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Improving the resilience of water systems

Louise Ellis, Associate

November 2019

Objectives

1. Understand the definition of resilience.

2. Understand the shocks and stresses affecting the water system.

3. Explore methodologies that have been used by cities and utilities to improve their water resilience.

4. Explore case studies of implemented resilience programmes.

5. Understand the common resilience challenges that cities and utilities experience.

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Why is water resilience important?

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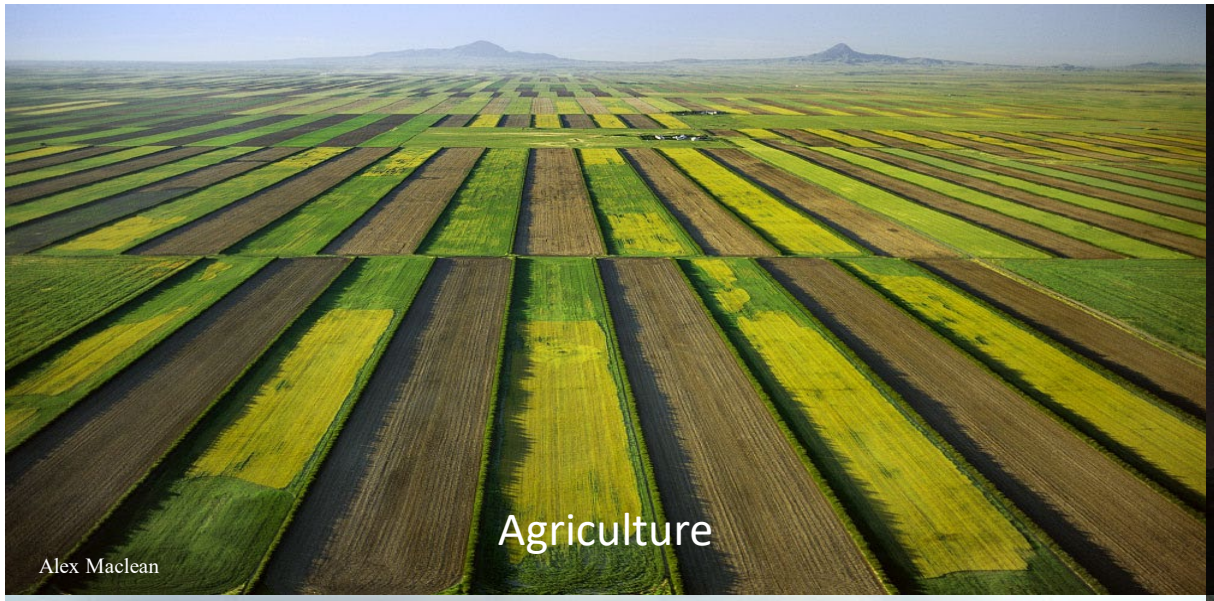
water is vital

Photo: Edward Burtynsky

Water is essential to the resilience of human and environmental systems



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1 in 4

large cities are already facing water stress

Global water consumption has

doubled every 20 years.

That's twice the rate of population growth.[11]

+55%

Water demand increase by 2050

Lost water through leaks or unbilled usage in 2013:

30%

Average American city

~53%

New Delhi

38%

Most developing nations

Many Pacific Island nations are

less than 5m above sea level

thousands of inhabitants are at risk

By 2030, If efficiency does not improve, worldwide water demand will outstrip supply by[10]

40%

It is estimated that between

1.6 and 2.4 billion

people live in river basins that experience water scarcity.[4]

3.2 million m³

The amount of water the 100 largest cities in the world transfer approximately 5,700km through artificial channels per day.[2]

Change in Precipitation by the end of 21st Century

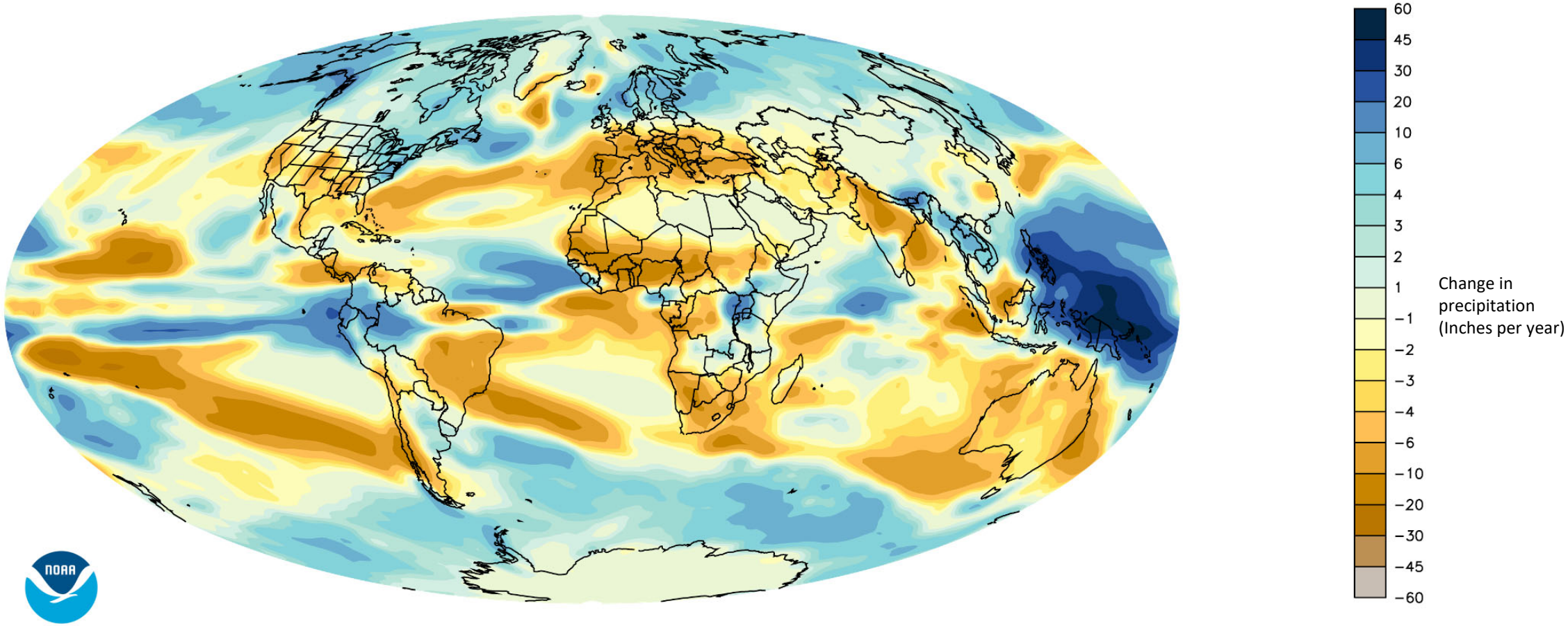

Image: Modified from NOAA GFDL CM2.1 model in conjunction with a high-emissions scenario, 2014

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Regulatory drivers

America's Water Infrastructure Act (AWIA) 2018

Water Act 2014

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What do we mean by resilience?

