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National Science Challenges | THE DEEP SOUTH
Te Kōmata o Te Tonga

The impacts of climate change on our stormwater and wastewater systems

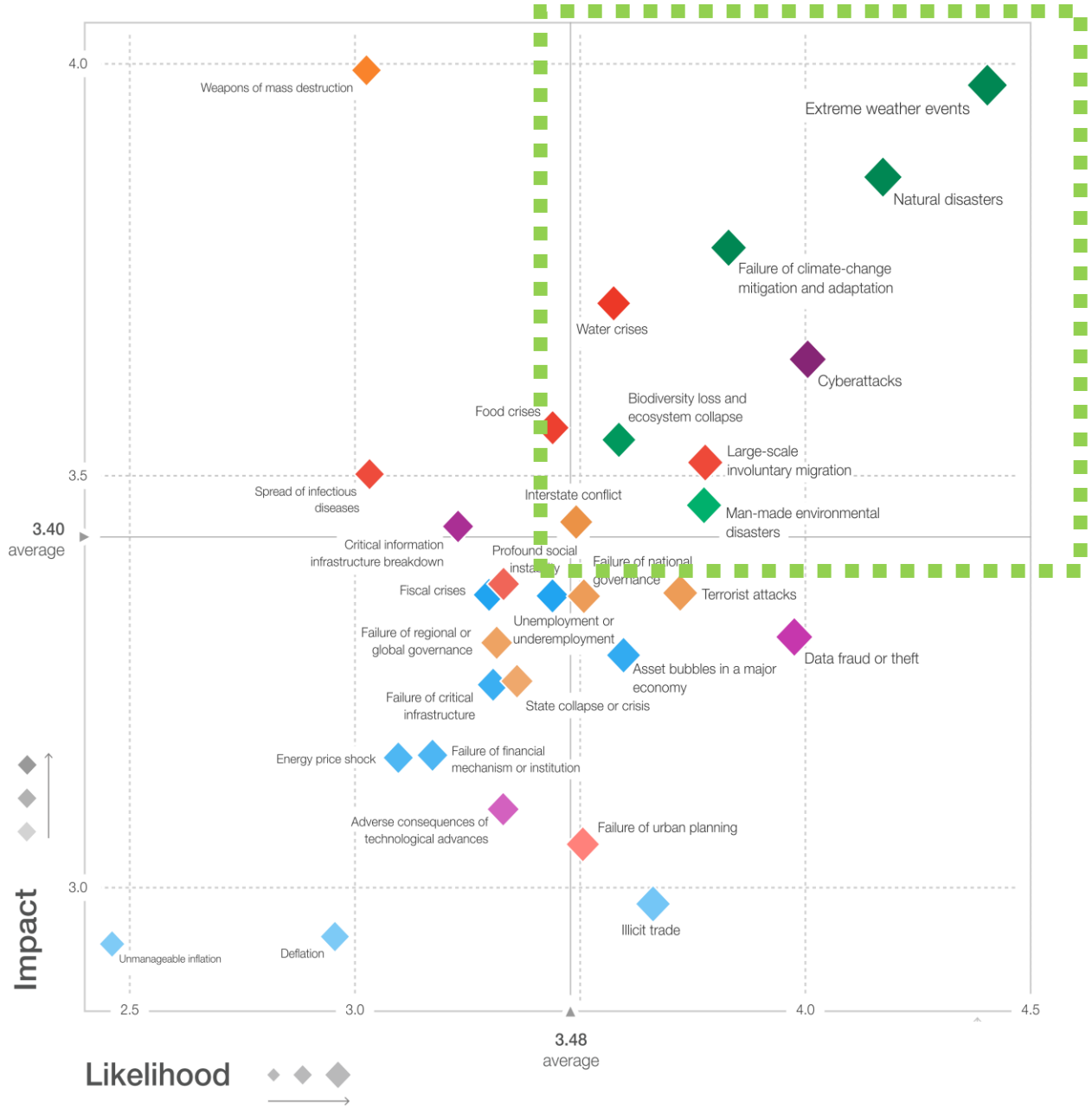
J. Hughes, K. Heays & E. Olesson (T+T), R. Bell, P. Blackett (NIWA), A. Stroombergen (Infometrics)

Agenda

- Background
- About the project
- Impacts summary
- Key implications
- Regional analysis
- Some recommendations (what may all this mean, and how should we respond?)

Background

WEF GLOBAL RISK REPORT



World Economic Forum:
Global Risks Report 2018

Top 5 Global Risks in Terms of Likelihood

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1st	Asset price collapse	Asset price collapse	Storms and cyclones	Severe income disparity	Severe income disparity	Income disparity	Interstate conflict with regional consequences	Large-scale involuntary migration	Extreme weather events	Extreme weather events	Extreme weather events
2nd	Slowing Chinese economy (<6%)	Slowing Chinese economy (<6%)	Flooding	Chronic fiscal imbalances	Chronic fiscal imbalances	Extreme weather events	Extreme weather events	Extreme weather events	Large-scale involuntary migration	Natural disasters	Failure of climate-change mitigation and adaptation
3rd	Chronic disease	Chronic disease	Corruption	Rising greenhouse gas emissions	Rising greenhouse gas emissions	Unemployment and underemployment	Failure of national governance	Failure of climate-change mitigation and adaptation	Major natural disasters	Cyber-attacks	Natural disasters
4th	Global governance gaps	Fiscal crises	Biodiversity loss	Cyber-attacks	Water supply crises	Climate change	State collapse or crisis	Interstate conflict with regional consequences	Large-scale terrorist attacks	Data fraud or theft	Data fraud or theft
5th	Retrenchment from globalization	Global governance gaps	Climate change	Water supply crises	Mismanagement of population	Cyber-attacks	High structural unemployment or underemployment	Major natural catastrophes	Massive incident of data fraud/theft	Failure of climate-change mitigation and adaptation	Cyber-attacks

