Climate Change Impacts

Latest information for New Zealand

Julie King and Warren Gray
Ministry for the Environment

National Lifelines Forum
7-8 Oct 2008

What's new?

Climate Change Effects & Impacts Assessment 2nd ed.

www.mfe.govt.nz/publications/climate/climate-change-effect-impacts-assessments-may08/index.html

Preparing for Climate Change 2nd ed. (aka 'Red Book')

www.mfe.govt.nz/publications/climate/preparing-for-climate-change-guide-for-local-govt/

Coastal Hazards & Climate Change 2nd ed.

www.mfe.govt.nz/publications/climate/coastal-hazards-climate-change-guidance-manual/

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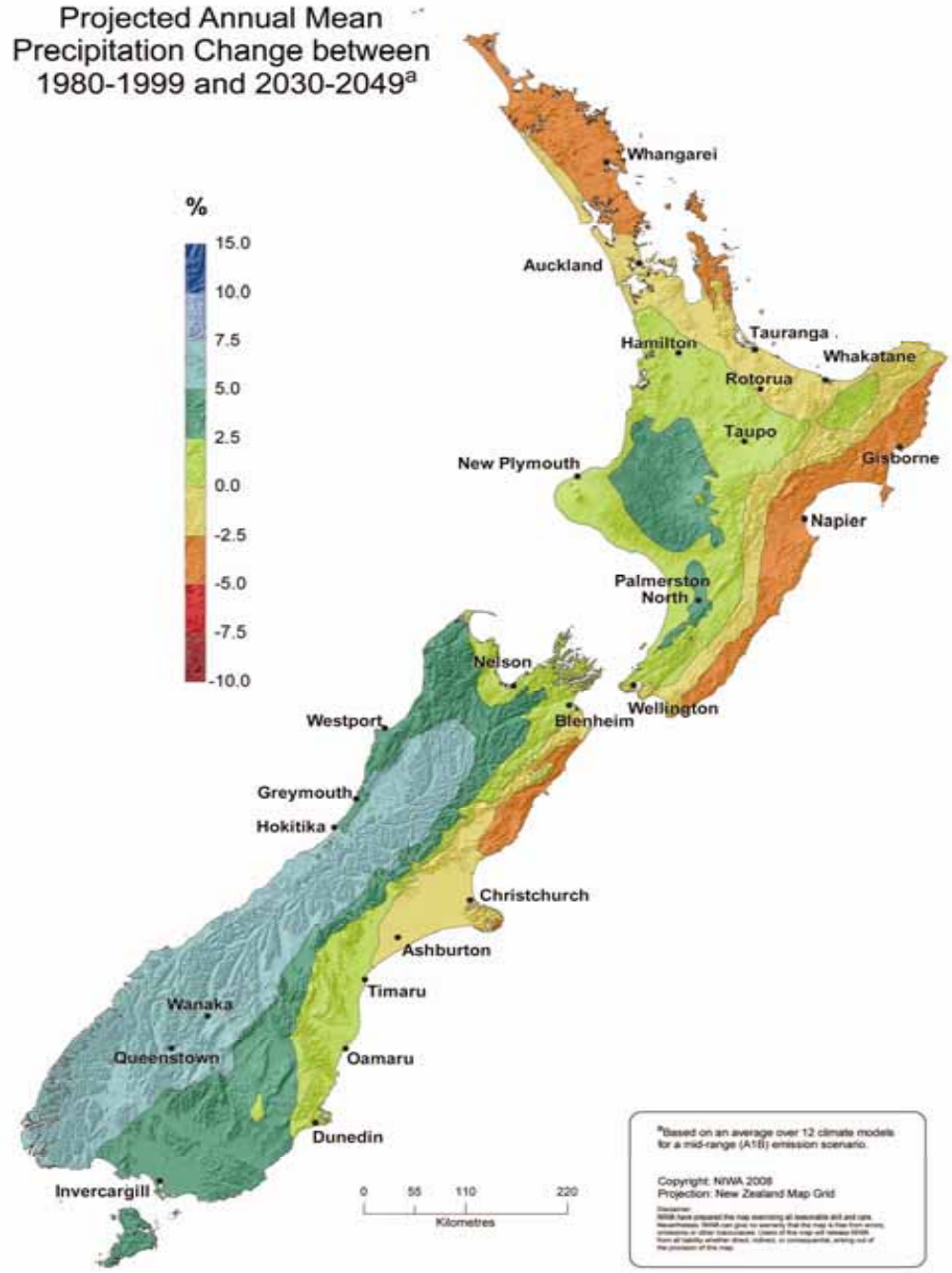
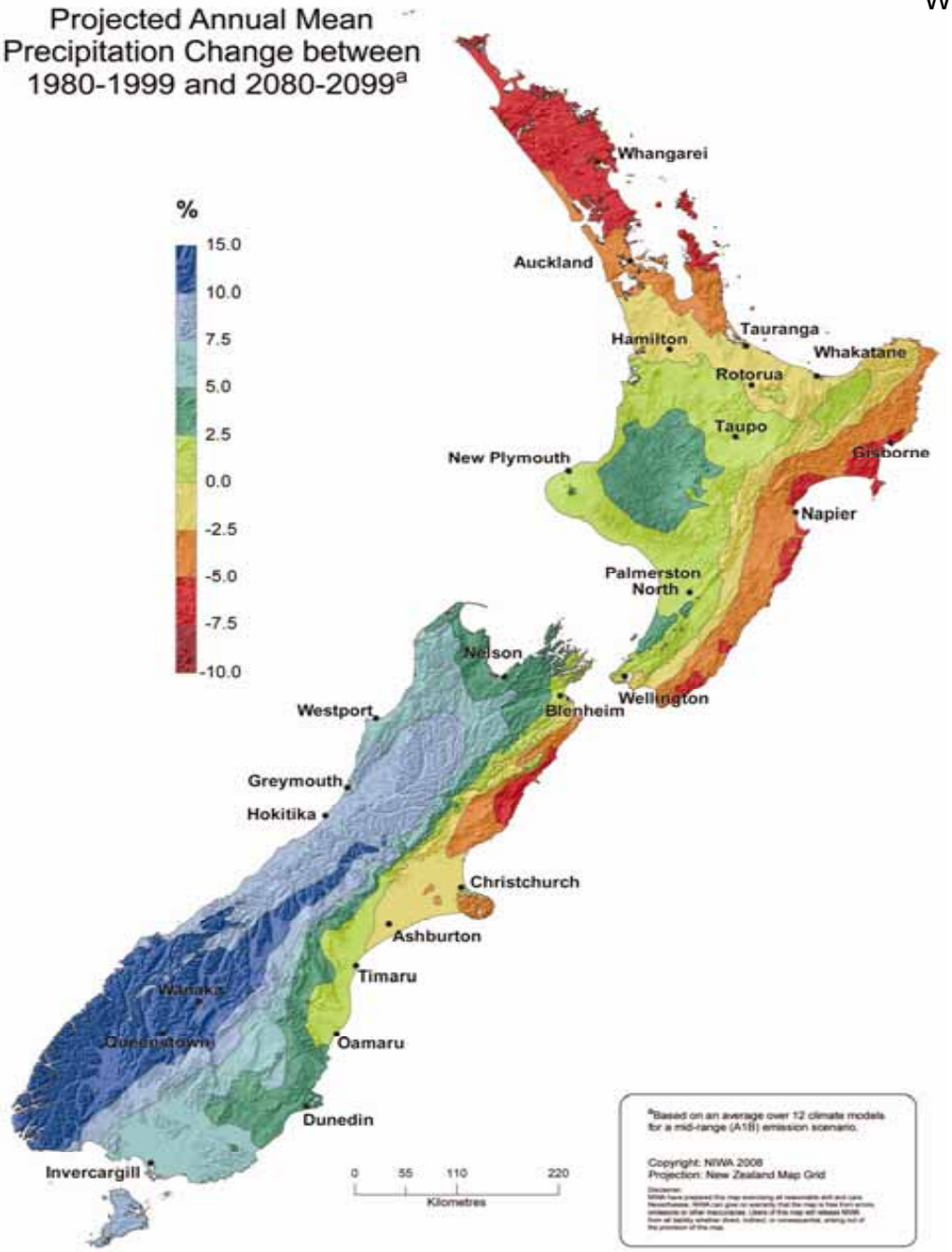