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*The **capacity of cities** (individuals, communities, institutions, businesses and systems) **to survive, adapt, and thrive** no matter what kinds of chronic **stresses** and acute **shocks** they experience*

City Resilience: Rockefeller Foundation, 2013

*Resilience is the **ability to cope** with, and **recover from**, **disruption**, and **anticipate trends and variability** in order to **maintain services** for **people** and **protect the natural environment**, now and in the future.*

Ofwat 2015

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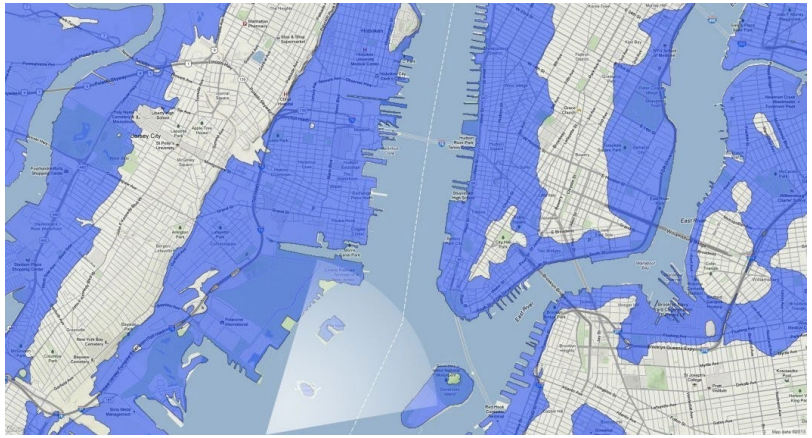
Resilience

- Uncertainty
- Low likelihood, high consequence shocks or long-term chronic stresses
- System-wide or multi-system impacts

5 feet sea level rise

12 feet sea level rise



25 feet sea level rise

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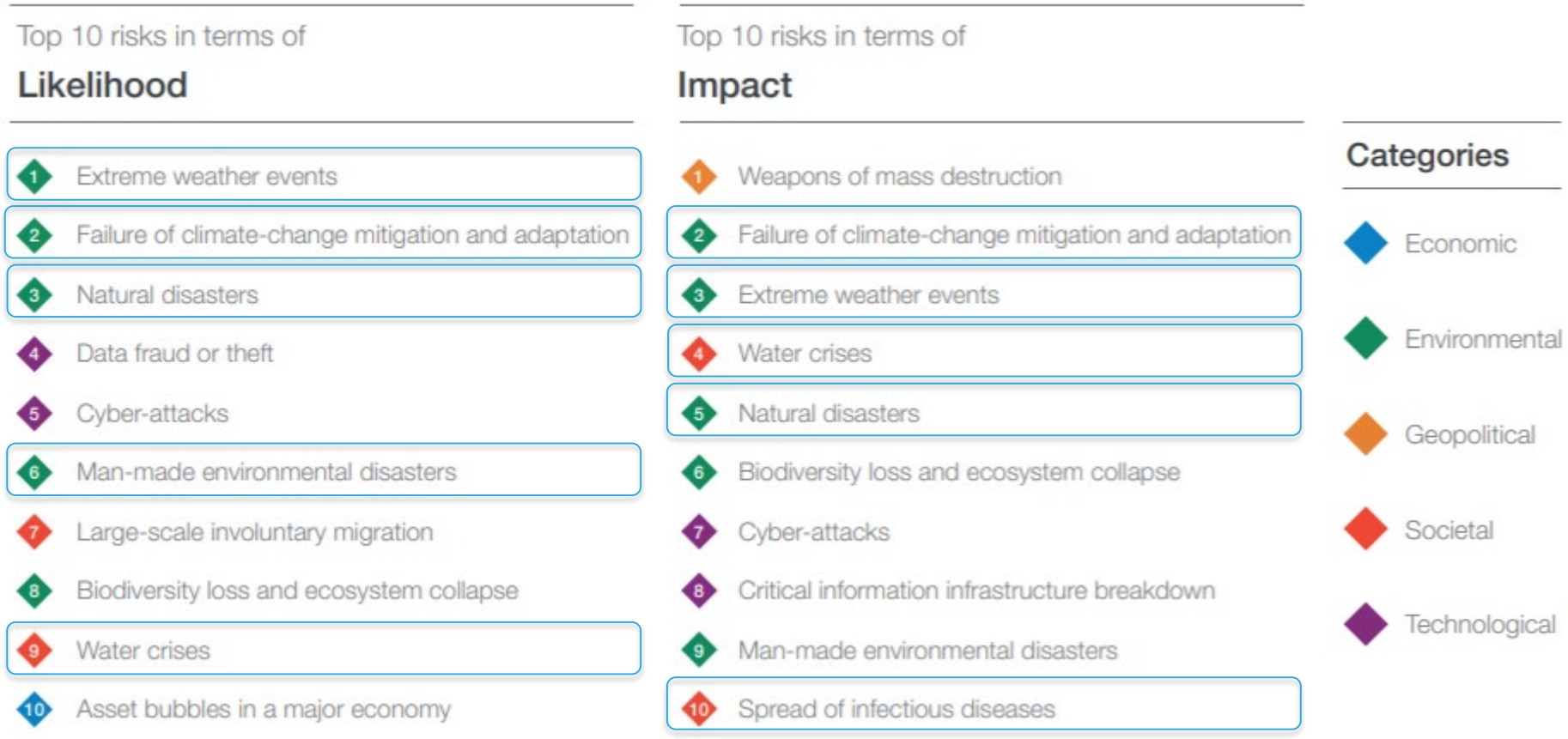
World Economic Forum 2019

Risk landscape



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Shock: Flooding
Stress: Climate change


