# Water services climate risks and adaptation

## Water New Zealand Conference and Expo Workshop Summary

**Introduction**

The Water New Zealand conference and expo was held in Christchurch on 18-20 October 2022. As part of this conference the Water New Zealand Special Interest Group on Climate Change held a workshop focussed on climate change adaptation in the water sector. This workshop documented participant's perspectives on three questions in relation to specific components of three waters infrastructure:

1 What guidance/resources/case studies of action exist already?

2 What are the barriers to action?

3 What can be done to help us move forward? By WNZ, the Climate Change group, you, the government etc.

Six elements of the 3-waters infrastructure that were discussed were:

- Drinking water
- Stormwater networks
- Stormwater treatment
- Wastewater networks
- Wastewater treatment
- People and workplace

This document presents a summary of the ideas captured from the workshop. It can be read in conjunction with a supporting graphic, produced at the workshop and provided in Appendix A. The documented notes from the workshop are included in Appendix B.

**Acknowledgements**

Our thanks the Deep South Science Challenge for sponsoring this workshop, which has enabled development of this workshop summary. The workshop builds on the following work undertaken previously was used to provide a baseline of water infrastructure risks to build on:

- Water supply, people and workforce risks were based on those identified in the Water Services Association of Australia Climate Change Adaptation Guidelines
- Stormwater and wastewater were risks were based on those identified in the Deep South research report Stormwater, wastewater and climate change: Impacts on our economy, environment, culture and society

The Climate Change group is a special interest group of Water New Zealand. This summary of workshop discussions has been authored by committee member Katherine Cowper-Heays, Water and climate risk consultant and Tonkin and Taylor.



Tonkin & Taylor Ltd | 1 Fanshawe St, Auckland Central, Auckland 1010, New Zealand
PO Box 5271, Victoria Street West, Auckland 1142 P +64-9-355 6000 F +64-9-307 0265 E akl@tonkintaylor.co.nz

# 1 Climate change risks to stormwater, wastewater and water supply

Stormwater, wastewater and water supply systems provide a critical service to society. Their vulnerability to the impacts of climate change places the safety, health and sanitation of many communities at risk. The impacts of climate change on three-waters systems are numerous and can lead to wide ranging implications over changing timescales. Risks to three waters infrastructure may result in a range of impacts. Key climate impact themes for each of the three waters are summarised in Table 1.

Climate risks and impacts can occur on varying scales. Understanding risks to a single element or component is important to enable appropriate adaptation planning and responses. It is also relevant to consider how risks will arise across a connected system, and how these relate to wider operational considerations. In addition to this, the nature of three waters infrastructure is such that it tends to be embedded into the community that it serves, and as such, the wider context is relevant, particularly when considering adaptation responses.

**Table 1: Key climate change impacts on three waters infrastructure**

| Stormwater[1] | Wastewater | Water supply[2] |
|---|---|---|
| • Increased flooding of buildings and assets arising from higher peak flows, inundation from sea-level rise and raised groundwater levels<br>• Loss of land (including landslides) and damage to infrastructure arising from storm damage, temperature extremes, increased peak flows, asset failure, salinity exposure, groundwater level changes causing settlement and flotation and reduced flushing flows causing sedimentation.<br>• Deterioration of water quality arising from scour, bank/berm erosion resuspension of historical sediment, altered performance of water quality treatment devices, increased evaporation and dry out of vegetated systems, raised water temperatures and increased salinity exposure. | • Nuisance flooding, spills and odour arising from increased temperatures, changing user behaviour resulting in higher concentration flows and blockages, and waterlogging of on-site wastewater treatment plants.<br>• Water quality deterioration arising from increased uncontrolled wastewater discharges, increased infiltration, increased salinity of wastewater affecting the performance of wastewater treatment plants (WWTPs), behaviour changes resulting in higher concentration flows which may result in a deterioration in the quality of treated wastewater discharges.<br>• Damage to infrastructure arising from storm damage, overheating and increased wear of pumping stations, waterlogging, soil structure and ecological changes affecting the performance of on-site systems, temporary or permanent inundation, groundwater fluctuation causing ground settlement or flotation, and changing user behaviour causing increased concentration wastewater leading to corrosion, blockages and increased maintenance at the WWTPs. | • Reducing asset life or increasing operational complexity arising from extreme weather. For example, extreme rainfall may lead to larger and faster inflows with increased sediment loads, increasing temperature may change the nature of biological and chemical reactions during treatment, and increasing temperatures may decrease the quality of raw water inflows to water treatment plants by contributing to algal blooms.<br>• Limitations on water availability may arise due to drought and increasing frequency and length of peak demand periods during very hot days and extended dry periods.<br>• Reduced disinfection residuals in water distribution due to increasing temperature.<br>• Relocation or adaptation of assets may be required due to exposure to increasing coastal or fluvial flooding. |