Projected Annual Mean Precipitation Change between 1980-1999 and 2030-2049[a]
%
15.0
10.0
7.5
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
Whangarei
Auckland
Hamilton
Tauranga
Whakatane
Rotorua
Taupo
Gisborne
New Plymouth
Napier
Palmerston North
Wellington
Nelson
Blenheim
Westport
Greymouth
Hokitika
Christchurch
Ashburton
Timaru
Wanaka
Queenstown
Oamaru
Dunedin
Invercargill
0 55 110 220
Kilometres
[a]Based on an average over 12 climate models for a mid-range (A1B) emission scenario.
Copyright: NIWA 2008
Projection: New Zealand Map Grid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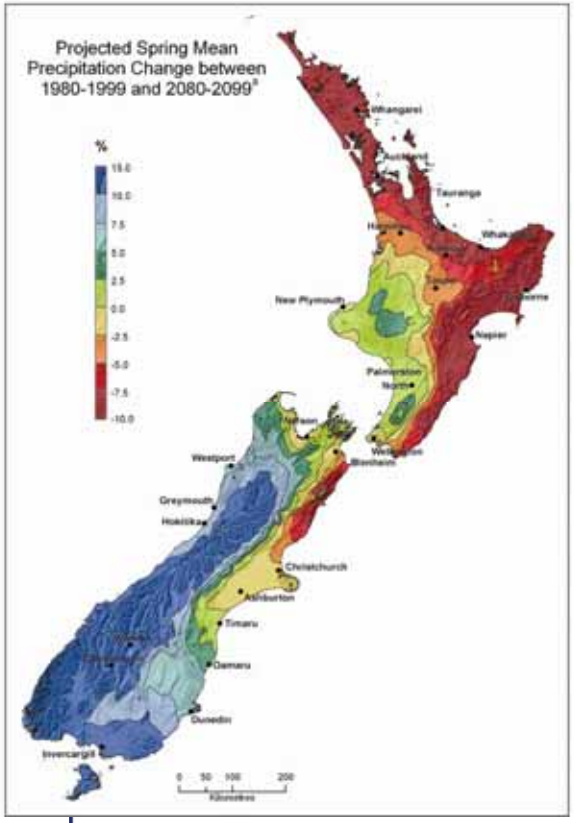