Shock: Drought
Stress: Climate Change


Shock: Asset failure
Stress: Ageing infrastructure

Shock: Civil Unrest

Stress: Technological change

Stress: Demographic change

Stress: Recession

Stress: Macro-Industrial Change

Resilience Tools and Approaches

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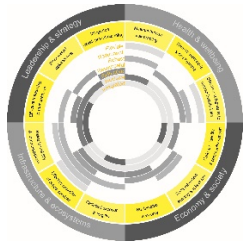
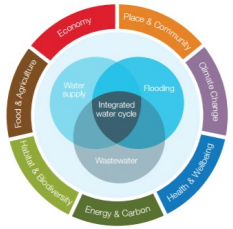
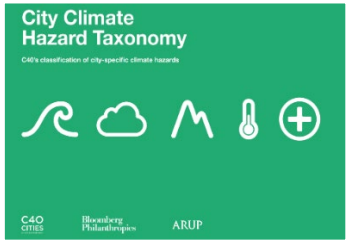
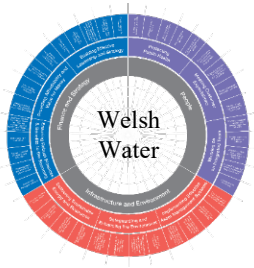
Timeline of Resilience Tools and Approaches

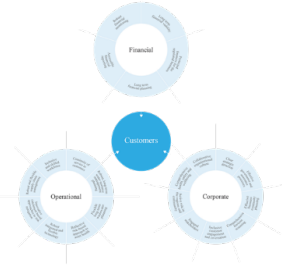
2012 2013 2014 2015 2016 2017 2018 2019

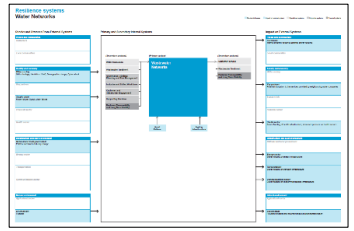












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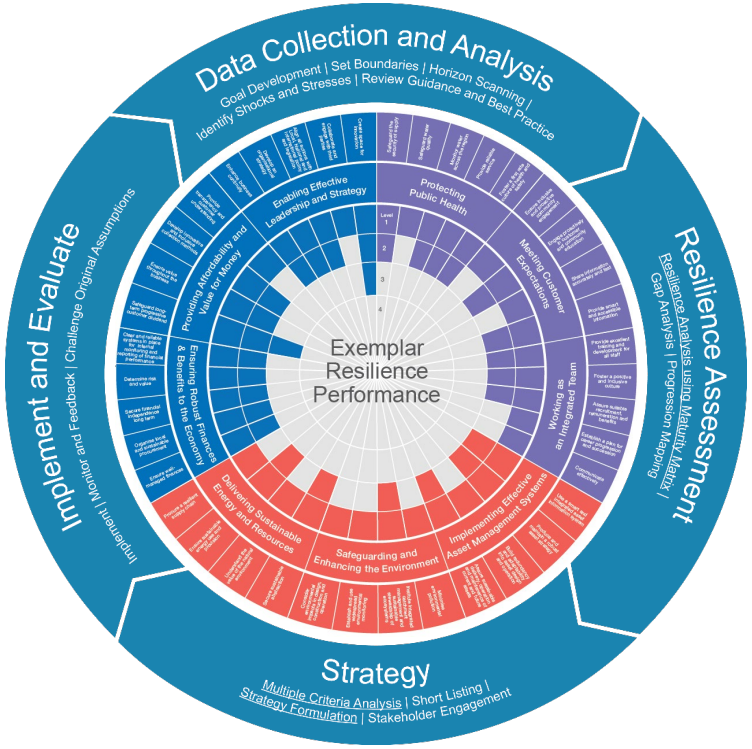
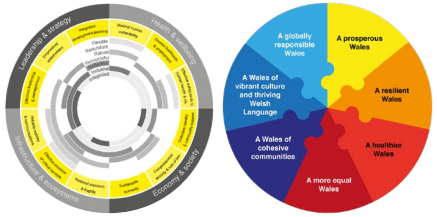
Welsh Water Resilience Framework and W2050





Review emerging legislation and guidance and global resilience best practice

Work with Cardiff University to horizon scan for future shocks and stresses

Develop exemplar resilience framework

Apply framework to Welsh Water

Development of Welsh Water 2050 for consultation

Public and stakeholder consultation

Update of Welsh Water 2050

Development PR19 Business Plan

Benefits for 3.1 million customers and the environment

MCA AWARDS 2017

Winner in the Finance and Risk Category

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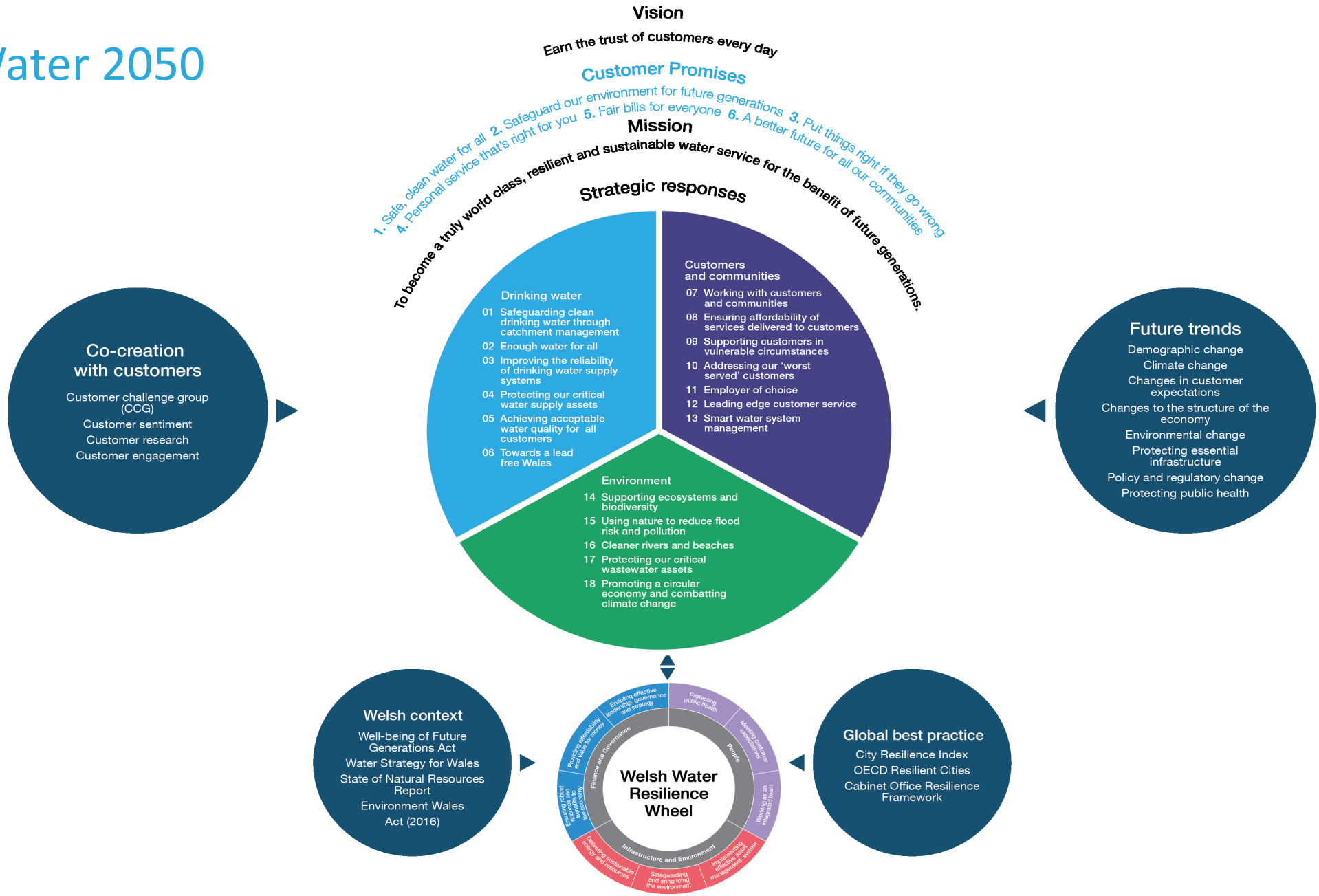
Welsh Water 2050



