, table C2-1.
  - Identify key risks. Following assessment of strength of evidence levels, prepare a summary tabulation by domain or sector, as shown in table B3-5.

B3.3 Guidance on the assessment steps

Guidance on Step 1: Context and hazards

The context for Stage 2 flows from the results of Stage 1. Engagement is again required to gather and analyse information, following similar methods with stakeholders, agencies and partners as identified in Stage 1. Guidance is provided in chapter C1.

Hazards

Chapter B1 describes several hazard categories based on primary and secondary climate variables, such as changes in temperature, precipitation, storms, and changes to coasts and oceans (see table B1-2). The first-pass risk screening (Stage 1, chapter B2) should have identified priority hazards for each value domain or sector, including changes to these hazards for the RCP8.5 projection (eg, changes in climate seasonality), considered over the three timeframes (present day, around 30 years, and by 2100).

For the detailed risk assessment, further available information, publications and data should be sourced to better resolve the exposure and vulnerability components across the sub-national climate zones for risks rated moderate to high in Stage 1. Combined expert elicitation may be needed to provide more specific and detailed information on hazards, exposure, vulnerability and impacts. This should be undertaken with the aim of better defining the exposure, sensitivity and coping capacity of each sector.

Results from this engagement then need to be reconciled between sectors (see chapter C1) into the vulnerability rating scale (table B3-1).

This could involve in-depth discussions with research providers, local and central government agencies, Māori, iwi, hāpu and other stakeholders to source data and information to better define exposure, sensitivity and coping capacity. This can be supported by literature reviews of relevant New Zealand and international reports and publications.

Guidance on Step 2: Exposure assessment

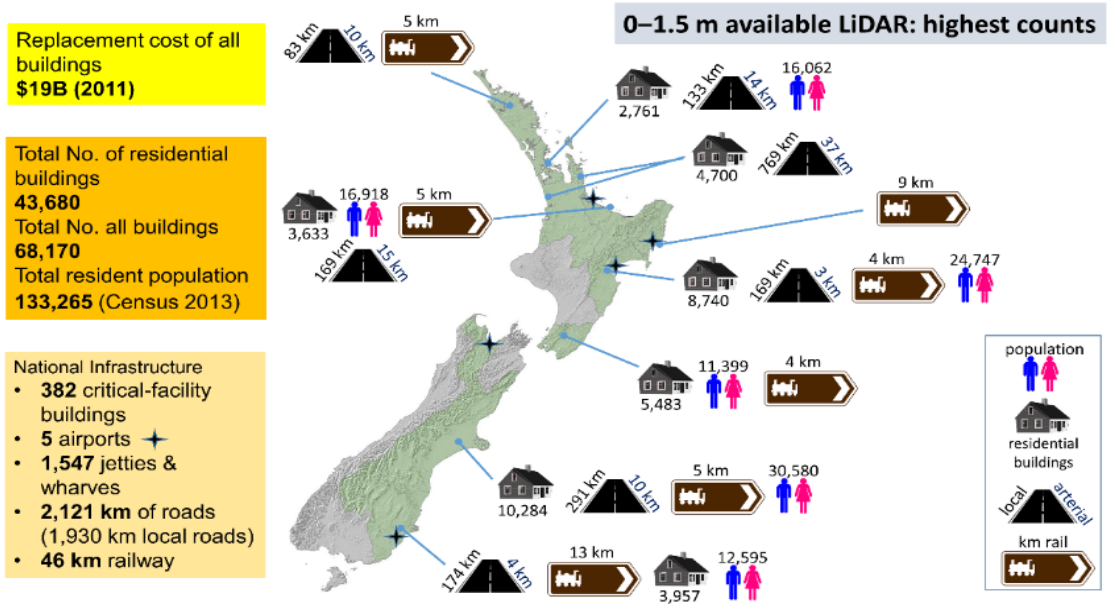
Exposure is defined as:

> The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by natural hazards and climate change (see Glossary).

Elements (eg, people, buildings, infrastructure, environments, primary production and critical facilities) are exposed to climate change hazards if they are spatially located within an area affected by a climate-related hazard. Exposure is assessed using the projections (eg, Ministry for the Environment (2018) maps of climate projections) or other available hazard-exposure layers (eg, coastal flooding with sea-level rise).

Figure B3-2 shows a coastal example of a national exposure assessment for sea-level rise.

Figure B3-2: Example of a national-scale exposure analysis of physical assets and people in coastal areas potentially affected by a sea-level rise of 1.5 metres



Source: Bell et al, 2015; Ministry for the Environment, 2017

Note: LiDAR = Light Detection and Ranging.

The degree of exposure can be expressed by absolute numbers, densities or proportions of the elements at risk (eg, people, buildings, infrastructure, and the economy) that are exposed. The extent of exposure is measured spatially (eg, a map of the hazard overlying the elements present or tabulated lists) and temporally (the three timeframes, plus 2150 for coastal flooding exposure) to determine this aspect of risk.

In most cases, the extent and numbers defining the exposure will increase with time for any given climate change projection. Besides the change in hazard over time (projections), which alters the extent or location of exposure, the temporal component of exposure can also relate to the assets' lifespan (eg, could be short-life assets), or changes to the asset base over time (eg, more buildings or infrastructure in the hazard area, or a growing population such that, over time, more people are exposed).

Exposure data can therefore be spatial and temporal. The 'quality' of spatial resolution will be influenced by the availability of trustworthy data, the total available human resources and the time spent on the assessment. National-scale exposure analysis may need to be tailored to the broad, regional (sub-national scale) enumeration of elements exposed to different hazards. For example, drier summers or autumns in the east from North Otago to East Cape for zones 3, 4 and 5 (figure B1-1) may affect dairying, so a broad estimate of the exposure could be the area (hectares) of dairying land in those regions (and also aggregated to national scale) likely to be exposed to drier conditions.

Rate exposure on a four-point scale, from low to extreme, as indicated in table B3-1. Any elements that have a 'low' exposure rating at this step should not be carried through to the next step (vulnerability assessment).

Table B3-1: Exposure rating scale

Description of exposure level	Definition
Extreme	>75% of sector or element is exposed to the hazard
High	50–75% of sector or element is exposed to the hazard
Moderate	25–50% of sector or element is exposed to the hazard
Low	5–25% of sector or element is exposed to the hazard

Guidance on Step 3: Vulnerability assessment

The IPCC's Fifth Assessment Report (AR5) describes vulnerability as encompassing "a variety of concepts and elements, including sensitivity or susceptibility to harm or damage, and lack of capacity to cope and adapt (adaptive capacity)" (IPCC, 2014a, p 128). Vulnerability is derived from the interplay of sensitivity and adaptive capacity. It contributes directly to the impact or consequences of a hazard on the exposed objects.

Sensitivity

Sensitivity as a concept defines the degree to which an exposed object, species, system, sector, taonga or community could be affected by a specific climate-related hazard. Sensitivity may include physical attributes of a system (eg, building material of houses, type of soil on agriculture fields, temperature or frost tolerance of a type of horticulture or viticulture), and social, economic and cultural attributes (eg, age structure, income structure). Examples of sensitivity and their connection to exposed elements are described in box B3-1.

Box B3-1: Examples of sensitivity of elements to climate change hazards

Examples of sensitivity include:

- characteristics of an exposed population, such as age, which contribute to a predisposition to be more sensitive to heatwaves
- incomes of households or businesses (eg, lack of access to insurance leads to higher sensitivity to hazards)
- quality and durability of building materials or the condition of assets, infrastructure or services (eg, aged or poorly maintained assets have a higher sensitivity)
- infrastructure network redundancy (eg, are there alternative road routes, how sensitive is the electricity network to exposed sub-stations)
- aquaculture and marine farming, which are particularly sensitive to sea temperatures and nutrient availability
- tolerance of sub-alpine habitats and species to changing snow lines and rising mean temperatures.

Adaptive capacity

The Climate Change Adaptation Technical Working Group's Stocktake Report (2017, p 98) defined **adaptive capacity** as:

> The resources available for adaptation to climate change and variability or other related stresses, as well as the ability of a system to use these resources effectively in pursuit of adaptation.

However, adaptive capacity goes beyond having the necessary resources at hand. It also reflects the willingness and capability to convert those resources into effective adaptive action (Cinner et al, 2018). Examples of adaptive capacity characteristics are described in box B3-2.

Box B3-2: Adaptive capacity characteristics

Examples of adaptive capacity characteristics include:

- appropriate emergency response capacity to respond to more frequent hazard events or stressors, such as drought, pest and disease invasions, heatwaves, epidemics from vector-borne diseases
- business continuity plans and strategies to reduce risk and minimise disruption
- capacity and resources to upgrade or change critical infrastructure and utilities (eg, respond to electricity demand in hotter summers, reroute coastal roads, upgrade bridges, shift primary–industry processing plants)
- capacity and willingness of communities, businesses and the primary sector to accept reducing levels of service (eg, stormwater, maintaining road access, wastewater systems, flood protection in transition to a more transformative situation)
- resources and capability of local government to address climate change impacts and implications
- access to insurance and hence bank finance (private and public assets)
- capacity and resources available to switch to alternative types of activities or production (eg, capacity of fishing quota system to respond to changes in geographical distribution of fish stocks), different tourism activities (eg, loss of glaciers), changing types of horticulture or aquaculture.

Determining vulnerability ratings

Quantitative vulnerability assessments are complex and not yet well developed in Aotearoa New Zealand.[6] The main challenge is understanding how sensitivity and adaptive capacity will evolve in the future, as New Zealand faces increasing risks and social-economic adjustments from climate change and policy responses to mitigating greenhouse gas emissions. Therefore, the first iteration of the NCCRA will only involve a high-level qualitative assessment, allowing further narratives to be introduced and appraised in future iterations. The first assessment will not involve the use of different future scenarios, such as the Shared Socioeconomic Pathways (SSPs) (Frame et al, 2018a).

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[6] A current research topic in the Resilience to Nature's Challenges and Deep South Science Challenges (see https://resiliencechallenge.nz and www.deepsouthchallenge.co.nz, for further information).

The vulnerability of Māori populations and taonga needs to be discussed in detail with local iwi or hapū. Each value domain in this framework has a kaupapa Māori component to it: Culture – Ahurea Māori/Tikanga Māori/Māori culture; natural environment – He Kura Taiao/Living treasures; economy – Whakatipu Rawa/Māori enterprise, built infrastructure – Te Whare Āhuru He Oranga Tāngata/Safe homes, healthy people; and governance–Te Tiriti o Waitangi partnerships. Through an elicitation process with key stakeholders and partners, such as the Iwi Chairs Forum, Māori Women's Welfare League, New Zealand Māori Council and Office of the Māori Climate Commissioner, decide on appropriate data and information, indicators or qualitative descriptors for the vulnerability assessment that covers both sensitivity and adaptive capacity with regard to the elements or activities at risk. This should be done specifically for the kaupapa Māori components for each value domain or sector.

The elicitation process should produce a 'qualitative' ranking of vulnerability from low to extreme, based on the descriptions and definitions in table B3-2.

Table B3-2: Vulnerability rating scale

Description of vulnerability	Definitions
Extreme	Extremely likely to be adversely affected, because the element or asset is highly sensitive to a given hazard and has a low capacity to adapt.
High	Highly likely to be adversely affected, because the element or asset is highly sensitive to a given hazard and has a low capacity to adapt.
Moderate	Moderately likely to be adversely affected, because the element or asset is moderately sensitive to a given hazard and has a low or moderate capacity to adapt.
Low	Low likelihood of being adversely affected, because the element or asset has low sensitivity to a given hazard and has a high capacity to adapt.