[1] Hughes, J., Cowper-Heays, K., Olesson, E., Bell, R., & Stroombergen, A. (2019) Stormwater, wastewater and climate change: Impacts on our economy, culture and society. Deep South Science Challenge

[2] Water Services Association of Australia (2016) Climate Change Adaptation Guidelines. WSA 303 – 2016-v1.2

# 2 Climate adaptation in the water sector

The focus of the climate change adaptation workshop was on identifying necessary next steps in climate change adaptation in the water sector. This was achieved through presenting a baseline understanding on climate risks and impacts to three waters infrastructure, then using group discussion to identify existing guidance, resources and case studies that may support adaptation, discussing barriers to adaptation, and finally by gathering the perspectives of workshop participants on the appropriate next steps for climate change adaptation relating to water supply source, stormwater conveyance and treatment, wastewater networks and treatment, and people and workplaces within the water sector.

## 2.1 Water supply

When considering the adaptation of water supply infrastructure to climate change, available resources relate primarily to case studies or location specific assessments (e.g. 'Minimum flow recommendations for the Wellington region' by GWRC), as well as downscaled climate projection data that is useful to inform all types of risk assessment and adaptation planning (NIWA projection NZ SeaRise, HIRDS v4, IPCC). Hydrological monitoring data and district/regional plans and design specifications are also relevant and useful supporting information, however these tend to differ in granularity and detail between councils.

A lack of data, high costs, public perceptions and insufficient policy and guidance are some of the main barriers identified relating to action against climate change adaptation for drinking water. As climate change places increasing pressure on water availability, many of these issues will become critical. Key actions identified that may support climate change adaptation include:

- Guidance and widespread adoption of the principles of Te Mana o Te Wai.
- Development of New Zealand specific guidance for drinking water.
- Review of water allocation practices as existing approaches to water source allocation may be inadequate to manage complex and competing demands.
- Incentivisation for wastewater reuse, greywater recycling and rainwater harvesting in response to increasing water scarcity. This may require a change of public perceptions and a drive towards a shift in values in relation to water reuse.

## 2.2 Stormwater

As with water supply, national scale climate guidance and resources are available to support stormwater adaptation planning, including the National Adaptation Plan and climate projection data. Infrastructure technical specifications such as council codes of practice are the primary source of design guidance.

### 2.2.1 Conveyance

Barriers to climate adaptation of stormwater conveyance infrastructure include a potential prioritisation of water and wastewater over stormwater when there are low resources. The stormwater community also lacks clear leadership, which is compounded by a perceived lack of integration across council groups. Adaptation is further prevented by entrenched values relating to traditional design methods (e.g. pipes over open channels), ongoing development in flood prone areas, and insufficient value and recognition placed on the importance of maintaining suitable floodplains and overland flow paths.

A key action identified to support climate change adaptation of stormwater conveyance is the development of nationally consistent standards and guidance for stormwater. This would include

guidance on flood modelling, hazard mapping, planning rules (building height, overland flow), and guidance on water retention to mitigate flood.