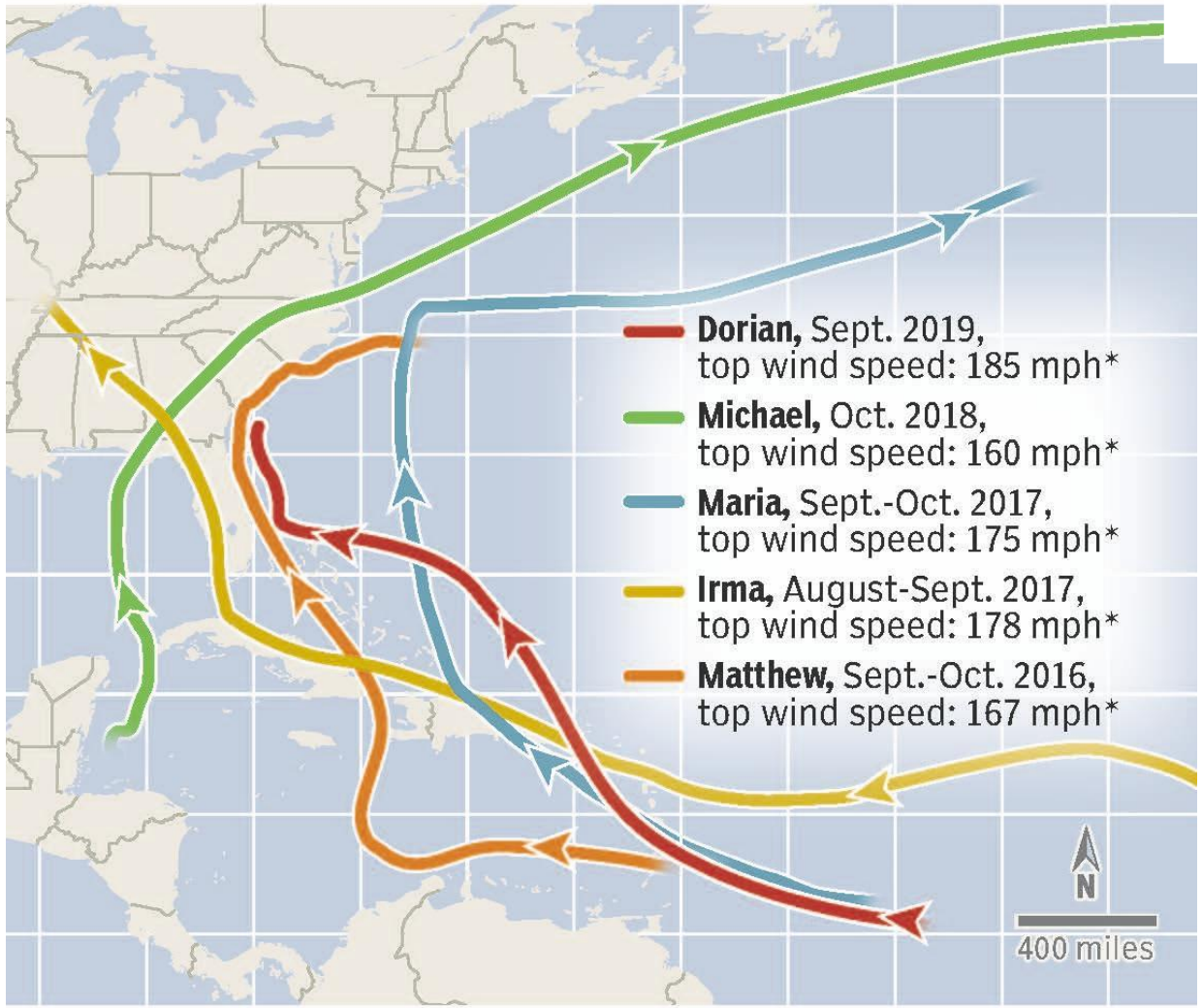
Top 5 Global Risks in Terms of Impact

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1st	Asset price collapse	Asset price collapse	Fiscal crises	Major systemic financial failure	Major systemic financial failure	Fiscal crises	Water crises	Failure of climate-change mitigation and adaptation	Weapons of mass destruction	Weapons of mass destruction	Weapons of mass destruction
2nd	Retrenchment from globalization (developed)	Retrenchment from globalization (developed)	Climate change	Water supply crises	Water supply crises	Climate change	Rapid and massive spread of infectious diseases	Weapons of mass destruction	Extreme weather events	Extreme weather events	Failure of climate-change mitigation and adaptation
3rd	Oil and gas price spike	Oil price spikes	Geopolitical conflict	Food shortage crises	Chronic fiscal imbalances	Water crises	Weapons of mass destruction	Water crises	Water crises	Natural disasters	Extreme weather events
4th	Chronic disease	Chronic disease	Asset price collapse	Chronic fiscal imbalances	Diffusion of weapons of mass destruction	Unemployment and underemployment	Interstate conflict with regional consequences	Large-scale involuntary migration	Major natural disasters	Failure of climate-change mitigation and adaptation	Water crises
5th	Fiscal crises	Fiscal crises	Extreme energy price volatility	Extreme volatility in energy and agriculture prices	Failure of climate-change mitigation and adaptation	Critical information infrastructure breakdown	Failure of climate-change mitigation and adaptation	Severe energy price shock	Failure of climate-change mitigation and adaptation	Water crises	Natural disasters

Economic Environmental Geopolitical Societal Technological

Five Cat 5s in four years

The tropical Atlantic has created a rash of Category 5 hurricane since 2016 with five forming, including Hurricane Michael, whic made landfall in Florida's Panhandle in 2018.



*These are sustained wind speeds

Source: NOAA; maps4news.com/©HERE

GATEHOUSE MEDIA

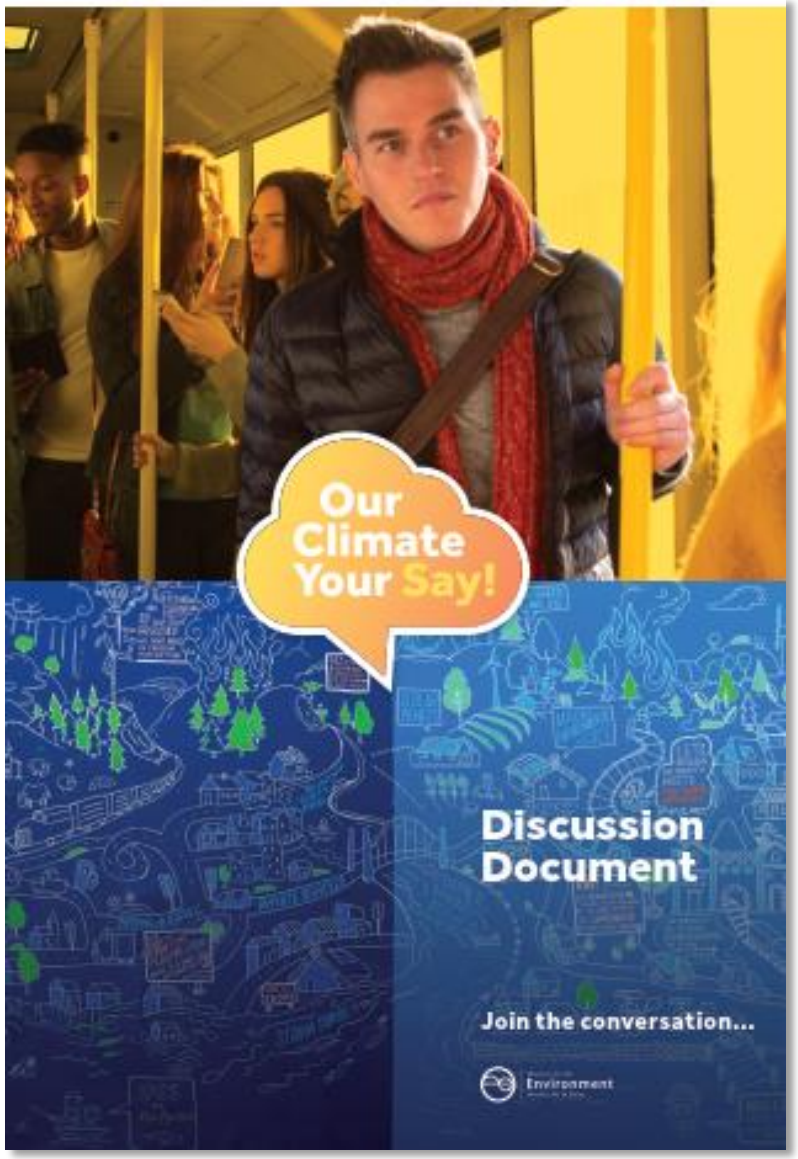
Hurricane Michael's slightly lower pressure than Katrina does not necessarily mean that it will be as dangerous or more so than the storm that flooded New Orleans. Katrina killed more than 1,000 people due to infrastructure failures and mismanagement of emergency resources, not because of where it sat on the record charts,