Outcomes of the vulnerability assessments need to be reconciled according to sector and expert agreement categories, to ensure biases are not averaged. The same members and assessors of the engagement project team should meet to assess the responses, rather than this being done separately or by several people independently of each other. Once each expert group has been coded, the assessor(s) can reconcile the various groups according to their level of agreement. An example of how this reconciliation process could proceed is given in chapter C1.

Guidance on Step 4: Consequence assessment

Consequence is an important component of assessing risk. A higher consequence from a hazard significantly exacerbated by climate change (eg, more frequent coastal flooding or a seasonal shift in rainfall) will naturally lead to a higher risk rating. The level of exposure and vulnerability of a sector or element will influence the consequences and affect severity.

The development of consistent consequence tables is critical for comparing consequences across a range of outcome types. This will need expert consultation and elicitation. Chapter C2 (table C2-2) sets out the proposed consequence table for the NCCRA. The example criteria in table C2-2 represent only broad consequence measures that may need further detailed articulation across the various sectors. This requires an expert group representing different disciplines and domains to work together to align consequence levels across the domains.

The severity of consequences also relates to the importance of a particular asset, taonga, sector, environment or service provision or function. This will vary based on differing values

and worldviews that may be held, Te Tiriti o Waitangi principles, statutory requirements and standards, and the balance of consequences across the four LSF wellbeing capitals (rather than just monetisation of the consequences, such as at-risk building replacement costs). For example, in a built environment or economic context, a hospital within a floodplain will be rated as more important (higher consequence and impact) than a residential house, due to the potential social, economic and health consequences that would result if it were adversely affected. In an environmental context, certain taonga species may be deemed of higher cultural consequence (importance) than others. For community-based elements, consequence is likely to be more difficult to assess.

A single risk event or episode can generate many consequences that can have both positive and negative effects across the four LSF capitals and impact multiple value domains and sectors. Initial consequences can escalate through cascading and cumulative effects, but ongoing stressors can also lead to cumulative effects. Examples are described in box B3-3.

Box B3-3: Examples of cascading and cross-cutting risks and consequences

Cascading effects, also known as knock-on effects, tend to be associated with events where a primary threat is followed by a dynamic sequence of secondary hazards. For example, earthquakes or floods can not only heavily damage roads and compromise other critical infrastructure or services, such as electricity grids, potable water supply, but also disrupt tourism operations and supply-chain logistics. The cascading effect of heatwaves or drought could also trigger wildfires, which could be exacerbated by a lack of water supply and inaccessible roads, causing trickle-down impacts and consequences on other value domains, unless planned for.

Similarly, an ongoing rise in groundwater levels as a result of sea-level rise will lead to dampness and mould issues in housing, foundation and road instabilities and increase liquefaction potential, thereby affecting multiple domains and sectors in a cascading and cumulative manner.

Evaluating cross-cutting risks and issues

In undertaking the risk assessment, cross-cutting risks and issues will arise from two main directions:

1. those being revealed during assessment of discrete domains and sub-domains
2. others at the domain or sub-domain level that are considered relatively low risk but have the potential, cumulatively across several domains, to present significant risk across multiple sub-national zones.

For those in the first category, it is likely judgement calls can be made in terms of materiality and potential consequence. Where minor, they can likely be ignored, but if otherwise, they need to be reported along with other risks. These may need further assessment alongside assessment in other domains.

Those in the second category will be more difficult to identify. During the engagement process, specific attention should be paid to identifying potential cross-cutting risks that may be relatively minor under individual domains or sub-domains but that cumulatively may pose significant risks. Again, these need to be reported on, particularly to enable active ongoing monitoring and evaluation.

Cross-cutting risks and issues of material significance are to be separately reported on, to enable consideration relative to all domains. An example of where cross-cutting issues are separately reported is the *Thirty Year New Zealand Infrastructure Plan 2015* (The Treasury, 2015).

Guidance on Step 5: Risk scoring

A **risk score** is conventionally derived by combining the probability (or likelihood) of an adverse event with the magnitude of the expected consequences. To address the evolving impacts of climate change, risk is better defined as the interplay between hazards, exposure and vulnerability, as discussed in chapter A2. Risk assessments that consider risks from ongoing climate change must consider the changing characteristics and intensity of the considered hazard and the set of receptors exposed to it.

The probability aspect of a climate-related hazard impacting on receptors is better reframed for climate change risk by assessing consequences at different junctures (present and two future timeframes, plus by 2150 for coastal flooding risk) and across different climate projections (two for this framework). The assessment should consider:

1. adaptation thresholds for consequences (eg, number of floods in a decade, increment of sea-level rise, a seasonal temperature threshold) when objectives for safety, wellbeing, economic returns or system performance can no longer be met, and the timeframes for when these thresholds will eventuate for different projections
2. high consequence (life safety) hazards (eg, landslides and debris flows) generated by high intensity events (ie, rainfall), the frequency of which will increase over time. These require proactive risk reduction interventions in the short term rather than continuing to respond to consequences post-event.

Risk should also, ideally, consider evolving social-economic scenarios for different futures (eg, how primary production, land use, business and societies might operate under different degrees of climate change and commitments to greenhouse gas emissions). For the first NCCRA, in absence of a well-developed suite of national scenarios (other than the broad New Zealand shared socio-economic pathways – CCII report (Tait et al, 2016)), assessments will need to be limited to narratives developed through elicitation processes or adopting domain or sector scenarios that have already been applied and assessed. The vulnerability of the receptors exposed to the climate hazard then determines the consequences and impact severity.

Assemble a workbook by value domain or sector. To complete the risk assessment to this point, a workbook, such as in table B3-3, could be used to assemble and present the components of the risk scoring, as well as the final risk score. Other approaches may be chosen, but transparent decision-making must be maintained in assembling the components and to enable easy transition to the next stage of reporting (chapter B4), which is important for informing the development of the National Adaptation Plan.

- A workbook should be developed for each value domain or sector, where key climate-related hazards and their exposure and sensitivity will be defined first.
- Climate risk and opportunity will be identified based on the elicitation and workshop process. Opportunities that will result from climate changes could be captured separately and transferred to Stage 3, so they can be documented clearly within the final NCCRA report.

- Based on the hazard, exposure, vulnerability and consequences guidance (section B3.1 to B3.3), scoring should be completed, ranking from insignificant to extreme.
- In some cases, the consequence component may not be able to be meaningfully assessed or differentiated for a particular risk or risk area. In this instance, the risk will be based on the assessment of exposure and vulnerability only.

Table B3-3: Sample workbook

Sample Worksheet

Value Domain or sector: Agriculture — Example content only - for illustrating the method

Key climate hazards: (remove those not applicable)

Key sensitivities: Water, seasonality, temperature, sea-level rise

Climate hazard	Climate effects	Implications (including opportunities)	Exposure						Vulnerability						Consequences (risks)						Extent of risk (climate zones)
					by 2100		by 2150 (SLR)				by 2100		by 2150 (SLR)				by 2100		by 2150 (SLR)		
			Present	~30 yrs	RCP4.5	RCP8.5	RCP4.5	RCP8.5	Present	~30 yrs	RCP4.5	RCP8.5	RCP4.5	RCP8.5	Present	~30 yrs	RCP4.5	RCP8.5	RCP4.5	RCP8.5	
Change in mean annual rainfall	Decreasing rainfall in some climate zones … Western areas projections are for higher annual rainfall.	Decreasing precipitation with consequently less water for growth and irrigation. Wetter western areas may promote more growth – but more waterlogging?	Low	Moderate	Moderate	Major	–	–	Low	Low	Moderate	Major	–	–	Minor	Minor	Moderate	Major	–	–	Drier in north and east of North Island, and east of South Island (climate zones: 1, 3, 4, 5). Wetter in western regions (climate zones: 2, 6)
Higher mean temperatures	Warmer climate with decreasing frosts …	Changes in optimal regions for cropping and grasses. Potentially higher growth rates where adequate water.	Low	Moderate	Major	Extreme	–	–	Low	Moderate	Moderate	Major	–	–	Insignificant	Moderate	Major	Major	–	–	Agricultural regions throughout New Zealand including Chatham Islands (all climate zones 1–7)
Coastal and estuarine flooding	Lowland river and coastal areas subject to more frequent flooding including higher groundwater, …	Drainage increasingly difficult or expensive, low-lying coastal rural land less productive and more hazardous, … Also compound hazard from salinization.	Low	Moderate	Major	Major	Major	Extreme	Major	Major	Extreme	Extreme	Extreme	Extreme	Minor	Moderate	Major	Extreme	Extreme	Extreme	Areas around coasts, estuaries and lowland rivers of relatively flat low-lying land (all climate zones)
Continue below			Low	Low	Moderate	Moderate	–	–	Low	Major	Major	Major	–	–	Insignificant	Minor	Major	Major	–	–	

Instructions:
In the cells type rating and colur will be automatic

Rating options:

Exposure:	Vulnerability:	Consequences (Risks)
– Not assessed	– Not assessed	– Not assessed
Low	Low	Insignificant
Moderate	Moderate	Minor
Major	Major	Moderate
Extreme	Extreme	Major
		Extreme

The consequences score is derived based on consideration of the hazard, exposure and vulnerability as described in Step 4 above (see also table C2.2 for a description of a five-level scale from 'insignificant' to 'extreme'). At this stage, the risk assessment score will be taken as the consequence score. It is anticipated that risks will be assessed via a workshop approach, with input from various stakeholders and specialists.

Only risks falling under the categories of moderate, major or extreme as in the timescales in table B3-4 need to be scrutinised further.

Table B3-4: Ratings and timescales for risks requiring further assessment

Risks requiring further assessment			
		100-plus years	
Present	30 years	RCP4.5	RCP8.5
Moderate	Moderate		
High	High	High	
Extreme	Extreme	Extreme	Extreme

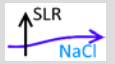
Assess strength of evidence and uncertainty

A certain pedigree of literature and information is needed to develop a robust summary of observed or projected impacts on sectors, particularly those associated with uncertain variables that support the scenarios and timeframes used. The strength of evidence criteria outlined in table C2-1 in chapter C2 provide guidance that includes demonstrated consensus in any elicitation process, including with Mātauranga Maori experts. If the strength of evidence rating is low or weak, but the risk is perceived to be relatively high, then recommendations for any key research, information or monitoring gaps should be transferred to Stage 3.

Identify key risks

As shown in table B3-5, a summary tabulation by domain or sector should be prepared following assessment of the strength of evidence. An Excel spreadsheet has been developed to expedite this reporting and incorporates automatic colour coding to entered ratings.