To be successful, the industry needs multidisciplinary collaboration between engineers, planners, ecologists, iwi, community, etc. A step-by-step approach could be taken to incrementally drive adaptation.

### 2.2.2 Stormwater treatment

Increasing climate hazards will place treatment devices under increased extremes and stress, highlighting the importance of well-designed, properly maintained and appropriately located structures which account for growth and can respond to changes in intensity, rainfall variability and temperature etc. Barriers to adaptation include limitations on funding, insufficient data, and increasing pressure from growth. A misalignment with current practices with Te Mana o Te Wai is likely to get worse unless action is taken to understand and incorporate it into stormwater management planning and practices.

A key activity to support adaptation of stormwater treatment is to develop an understanding of climate risks across all locations. This can be used to support prioritisation of action and develop appropriate and site specific adaptation strategies. This requires good baseline data (e.g. treatment device locations etc), which is not available in many locations at present. Other supporting actions include clear legislation on ownership and maintenance, national policy/standards on stormwater management, strengthened land-use planning controls to manage flood risk, and investment in community engagement and education to develop a community connection with water.

## 2.3 Wastewater

National data and guidance relevant to adaptation of the wastewater sector includes climate projections, LAWA data, case studies, and impact and implications research completed under the Deep South Challenge. Local/council rainfall data, bore monitoring data, and codes of practice are also relevant.

Key tools available for the wastewater sector include the Infiltration and inflow control manual (Water NZ), Australian risk-based guide for overflow (in progress), community engagement and optioneering tools, and treatment plant models for future temperature rises.

### 2.3.1 Wastewater conveyence

Climate change may place increasing pressure on wastewater network service delivery as the level of service provided during wet weather flows service may decline, particularly for gravity systems that discharge to the coast. This issue is likely to be compounded as community tolerance for overflows continues to decline. Barrers to climate change adaptation of wastewater networks include limitations on regional plan rules, cost, limitations on staff capacity, infill and growth, and uncertainty.

To enable the water sector to adapt to climate change, customer education may be useful to inform the community on the level of service, occurrence of overflows, and prevention of blockages. The separation of wastewater from greywater to allow reuse, increased attention to inflow and infiltration, and incorporating pressure/vacuum sewers to wastewater networks could also be incorporated. Risk assessments were identified as a useful tool to support decision-making on which networks to prioritise.

### 2.3.2 Wastewater treatment

Adaptation of wastewater treatment is limited at present by the minimal guidance and case studies available. Adaptation is further complicated by limitations on funding and costs, a lack of appropriate locations for networks, and negative community perceptions of treatment plants.

To enable wastewater treatment plants to adapt, investment in technology is required, particularly exploration into solutions to manage network storage to protect WWTPs. Increasing the practice of reuse at source as well as at the WWTP is another key action that will reduce inflows and reduce pressure on water supply networks. These key actions would be supported by strengthened climate change risks assessments for asset owners and operators, improved groundwater predictions, and changes to planning controls relating to an increasing need for flexibility under extreme weather conditions.

## 2.4 People and workplace

People and workplaces in the water sector work under a range of pressures. These include time and cost pressures, static standards and guidance under rapidly changing science, and competing timescales for decision-making, where 3-year term political systems are not compatible with the planning necessary to account for climate change (decades and centuries). The following key themes that would support the people and workplaces to adapt to these pressures were discussed during the workshop:

- Development of diversity and improved regard for wellbeing across the sector,
- Changing mindsets, for example shifting from 'doom and gloom' to a solution focused positive framework,
- Knowledge management and succession planning,
- Upskilling on technical knowledge, climate change science and Te Mana o Te Wai, including through building more diverse teams,
- Education, communication and knowledge sharing. This includes storytelling about change, community outreach, and disseminating information within organisations, across the sector, and out to the community.