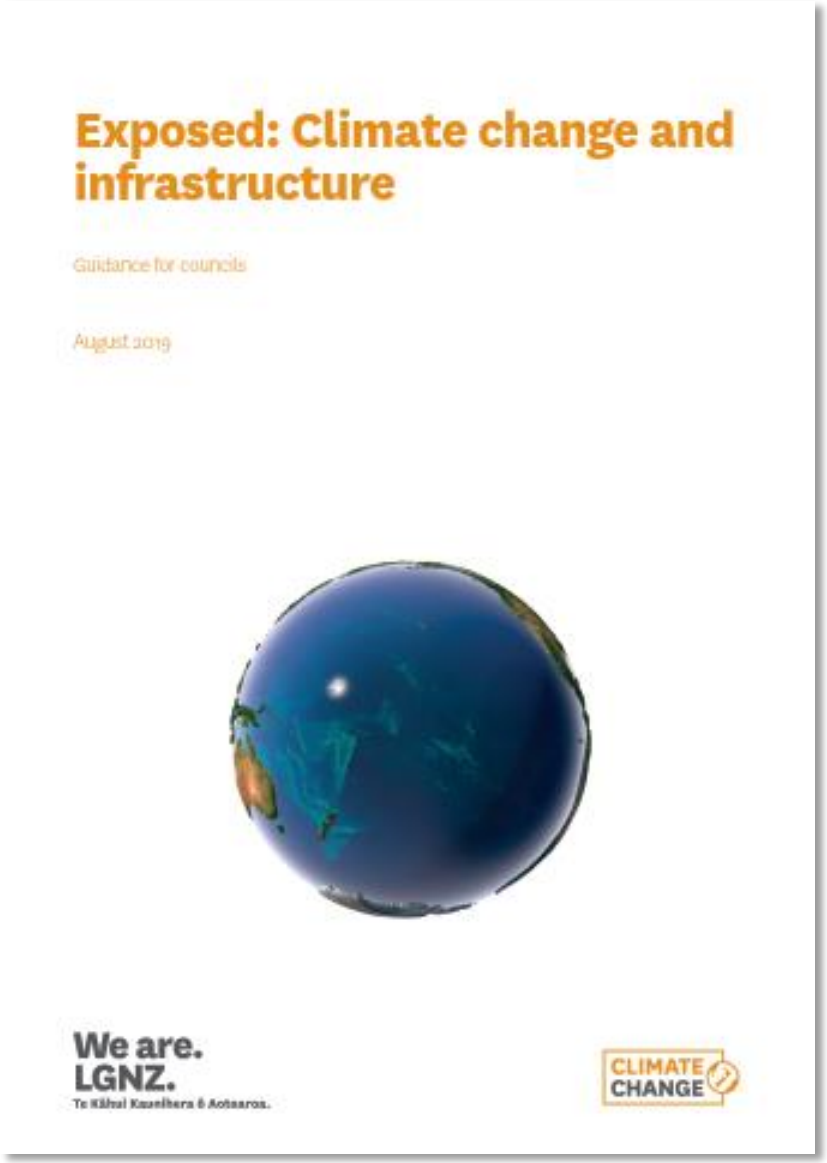
Infrastructure impacts

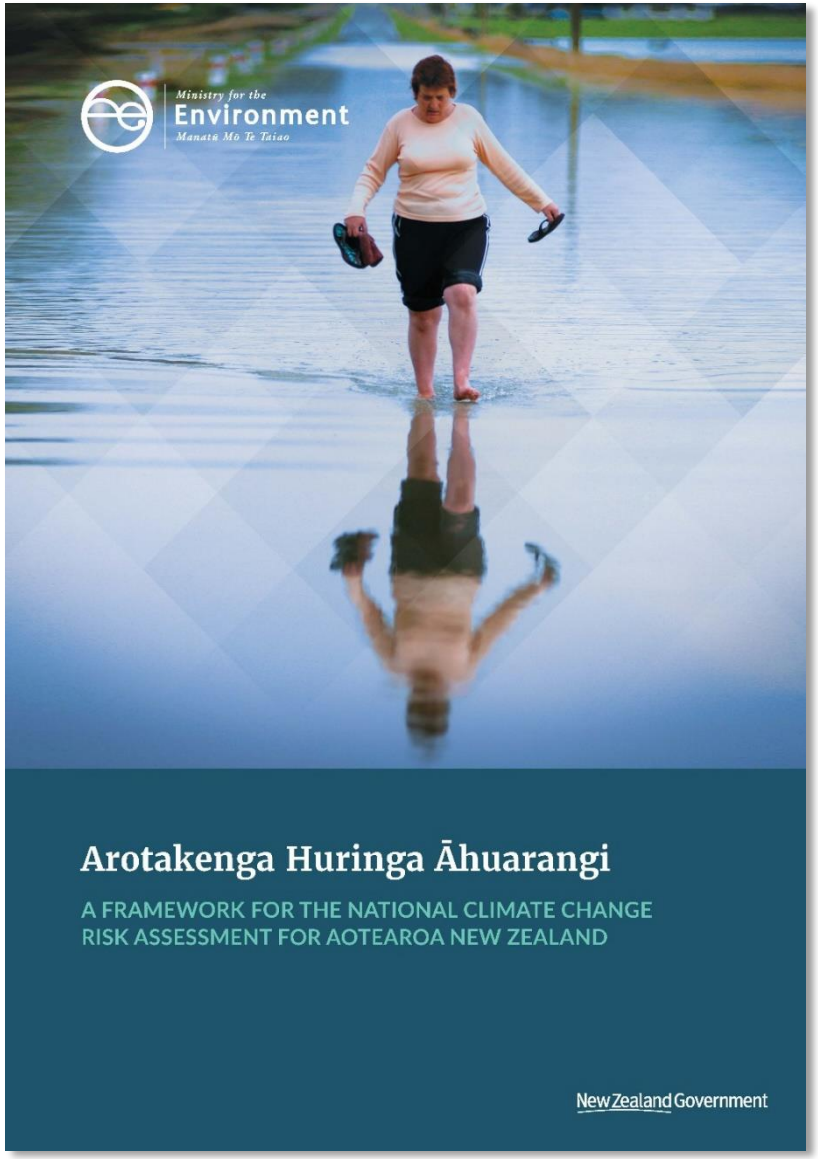
Is unprecedented the new normal?