Table B3-5: Summary table for domain or sector (example)

Value Domain or sector:	**Agriculture** Example content only – for illustrating the method											
Key climate hazards: *(remove those not applicable)*	 Higher mean temperature	 Heat waves	 Dry spells and drought	 Changes in seasonality	 Increased fire weather	 Storminess and winds	 Change in mean rainfall	 Landslide and soil erosion	 Increas-ing hail severity	 River and pluvial flooding	 Coastal and estuarine flooding	 SLR and salinity stresses
Key climate sensitivities:	Water, seasonality, temperature, sea-level rise											

Climate hazard	**Climate effects**	**Implications (including opportunities)**	**Risk rating** *(based on consequences table C2-2)*						**Strength of evidence**	**Current adaptation**
			Present	~30 yrs	by 2100		by 2150 (SLR only)			
					RCP4.5	RCP8.5	RCP4.5	RCP8.5		
Change in mean annual rainfall	Decreasing rainfall in some climate zones ...	Reduced water for growth and irrgation ...	Insignificant	Minor	Moderate	Major	–	–	Low	Low
Higher mean temperatures	Warmer climate with decreasing frosts ...	Changes in optimal regions for cropping/grasses. Potentially higher growth rates where adequate water ...	Minor	Moderate	Major	Extreme	–	–	Medium	Low
Coastal and estuarine flooding	Lowland river and coastal areas subject to more frequent flooding incl. higher groundwater, ...	Drainage increasingly difficult, low-lying coastal rural land less productive and more hazardous, ... Also compound hazard from salinization	Minor	Moderate	Major	Extreme	Extreme	Extreme	High	Medium
Continue below ...			Minor	Minor	Moderate	Moderate	–	–	Very high	Medium

The resulting risk scoring results should be made available for the expert participants to review, verify and suggest modifications if needed. This ensures that any perverse or bias outcomes are identified and reassessed if required.

Engagement activities	Prompts
Verifying Stage 2 outcomes	• Were all those with expert knowledge or information engaged in the process? • Do the results reflect perceived or actual risks? • Are there any perverse outcomes? • Send results back to engaged stakeholders for their verification of outcome. • Does the engagement strategy need to be revised and updated?

Chapter B4: Assessment Stage 3: Adaptation and decision urgency assessment

B4.1 Scope and purpose of adaptation and decision urgency assessment

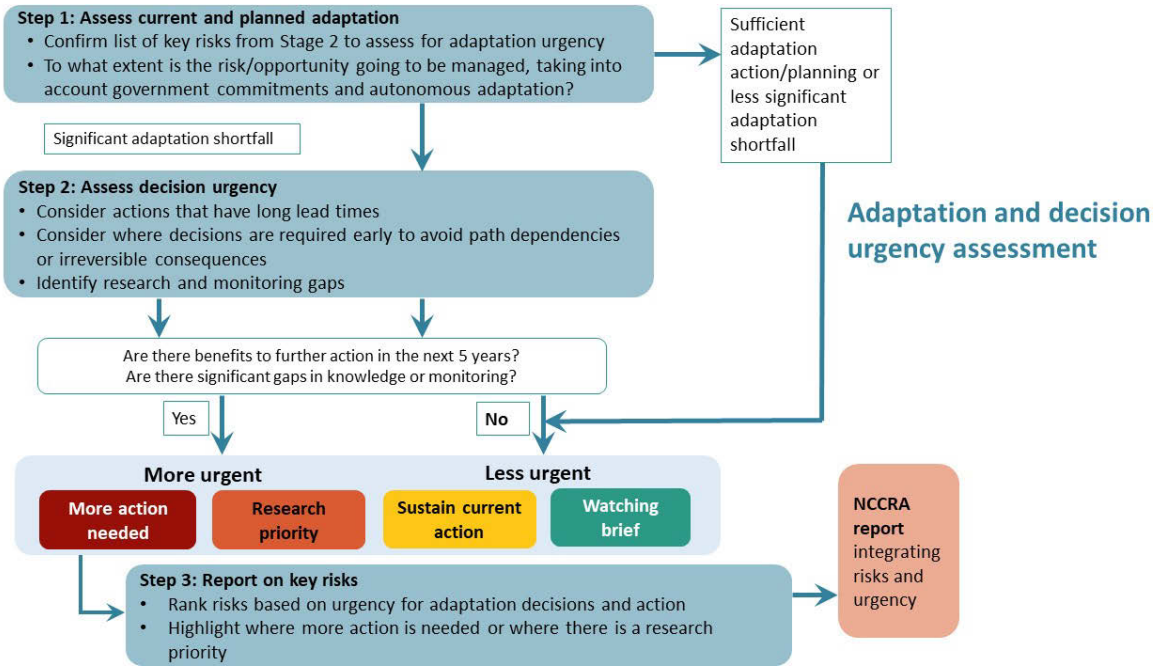
The main objective of undertaking the NCCRA using this framework is to highlight key risks that will help inform development of a National Adaptation Plan. It is important, therefore, that the outputs from the NCCRA are targeted towards this purpose.

To achieve this, a third assessment stage is recommended to assess current and planned adaptation strategies and actions to identify where gaps exist and quick decisions need to be made to prevent maladaptive path dependencies or irreversible consequences. This stage should also highlight opportunities where early action can reap benefits from changing climatic circumstances.

The framework uses the urgency ratings from the 2017 UK Climate Change Risk Assessment (Committee on Climate Change, 2017) to signal the need for adaptation decision-making, and the IPCC AR5 reporting frameworks have been adapted for New Zealand purposes (IPCC, 2014b). Figure B4-1 shows the process for Stage 3.

All risks through to this stage will either have been rated as key risks, based on potential future impacts across a range of wellbeing indicators, or be perceived as potentially high but more evidence is needed. It will be the role of those developing the subsequent National Adaptation Plan to decide on the priorities, particularly because these may coincide with government policy and budgeting cycles. The intention is to enable the NCCRA to deliver fairly clear messages across sectors in terms of key risks that need action.

Figure B4-1: Stage 3 process for assessment of adaptation and decision urgency



B4.2 Method for adaptation and decision urgency assessment

Taking the key risks from Stage 2, analyse the current and planned adaptation to highlight risks for which adaptation decisions need to be made most urgently, to inform a National Adaptation Plan.

- **Step 1: Assess current and planned adaptation**
  - Confirm list of key risks from Stage 2 and involve stakeholders, partners and agencies to canvass plans and activities to manage the identified risks.
- **Step 2: Assess decision urgency**
  - Are current actions sufficient to manage the evolving risk? Identify actions that limit future adaptations (ie, may result in lock-in of current practice or vulnerability).
  - Consider where early action is needed to avoid current pathway dependency (maladaptation) or irreversible negative consequences.
  - Consider decisions and actions that have long lead times for implementation.
  - Consider decisions that have long life spans (eg, infrastructure).
  - Identify research gaps where strength of evidence is low or there is deep uncertainty.
  - Identify monitoring gaps.
- **Step 3: Report on key risks based on urgency for adaptation decisions and action**
  - Highlight where further action is needed or there is a research priority.
  - Use an integrated reporting template to show risk scores and impact of adaptation.
  - Include where early action is critical, to take advantage of opportunities.

B4.3 Guidance on the assessment steps

Guidance on Step 1: Assess current and planned adaptation

Once you have identified major risks for potential consequences (based on the exposure and vulnerability of the sector, system or asset), next review current adaptations, regulations and policies to identify gaps where more action is needed or current actions need modifying. This is the starting point for assessing the urgency of decision-making around future adaptation actions.

Different types of adaptation activities need to be considered when determining the current level of adaptation, as shown in box B4-1. Stakeholder, partner and agency engagement should be used to tease out all types of activities to compile a full picture of adaptation strategies for the key risks.

Box B4-1: Types of adaptation

- **Anticipatory adaptation** – Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
- **Autonomous adaptation** – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- **Planned adaptation** – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve a desired state.
- **Private adaptation** – Adaptation that is initiated and implemented by individuals, households or private companies. Private adaptation is usually in the actor's rational self-interest.
- **Public adaptation** – Adaptation that is initiated and implemented by governments at all levels. Public adaptation is usually directed at collective needs.
- **Reactive adaptation** – Adaptation that takes place after impacts of climate change have been observed.

Source: IPCC, 2001.

Assess whether any risk management or adaptation strategies or actions are already in place or under development. If past or present changes in climate-related hazards or risk have been identified for the relevant value domain or sector, then consider whether any risk management or adaptation strategies are in place (or under development) to tackle this rising or emergent risk. This step should only be a high-level assessment of activities that may influence the level of risk for the sector or element.

After gathering information on current actions and plans in Step 1, a follow-on consideration is whether these strategies or actions are sufficient to reduce risk by asking if they are:

- short-term fixes to buy time or lock in future path dependencies – therefore, the risks (or residual risks eg, higher sea wall could be breached) are still present and need to be assessed in the NCCRA
- long-term options or transformational changes in practices or responses, with inherent adaptive flexibility and, therefore, only require 'ongoing monitoring' or a 'watching brief' to ensure maladaptation or unintended impacts have not occurred.

Integrating adaptation into climate change planning and decision-making will include both incremental and transformational adjustments. It is important to consider that the time horizons for risk often differ from those required for adaptation planning. For example, a risk such as rising groundwater levels may not manifest itself for several decades, but the timeframes related to land-use planning processes mean adaptations now may reduce consequences and impact severity in future.

Guidance on Step 2: Assess decision urgency

Adaptation actions or options will require considerable lead times not only to develop a plan but to implement it (eg, managed relocation from very low-lying coastal or flood plain areas may take decades to achieve). If an important risk looks to be emerging in the medium-to-long term (30-plus years), but requires long lead times for implementation or effectiveness of an adaptation strategy, then this could be rated as more urgent than a decision on another risk where adaptation does not require such a lead time, even if it may emerge sooner.

The assessment should consider where delays may increase long-term costs or reduce expected benefits. This can happen particularly in the case of slow-onset trends, which can grow steadily but imperceptibly until they reach a tipping point.

Engagement with stakeholders in a series of 'positive enquiry' questions can elicit information on options and barriers. Such questions could include the following.

- **Would action have early, robust benefits?**

  This could lead to identified 'no-regret' or 'low-regret' actions that help build future resilience.

- **Do decisions have long lead times?**

  Adaptations with long lead times may require action sooner.

- **Is there potential for lock-in?**

  This point serves to show that, in some instances, avoiding actions can maintain options and be more effective in the longer term. This includes areas where decisions today could 'lock-in' vulnerability of assets or communities for a long time. Fast-tracking of adaptation may be desirable if a wrong decision today will make us more vulnerable in the future and if those effects are costly to reverse. Several strategic decisions potentially fall into this category, including those on long-term infrastructure (eg, the location of new ports, airports, roads), land-use planning and the management of development trends, such as regional water demand.

Prompts for engagement on assessing current and planned adaptation are shown below.

Engagement activities	Prompts
Assessing current and planned adaptation	• What adaptation measures and policies is your agency currently undertaking or planning for climate change? • What adaptive measures could be taken in the future? • Are there any new policy initiatives that need to be implemented? • What are the implications of any actions to the different sectors and Māori? • What is the impact on sectors of waiting or not waiting on actions? • How will your agency monitor the effectiveness of climate change policies?

Engagement activities	Prompts
	• Is there a process for changing policies if they are deemed ineffective? • Do any regions require a national all-of-government approach? • What are the priority issues? To whom? • Where are the gaps in knowledge?