# 3 Conclusions

These discussions identified numerous actions, some of which are relevant across many facets of the water sector. Key actions include:

- Improved uptake of guidance and training on the inclusion of the principles of Te Mana o Te Wai,
- Further development of nationally consistent standards and guidance;
- Improved understanding of climate change risks at appropriate granularity to inform adaptation planning.

This workshop will help the Water New Zealand Special Interest Group on Climate Change to identify actions that it can take to support the water sector to adapt to climate change.

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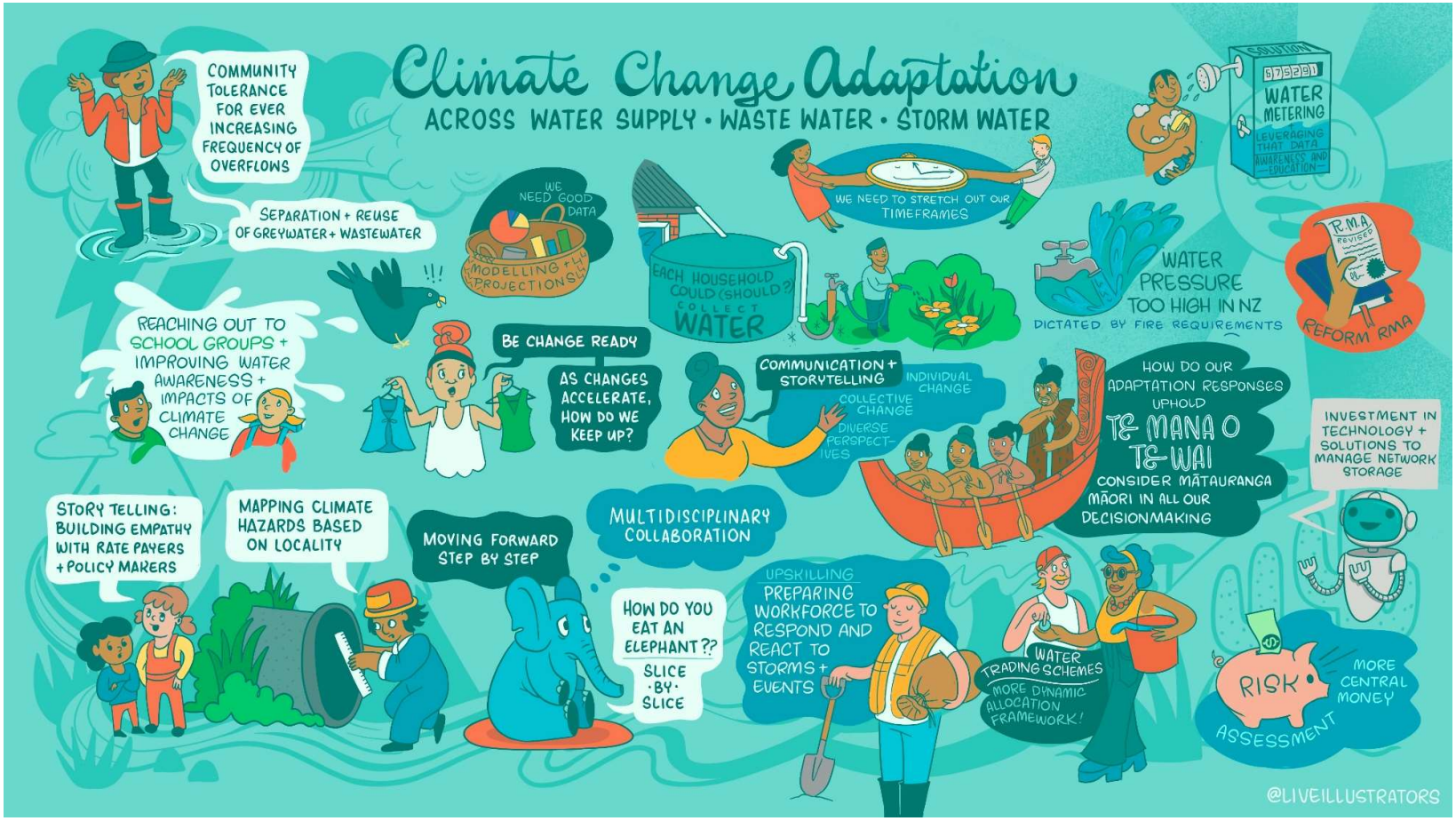
# Appendix A Workshop image