- ICNZ: $234M in insured losses 2017;
- ICNZ: $72M in May event, $225M to Oct 2018

- What about uninsured?


Our Climate Your Say!
Discussion Document
Join the conversation...
Environment


Exposed: Climate change and infrastructure
Guidance for councils
August 2019
We are. LGNZ.
Te Kāhui Kaunihera ō Aotearoa.
CLIMATE CHANGE


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

The research project

National Science Challenges

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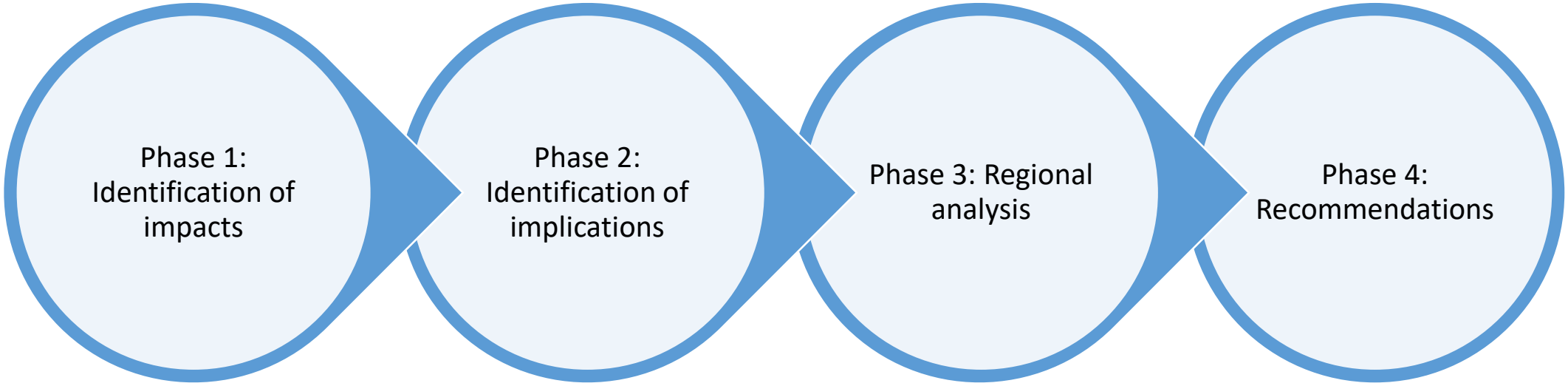
Te Kōmata o Te Tonga

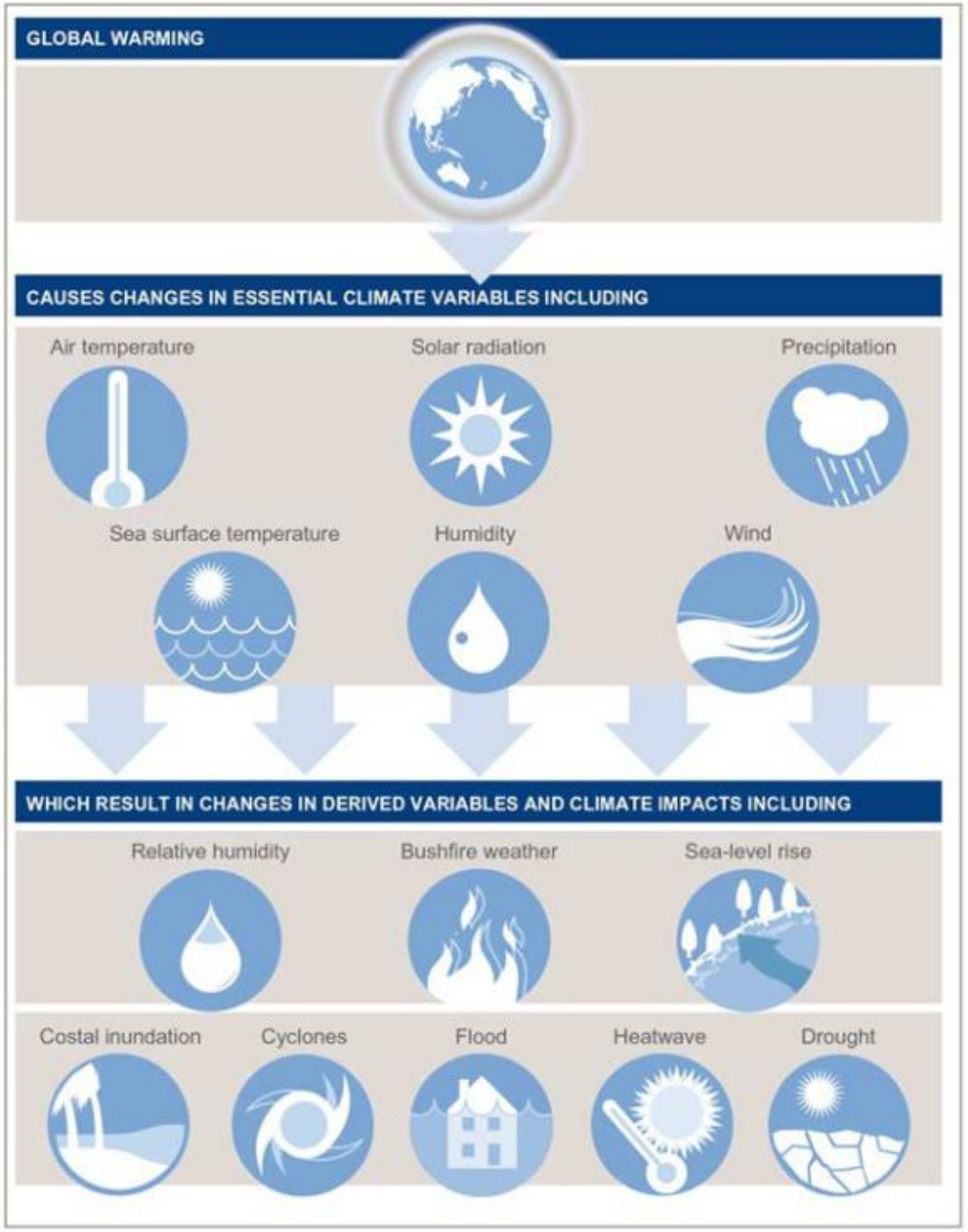
Wastewater & Stormwater Impacts

Project overview - methodology



Including Case Studies

Working group



Climate hazards

- Increased rainfall
- Decreased rainfall
- Sea level rise
- Increased temperature
- Increased wind