Urgency categories for decision-making

From the engagement process, the major risks are ranked and rated in terms of urgency for action. Judgement of urgency is based on available evidence about:

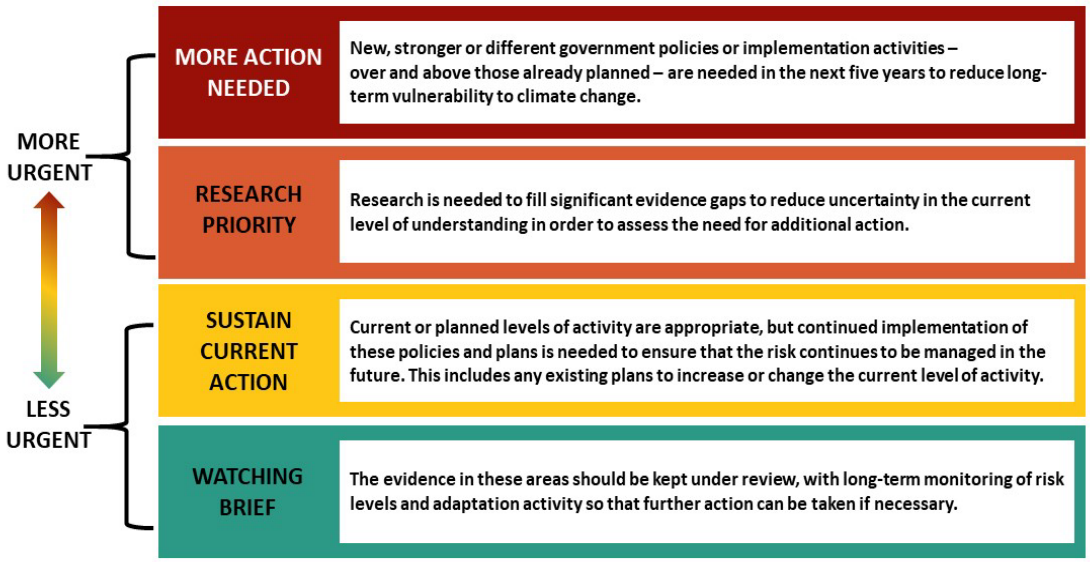
- the opportunity for intervention or early adaptation
- the difficulty of adaptation
- the lead time for adaptation
- existing or expected socio-economic trends
- the flexibility of the system in terms of the ability to change decisions in the future that are made today.

Typical risk management language refers to levels of risk, that is, high, medium, low; or acceptable, tolerable, intolerable. To avoid confusion and provide a measure that relates directly to 'adaptation decision-making', the NCCRA framework adopts the UK Climate Change Risk Assessment urgency categories. This provides clear signals about the urgency of decisions and actions (Committee on Climate Change, 2017).

In this approach, less urgent categories are designated as either 'watching brief' (where risks should be monitored and reviewed) or 'sustain current action' (where current or planned actions need to be carried out). The more urgent categories are designated 'research priority' (where risks are potentially high but significant evidence gaps exist and/or little is known about adaptation) and 'more action needed' for risks where stronger change in adaptation planning and activity is urgently required to reduce the impacts (consequences).

Figure B4-2 lists definitions for the urgency categories.

Figure B4-2: Urgency categories for adaptation action on key risks



Source: Based on the Climate Change Risk Assessment urgency categories (Committee on Climate Change, 2017)

The overall assessment considers uncertainties about the levels of future climate change, exposure and vulnerability identified in chapter B3. Specific, tailored engagement may be required with those agencies where further urgency is required for adaptation, to ensure no actions have been missed in the previous step, and it is within their mandate to action the urgency rating that is applied. This should address whether any other planned adaptation activities have been missed.

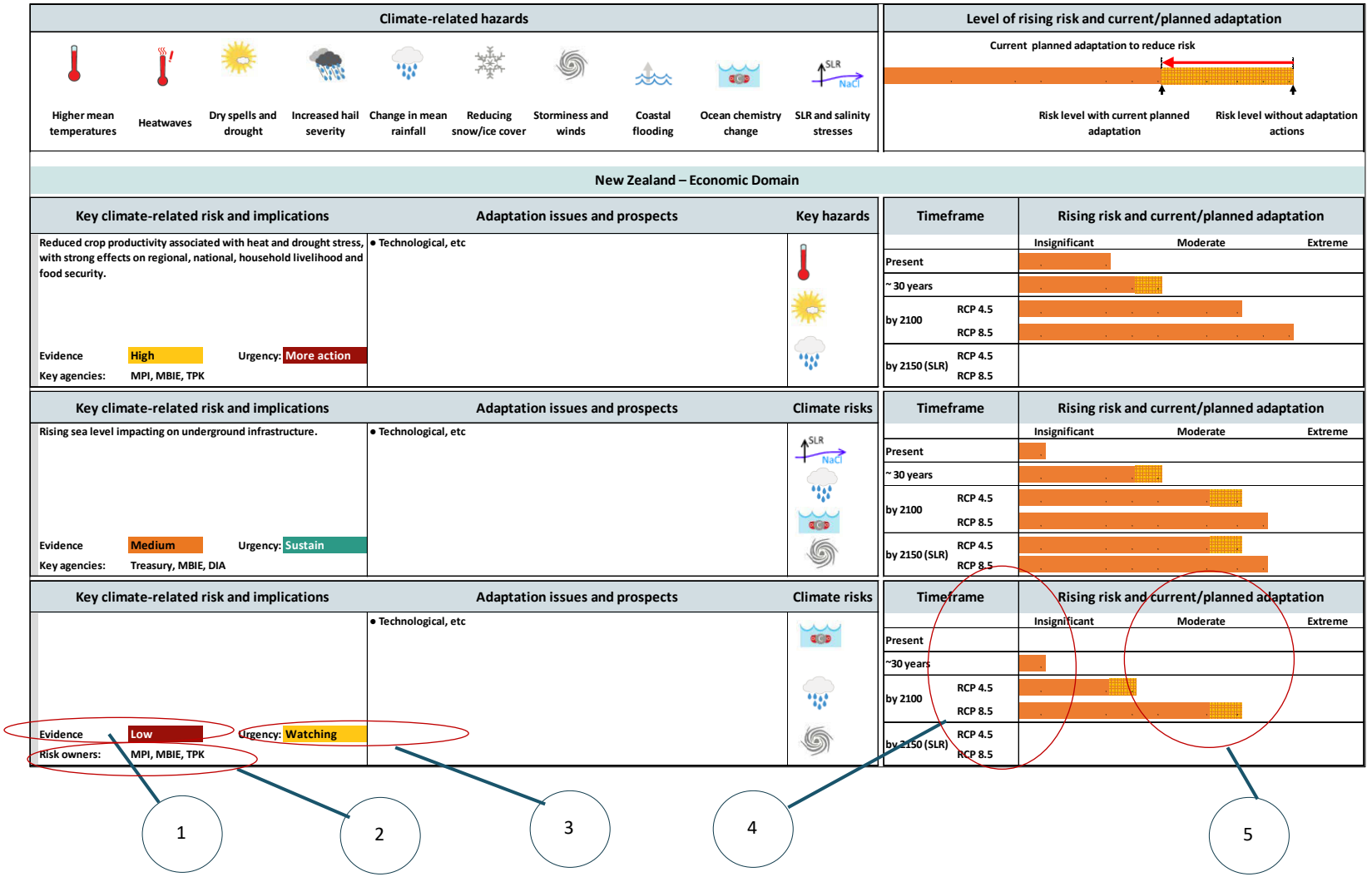
Guidance on Step 3: Report on key risks

Integrated reporting for policy-makers and others

The IPCC AR5 developed a climate adaptation reporting framework targeted at policy-makers but that is useful for many other users (IPCC, 2014b). This is considered to be particularly applicable to Aotearoa New Zealand and for the purpose of informing development of the National Adaptation Plan. It helps focus on the key risks that need attention in the National Adaptation Plan and should also help manage trade-offs and monitoring. Enhancements to the IPCC approach include adding confidence levels, urgency ratings and custodians of risk.

This format can be used to present risks in terms of urgency for each value domain as well as subsets. Guidance is provided below on the content and methods to be applied. The content in table B4-1 is indicative only and represents no level of analysis or assessment.

Table B4-1: Integrated reporting



Guidance on the reporting template

1. The strength of evidence is directly sourced from outputs of the Stage 2 detailed risk assessment (chapter B3, table B3-5). Options are low, medium and high.
2. Key agencies are those parties that have been identified to date with responsibilities related to the risk. Where known or anticipated, the lead custodian is highlighted.
3. The urgency rating is directly derived from qualitative assessment (chapter B4). Options are: more action (for More Action Needed), research (for Research Priority), sustain (for Sustain Current Action) and watching (for Watching Brief).
4. The timeframes are as discussed in chapter A3 and chapter B1.
5. The total risk level (orange plus hatched yellow) is the level as derived from the Detailed Assessment (chapter B3). The hatched yellow represents the largely qualitative assessment of potential for adaptation (chapter B4).

An Excel spreadsheet has been developed to expedite this reporting and incorporates automatic colour coding across points 1, 3, 4 and 5.

Part C: Supplementary material

Wāhanga C: Kōrero āpiti

Chapter C1: Developing an engagement plan

Any engagement process will follow accepted good practice, for example, the International Association of Public Participation process of design, methods and evaluation.[7] At the outset of planning the risk assessment process, and while starting to understand the context of the assessment, an engagement plan should be developed that reflects the process shown in table C1-1. This plan will guide the engagement process, to ensure project outcomes are met.

It is expected that, while different forms of engagement will be required (as described in chapter A4 and shown in figure A4-1), expert elicitation will be the main method for extracting information from the different sectors. This formal procedure is used for obtaining and combining expert judgements, and is often used when existing information cannot be easily provided, agreed upon or accessed. Because expert biases can result in perverse outcomes, it is important structured elicitation protocols are followed, and the reconciliation across experts is carried out in a transparent and robust manner (see table C1-1 for an example of how this can be done).

The engagement strategy is a living document and you should update it as the project progresses. For example, once engagement begins, if you identify further stakeholders (eg, experts, pan-Māori representatives), add them to the engagement strategy. There should be a regular cycle of engagement planning, implementing the plan, monitoring and reflecting on the outcomes against objectives and plan review. As well as ensuring the engagement plan is meeting its objectives, this review cycle also provides for the 'monitor and review' part of the risk assessment process. To inform the development of the strategy, the activities in table C1-1 should be undertaken.

Table C1-1: Engagement activities required to develop the engagement plan

Engagement activities	Prompts
Understand context	• What are the international, national and regional influences? • What political debate is occurring? • How important is the project to New Zealand? • Where does the need to make a decision come from? • What is the policy approach to engagement from the Ministry for the Environment? • What are the key drivers for engagement? • How is climate change affecting New Zealand now, in 30 and 100 years' time? • What overlaps or cross-cutting themes are emerging for climate change adaptation? • How will the engagement outcomes be used to inform the risk assessment? • Is there any potential cross-over with any other engagement processes occurring around the same time? • Is the Government currently engaging with this group on any other matters? • Has the Government engaged recently on this issue or with the same audience, and what was the result? • What other activities might be occurring within Māori communities that may affect your process? • Is there an opportunity to coordinate with other engagement processes occurring? • How can this opportunity for involvement and meaningful engagement be maximised?

[7] International Association of Public Participation (IAP2) for good practice engagement guidance and templates: www.iap2.org.

Engagement activities	Prompts
Scope the project	• Provide a clear statement of why this project and engagement is being undertaken. • What is the understanding of the focus of the engagement? • What is the reason for the engagement? Why now? Why is it a priority? • What is the outcome of the project, that is, what influence will it have? • What are the limitations of the scope, and what is out of scope? • What are the absolute requirements to achieve the outcome? • What are the key messages? • How will information be gathered, stored, accessed, used?
Understand people	• Who should be in the engagement team? – What skills do they bring? – Are team members IAP2 certified? – Do they have experience and knowledge of effective Māori engagement? • What type of interest should people have in this project? For example, IAP2 Orbit of Public Participation? – Who needs to be aware but not actively involved? – Who will be watching the process who the consultant may not be aware of? – Who will need to review the outcome? – Will advisors be required to the project team? – Who has interest and knowledge so their direct involvement is required? – Who are the decision-makers in the final outcome?
Set purpose	• What is the purpose of the engagement? • What engagement goals can be set so that progress can be monitored and milestones achieved?