Tonkin & Taylor Ltd | 1 Fanshawe St, Auckland Central, Auckland 1010, New Zealand
PO Box 5271, Victoria Street West, Auckland 1142 P +64-9-355 6000 F +64-9-307 0265 E akl@tonkintaylor.co.nz

## Appendix B Workshop notes

Table 1 provides the outputs from the workshops. Key adaption actions that have been chosen for further consideration by the Special Interest Group are highlighted in bold.



Tonkin & Taylor Ltd | 1 Fanshawe St, Auckland Central, Auckland 1010, New Zealand
PO Box 5271, Victoria Street West, Auckland 1142 P +64-9-355 6000 F +64-9-307 0265 E akl@tonkintaylor.co.nz

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**Table 1: Workshop outputs**

| Three Waters Infrastructure | Guidance / Resources | Barriers | Adaptation |
|---|---|---|---|
| Drinking water source | • Drought vulnerability framework UK water industry research<br>• Regional Plans. Allocations controlled / dictated by NES / NPS<br>• Climate change projection data - NIWA<br>• NIWA: Projection data including sea level rise, HIRDS v4, coastal aquifers. IPCC<br>• NIWA national tool climate change on stream flows<br>• Auckland's catchment modelling. Watercare. Whangarei SW<br>• Case study: Greater wellington water allocation and minimal flows. Changing standards | • Everyone still thinks water is free<br>• Opinion and biases i.e. distrust of reuse<br>• Cost: Cheapest / easiest sources have already been tapped into<br>• Lack of data: hydrology availability, groundwater<br>• Over-simplified / un-sophisticated approach to allocation.<br>• Reliance on mixed use - irrigation which leads to competition<br>• Aquifer sources hard to understand / model<br>• Misalignment with Te Mana o Te Wai<br>• Preparedness for current issues i.e. drought / flood / etc.<br>• How will water schemes be managed?<br>• Ways to increase nutrient control and monitoring | • **Solution: Taking a proper Te mana o te wai approach**<br>• **NZ specific guidance**<br>• RMA reform<br>• Water-metering and leveraging that data as well as awareness and education<br>• Sharing information / learning / case studies e.g. between councils. Source information shared e.g. at a national risk assessment level<br>• Water trading schemes or a more dynamic allocation framework<br>• A centralised group source of expertise doing impact analysis that a council can then use<br>• Generally lifting the burden off councils<br>• **Incentivisation for reuse at source and at WWTP**<br>• **Shift in values i.e. recycling grey water**<br>• Start thinking about how each household can start collecting water BUT with clear guidance / allocation on what to use it for (not necessarily potable)<br>• Water pressure too high in NZ. Dictated by fire safety requirement |