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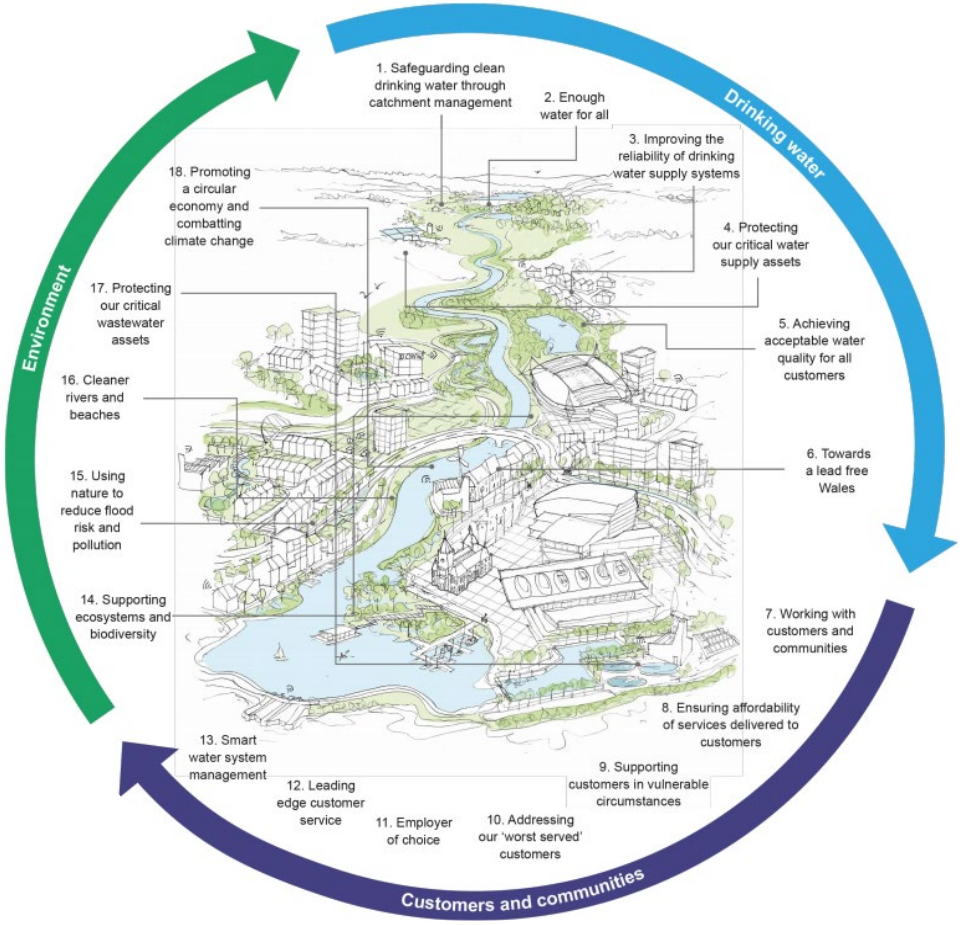
Benefits for Customers and Environment

Represents investment of £4.5 - 9bn over next 30 years



Safeguarding clean drinking water through catchment management

- Improved protection of raw water quality for between 1.1 million and 2.6 million customers
- Wider benefits for communities and the environment e.g. improved biodiversity, environmental stewardship and recreation opportunities

Improving the reliability of drinking water supply systems

- Create a resilience grid system that allows greater flexibility to supply 1.2 million customers
- Reduce the number of customers that are reliant on a single source of supply from 340,000 to 22,000

Working with customers and communities

- Our customers will play an increased role in shaping our work and we will encourage our customers to take part in collaborating and co-creating our strategies and projects

Ensuring affordability of services delivered to customers

- Continue to deliver water services to customers that are affordable for households

Cleaner rivers and beaches

- Make our contribution to achieve 'good' status amongst all rivers constituting between 1,000 and 1,500 km of rivers in Wales

Promoting a circular economy and combatting climate change

- By being energy neutral, we will have reduced our carbon emissions by over 80%
- increase our deployment of energy efficient treatment processes and assets