Note: IAP2 = International Association of Public Participation.

When establishing timeframes, you should consider the capacity of your partners and stakeholders to participate effectively in your engagement process, and timeframes should remain as flexible as possible to allow for unexpected situations. In particular, for Māori, negotiating sufficient time to consider the kaupapa and response should be agreed together; it is important to go to Māori with initial thinking and proposals rather than a fully formed or fixed view (Ministry for the Environment, 2018).

Some engagement processes will need to include full disclosure on how information gathered will be used, stored, accessed; privacy requirements and longevity (ie, they will be undertaken according to ethical principles). This is particularly important for citizen or stakeholder surveys, hui, structured interviews and any mātauranga Māori that is collected. Any ethical considerations should be included in the engagement plan. The Royal Society of New Zealand provides a code of ethics which should be followed throughout the risk assessment process.

Example of how to reconcile different sector expert elicitation outcomes

The elicitation process could involve scenarios based on the consequence table that experts associate a timeframe to (eg, present; 30 years; 100 years). This is then reconciled by the assessor. An example is given in figure C1-1, based on three levels of risk; however, this could be adapted to different levels of risk, such as extreme, high, medium, low. The number of percentage categories are important to ensure averages are not used, because averages will bias the outcome.

Figure C1-1: An example of coded responses for expert elicitation on consequences and timeliness

A	90% or more described this as acceptable or tolerable and the percentage who found it only tolerable was 10% or less.
A-	70% or more found this acceptable. Those who found it tolerable was no more than 25%.
A/T	70% or more found this acceptable or tolerable with the majority finding it acceptable. 50/50 is where percentage of respondents were even for both acceptable and tolerable.
T/A	70% or more found this acceptable or tolerable with the majority finding it tolerable.
T	Majority find this tolerable – those who find acceptable or intolerable differs by 4% or less.
T/I	70% or more found this tolerable or intolerable with the majority finding it tolerable.
I/T	70% or more found this tolerable or intolerable with the majority finding it intolerable.
I-	More than 70% found this intolerable and less than 10% found it acceptable.
I	89% or more found this intolerable or tolerable the % of who found it tolerable was 10% or less.
?	This indicates the presence of a significant minority contrary voice of 20% or more.

Source: Kilvington and Saunders (2015)

To reconcile the elicitation activities from five different groups, the process below could be followed (refer to Kilvington and Saunders (2015) for the full process) to compile one recommended set of thresholds:

1. insert all 100 per cent scores
2. insert all remaining scores and colours
3. make judgement calls where majorities from each information stream align; leave blank where there are inconsistent majorities requiring considered judgement
4. make considered judgement for outlier areas – relying on knowledge about how numbers were determined and weight of opinion, as well as consistency and workability of final outcome.

When opinion diverges between the groups, judgement is required on which direction to take. Factors that need to be considered include the strength of opinion expressed by each contributing group, the overall trend towards risk acceptability, and emphasis on either consequence or likelihood.

Chapter C2: Risk assessment criteria

C2.1 Strength of evidence criteria

Table C2-1 provides a metric to rate the strength of evidence, including expert consensus (and therefore level of confidence), for use in the risk screening and detailed risk assessment stages.

Table C2-1: Strength of evidence indicators

Measure	Evidence	Information	Methods	Consensus
1 – Low	Inconclusive evidence for impacts	Limited information, extrapolations, poor documentation	Not tested	Disagreement or lack of consensus among subject matter experts. No views expressed and shared by Mātauranga Māori experts
2 – Medium	Suggestive evidence for impacts	A few sources of information, incomplete models, minor documentation	Emerging	Competing consensus among subject matter experts. Few views expressed and shared by Mātauranga Māori experts
3 – High	Moderate evidence for impacts	Several sources of information, partial models, some documentation	Varying	Moderate consensus among subject matter experts. Some views expressed and shared by Mātauranga Māori experts
4 – Very high	Strong evidence for impacts	Multiple sources of information, established models, well documented	Accepted	Strong consensus among subject matter experts. Multiple views expressed and shared by Mātauranga Māori experts

C2.2 Consequence rating criteria

Table C2-2 provides indicative metrics for rating the severity of consequences against the LSF capitals and across the framework's six value domains. The metrics generally do not reflect event-based consequences but focus on impacts resulting from changes in climate-related hazards.

Table C2-2: Consequence rating criteria

Value domain		Consequence level (national scale aggregated from the seven sub-national climate zones)				
		Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
Human	**Society**	No discernible changes in damage, casualties or displacement of households from weather-related events. Small increase in demand nationally for welfare, education and community services after events, including prolonged drought or heatwaves. Full access to essential consumer products (apart from expected major events). Individuals generally feel attached to their communities and trust and cooperation is high. Most people satisfied or very satisfied with life in New Zealand, despite the	Growing number of people affected by more frequent weather-related events and sea-level rise in different pockets around Aotearoa New Zealand, but the slight increase in injuries and illness (and even a few climate-related fatalities) can still be managed through existing health and emergency management plans. Less than 100 additional displaced households during more frequent, weather-related events, with local or regional housing agencies managing within existing resources. Despite increasing number of events, including persistent drought and heatwaves, welfare services can still be	Significant number of people (hundreds) and communities affected by more frequent weather-related events and sea-level rise around Aotearoa New Zealand, with noticeable increases in injuries, casualties (tens of more people than expected over time), illness and heat stress, which may challenge existing health and emergency management responses. May require additional support from outside the region and national agencies. Significant number of people affected (and more frequently) with hundreds more displaced households during events exacerbated by climate change.	High number of people (thousands) and communities affected by more frequent, weather-related events and sea-level rise around Aotearoa New Zealand, with large increases in injuries, casualties (tens to hundreds more people than expected over time), illness and heat stress, which strongly challenge existing health and emergency management responses. Will require strong support from outside the region and national agencies. Significant number of people affected (and more frequently) with thousands more displaced households during events exacerbated by climate change.	Large number of people (tens of thousands) and communities affected by more frequent, weather-related events and sea-level rise around Aotearoa New Zealand, with steep increases in injuries, casualties (hundreds more people than expected over time), illness and heat stress, which may overwhelm existing health and emergency management responses. Will require strong ongoing support from national agencies. Significant number of people affected (and more frequently) with tens of thousands more displaced households during events exacerbated by climate change.

Value domain	Consequence level (national scale aggregated from the seven sub-national climate zones)				
	Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
	climate-related changes, and can see the opportunities. The wellbeing of whānau is minimally affected. The overall wellbeing of rural or urban communities is minimally affected (including support industries and primary production). Climate-related changes are well inside the 'coping range'.	managed through existing local or regional services. Isolated and short-term disruption to education, employment and community services. Minor increase in short-term disruption to accessing essential consumer products. The wellbeing of whānau within some communities increasingly becomes negatively affected. The overall wellbeing of rural or urban communities is somewhat affected and more often (including support industries and primary production). Climate-related changes remain inside the 'coping range', but can be stretched during more frequent 'nuisance' weather	Welfare services in response to hazard events and stressors (eg, drought, heatwaves) require more substantial regional and occasional national coordination than previously. Multiple short- to-medium term disruption to education, business and community services. Pockets of individuals are distrustful or disengaged. Multiple short-term disruptions to access to essential consumer products. The wellbeing of hapū and iwi within some regions or across some sub-national climate zones is significantly affected. The overall wellbeing of rural or urban communities is	Special welfare funds become available (eg, mayoral relief). Widespread short-to-medium term disruption to education, business and community services. Distrust or disengagement evident across multiple communities throughout Aotearoa New Zealand. Widespread short-to-long term disruption to essential consumer products. The wellbeing of hapū and iwi within most regions or sub-national climate zones is majorly affected. The overall wellbeing of rural or urban communities is majorly affected across most sub-national climate zones and more often (including support industries,	Additional national welfare funding mechanisms needed. Widespread longer-term disruption to education, business and community services. Widespread distrust or disengagement nationally. Widespread medium-to-long term disruption to essential consumer products – otherwise make changes to infrastructure services, community locations or local or regional economic activities. The wellbeing of hapū and iwi within most regions or sub-national climate zones is seriously affected. The overall wellbeing of rural or urban communities is seriously affected across most sub-national climate zones and more often

Value domain	Consequence level (national scale aggregated from the seven sub-national climate zones)				
	Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
		events from flooding, especially in coastal areas. Access to climate-related insurance and mortgages declines in some local pockets.	significantly affected across some sub-national climate zones and more often (including support industries, lifelines and utility services and primary production) – with some communities permanently affected from changes in primary production, tourism or rising sea levels. Climate-related changes begin to challenge the 'coping range', and more frequent 'nuisance' weather events (flooding, especially in coastal areas) will, for some communities and areas, exceed 'coping capacity'. Access to climate-related insurance and mortgages declines in some localities, especially low-lying coastal areas.	lifelines and utility services and primary production), with a significant number of communities permanently affected from changes in primary production, tourism or rising sea levels. Climate-related changes challenge the 'coping range', and more frequent 'nuisance' weather events (flooding, especially in coastal areas) will, for some communities and areas, exceed local 'coping capacity'. Access to climate-related insurance and mortgages declines for a significant number of communities (or suburbs) across Aotearoa New Zealand, especially low-lying coastal areas.	(including support industries, lifelines and utility services and primary production), with a high number of communities permanently affected by changes in primary production, tourism or rising sea levels. Climate-related changes exceed the 'coping range' for many communities or a primary or secondary industry, and more frequent 'nuisance' weather events (flooding, especially in coastal areas) will, for a significant number of communities and areas, exceed both local and regional 'coping capacity'. Access to climate-related insurance and mortgages declines for many communities or suburbs across Aotearoa New Zealand, especially low-lying coastal areas.