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| Three Waters Infrastructure | Guidance / Resources | Barriers | Adaptation |
|---|---|---|---|
| Stormwater conveyance | **Guidance/resources:**<br>• National Adaptation Plan<br>• Infrastructure technical specifications. For example, council codes of practice<br>• NIWA rainfall climate guidance<br>• LGA level of service responsibilities between TA's and Regional Councils<br>**Other considerations:**<br>• Risks: Contamination caused by overflows<br>• Challenge: Legacy development does not formalise secondary flow paths<br>• Challenge: Sea level rise reduces driving head<br>• Challenge: Increased groundwater levels result in pipe floatation and loss of capacity<br>• Challenge: Longer, more intense dry periods lead to a decrease in permeability<br>• Challenge: Increase rainfall intensity (more extreme storm events) increase runoff and quality of flow to conveyance | • Water and wastewater tend to be prioritised over stormwater when there are less resources (capital and human). i.e. stormwater is the 'poor cousin'.<br>• Wide range in timeframes of interest (e.g. from 5 years to 300 years)<br>• The industry is familiar with the status quo. This is not necessarily enough in the face of increasing change and uncertainty.<br>• Lack of leadership to make the needed change<br>• Lack of community willingness to 'live with flooding'<br>• Lack of integration across council groups. Parks/Infrastructure/Development/etc.<br>• Development community slow to adopt technology i.e. Smart Tanks<br>• De-valuing land subject to flooding and OLFP when it actually is critical to support other developments<br>• Reluctant to change the way things were done in the past by decision makers because they cover lot of responsibility<br>• Reliance on pipes rather than 'open' systems | • Step by step to move us forward.<br>• **National standards and guidance:**<br>– Consistent approaches across New Zealand and across three water networks. All three will be impacted by climate impacts (technical details will differ) but all three waters will need to adapt / relocate in a community.<br>– **Consistent standards and ways to do things. Flood modelling, hazard mapping, planning rules (building height, overland flow), and guidance on water retention to mitigate flood.**<br>– National Policy Statement for flood hazard management<br>– Stop development / growth in hazardous high-risk areas<br>• Recognition of long-term charge and being change ready. No longer static environment as change accelerates how do we keep up<br>• Recognise stormwater as a resource<br>• Multidisciplinary collaboration: Engineers, planners, ecologists, iwi, community etc. |
| Stormwater treatment | • Design standards rarely change<br>• Design standards differ across the country<br>• Risk: desire to stop maintaining grass | • Protection of systems<br>• Location of stormwater treatment devices | • Need good baseline data on treatment device locations etc. Not always done by different asset managers. |

| Three Waters Infrastructure | Guidance / Resources | Barriers | Adaptation |
|---|---|---|---|
| | | • Importance of well-designed structures to respond to intensity etc.<br>• Maintenance of attenuation system<br>• Lack of landscape integration<br>• Cost on rate payers<br>• Poor data on stormwater devices. How much resources should be allocated. Planning on future scenarios<br>• Increasing negative impact on Te Mana o Te Wai<br>• Te Mana O Te Wai needs to be understood and incorporated otherwise it's going to get worse<br>• Implementation plan: shift, protect<br>• Growth is another barrier<br>• Obstruction of overland flow paths – these need to be kept clear to convey flow under all intensity rainfalls. | • **Understanding risks and mitigation prioritisation**<br>– **Need mapping of climate hazards and risk to assets (where it is not done already). Assessments should be based on locality, frequency, impacts, and costs associated. This information can be used to prioritise which systems need to be addressed first.**<br>• Need legislation to clarify management of assets: who owns them / who maintains them.<br>• Government policy / standard for stormwater management.<br>• Land-use planning controls to manage flood risk.<br>– Low-lying flood prone land should be recognised as being valuable because it enables development in other areas by service a flood management purpose.<br>– Need to proactively set aside land for attenuation<br>– Dependant on developer and Council appetite to set aside land<br>• Mini ecosystems via wetland (carbon sink) opportunity for multipurpose land use.<br>• Stormwater treatment devices help community connection with water. Placement of sign boards at wetlands etc can help to raise community awareness and engagement.<br>• Storytelling: building empathy with ratepayers / policy makers etc. |
| Wastewater Conveyance | • NIWA climate information portal / deep south | • Balancing over-design with mitigation<br>• Infill and growth putting extra pressure on networks | • Use risk assessment to inform prioritisation<br>• Customer education about overflows level of service, blockage, and when overflows occurred |