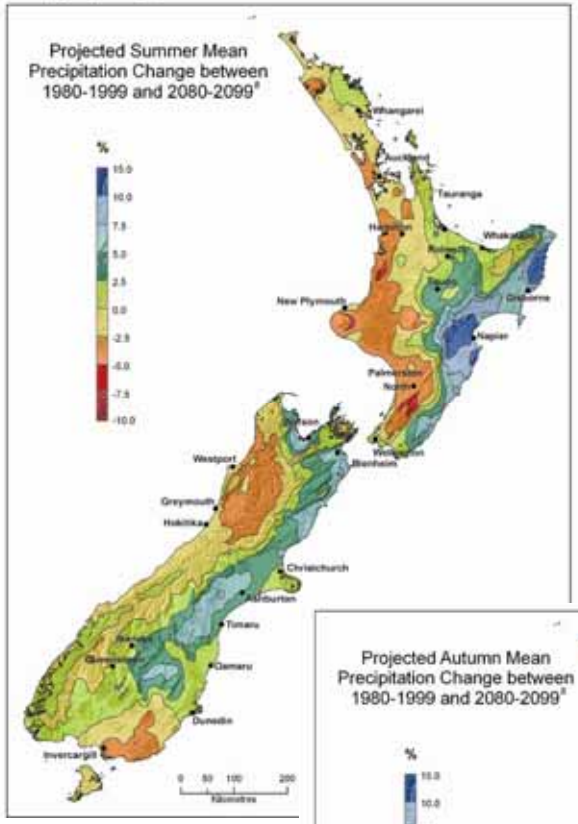

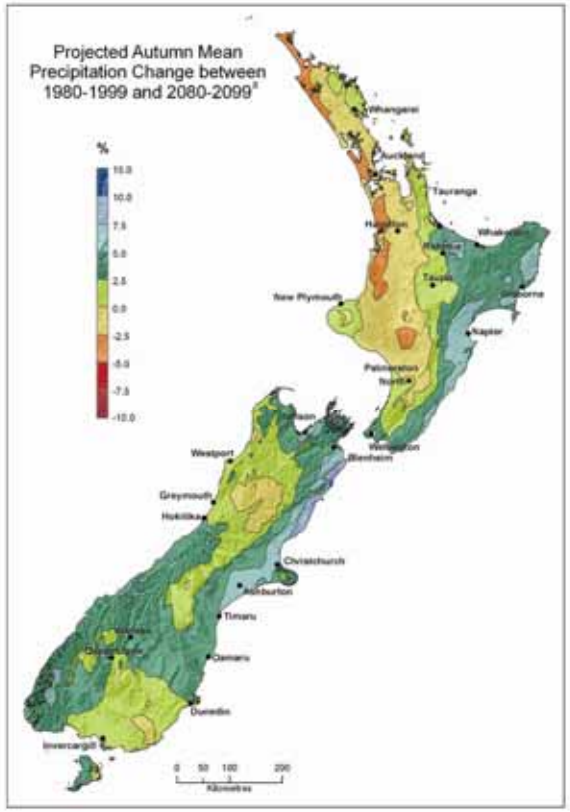

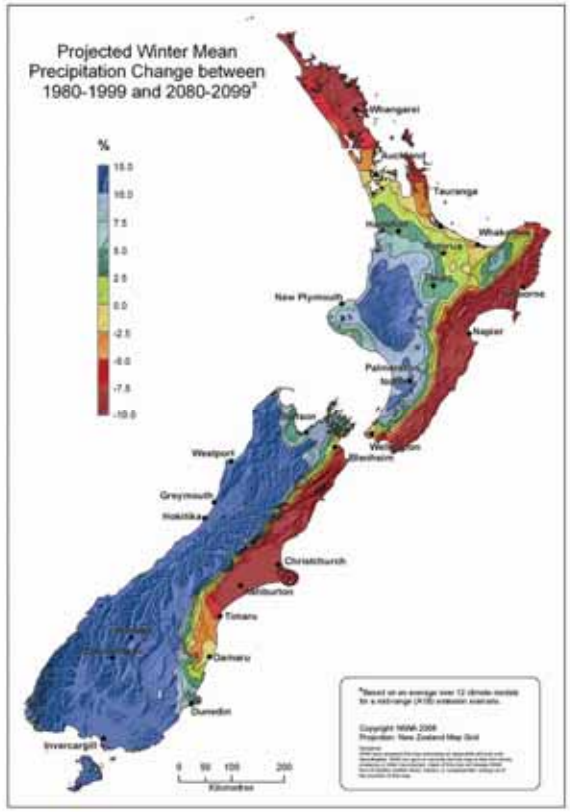

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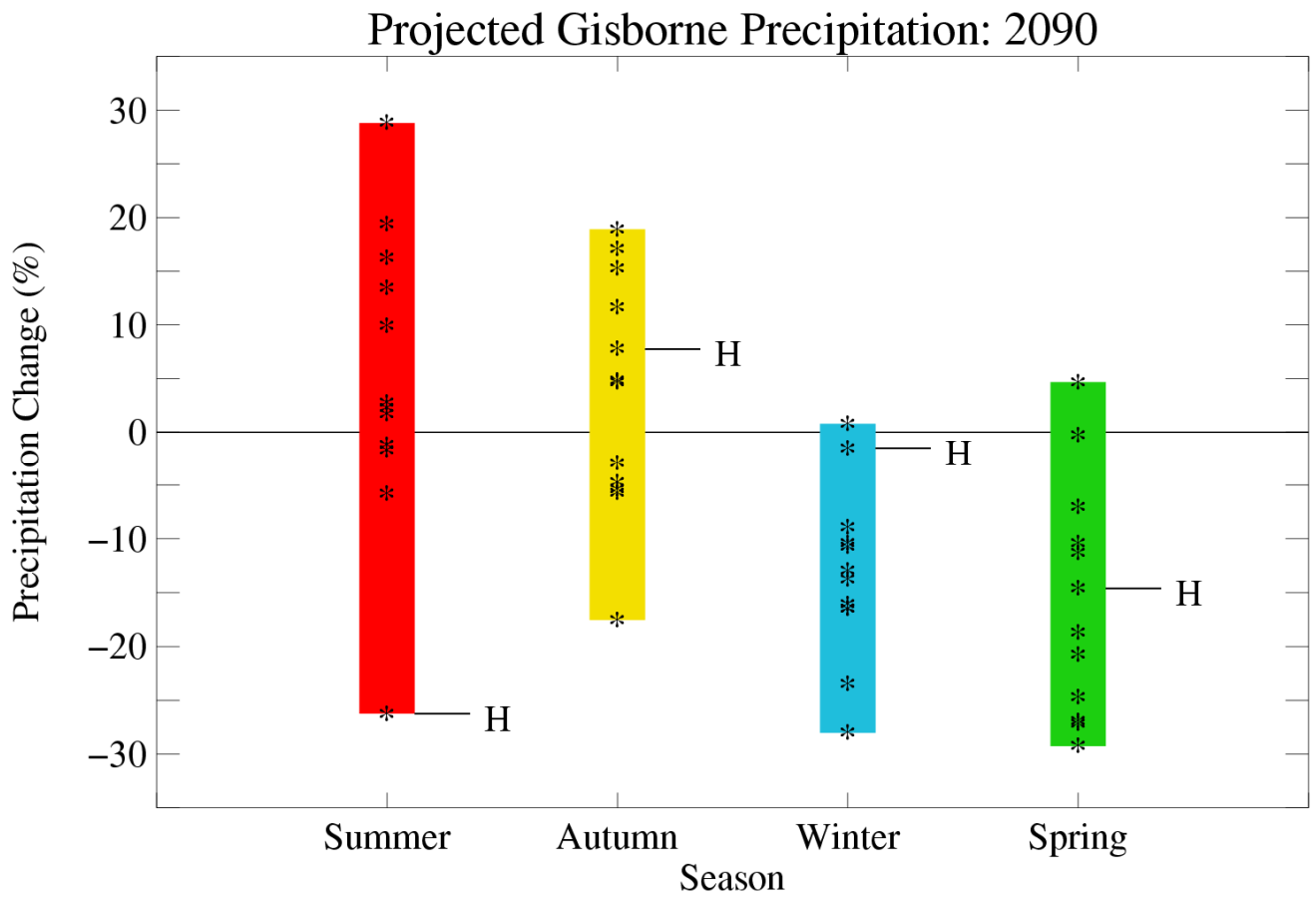
Seasonal Rainfall Changes