Value domain	Consequence level (national scale aggregated from the seven sub-national climate zones)				
	Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
Culture	No impact	Little impact on the ability of people to participate and/or express their cultural identity. Temporary minor damage to cultural values, identity, heritage and knowledge.	Most people have the ability to participate in cultural life and express their cultural identity, but some pockets of dissatisfaction. Some decline in status and condition of sites of national cultural significance, loss of cultural values, identity, heritage and knowledge.	Many people unable to participate in cultural life and/or express their cultural identity. Large pockets of dissatisfaction. Major decline in status and condition of sites of national cultural significance. Significant loss of cultural capital, cultural values, identity, heritage and knowledge.	Most people unable to access or participate in cultural life and/or express their cultural identity. Permanent loss of cultural capital, cultural values, identity, heritage and knowledge. Irreversible decline in status and condition of sites of national cultural significance.
Natural environment	Negligible impact or very short-term, event-driven, reversible effects. Difficult to isolate the trend for any climate-change influence from other natural, climatic and human factors (very low signal to noise ratio).	Temporary localised or minor regional decline in land, water, air, soil, ocean quality or habitats and landscape attributable to climate change. Short-term temporary loss or minor decline in quality and status of designated sites attributable to climate change.	Sustained local and regional impacts on taonga species, habitats and landscapes across some sub-national climate zones. Sustained localised or regional impacts on quality and status of environmental protected sites or marine-protected areas of national importance.	Widespread degradation of air quality, water quality, soils, and marine environments across most sub-national climate zones. Medium-term loss of biodiversity after more frequent or persistent events (eg, droughts, marine heatwaves, floods) and increasing pressure of more permanent loss of biodiversity.	Permanent degradation of air quality, water quality, soils and marine environments nationally. Permanent loss of biodiversity. Permanent, widespread loss of significant natural areas or taonga species. Substantial loss of climate-sensitive environments (eg, salt

Value domain	Consequence level (national scale aggregated from the seven sub-national climate zones)				
	Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
		Temporary short-term loss or minor decline in quality and status of taonga species. Ability to detect minor evolving trends from climate-change influences over the background of other natural, climatic and human factors (low signal to noise ratio).	Sustained localised impacts on ecosystem services and water, air, and soil quality. Sustained localised impacts on recreation, aesthetics, bio-chemistry or biodiversity attributable to climate change. Emergence of geographical shifts of species to maintain preferences for climate tolerance eg, fisheries, mangroves, tuna? Ability to detect trends of stronger effects or decline or increase from climate-change influences over the background of other natural, climatic and human factors (moderate signal to noise ratio). Moderate cross-sector consequences from	Loss of significant natural areas or taonga species. Increasing decline or loss of climate-sensitive environments (eg, salt marsh, coastal lakes, sub-alpine ecosystems). Noticeable geographical shifts of species to maintain preferences for climate tolerance eg, fisheries, mangroves, tuna? Ability to detect trends of deleterious effects or decline or increase from climate-change influences over the background of other natural, climatic and human factors (high signal to noise ratio). Major cross-sector consequences from environmental change (eg, primary sector, tourism, ecosystem services, Māori businesses, governance).	marsh, coastal lakes, sub-alpine ecosystems). Strong geographical shifts of species to maintain preferences for climate tolerance eg, fisheries, mangroves, tuna? Obvious trends of major effects or decline or increase from climate-change influences over the background of other natural, climatic and human factors (high signal to noise ratio). Substantial cross-sector consequences from environmental change (eg, primary sector, tourism, ecosystem services, Māori businesses, governance).

Value domain	Consequence level (national scale aggregated from the seven sub-national climate zones)				
	Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
			environmental change (eg, primary sector, tourism, ecosystem services, Māori businesses, governance).		
Economy	No impact; less than 1% of gross domestic product (GDP).	A small number of individuals are affected with minimal financial losses. Short-term business disruption and/or minimal impact on profitability. Short-term increases in local and central government costs. Short-term loss of output for a key economic sector. Limited disruption to employment. Total financial losses 1–2% of GDP. A small number of livestock lost with minimal financial losses.	Many individuals with significant financial losses. Medium-term business disruption and/or moderate impact on profitability. Medium-term increase in local and central government costs, minimal loss of assets. Medium-term loss of output for a key economic sector. Temporary reduction in employment. Total financial losses 2–3% of GDP. Many stock losses with significant financial losses.	Significant number of people affected, with large financial losses. Long-term business disruption and/or significant impact on profitability. Long-term increases in local and central government costs, some loss of assets. Long-term loss of output for a key economic sector. Medium- to long-term reduction in employment. Total financial losses 3–4% of GDP. Significant number of livestock losses, with large financial losses.	Whole-of-community impacts with large financial losses. Permanent loss of business output and / or widespread business failure. Long-term costs for local/central government increases, and significant loss of assets. Closure of key economic sector(s). Widespread job losses. Total financial losses >4% of Gross Regional Product. Whole of livestock sector with large financial losses.

Value domain	Consequence level (national scale aggregated from the seven sub-national climate zones)				
	Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
Built environment	Minor or insignificant infrastructure disruption at local level (business as usual). Negligible damage to residential dwellings, commercial, government, and non-commercial buildings. Negligible damage to Māori cultural assets, such as marae, urupā, wāhi tapu and wāhi taonga.	Isolated and short-term infrastructure service disruption. No permanent damage. Some minor restoration work required. Early renewal of infrastructure by 10–20%. Need for new or modified ancillary equipment. Between 1–50 residential homes, 1–10 commercial buildings and 1–10 government and non-commercial buildings require assessment. Planning for future relocation required. Damage to 11–25% of Māori cultural assets, such as marae, urupā, wāhi tapu and wāhi taonga.	Multiple short-term infrastructure service disruptions. Damage recoverable by maintenance and minor repair. Early renewal of infrastructure by 21–50%. Damage to 51–250 residential dwellings requires assessment. Most easily repairable and covered by insurance, but some specialised relief and financial assistance required. Some dwellings require immediate relocation. Between 11–100 commercial buildings and 11–100 government and non-commercial buildings require assessment. Some require temporary relocation.	Widespread short-to-medium term distuptions to infrastructure service. Extensive infrastructure damage requiring major repair. Major loss of infrastructure service. Early renewal of infrastructure by 51–90%. Damage to 251–1000 residential dwellings requires assessment. Widespread structural damage mostly repairable, but significant numbers need to be immediately relocated. Costs exceed insured value. Between 101–500 commercial buildings and 101–500 government and non-commercial buildings require assessment. Many need to be permanently relocated.	Widespread, long-term service disruption. Significant permanent damage and/or complete loss of the infrastructure and its service. Loss of infrastructure support and translocation of service to other sites. Early renewal of infrastructure by more than 90%. More than 1000 residential dwellings require assessments for immediate relocation. More than 500 commercial buildings and more than 500 government and non-commercial buildings require assessment for permanent relocation options. Extensive structural damage in multiple regions and cities. Costs significantly exceed insured value. Damage to more than 75% of Māori cultural assets, such as

Value domain	Consequence level (national scale aggregated from the seven sub-national climate zones)				
	Insignificant No significant change in impact nationally that can be handled through business-as-usual processes or some local or regional impacts with no specialised management required	**Minor** Some minor impacts at the national scale that could be addressed through local or regional management and adaptation processes	**Moderate** Significant impacts at the national scale of interest to national agencies to address adaptation, or a major impact for 1–2 sub-national climate zones	**Major** Major impacts at the national scale of high interest to national agencies to quickly address adaptation, or an extreme impact for 1 sub-national climate zone	**Extreme** Extreme impacts at the national scale (or even in a few sub-national climate zones) of heightened interest to national agencies to urgently address adaptation. May be of interest to international partners or financial or insurance institutions
			Damage to 26–50% of Māori cultural assets, such as marae, urupā, wāhi tapu and wāhi taonga.	Damage to 51–75% of Māori cultural assets, such as marae, urupā, wāhi tapu and wāhi taonga.	marae, urupā, wāhi tapu and wāhi taonga.
Governance	No impact or some low-level inconsequential impacts. Busines- as-usual disruption to non-essential local level governance.	Some minor impacts at the local level. Disruption to some local level governance and decision-making functions (eg, temporary limited access to local facilities). Some negative impacts on perceived reputation. Minimal effects to Te Tiriti o Waitangi rights.	Moderate localised impacts on decision-making functions. Limited access or damage to district facilities requiring temporary relocation, which has minor impacts on service delivery. Moderate impacts on perceived reputation that will require specialised management to restore. Some Te Tiriti o Waitangi rights are temporarily eroded or damaged.	Major multi-functional, multi-regional impacts on decision-making functions. Limited access or damage to regional facilities, requiring long-term or permanent relocation, which has moderate impacts on service delivery. Major impacts on perceived reputation that will require significant resources and time to mitigate. Major erosion or damage to Te Tiriti o Waitangi rights.	Limited access or damage to facilities, which has major impacts on service delivery at all levels of government. Significant disruption to the functioning of government at the national level. Significant impacts on perceived reputation that will result in permanent or near permanent damage. Te Tiriti o Waitangi rights are lost.

Chapter C3: Rationale for selecting projections and aligning projections to timeframes

The rationale for recommending the two climate-change projections (RCP4.5 and RCP8.5) is as follows (adapted from Ministry for the Environment, 2017).

- Because of the uncertainty about future changes in climate, it is necessary to examine a range of climate projections that reflect future states. Using more than one scenario, rather than a single 'best' or 'worst' estimate, also avoids estimates of risks being invalidated as new information or projections becomes available.
- A range of projections enables the rate of increase in risk to be explored for different sectors and themes, to better determine the emergence of thresholds for critical impacts in a changing risk environment, and to examine non-linear responses.
- Projections selected for the NCCRA adopt the internationally accepted representative concentration pathways (RCPs) used by the IPCC in its global assessment reports.
- Although it is desirable to use a wide range of scenarios, especially for detailed risk assessments at the local and regional level to inform adaptation pathways, in practice, two projections should be manageable for the detailed risk assessment and one projection (RCP8.5) for the risk screening.
- Given the deep uncertainty around ongoing sea-level rise (eg, polar ice sheet tipping points) and the relative maturity of recent coastal risk assessments, a higher scenario could also be considered for the assessment of coastal climate-related hazards in Stage 2 where information and data are available. This higher scenario could use the upper H^+ sea-level rise scenario from the Coastal Hazards and Climate Change Guidance (Ministry for the Environment, 2017). This may highlight future risks for long-lived assets or infrastructure and new coastal developments.

At present, detailed projections are mostly available until 2100 only (eg, IPCC Fifth Assessment Reports (IPCC 2013; 2014b) and Ministry for the Environment (2018) projections). However, a longer view is necessary, given we are close to 2020. Until detailed projections are extended, initial risk assessments should apply extrapolation of projections based on the rate of change later this century for RCP4.5 and RCP8.5.

Projections for sea-level rise are already available out to 2150 for Aotearoa New Zealand in the Coastal Hazards and Climate Change Guidance (Ministry for the Environment, 2017). For coastal areas of known ongoing subsidence (eg, lower North Island, urban deltas, Hauraki Plains), it is also recommended to add an appropriate average trend for vertical land movement to determine the relative sea-level rise for each sub-national zone. Land movement rates can be sourced from the Coastal Hazards and Climate Change Guidance (Ministry for the Environment, 2017), or use updated trends currently being analysed in the NZSeaRise research programme (Richard Levy, Victoria University of Wellington and GNS Science, pers comm).

Chapter C4: Information sources for climate change variables and impacts

Realistically, the first NCCRA can only assess **existing and available** data and knowledge on climate change impacts. It will, in many cases, comprise mostly qualitative information on the components of risk (hazard, exposure and vulnerability). It is also recognised that, in developing the framework, the level of information about climate-related hazards will vary considerably across the value domains and sectors and is especially pertinent for cross-cutting or cascading impacts. Therefore, it is important to develop processes where possible that synthesise quantitative hazard or exposure information and data. This will ensure sufficient flexibility to handle both types of information (qualitative and quantitative) in a consistent manner. Use of mixed methods also deals more widely with uncertainty in future climate change by exploring possible impacts and implications through elicitation for various future narratives (projections and social–economic scenarios).

At present, some of the information on hazards may not be specifically tied to the RCP projections. General guidance is given in section B1.4 on how to align existing information, or findings from engagement processes and risk workshops, which is not specifically tied to relevant RCP projections, with the two projections (RCP4.5 and RCP8.5) recommended for the framework.

Potential hazards exist where the effect of climate change is not clearly prescribed, largely unknown or not available from New Zealand climate projections, for example, ocean nutrient-cycle and air quality changes. In these situations, action, such as a research gap or assigning a watching brief (chapter B4), can be determined if stakeholders in a value domain or sector recognise potential adverse vulnerabilities, for example, an activity or wellbeing that is sensitive to the specific hazard (or climate variable).

The assessor will need to assemble relevant information and datasets that are currently available or accessible (rather than develop new information or model simulations). Information and observations can be broadly accessed from the types of sources discussed below. This ensures wider coverage of potential impacts on Aotearoa New Zealand than what may necessarily be used in rigorous scientific assessments, such as IPCC assessment reports, provided they are credible or reputable sources (and cited in all cases, for transparency and legitimacy).