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Resilience in the Round

Dŵr Cymru Welsh Water

SEVERN TRENT WATER

Affinity Water

United Utilities helping life flow smoothly

Thames Water

love every drop anglianwater

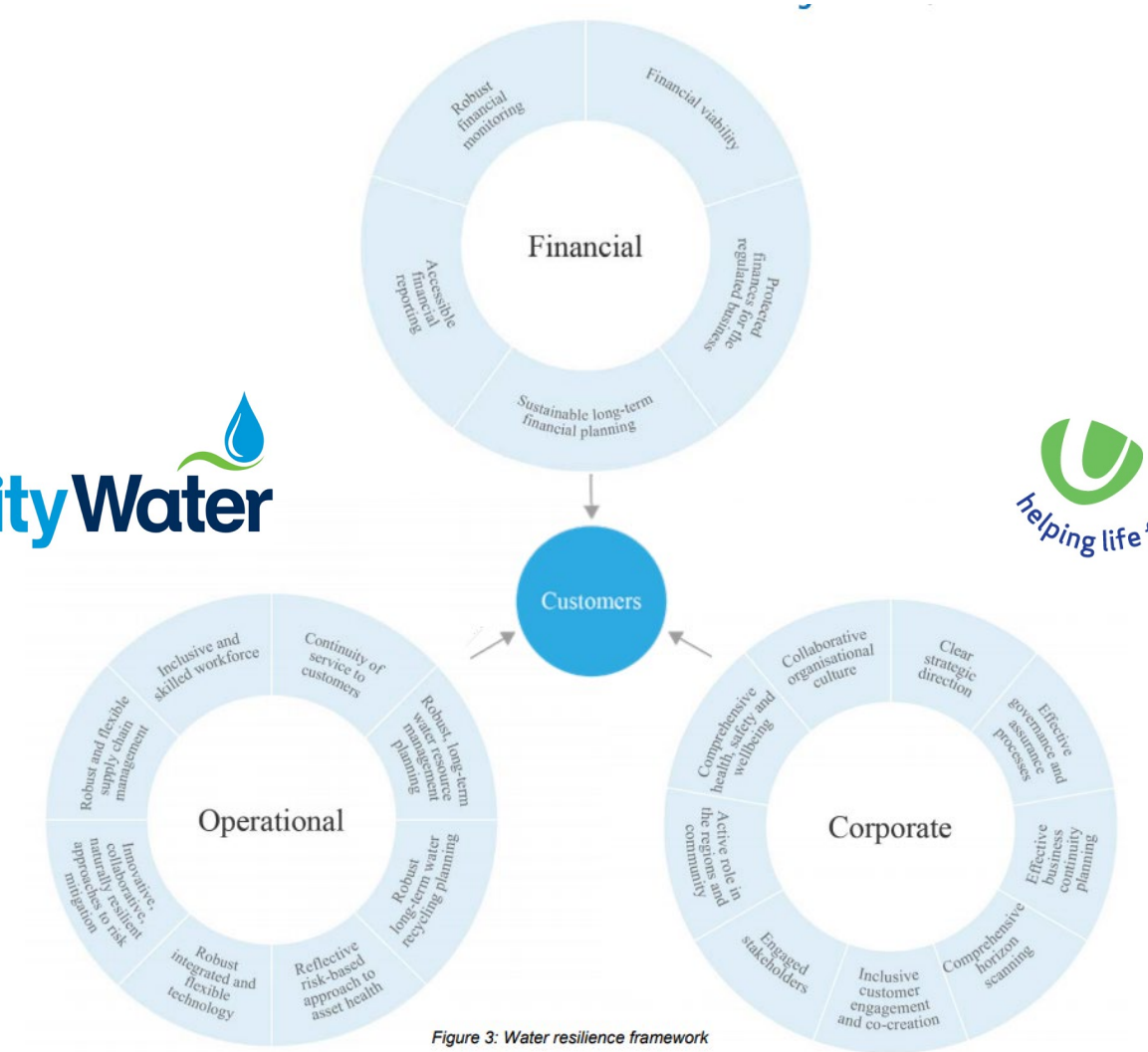

Figure 3: Water resilience framework

Serving 41 million customers in the UK

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Resilience in the Round

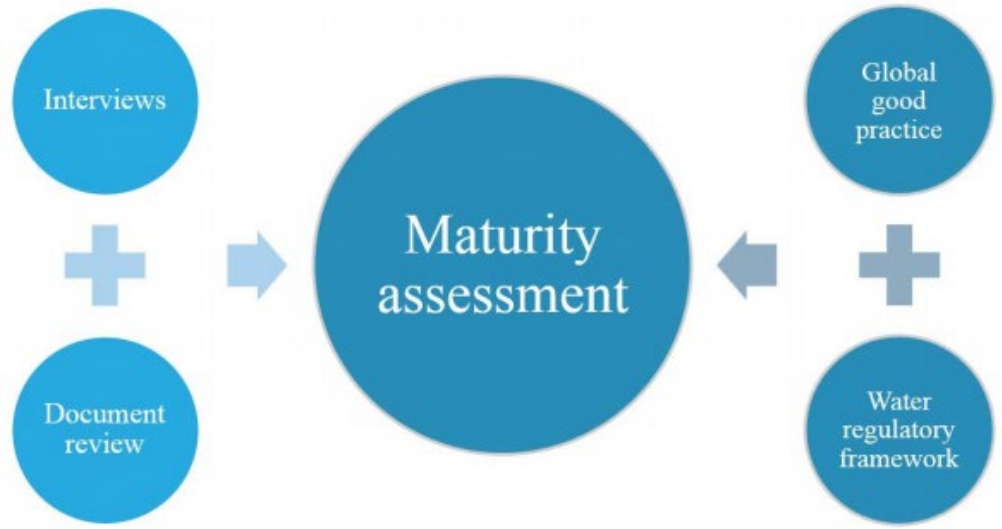

Figure 4: Maturity assessment approach

Table 5: Definition of the maturity assessment scoring scale

Level 5: Leading	The company has a best practice approach to this goal with cutting edge actions and responses currently in progress. There is significant horizon scanning for future changes and clear methods to including these within plans and strategies. Regular reviews and updates are part of business as usual.
Level 4: Response actioned	The company has created a response and actions to meet this goal which is being applied in practice across the company. The company is focused on proactive actions to prevent issues before they arise.
Level 3: Response developed	The company set a clear goal around this and has developed a response. This response has yet to be widely actioned, though some pilots may have been undertaken.
Level 2: Aware	The company is aware of the need for this goal but has not yet been formally adopted into process, plans, strategies and operational activities. There has been very limited response to these gaps. In general the company reacts only to issues that arise as they arise
Level 1: Unaware	The company has not determined this as a goal. There are significant gaps in understanding, processes, plans, strategies and operational activities to achieve this goal.

Maturity Summary	1 Unaware	2 Aware	3 Response developed	4 Response actioned	5 Leading
Water resource management planning and drought planning has been undertaken for the long-term and integrated into business planning to ensure that the company can meet their supply obligations and facilitate sustainable growth. Plans are produced collaboratively with the EA and regional planning groups to ensure best value for customers with respect to cross-company, regional and national supply options. The approach looks at a full range of hazards based on a robust evidence base. Water resource management planning looks beyond the statutory 25 years into the future and develops adaptive pathways for delivering in the long-term.	Current and Ongoing Activities				
	Planned for AMP7 and beyond				