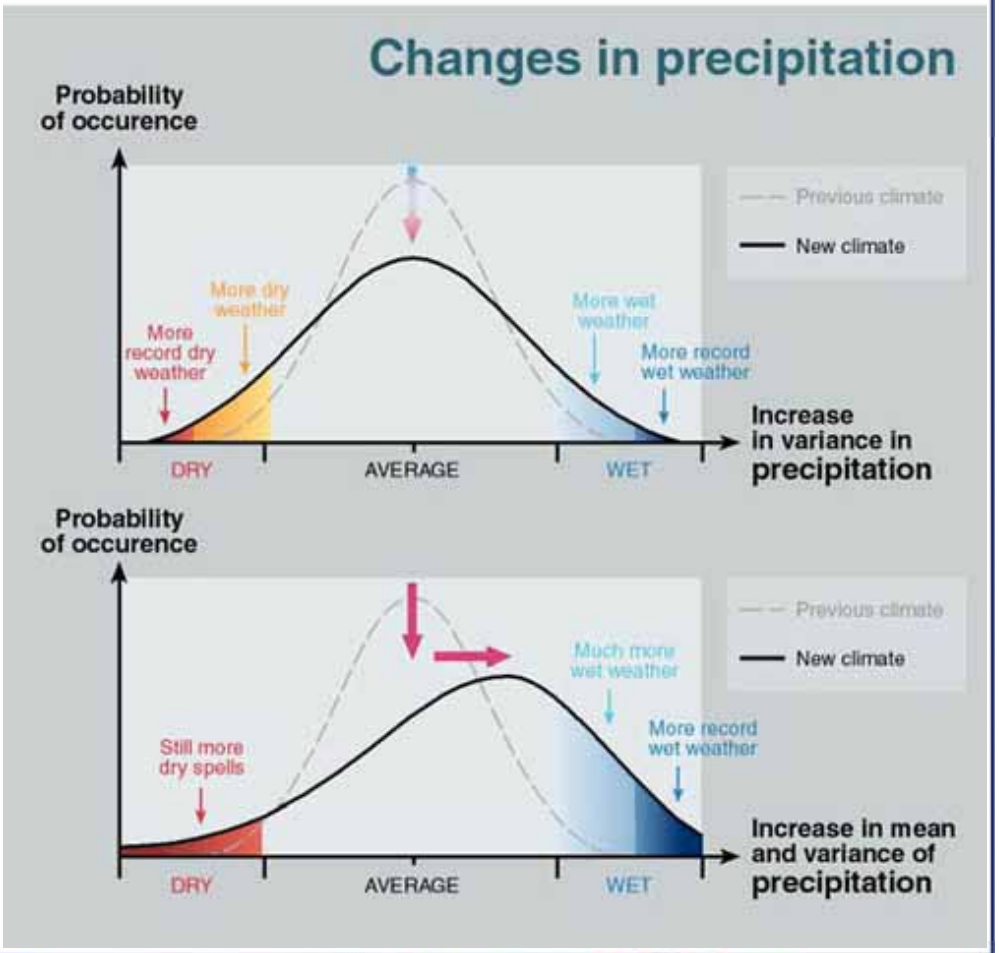
Regional Temperature 2090

	Summer	Autumn	Winter	Spring	Annual
Otago	2.0 [0.7, 4.8]	2.0 [0.8, 4.6]	2.2 [0.8, 4.8]	1.7 [0.5, 4.3]	2.0 [0.8, 4.6]

Regional Rainfall 2090

	Summer	Autumn	Winter	Spring	Annual
Kapiti	-1 [-38, 16]	+2 [-12,+14]	+9 [0,+26]	+2 [-15, +26]	+3 [-7, +14]

Extremes



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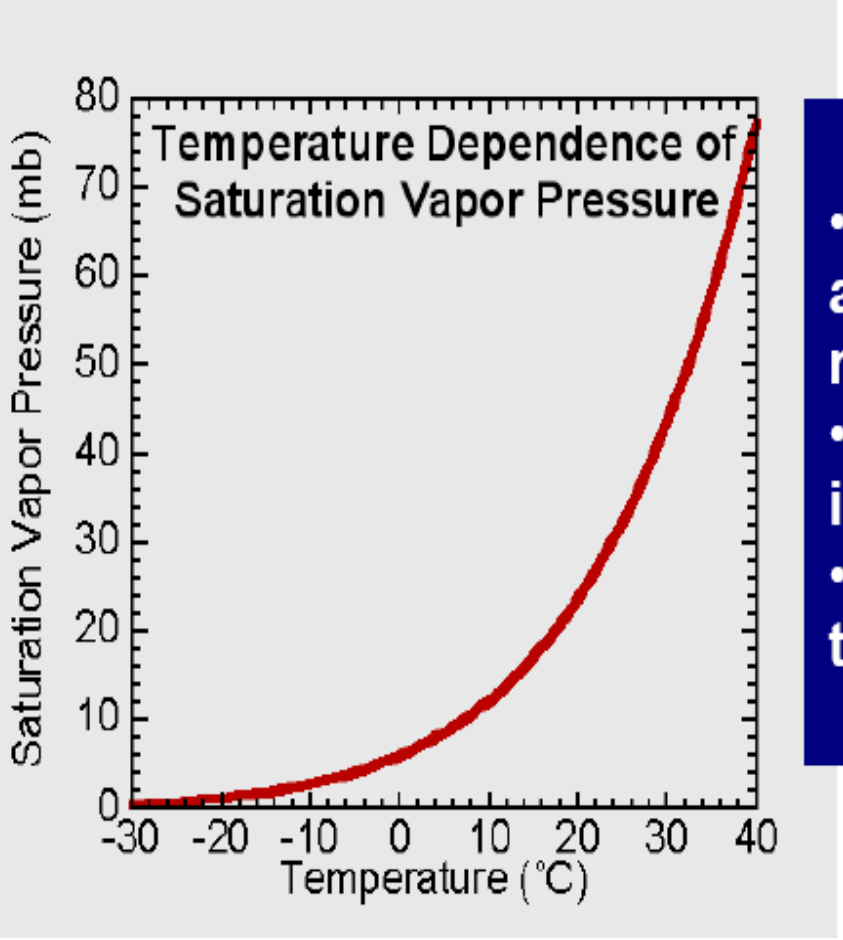
Rainfall Intensity