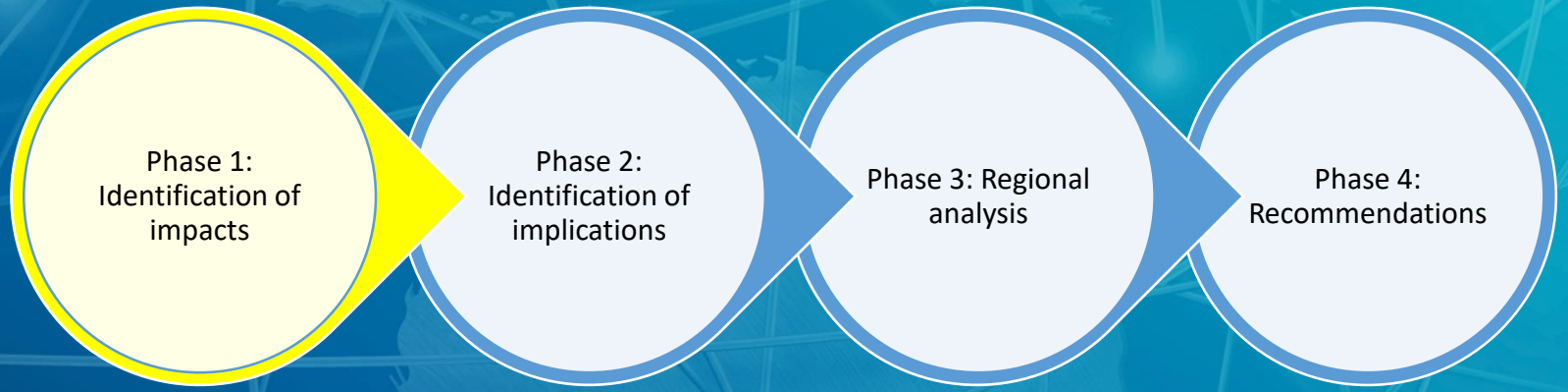
Stormwater assets considered

Conveyance • Piped networks • Overland flow paths • Stopbanks
Treatment • Stormwater quality improvement devices

Wastewater assets considered

Conveyance • Separated gravity system • Combined gravity system • Pressure system • Pump stations
Treatment • Treatment plants and processes • On site wastewater systems

Impacts on stormwater systems – some key examples



Key stormwater conveyance impacts

Increased Rainfall:

- Increased flooding
- Damage to infrastructure
- Scour and erosion
- Increased contaminant concentrations
- Resuspension of sediments
- Raised groundwater table

Reduced rainfall / increased temp:

- Reduced baseflows
- Warmer water temperatures

Contaminant loading

Increased rainfall:

- Scour and erosion causes TSS increase
- Higher velocities collect more rubbish and debris
- Pollutants of many types
- Higher flows, mean increased flushing

Key stormwater treatment device impacts

- Higher peak flows
- Increased contaminant loadings
- Reduced capacities
- Salinity impacts
- Rising groundwater
- Increased evapotranspiration
- Plant stress – eg in rain gardens

- All leading to potential for reduced L.O.S.

Case Study - Whangamarino

Whangamarino Wetland (left, source: DOC) and nearby fish mortality during 2017 floods (right, source: Andrew Rumsby, PDP & Waikato Regional Council)

Impacts on wastewater systems

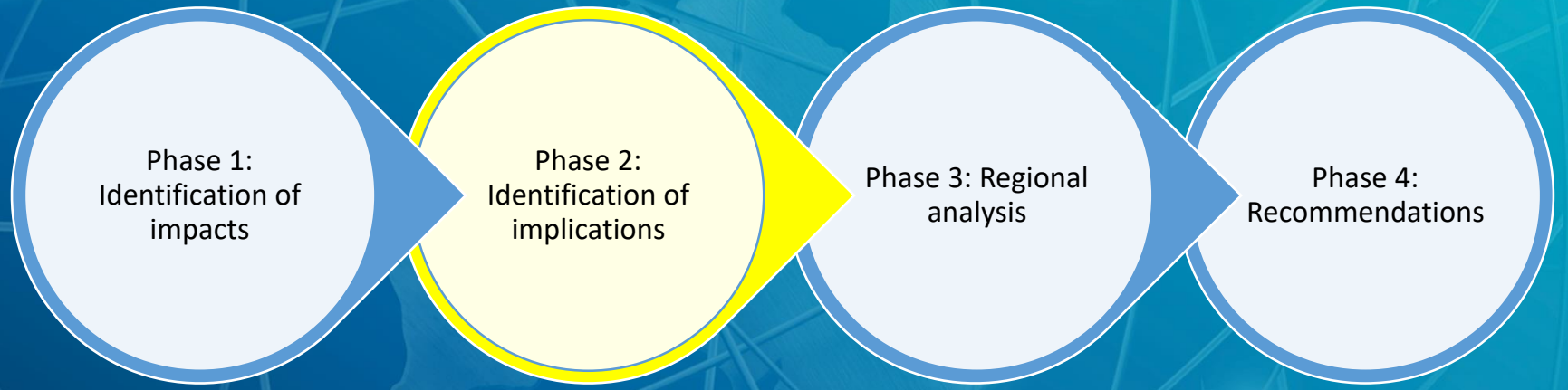
Wastewater network impacts

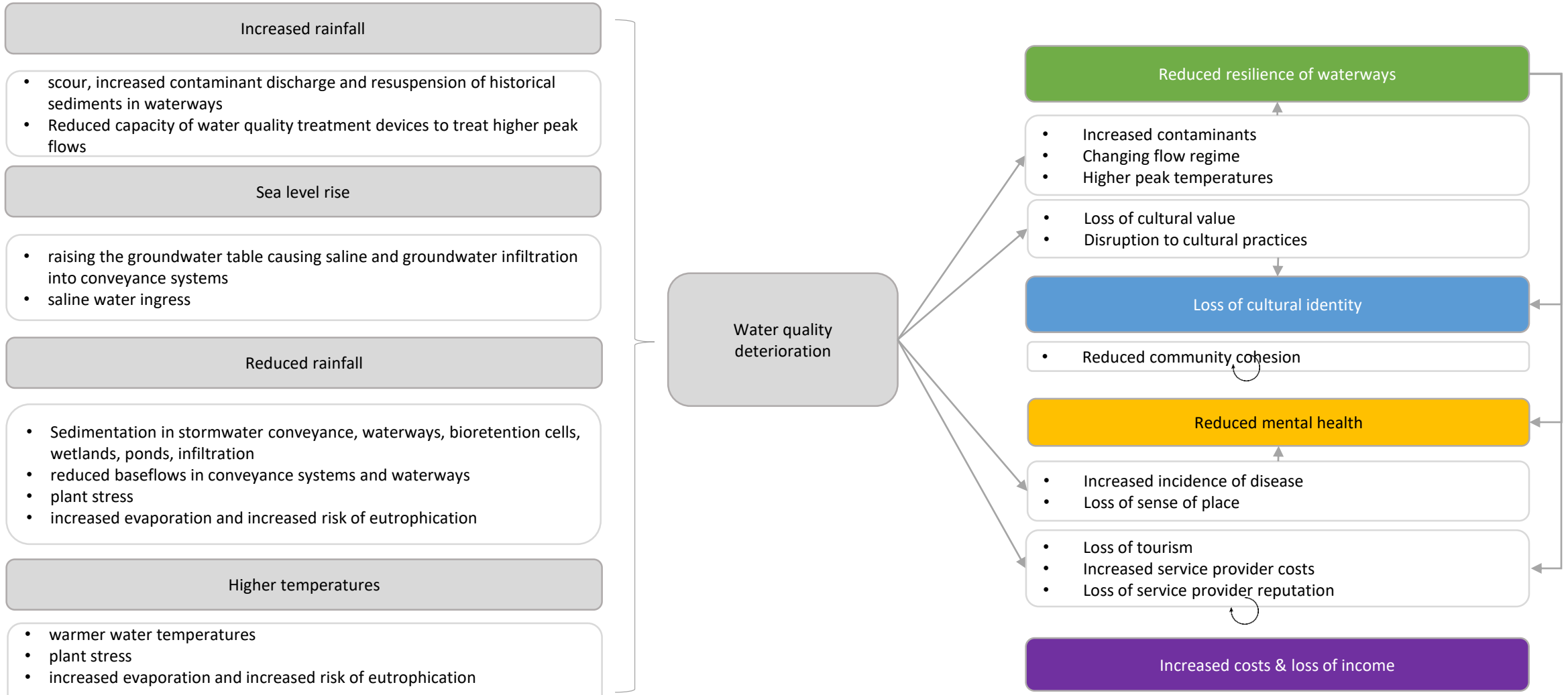
Increased rainfall:

- Increased incidences of overflows in wet
- Corrosion risk due to salinity
- Flotation of pipes
- GW ingress
- Infrastructure damage
- Blockages within systems due to low flows in drought

LA Case Study (2015)

Cascading implications




Increased rainfall
scour, increased contaminant discharge and resuspension of historical sediments in waterways
Reduced capacity of water quality treatment devices to treat higher peak flows
Sea level rise
raising the groundwater table causing saline and groundwater infiltration into conveyance systems
saline water ingress
Reduced rainfall
Sedimentation in stormwater conveyance, waterways, bioretention cells, wetlands, ponds, infiltration
reduced baseflows in conveyance systems and waterways
plant stress
increased evaporation and increased risk of eutrophication
Higher temperatures
warmer water temperatures
plant stress
increased evaporation and increased risk of eutrophication
Water quality deterioration
Reduced resilience of waterways
Increased contaminants
Changing flow regime
Higher peak temperatures
Loss of cultural value
Disruption to cultural practices
Loss of cultural identity
Reduced community cohesion
Reduced mental health
Increased incidence of disease
Loss of sense of place
Loss of tourism
Increased service provider costs
Loss of service provider reputation
Increased costs & loss of income

Example: Implications arising from uncontrolled wastewater discharges

- Environmental / habitat degradation
- Significant cultural impacts on water quality, mauri of waterways, mahinga kai, identity and connection to turangawaewae…
- Reduced mental health for community members
- Loss of cultural identity and community cohesion
- Increased incidence of disease
- Reduced amenity of waterways can lead to *solastalgia*, or a loss of sense of place
- Increased preventative maintenance and water quality management costs

The Washington Post
Democracy Dies in Darkness

Wonkblog | Analysis

Houston is experiencing its third '500-year' flood in 3 years. How is that possible?

By **Christopher Ingraham**
August 29, 2017 at 7:30 AM

This drone video taken Aug. 27 shows the historic flooding in Houston caused by Hurricane Harvey. (ahmed.gul/Instagram)