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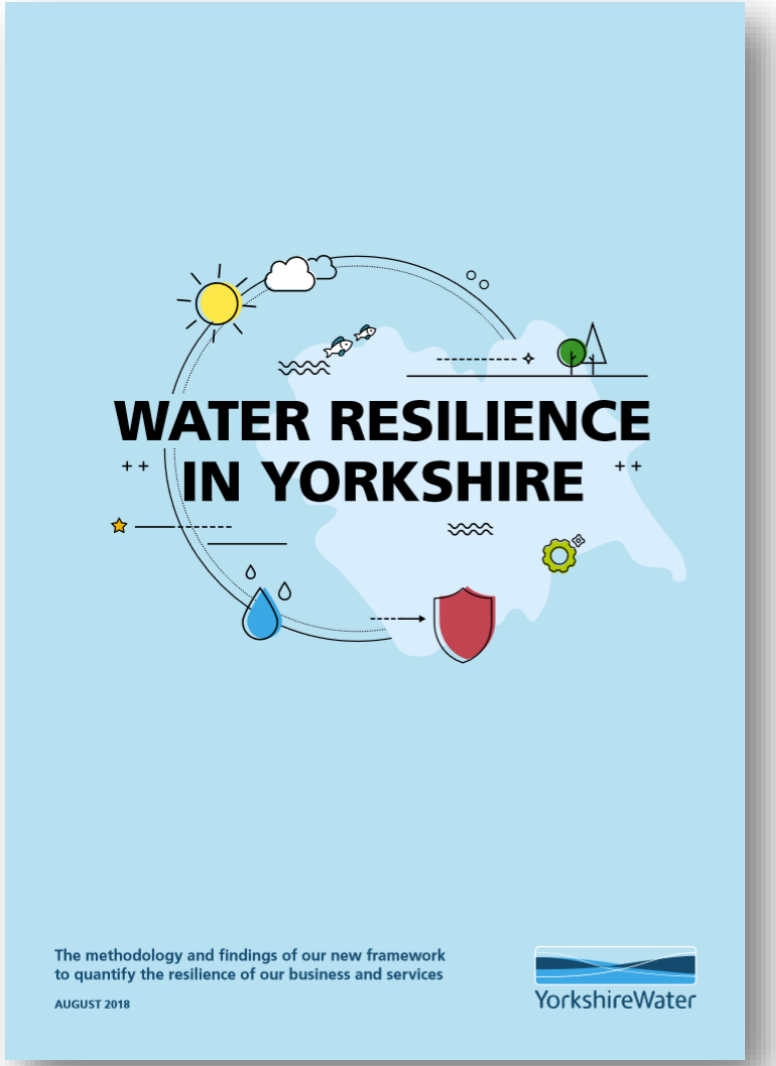
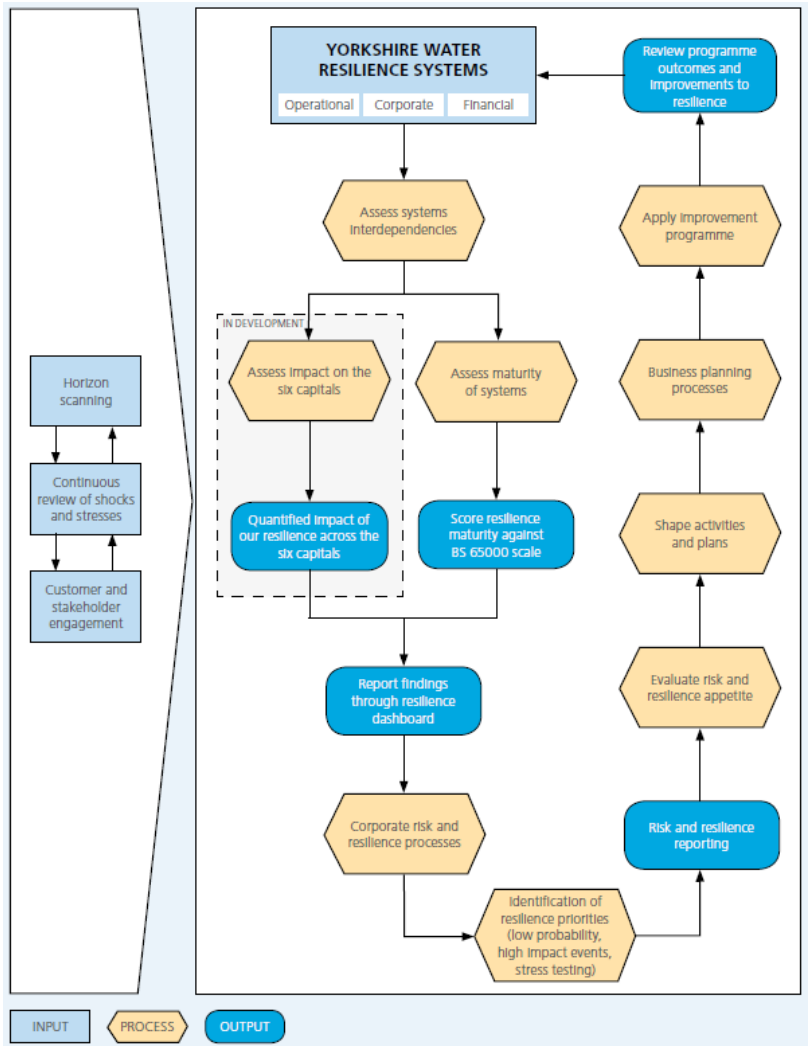
Yorkshire Water Systems Resilience Assessment