- For every 1°C warming, the atmosphere, when saturated, holds 8% more moisture
- Rain events are likely to become more intense, leading to greater storm-runoff
- The frequency of heavy rainfall is likely to increase

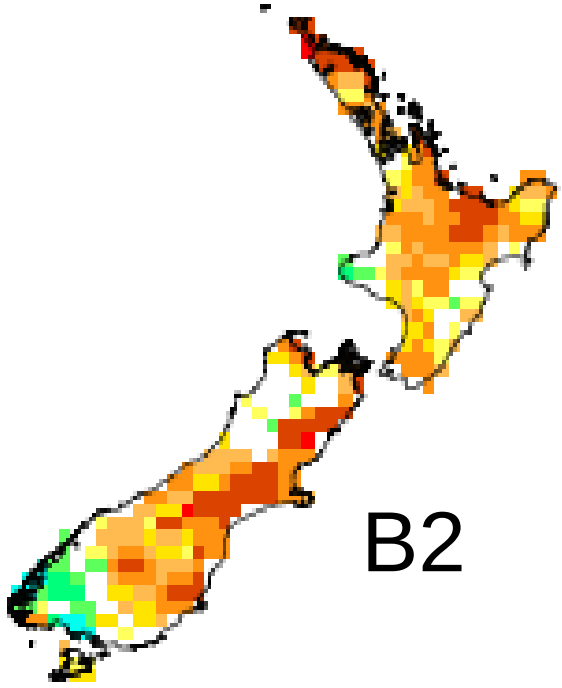
Jim Salinger - NIWA

Percent change in rainfall intensity

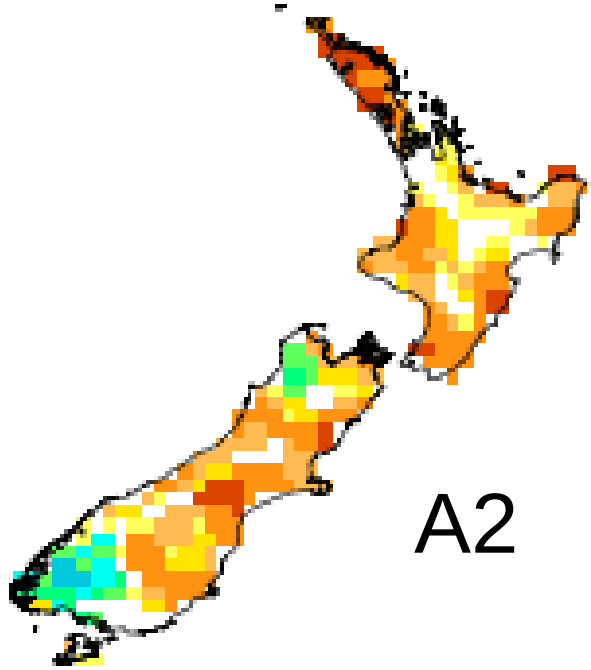
ARI (years) → Duration ↓	2	5	10	20	30	50	100
< 10 minutes	8.0	8.0	8.0	8.0	8.0	8.0	8.0
10 minutes	8.0	8.0	8.0	8.0	8.0	8.0	8.0
30 minutes	7.2	7.4	7.6	7.8	8.0	8.0	8.0
1 hour	6.7	7.1	7.4	7.7	8.0	8.0	8.0
2 hours	6.2	6.7	7.2	7.6	8.0	8.0	8.0
3 hours	5.9	6.5	7.0	7.5	8.0	8.0	8.0
6 hours	5.3	6.1	6.8	7.4	8.0	8.0	8.0
12 hours	4.8	5.8	6.5	7.3	8.0	8.0	8.0
24 hours	4.3	5.4	6.3	7.2	8.0	8.0	8.0
48 hours	3.8	5.0	6.1	7.1	7.8	8.0	8.0
72 hours	3.5	4.8	5.9	7.0	7.7	8.0	8.0

Extreme Rainfall

Change in 20 year return periods



B2



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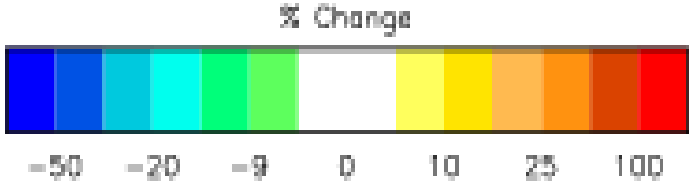
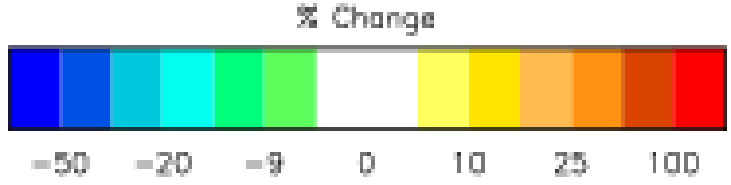
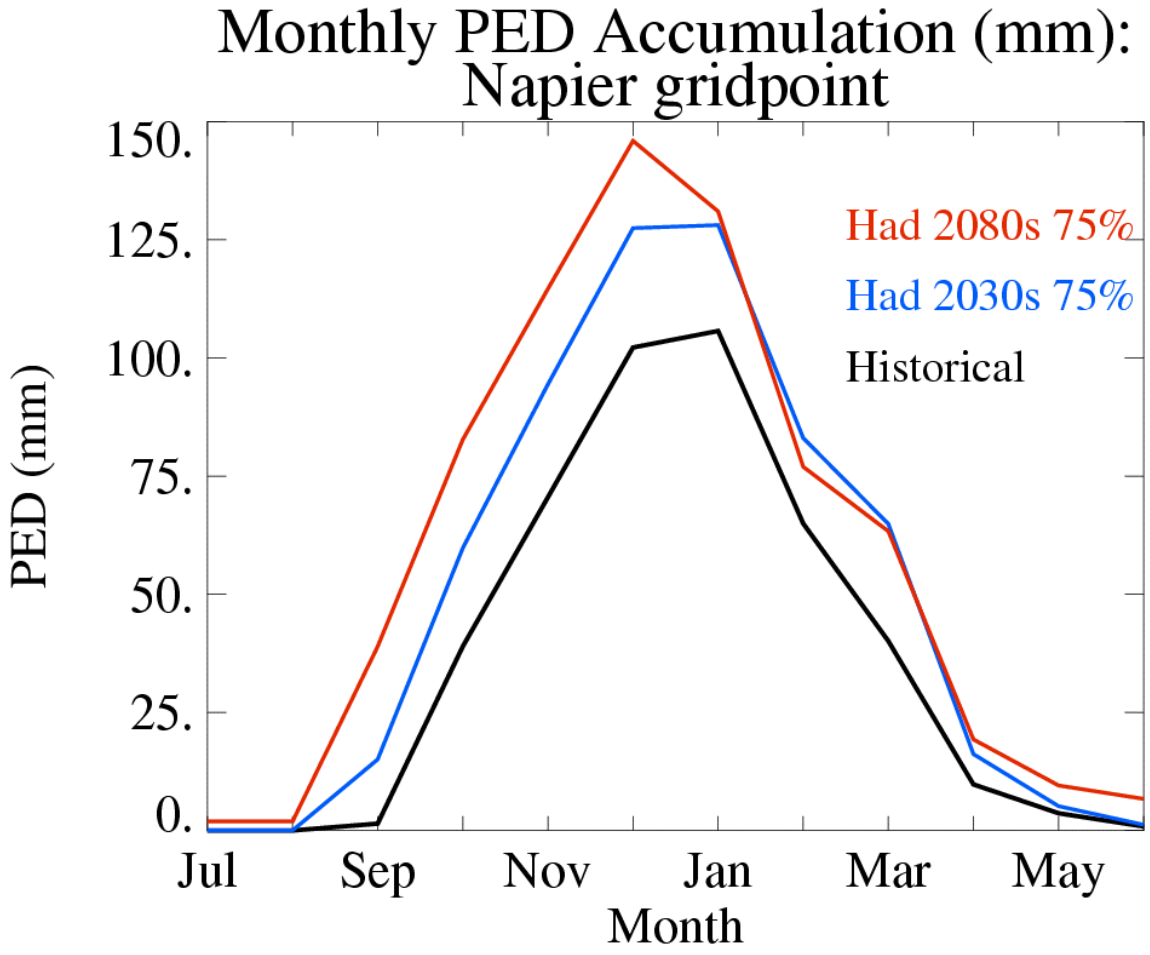