C4.1 Sources and databases

Potential sources of information and datasets (not exhaustive):

- published and reviewed reports, such as local and central government, Crown research institutes, sector groups, universities, National Science Challenges (eg, Deep South, Sustainable Seas, Our Land and Water), international (eg, Organisation for Economic Co-operation and Development)
- Ministry for the Environment Climate Projections (2018) developed by NIWA: www.mfe.govt.nz/publications/climate-change/climate-change-projections-new-zealand

- Ministry for the Environment Guidance for Local Government on Preparing for Climate Change (no date): www.mfe.govt.nz/climate-change/climate-change-guidance/guidance-local-government-preparing-climate-change
- climate change impacts or design tools, for example, High Intensity Rainfall Design System (HIRDS version 3): https://hirds.niwa.co.nz/ as summarised by Ministry for the Environment (2018)
- Urban Impacts Toolbox: www.niwa.co.nz/climate/urban-impacts-toolbox
- Climate Change Impacts and Implications reports: https://ccii.org.nz/
- Droughts and extreme winds under climate change (NIWA report for Ministry for Primary Industries): www.niwa.co.nz/climate/research-projects/risk-of-drought-and-extreme-winds-under-climate-change
- Ministry for the Environment State of the Environment assessment reports and Statistics New Zealand and Ministry for the Environment reported environment domain statistics,[8] for example, waves, coastal sea-level rise, mean temperature trend
- information provided by lifeline utilities and local councils under the reporting power of the Zero Carbon Bill
- Census (2013, 2018) for population data
- published journal papers focused on the New Zealand climate (but some international papers may be relevant or scalable)
- IPCC special reports and assessments. The Australasian chapter of IPCC Working Group II assessment reports have specific climate information relevant to New Zealand (IPCC, 2014b): www.ipcc.ch/report/ar5/wg2/
- structured elicitation processes, such as risk workshops (to be defined in the engagement plan for the risk assessment stages),[9] led by experts (researchers, Māori experts and practitioners) engaging with sector adaptation leaders, iwi and hapū organisation representatives and key stakeholders
- engaging with Māori advisory groups (national, pan-regional, iwi and hapū)
- iwi and hapū environmental management plans
- iwi and hapū climate change plans and strategies.

Different levels of information gathering on hazards and opportunities can also be used.

- Engage with relevant research institutions to source data and information on climate change hazards for RCP4.5 and RCP8.5 projections at the recommended timeframes, if not available in the Climate Change Projections for New Zealand (Ministry for the Environment, 2018) – usually derived from climate–ocean models.
- For present-day, climate-related impacts – engage with regional, unitary and district councils through Local Government New Zealand, central government (eg, Ministry of Civil Defence and Emergency Management) and the Insurance Council of New Zealand. Also

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[8] For the marine domain see New Zealand's Environmental Reporting Series Environmental Indicators: Marine: http://archive.stats.govt.nz/browse_for_stats/environment/environmental-reporting-series/environmental-indicators/Home/Marine.aspx (other domains are also accessible from this URL).

[9] For example, facilitated risk workshops at the inception of major infrastructure projects are often convened with multiple parties and disciplines to co-produce a risk assessment and rank the critical risks to the project.

consult the report for Treasury on the attribution of climate change to recent rainfall and drought events (Frame et al, 2018b).

- Literature reviews focused on present and future impacts for New Zealand – engage first with researchers who often have undertaken these reviews and sometimes published them, for example, Rouse et al (2017) for coastal adaptation.
- Structured elicitation processes with multiple parties and disciplines relevant for the value domain or sector, particularly for those hazards where definitive quantitative projections are not available.

Attention should be given to ensuring that, as new information sources are identified, the 'non-exhaustive list' above is updated.

C4.2 Climate change variables contributing to hazards

A 'long list' of climate-related variables used for a suggested suite of climate-related hazards and evolving stressors is shown in table C4-1, if amendments or additions are necessary to the hazards in table B1-2.

Table C4-1: Categories of climate change and associated effects (climate variables) considered in formulating hazards arising from climate change in table B1-2

Categories of climate change	Climate change variables (effects)
Rising temperatures	• Higher day and night temperatures • More heatwaves and warm spells • Fewer frosts or cold days • Changes in seasonality • Interannual variability (eg, ENSO) • Freshwater and estuaries: higher mean temperatures • Marine and coastal waters: higher mean temperatures • Marine and coastal waters: heatwaves
Rainfall and hail	• Higher or lower mean annual rainfall in sub-national climate zones • Changes in rainfall seasonality • Interannual variability (eg, ENSO) • Changes in extreme rainfall: high intensity and persistence • Floods (fluvial and pluvial) • Increase in hail severity or frequency • Rain-induced landslides • Changes in sedimentation from catchment runoff
Dryness and drought	• Increase in dry spells • Higher drought frequency and persistence • Fire weather (harsher, prolonged season) • Changes in seasonality • Interannual variability (eg, ENSO) • Low river flows and lake levels
Storminess and wind	• Changes in mean wind speed and direction • Changes in wind seasonality • Interannual variability (eg, ENSO) • Changes in extreme wind speed

Categories of climate change	Climate change variables (effects)
	• Increase in convective weather events (tornadoes, lightning) • Increase in storminess (frequency, intensity) including tropical cyclones
Snow and ice	• Receding snowline • Reduced snow and glacier cover • Earlier snow melt • Increase in avalanches
Coastal change: sea-level rise, waves, ocean circulation and carbon dioxide uptake	• Relative sea-level rise (including land movement) • Change in tidal range or increased water depth • Permanent increase in spring high-tide inundation • Permanent and episodic saline intrusion • Rising groundwater from sea-level rise • Changes in waves and swell • More frequent coastal flooding (storm-tide, waves) • Coastal and cliff erosion • Changes in sedimentation (estuaries and harbours)
Ocean changes	• Changes in ocean nutrient cycling – upwelling and carbon • Ocean acidification (pH decreasing) • Ocean circulation changes
Others	• Air quality changes • Carbon dioxide increase (plants) – but consider other countering effects • Humidity changes from changes in cloudiness • International climate-related influences, eg, immigration, markets

Note: This list should be checked for any other aspects to consider when determining the hazards in chapter B1. ENSO = 2–4 year El Niño–Southern Oscillation, but could include the longer 20–30 year Interdecadal Pacific Oscillation.

Chapter C5: Using the framework at different scales

The risk assessment methodology described in the framework is flexible to support regional and local or sectoral risk assessment. Assessments undertaken at different scales would involve different information requirements, as outlined in table C5-1.

Table C5-1: Levels of climate change risk assessment showing the information needed at different scales, from national to district and local assessments

Three scales of climate change risk assessment	Attributes	Links with
National and sub-national-scale climate change risk assessment	Informs government agencies, ministers, sector groups, pan-Māori, iwi and hapū organisations by providing a systematic examination of the additional risks from climate change on New Zealand	• National Adaptation Plan • Living Standards Framework • National Disaster Resilience Strategy • National policy statements • MBIE research strategies • Sector national plans • Conservation management plans • National infrastructure plans • National security risk management • Pan-Māori strategies
	Uses New Zealand-wide climate projections and exposure mapping, and assesses risks to domains and sectors	
	Aggregation of risks up to a national or sub-national level	
	Detail: focus on highest national-level risks (short and long term) to inform the National Adaptation Plan (mandatory under proposed Zero Carbon Bill)	
Regional and catchment scale climate change risk assessment	Informs regional and unitary councils, infrastructure and natural resource managers, district health officials, iwi, hapū and other stakeholders by providing a systematic examination of the additional risks of climate change on a region	• Long term plan (regional) – 10 year • Infrastructure strategy (regional) – 30 year • Regional plans (including coastal) • Regional policy statements • CDEM group plans; lifelines • Iwi and hapū management plans • Growth and development strategies
	Uses downscaled climate projections, regional hazard and exposure modelling, and vulnerability analysis to assess risks to regional domains or sectors and catchments	

Three scales of climate change risk assessment	Attributes	Links with
	Regional-level view, aggregation of risks up to a regional level and disaggregate down from the national scale	
	Detail: focus on regional risks to inform region-wide plans, catchment management and climate change strategies	
District and city scale climate change risk assessment	Informs district and city councils, infrastructure and natural resource managers, public health officials, iwi, hapū, whānau and other stakeholders by providing a systematic examination of the additional risks of climate change on districts and cities and local communities and marae	• District plans • Long-term plan (district) – 10 year • Infrastructure strategy (district) –30 year • Iwi and hapū management plans • Iwi and hapū climate change strategies • Housing (Building Act 2004 and Special Housing Areas) • Spatial and structure planning • Growth and development strategies
	Uses downscaled climate projections, district and city hazard and exposure modelling, and suburb or town vulnerability analysis to assess risks	
	District and local community view, risks resolved at a district and local level eg, to communities, district plans, structure plans and services	
	Detail: focus on local or city-wide risks to inform adaptation plans for communities and assets and district and city climate change strategies	

Note: CDEM = Civil Defence Emergency Management; MBIE = Ministry for Business, Innovation and Employment.

Local governments are at the front line in dealing with the impacts of climate change. They have a role in ensuring that regional and local circumstances are adequately considered in the overall adaptation response.

They need to:

- manage risks to, and impacts on public assets owned and managed by local government and local government-owned entities
- manage risks to, and impacts on local government service delivery
- ensure local planning and development regulations are consistent with central government adaptation approaches
- facilitate building resilience and adaptive capacity in the local community (eg, providing information about relevant climate change risks)
- involve local communities directly in efforts to facilitate effective change.

How will this framework help risk management in local government or other agencies? Can iwi and hapū use the framework for place-based risk assessment?

- They can carry out a risk assessment using this framework, but apply local 'elements' to the value domains in chapter A3, to inform decisions on sectors to assess at Stage 1.
- It is anticipated all the steps mapped out in this framework can be followed at the local government, iwi and hapū levels. The content and considerations will be more localised, and it is likely greater quantitative detail will be available. As at the national level, lack of quantitative detail should not delay undertaking a localised risk assessment and developing an adaptation plan.
- At the national level, the direction of risk assessment, of necessity, needs to be targeted more at policy and fiscal settings. At the localised level, the risk assessment can be targeted towards more specific localised actions.
- As expressed in the framework, the process of expert elicitation and engagement are important components in undertaking a risk assessment.
- It is anticipated that risk assessments at the local level will contribute to national level risk assessment and vice versa, so that, over time, the iterations will present substantial benefits to all. Where cross-cutting risks are involved, learnings at the local level are expected to provide valuable information at the national level.

Local risk assessments should consider:

- priority geographical areas (eg, coastal regions, areas of social deprivation)
- priority sectors or departments
- the data currently available.