smoothvega
@smoothvega

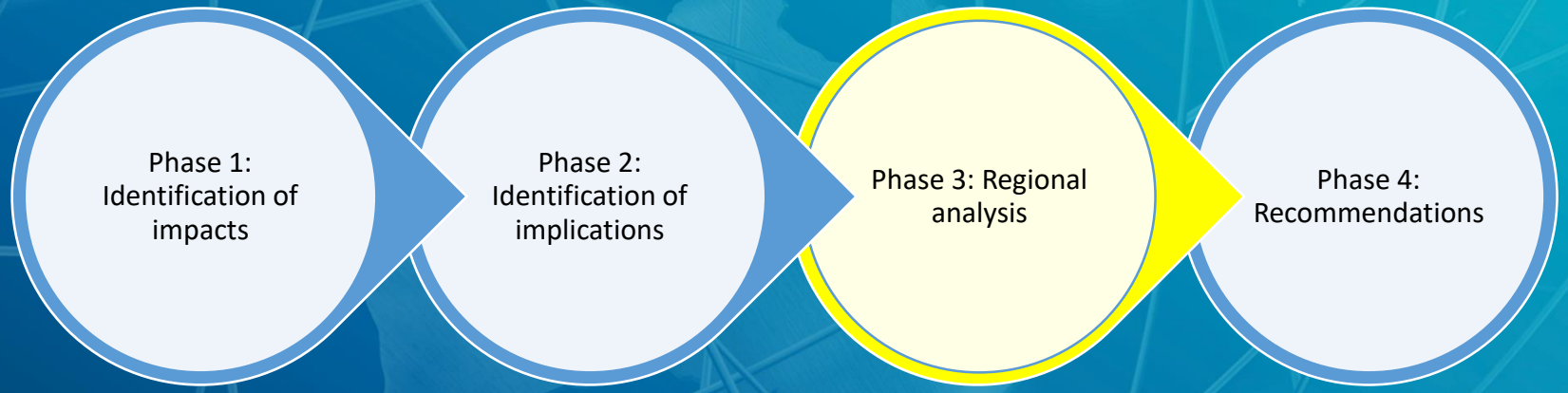
Follow

This makes me sick #Houston

10:51 AM - 28 Aug 2017

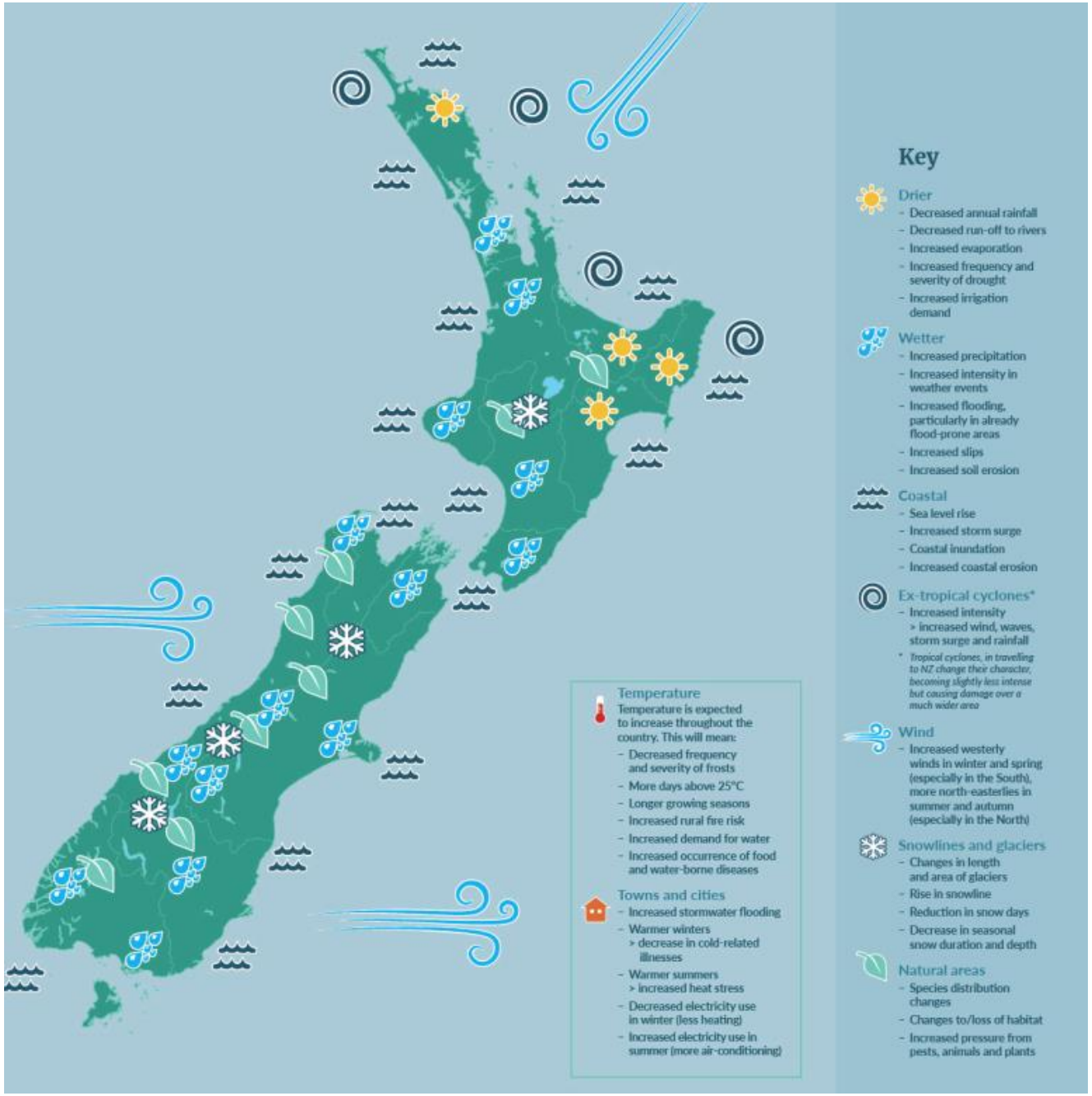
8,675 Retweets **14,860** Likes

Regional analysis



Regional Analysis

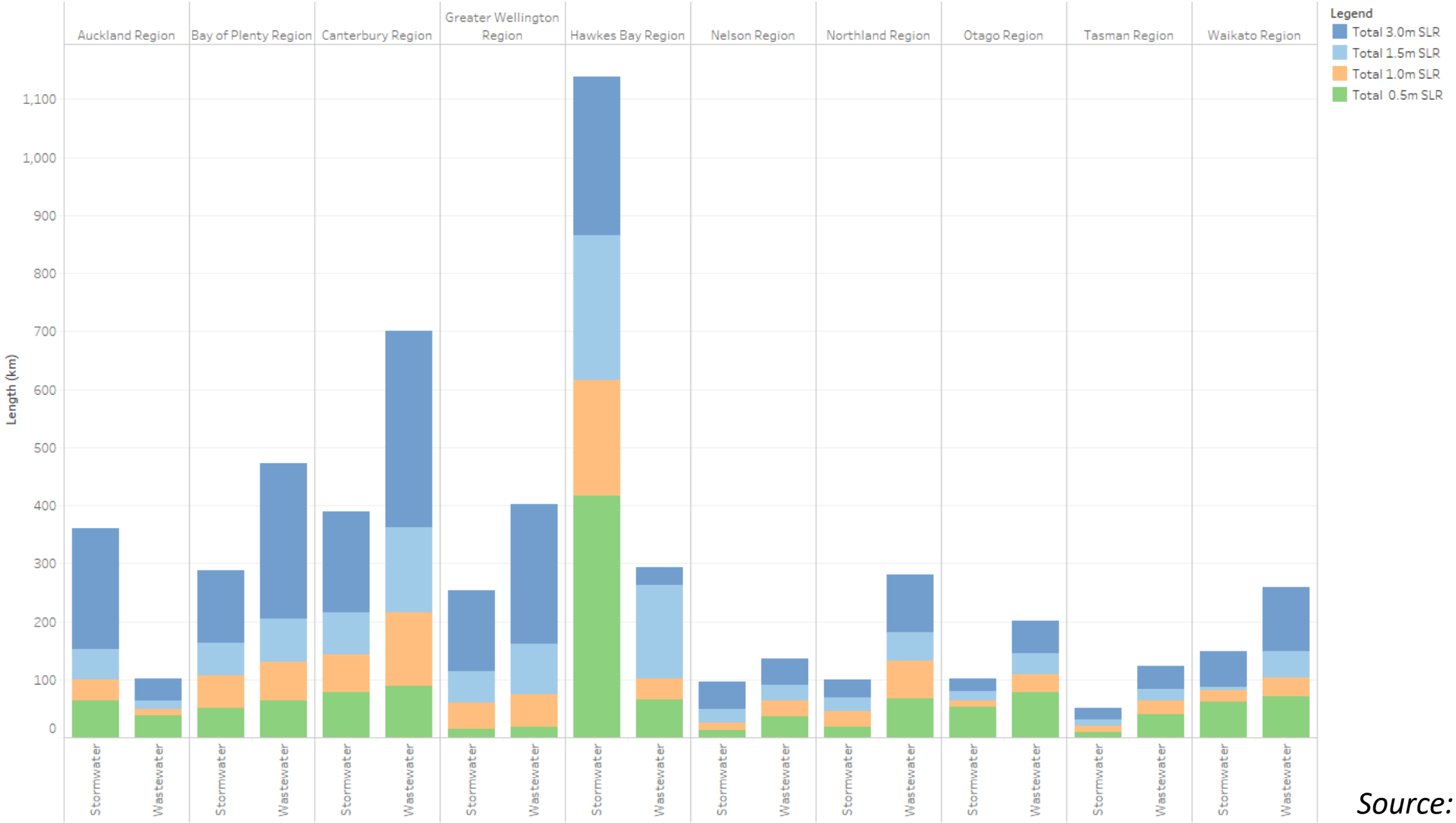
- How might these impacts unfold around NZ?
- Physical factors when combined with climate drivers, may lead to increased risk.