| Three Waters Infrastructure | Guidance / Resources | Barriers | Adaptation |
|---|---|---|---|
| | • Rainfall data & flow monitoring (some areas)<br>• Council code of practice<br>• I&I standards - Water NZ<br>• Overflow guide - Australia risk-based guide (in progress)<br>• Land and water information portal | • Managing uncertainty<br>• Level of service for wet weather flows<br>• Regional plan rules<br>• Costs vs willingness to pay<br>• Prioritisation across WSE. Can't afford or haven't enough skills / capability to action all communities at once<br>• Gravity systems feed to the coast<br>• Community tolerance for ever increasing number / frequency of overflows | • Future vision for our wastewater systems<br>• Separation and reuse of greywater and wastewater<br>• Change of level of service in response to climate change – may require increased funding<br>• Circular economy<br>• Integrated water approach - decentralised.<br>• Increased attention to inflow and infiltration |
| Wastewater treatment | • NIWA modelling of future rainfalls<br>• Community engagement tools<br>• Monitoring data from shallow groundwater bores<br>• Optioneering tools<br>• Sea level rise predictions<br>• Treatment plant models for future temperature rises | • Not enough guidance and case studies<br>• Centralised vs. decentralised<br>• Network vs treatment upgrade costs / complexity<br>• Funding sources<br>• Limited locations for WWTPs networks / discharges. May need to adapt low lying ponds with alternative treatment approaches. NBR alternative to ponds. Barriers include:<br>– Higher tech results in higher cost,<br>– Public perceptions to new approaches<br>– Increasing complexity | • More risk assessment work for assets owners and operators. This needs increased funding from central government for risk assessment and preventative work.<br>• **Incentivisation for reuse at source and at WWTP**<br>• **Investment in technology / solutions to manage network storage to protect WWTPs**<br>• Improved groundwater predictions<br>• Planning for peak weather conditions and consent impacts / flexibility |

Note:

| Three Waters Infrastructure | Barriers | Adaptation | |
|---|---|---|---|
| People and workplace | • Generational difference in perception of the need to change / grow / learn / adapt<br>• Time and cost pressures in a very busy industry lacking resources<br>• Standards are not dynamic and flexible to allow adaptation. They are aged and out of date.<br>• Fear of the unknown and lack of understanding<br>• Difficulty in deciding what to prioritise with limited resources and competing crises<br>• Lack of general awareness that the current practices/direction is not sustainable<br>• Competing timescales for decision-making. 3-year term political systems are not compatible with making 100-year plans<br>• Climate impacts and our response are all emotionally charged. Connections to whenua and whare and environment at risk will be fraught<br>• Adaptation is trigger based causes uncertainty for people and programmes<br>• How to ensure "essential service people" are free to deliver things in a disaster | • Diversity and wellbeing<br>– Diverse teams required to solve problems Collaboration: diversity and different group coordination<br>– It's the people: we need to look after each other. Post Covid-19 we have appreciated this more<br>– Fatigue management<br>– Need to consider emotional and psychological effects of damage (not just physical)<br>– Data collection including repairing wellbeing / impacts so that we can understand impacts from climate change incidents<br>• Changing mindsets:<br>– Need to learn to look at the world differently<br>– Develop openness of staff to new tech and make it safe to learn and change.<br>– Shift focus from doom and gloom to solutions focused positive framework<br>• Knowledge management succession planning | • Upskilling<br>– **Upskilling people and creating diversity of ideas. Including learning technical skills, learning climate change, and learning Māori cultural values. Balancing upskilling fundamentals**<br>– Making ever increasing climate risk response part of the CDEM planning and training agenda (not just EQ, flood and now pandemics)<br>– Preparing workforce to respond and react to storm events etc.<br>– Upskilling staff in new fields such as CC and traditional engineering<br>– Raise the bar for the operators' qualifications<br>– Need to increase stormwater capability within council<br>• Education and communication<br>– **Communication and storytelling e.g. about individual change, collective change, and diversity of perspective**<br>– Spread of knowledge including dissemination of info (internal and external)<br>– Education on how to adopt a more adaptive planning approach<br>– Increasing community awareness of Te Mana o Te Wai<br>– Reaching out to school groups and improving awareness of water and impacts of climate change (from kids to their parents / adults) |

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