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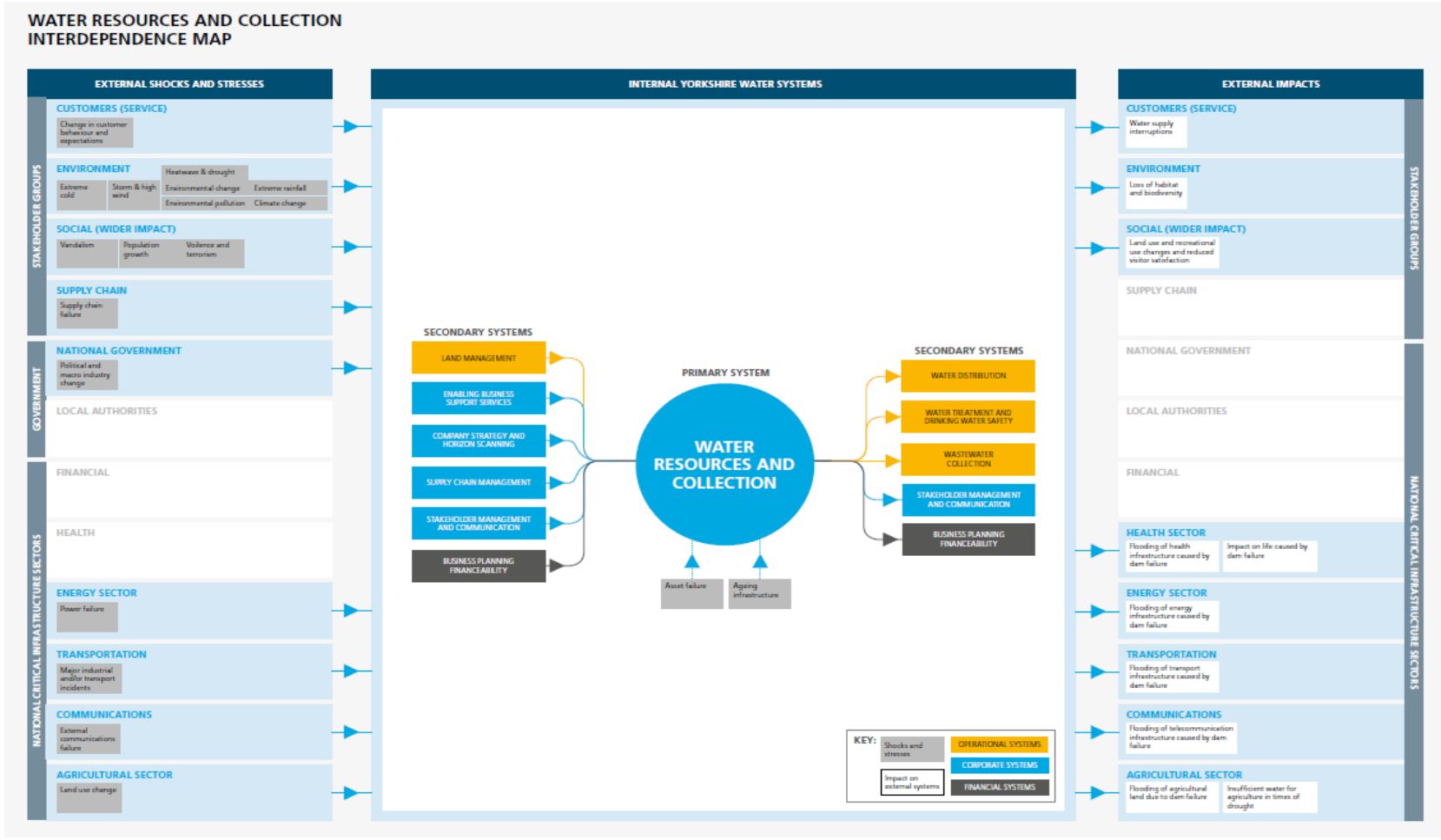
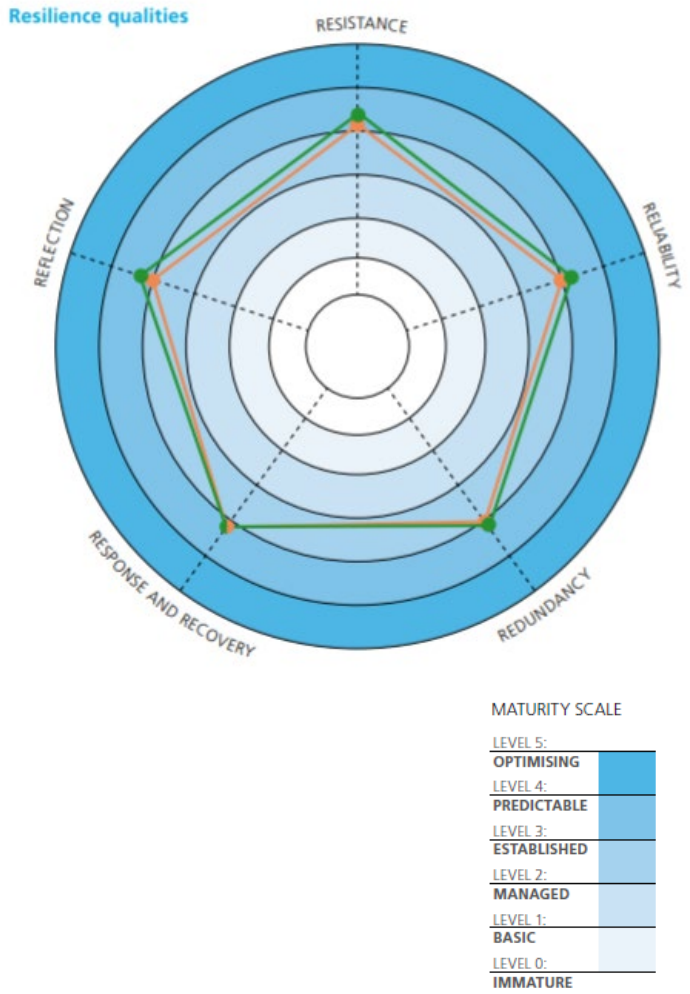
Yorkshire Water Systems Resilience Assessment





YorkshireWater

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City Water Resilience Approach

Objective

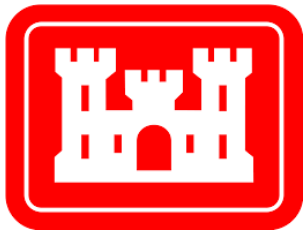
An approach that allows a city to:

- Develop a **collective understanding of their water system** and the shocks and stresses they face;

- **Diagnose their water resilience vulnerabilities**, and

- Develop a **collective action plan** to improve their urban water resilience and support the user through implementation, monitoring and evaluation.

There are a large number of stakeholders involved in the water cycle…



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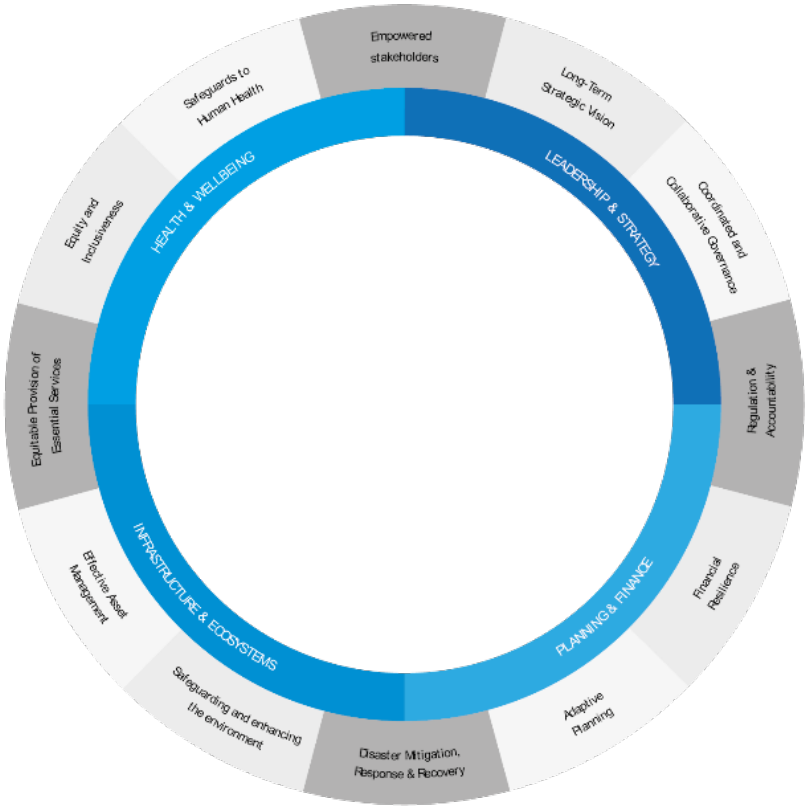
Principles of the City Water Resilience Approach