Consequence - Pasture

- EcoClimate report for MAF
- Updated to use new projections
- Looks at
  - Soil moisture deficit
  - National pasture productivity

Change in drought timing



Preparing for Climate Change

- Summary of *Climate Change Effects & Impacts Assessment (2nd ed.)*
- First published 2004, updated in 2008
- Summary of current & future climate
- Local government & climate change
  - responding to climate change
  - using the risk assessment process

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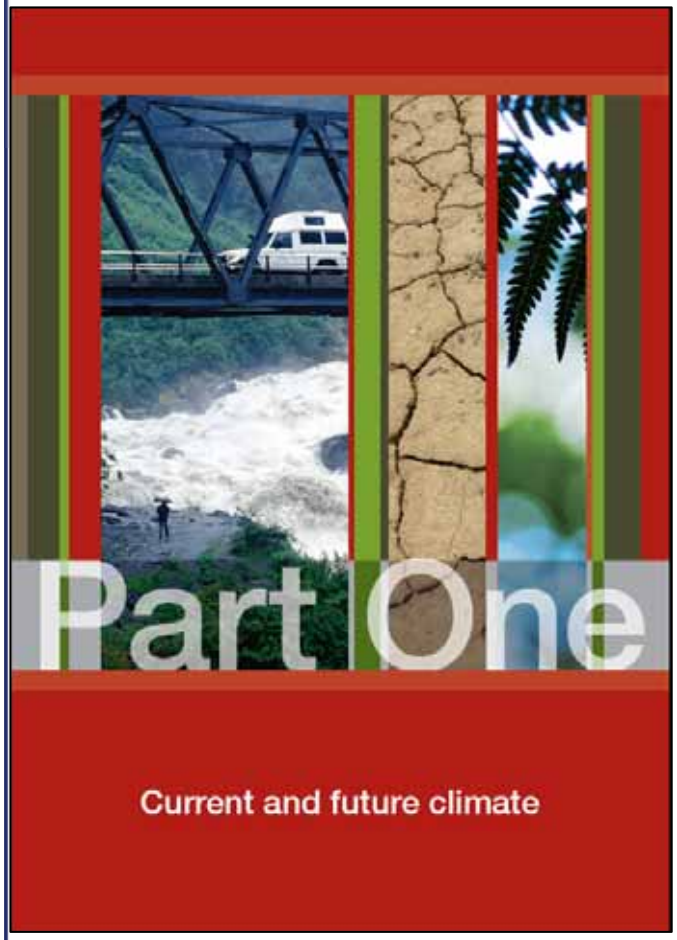
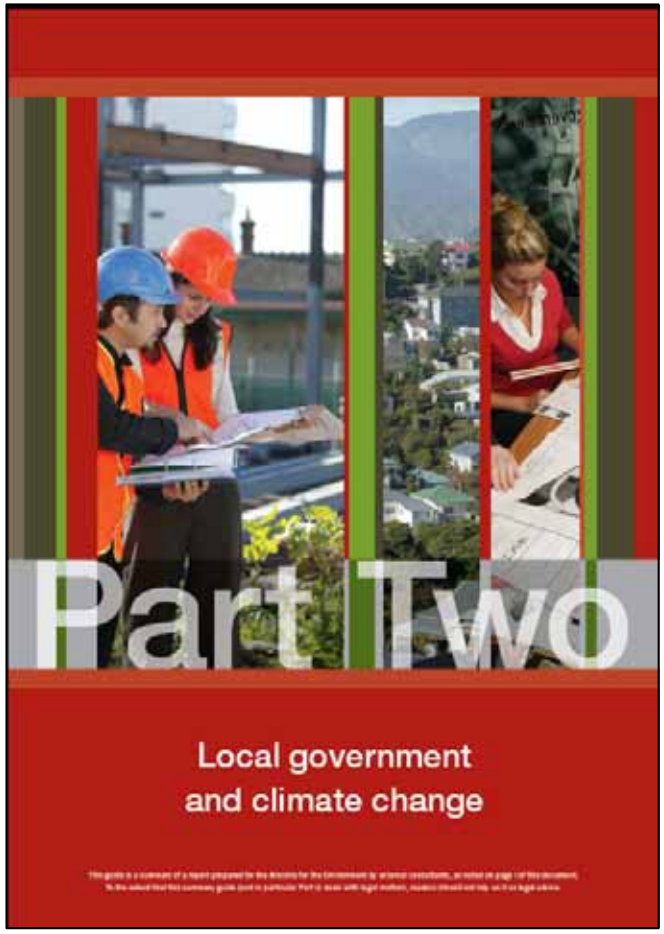
Part One – Current & Future Climate



- Future climate
- Changes in temperature
- Changes in rainfall
- Extreme weather events
- Other climate changes
- Regional changes
- Current climate variability
- Is it climate change or just natural climate variability?