Factors that may increase risk

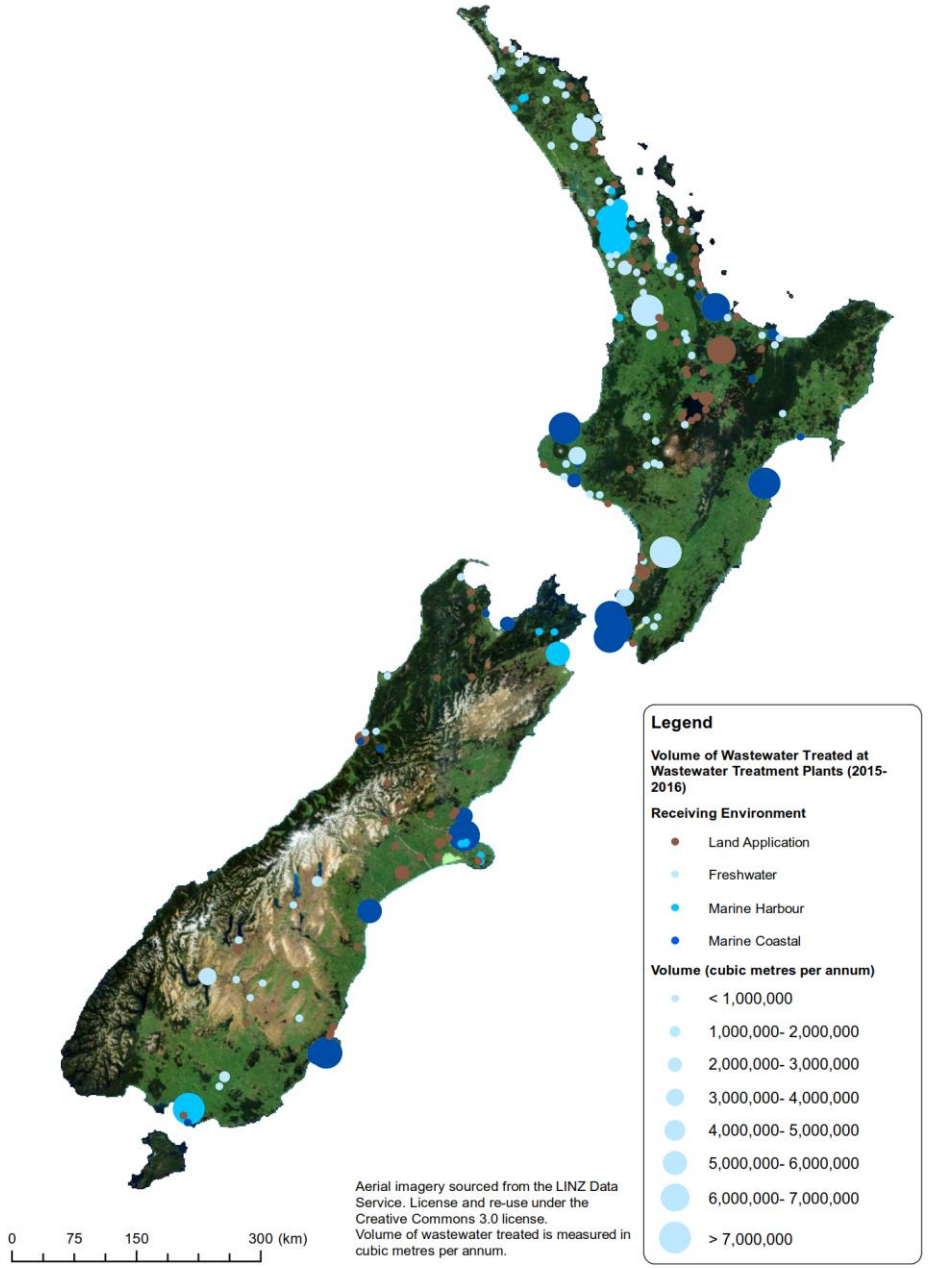
1. Communities that rely on pumped stormwater systems or are protected by stopbanks
2. Communities with environmentally compromised waterways
3. Communities with low-lying areas prone to flooding or sw systems prone to inundation
4. Communities with low-lying coastal wastewater treatment plants
5. Communities with WWTP which discharge to rivers
6. Other factors that may mean they may have specific vulnerabilities. E.g. socio-economic

Local Government Sea Level Rise Exposure: Total Length of Pipes (km) per Region by Sea Level Rise Increment (LiDAR)

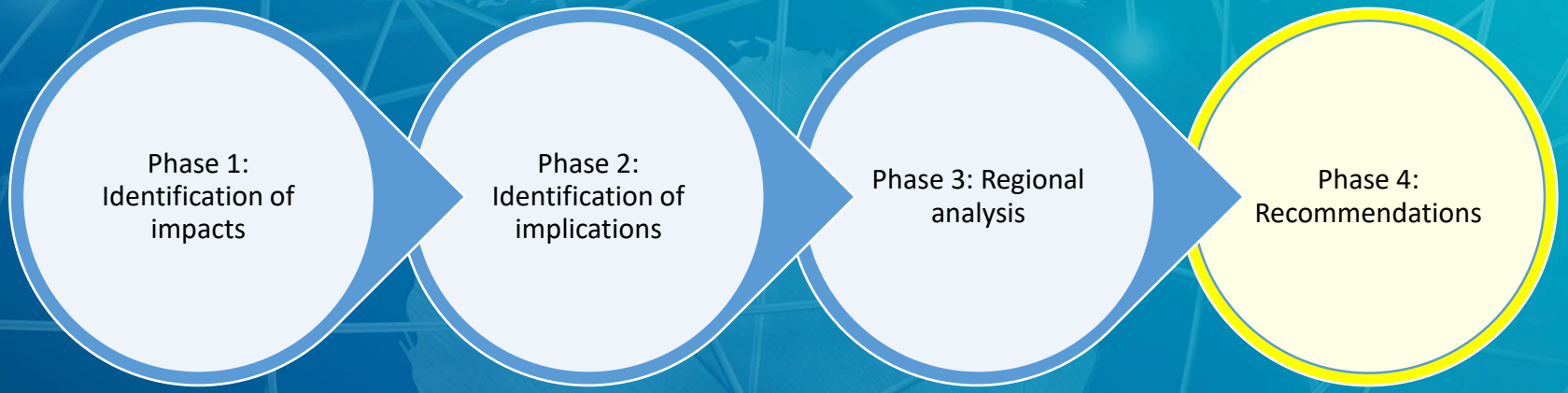


Source: LGNZ

WW treatment plant discharges



Summary and next steps



Guiding principles

- **Cooperation and collaboration** between councils, government, business, communities, lifeline services, Māori, researchers and other experts – incuding sharing of best practice in climate risk assessments, adaptation planning, stormwater and wastewater management and design.
- **Stewardship / kaitiakitanga and precaution** – including shifting planning and asset management focus from response-based action to preventive action; embedding water sensitive urban design approaches within council standards and developing upskilling and education initiatives around this.
- **Prioritise the most vulnerable**, and working with them to understand climate hazards that may affect them, and to develop response and adaptation strategies that are acceptable, effective and recognise the unique social/cultural/economic circumstances of each community
- **Long term, adaptive thinking and the development of adaptation pathways and plans**; consideration of a range of 'typologies' of adaptation options; Consideration and awareness of broader implications of insurance and un-insurability due to climate change; and securing funding sources to ensure appropriate levels of service can be maintained.
- **Prioritise actions with multiple benefits or which have 'low-regrets'** - identifying actions which meet other national/sectoral challenges such as freshwater quality, aging infrastructure, biodiversity or GHG reduction; considering nature-based systems and water-sensitive urban design principles.

Greta Thunberg

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Thankyou