Glossary and abbreviations

Glossary

Term	Definition
Adaptation	A response strategy to anticipate and cope with impacts that cannot be (or are not) avoided under different scenarios of climate change (IPCC, 2014b). The process of adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate change and its effects (IPCC, 2014b). Adaptation can be categorised as either: • incremental – actions where the central aim is to maintain the essence and integrity of a system or process at a given scale • transformational – actions that change the fundamental attributes of a system in response to climate and its effects.
Adaptation threshold	Conditions, threshold, performance or level of service that is reached when agreed objectives (eg, health and safety, economic or environmental sustainability) would no longer be met, and an alternative adaptation pathway needs to be proactively implemented before the threshold is reached. Note: sometimes 'tipping point' is used, especially for environments, but this term is usually restricted to changes that are irreversible or unrecoverable.
Adaptive capacity	The resources available for adaptation to climate change and variability or other related stresses, as well as the ability of a system to use these resources effectively in the pursuit of adaptation (Brooks and Adger, 2005). It is somewhat different from 'adaptiveness', which is an inherent ability to absorb and cope with change (sometimes called 'autonomous adaptation'). Whereas 'adaptation capacity' focuses more on the barriers and enablers (including resources) for being able to implement adaptation. Communities, hapū and iwi can exhibit adaptiveness but may be limited by adaptive capacity due to the inequities already present in Aotearoa New Zealand relating to accessing resources. This could significantly hinder such communities, hapū and iwi groups in achieving better adaptation outcomes for their communities.
Assets	'Things of value' that may be exposed or vulnerable to a hazard or risk. Physical, environmental, cultural, financial or economic element that has tangible, intrinsic or spiritual value (see **Taonga**).
Climate change	Climate change refers to a change in the state of the climate that can be identified (eg, by using statistical tests) by changes or trends in the mean and/or the variability of its properties, and that persists for an extended period, typically decades to centuries. Climate change includes natural internal climate processes or external climate forcings, such as variations

Term	Definition
	in solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or changes in land use (adapted from IPCC, 2013, annex III).
Climate projection	A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission–concentration–radiative–forcing scenario used, which is in turn based on narrative with assumptions, for example, future socio-economic, technological developments or land-use change that may or may not be realised (adapted from IPCC, 2013, annex III).
Community	A community may be a geographical location (community of place), a community of similar interest (community of practice) or a community of affiliation or identity (such as industry).
Compound hazards and stressors	Combined occurrences of multiple hazards and stressors (ie, cumulative hazards) that will become more significant in the future as adaptation thresholds are reached, for example, for a low-lying coastal area, a persistent wet season (high groundwater, reduced field capacity) is followed by a coastal storm amplified by sea-level rise coincident with intense rainfall, leading to compound flooding impacts.
Confidence	A qualitative measure of the validity of a finding, based on the type, amount, quality and consistency of evidence (eg, data, mechanistic understanding, theory, models, expert judgement) and the degree of agreement.
Consequence	The outcome of an event that may result from a hazard. It can be expressed quantitatively (eg, units of damage or loss, disruption period, monetary value of impacts or environmental effect), semi-quantitatively by category (eg, high, medium, low level of impact) or qualitatively (a description of the impacts). It is also defined as the outcome of an event affecting objectives (ISO/IEC 27000:2014 (ISO, 2014) and AS/ISO 31000:2009 (Standards New Zealand/Standards Australia, 2009).
Coping capacity	The ability of people, institutions, organisations and systems, using available skills, values, beliefs, resources and opportunities, to address, manage and overcome adverse conditions, risk or disasters in the short to medium term. The capacity to cope requires continuing awareness, resources and good management, both in normal times and during disasters or adverse conditions. Coping capacities contribute to the reduction of disaster risks (Secretary-General United Nations, 2016).
Driver	An aspect that changes a given system. Drivers can be short term, but they are mainly long term in their effects. Changes in both the climate system and socio-economic processes, including adaptation and mitigation, are drivers of hazards, exposure and vulnerability. Thus drivers can be climatic or non-climatic.
Emissions	The production and discharge of substances that are potentially radiatively active (ie, absorb and emit radiant energy) in the atmosphere (eg, greenhouse gases, aerosols).

Term	Definition
Exposure	The presence of people, livelihoods, species or ecosystems, environmental functions, services, resources and infrastructure, or economic, social or cultural assets in places and settings that could be adversely affected by natural hazards and climate change. The number, density or value of people, property, services or other things we value (taonga) that are present within an area subject to one or more hazards (ie, within a hazard zone), and that may experience potential loss or harm.
Frequency	The number or rate of occurrences of hazards, usually over a particular period.
Hazard	The potential occurrence of a natural **or** human-induced physical event, trend **or** physical impact that may cause loss of life, injury or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources. The term hazard usually refers to climate-related physical events or trends or their physical impacts (IPCC, 2014b). An adverse event (hours to months) influenced or exacerbated by climate change and that may be a combination of more than one climate change factor.
Impact	An effect on natural and/or human systems. The term impact is used mainly to refer to the effects on natural and human systems of extreme weather and events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific timeframe and the vulnerability of an exposed society or system. Note: impacts are also referred to as consequences and outcomes.
Intergovernmental Panel on Climate Change (IPCC)	This is a scientific and intergovernmental body under the auspices of the United Nations.
Heatwaves	For Aotearoa New Zealand, heatwaves are currently defined as how many consecutive days the air temperature is more than 25 degrees Celsius.
Kaitiaki	Guardian, steward, custodian, trustee. The process and practices of protecting and looking after the environment are referred to as kaitiakitanga
Kaupapa Māori	This concept has many definitions and is used in various contexts. To ensure that nothing is left out, we offer those broader definitions here: • Māori approach, Māori topic, Māori customary practice, Māori institution, Māori agenda, Māori principles, Māori ideology – a philosophical doctrine, incorporating the knowledge, skills, attitudes and values of Māori society.
Māori values and principles	Māori values are derived from the traditional belief system based on a Te Ao Māori worldview. Values can be defined as instruments through

Term	Definition
	which Māori make sense of, experience and interpret their environment. They form the basis for Māori ethics and principles.
Mātauranga Māori	Mātauranga Māori or Māori knowledge systems are context specific to indigenous Māori people, and the term has its origins in Aotearoa New Zealand. The term has many definitions that cover belief systems, epistemologies, values and knowledge both in a traditional and contemporary sense. Mātauranga Māori can be defined as the knowledge, comprehension or understanding of everything visible and invisible existing in the universe.
Mitigation	Human intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC, 2014a, annex II).
Ōhanga	Prosperity, economy
Representative Concentration Pathway (RCP)	A suite of representative future scenarios of additional radiative heat forcing at the Earth's surface by 2100 (in Watts per square metre), which is the net change in the balance between incoming solar radiation and outgoing energy radiated back up in the atmosphere. Each RCP can be expressed as a greenhouse gas concentration (not emissions) trajectory adopted by the IPCC for its Fifth Assessment Report (AR5) in 2014 (IPCC, 2014b). See also appendix C.2 in *Coastal Hazards and Climate Change: Guidance for Local Government* (Ministry for the Environment, 2017).
Residual risk	The risk that remains (and may continue to rise) in unmanaged form, after risk management measures and adaptation policies have been implemented to adapt to climate change and more frequent hazards, and for which emergency response and additional adaptive capacities must be maintained or limits to adaptation addressed. Policy interventions and adaptation plans will need to reconcile changing residual risks with changing (evolving) societal perceptions of tolerable risk. (Adapted from SFDRR, 2015 and Adger et al, 2018.)
Resilience	The capacity of social, economic and environmental systems to cope with a hazardous event, trend or disturbance by responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation (IPCC, 2014a).
Risk	The potential for consequences where something of value is at stake and the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure and hazard. To address the evolving impacts of climate change, risk is better defined as the interplay between hazards, exposure and vulnerability (IPCC, 2014a, WGII). Climate change creates cascading risks in physical systems, ecosystems, economy and society, often inter-related and creating the circumstances in some situations for irreversible and undesirable exceedance of acceptable thresholds at multiple scales (Adger et al, 2018).

Term	Definition
Risk assessment	The overall qualitative and/or quantitative process of risk identification, risk analysis and risk evaluation, with multiple entry points for communication and engagement and monitoring and reviews (AS/NZS ISO 31000:2009: Risk Management (Standards New Zealand/Standards Australia, 2009).
Stressor (climate)	Persistent climatic occurrence (eg, change in pattern of seasonal rainfall) or rate of change or trend in climate variables, such as the mean, extremes or range (eg, ongoing rise in mean ocean temperature or acidification), which occurs over time (eg, years, decades, centuries), with important effects on the system exposed, increasing vulnerability to climate change.
System	A set of things working together as parts of an interconnected network and/or a complex whole.
Taonga Māori	An intangible or tangible object that is highly prized or treasured in Māori culture. Taonga Māori could be viewed in the following way: • **natural** (te taiao – the natural environment including whenua/land, ngahere/forests, awa/rivers, maunga/mountains and moana/ocean) • **human** (whānau/families, hapū/sub-tribes, iwi/tribes), spiritual (mauri/the intrinsic life force within living entities) • **social** (Mātauranga Māori/Māori knowledge, intergenerational transfer of knowledge) • **financial** (financial value of assets including land holdings) • **material capital** (buildings including marae, commercial investments and private homes).
Te Ao Maori	The Māori world
Tino rangatiratanga	Sovereignty, self-determination, autonomy
Uncertainty	A state of incomplete knowledge that can result from a lack of information or disagreement about what is known or even knowable. It may have many types of sources, from imprecision in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour.
Vulnerability	The predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm or damage, and lack of capacity to cope and adapt (adaptive capacity) (IPCC, 2014a). Assessing vulnerability is broader than conventional risk assessments by including indirect and intangible consequences on the four capitals from the Living Standards Framework and considering adaptiveness and adaptive capacity (eg, communities, whānau, hapū and iwi may be resourceful and adaptive but may lack the resources, insurance access and mandate or capacity to adapt).

Abbreviations

BRANZ	Building Research Association New Zealand
CAA	Civil Aviation Authority
CCATWG	Climate Change Adaptation Technical Working Group
CLUES	Catchment Land Use for Environmental Sustainability model
CO_2	Carbon dioxide
DHB	District health board
DOC	Department of Conservation
DIA	Department of Internal Affairs
DPMC	Department of the Prime Minister and Cabinet
EECA	Energy Efficiency and Conservation Authority
ENSO	El Niño–Southern Oscillation
EPA	Environmental Protection Authority
FOMA	Federation of Māori Authorities
GCP	Global Carbon Project
GIC	Gas Industry Company
Gt	Gigatonne
HIRDS	High Intensity Rainfall Design System
IAP2	International Association of Public Participation
IASA	International Institute for Applied Systems Analysis
IPCC	Intergovernmental Panel on Climate Change
LGNZ	Local Government New Zealand
LiDAR	Light Detection and Ranging
LINZ	Land Information New Zealand
LSF	Living Standards Framework
MBIE	Ministry of Business, Innovation and Employment
MCDEM	Ministry of Civil Defence and Emergency Management
MCH	Ministry for Culture and Heritage
MFAT	Ministry of Foreign Affairs and Trade
MfE	Ministry for the Environment
MHUD	Ministry of Housing and Urban Development

MOD	Ministry of Defence
MOE	Ministry of Education
MOH	Ministry of Health
MOJ	Ministry of Justice
MOT	Ministry of Transport
MPI	Ministry for Primary Industries
MPP	Ministry for Pacific Peoples
MSD	Ministry of Social Development
NCCRA	National Climate Change Risk Assessment
NDRS	National Disaster Resilience Strategy
NIWA	National Institute of Water and Atmospheric Research
NSS	New Southern Sky
NZDF	New Zealand Defence Force
PCE	Parliamentary Commissioner for the Environment
PHO	Primary health organisation
RCPs	Representative concentration pathways
SHA	Special Housing Area
SOLGM	Society of Local Government Managers
SRES	Special Report on Emission Scenarios
SSP	Shared socio-economic pathways
TEC	Tertiary Education Commission
TPK	Te Puni Kōkiri
W/m^2	Watts per square metre

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