Part Two – Local government & climate change



- Climate-related risk & local government
- Principles for responding to climate change
- Checklists for considering climate change in plans
- How to assess the impact of climate change on council functions

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Example 2

In 1997 North Shore City experienced a significant number of beach pollution events. This was linked to an unusually high number of wet-weather overflow events from its wastewater system.

Community concern led to a detailed analysis of what would be needed to modify the wastewater system so that a performance level of two overflows per year in 2050 could be achieved (taking into account increased population and other factors).

Scenarios were developed from historic rainfall information and predictions of increased frequency of intense rainfall events due to climate change; these scenarios were then applied to designing the modifications, and a risk and cost-benefit analysis undertaken.

The analysis showed that meeting the desired level of service by 2050 in the face of climate change effects would add $100 million to the cost, which had been estimated at $260 million when climate change effects were not considered. The community chose to accept the increased risk of events due to climate change (and therefore reduced level of service in the long term) rather than meet the additional cost of the desired level of service.

However, reviews of the system will incorporate consideration of climate change effects every 3–5 years. 'Future proofing' decisions on different components of the system (such as extensions into new development areas) will be made when and where opportunities or needs arise.

Example 3

Christchurch City Council examined in 2003 the potential effects of climate change on the Avon catchment and associated coastal areas, and how these risks could be managed. The study focused primarily on an economic analysis of likely damages, and the response options available to local government to manage these. The study discussed possible responses including minimum floor levels for buildings, subdivision restrictions, stopbank improvements, and tidal barrages.

Since this study was undertaken, changes have been made to the City Plan. Aspects of the study's findings have also been incorporated into the Urban Development Strategy that seeks to reduce the risks to the community from climate change. Options such as set-backs from waterways and raised floor levels of buildings in flood-prone areas have been incorporated.

Location of issue being addressed

Some locations are more vulnerable than others to climate change effects. For example, all proposed developments near the coast should be evaluated in terms of expected sea-level rise over this century, as well as other consequential effects such as increased coastal erosion, salt water intrusion into aquifers, and increased flooding. Development in flood plains also needs to take account of the potential for reduced flood return periods and potentially greater peaks.

Example 4

In the Hutt Valley, the value of development and the social and economic implications of a major flood are so significant that the community has reduced possible flood effects by investing in flood protection rather than by limiting development. The design was made more robust by taking climate change effects into account. There was inadequate information on possible climate change impacts for modelling purposes at the time decisions were made: the community chose a return period of 400 years as the basis for flood protection design, in the knowledge that the level of protection was likely to reduce over time due to climate change impacts. The Hutt Valley 2001 Flood Plain Management Plan provides detailed information on design considerations and levels of protection, taking into account climate change.

Extent of issue being addressed

Decisions that involve, for example, a single building or a small part of an infrastructure asset (unless the latter constrains the rest of the system) are less likely to have fundamental and long-term implications than decisions that affect larger areas. The exception is where a small development sets a precedent, leading to acceptance of subsequent applications.

Nature of issue being addressed

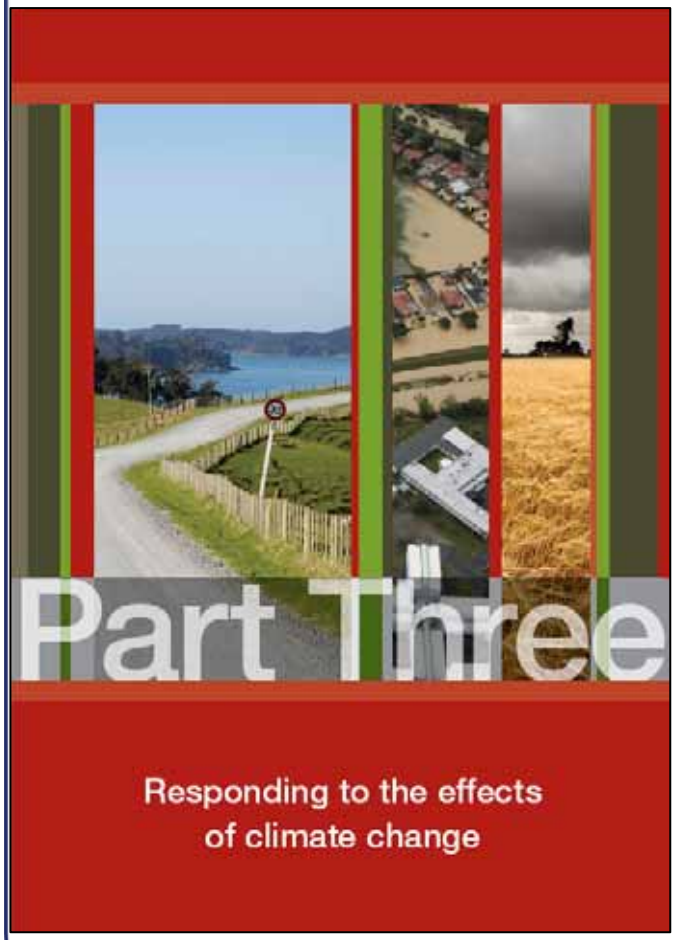
The risk assessment process should identify whether the issue is affected by a single climate parameter or whether it is a complex issue with multiple effects and implications over time. The latter needs to be addressed at a policy level, with decision-making carried through consistently over time. Relatively general information may be adequate to start policy development and information can be refined over time within a generic policy context. For example in planning an urban extension, there may be several options: low-lying coastal areas should be avoided, and if flood plains are being considered, higher and more frequent floods than in the past should be assumed.

Example 5

Transit New Zealand is the Crown Entity responsible for state highways. As such it is required to assess and manage risks to New Zealand's transport network, and ensure its sustainability. Transit New Zealand recognises that it is prudent to consider climate change in the design and planning of all major long-life infrastructures such as bridges, culverts, and causeways that could be affected by climate change impacts within the working life of the structure.

Future-proofing at the design stage makes later retrofits both feasible and cost effective. Some new state highway projects are already considering the impacts of climate change during design and construction. For example, the new section of causeway for Auckland's Upper Harbour Corridor (State Highway 18) was built 0.3 metres higher than the existing causeway, which was then raised to match it. This was in direct response to predicted sea-level rise.

Part Three – Responding to the effects of climate change



- Making climate change part of council decision-making
- Stage One: Qualitative assessment of the impact of climate change
- Stage Two: Preliminary assessment of the impact of climate change
- Stage Three: Detailed risk assessment of climate change effects
- Case Studies

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Case Study 1:
Southland water resources

Environment Southland identifi
environment in future:

- Environmental: The great
past 40 years. The daily t
- Population: The populatio
- Economic: Agriculture acc
land. Agricultural activitie
to freshwater resources.

Changes in land use can have a
has been a rapid expansion of d
economic activities that could i

Thus, if Environment Southland
freshwater environment, it woul
This would require some consid

Table 8: Examples of possible al

Scenario	Environment
1	Low-case scenario of c • slight temperature ch 0.5°C in most seasor • slight increase in sum to –10% in other sea
2	High-case scenario of c • temperature increase greater increases in v • precipitation increase seasons with likely in heavy rain

Case Study 2:
Water resources changes in three river catchments

In 2001 the Ministry of Agriculture
quantify the potential change in ag
to assess the implication of these
allocation issues.

Changes in three river catchments
and Tukituki in Hawke's Bay.

Environmental (climate and river fl
developed, though the land-use cha

The main steps in the developmen

- gathering of historical climat
catchment
- generation of two climate cha
precipitation, maximum temp
- use of a weather generator to
- river flow scenarios.

Land-use changes in each of the th
mean monthly degree-days, combi

Current economic trends for differ
would hold for 2050. The general p
climate, river flow and land-use ch
water demand and supply, using a

Case Study 3:
Stormwater and wastewater effects in North Shore City

A study by North Shore City Council on its wastewater system included examination of the possible effects of climate change on future wet weather overflows.

Existing system performance was translated into expected future performance based on changing rainfall (extreme events) using a statistically established relationship between existing rainfall patterns and existing system performance.

Key aspects of the development of scenarios included:

- the use of 17-year historical rainfall records to determine the existing condition of the receiving environment
- the use of NIWA studies showing likely increases in temperature and rainfall due to climate change
- estimation of storm characteristics in 2050 from the historical records and historical and predicted future rainfall.

The study acknowledged that climate change is well accepted worldwide. However, the effect on North Shore's wastewater system was based on a number of simplified assumptions with inherent uncertainties associated with modelling the effects of climate change. The study recommended that the results, therefore, should be used to assess trends rather than to provide absolute values.

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Coastal Hazards and Climate Change - A guide for local government

- Guidance first published 2004
- Second edition
  - Post IPCC 4th Assessment Report
  - Includes improved downscaling
- Opportunity also taken to:
  - Update chapters
  - Re-write chapters
  - Restructure format & layout
- Includes sea level rise advice, storm surge, waves, erosion, inundation

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Purpose of the guidance

- Provide planners and engineers with
  - Risk management process
  - Impacts information
- Help local government use climate change information in decisions, planning, asset management, consents
- Road tested on engineers, lifelines, planners

Future sea-level rise allowances

For planning and decision timeframes out to the 2090s, use the following in your risk assessment:

- use a **base value** of **0.5 m,** *and*
- assess consequences of higher sea-level rises
  - *at least* **0.8 m,** *and*
- allow **10 mm/year beyond 2100**

NES - Sea Level Rise

- Scope development of a National Environmental Standard on sea level rise
- Encourage a consistent approach to managing coastal hazards
- Stage 1: develop 'Issues and Options' paper for consultation & input into NES

Further work across government

- MAF, DoC, MoT, MoH Research
- Increase FRST and MRST $s
  - More detailed impacts info
  - Distributions
  - Downstream modelling – consequences
  - NIWA marine

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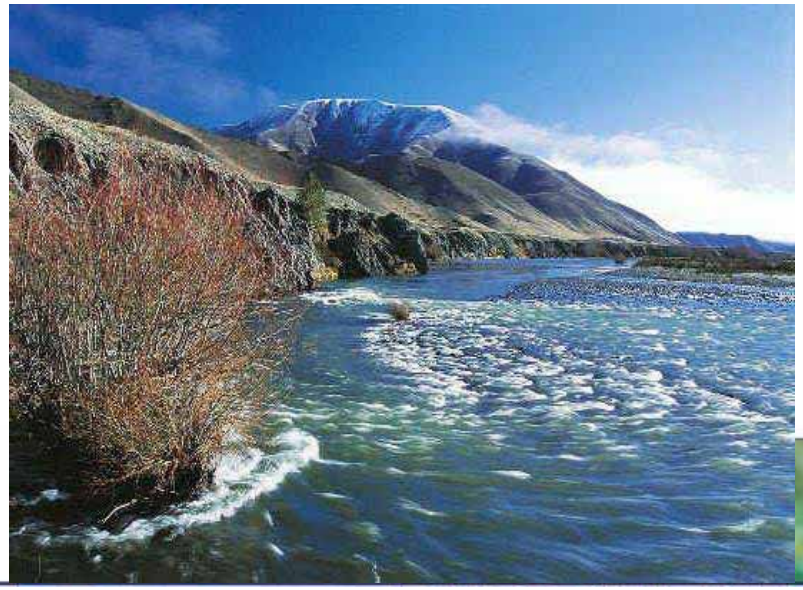
What's still to come in 2008/09?

- Case Studies
- Flooding and Climate Change guidance manual
- Summary publications – coastal, flooding
- Quality Planning Guidance Note (www.qp.org.nz/plan-topics/climate-change.php)



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2008/09 Adaptation Work Programme

- Progress NPS on Flooding
- Scope issues & options for NES on sea level rise
- Adaptation 'Toolbox'
- Education materials
- Urban materials
- Working with our partners

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Working with Lifelines Groups

- Workshops on climate change impacts held for 7 regions

- Rain intensity often top issue
- Rain totals next
- Wind, sea level and storm surge

- Most often asked after: lightning, hail, snow

Mind catching!

- Liquefaction
- Fog
- Salt spray
- Wind and powerlines
- Copper cable underground at coast
- Quote: design in flexibility to “allow” for future change rather than make things bigger/stronger
- “Current capacity inadequate!”