Inclusive and transparent	Brings together different perspectives from water and city stakeholders and encourages collective action
Systems-based	Takes account of inter-dependencies with other systems
Holistic	Includes leadership and strategy, planning and finance, infrastructure and ecosystems and personal, household and community resilience
Action-oriented	Encourages the ownership, development and progression of actions to improve water resilience
Scalable and global	Scalable from towns through to mega cities and applicable to a global context



A Collaborative Approach

Supported by:

The ROCKEFELLER FOUNDATION

THE RESILIENCE SHIFT

Project Partners:

ARUP

SIWI

PIONEERED BY THE ROCKEFELLER FOUNDATION 100 RESILIENT CITIES

AGWA

OECD

Steering Group:

THE WORLD BANK

UMASS AMHERST

ARUP

THE RESILIENCE SHIFT

PIONEERED BY THE ROCKEFELLER FOUNDATION 100 RESILIENT CITIES

The ROCKEFELLER FOUNDATION

Co-Creating the City Water Resilience Approach

RESILIENT GREATER MIAMI & THE BEACHES

RESILIENT CAPE TOWN

CDMX CIUDAD DE MÉXICO

HULL AND HALTEMPRICE LIVING with WATER

RESILIENT THESSALONIKI

RESILIENT ROTTERDAM

RESILIENT GM JP

Engaging with City Stakeholders

Fieldwork in eight cities with direct engagement of more than

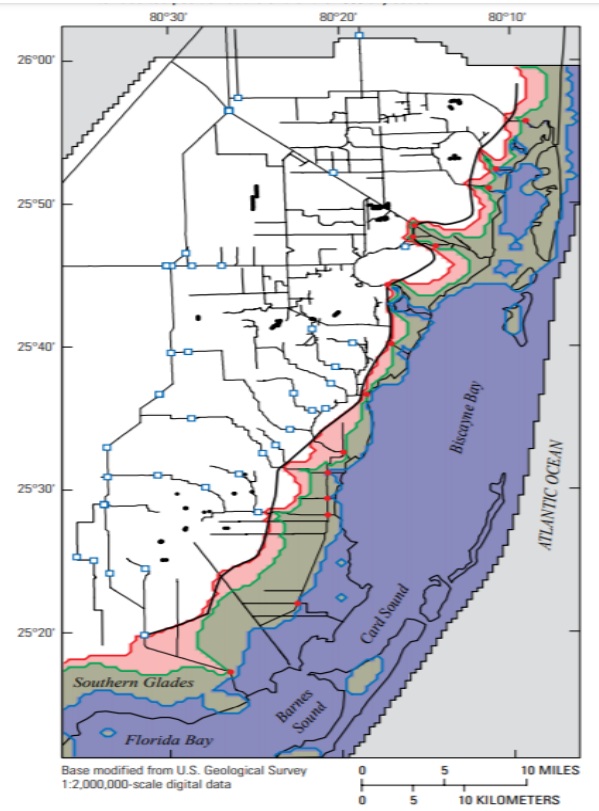
700 people

Resilience Programmes in the Cities

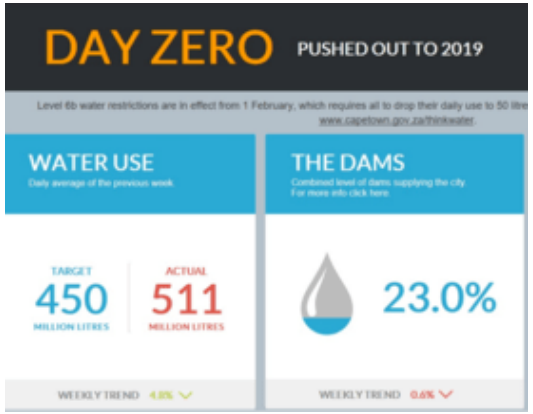
HULL AND HALTEMPRICE
LIVING with WATER

AGUA CAPITAL

SOUTHEAST FLORIDA
REGIONAL COMPACT
CLIMATE CHANGE



BE365



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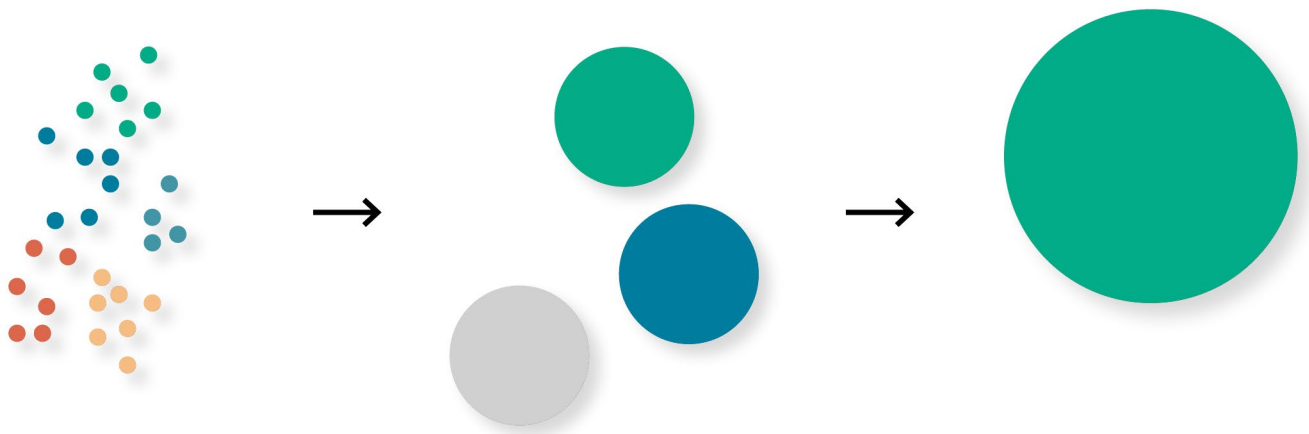
Development of the City Water Resilience Framework

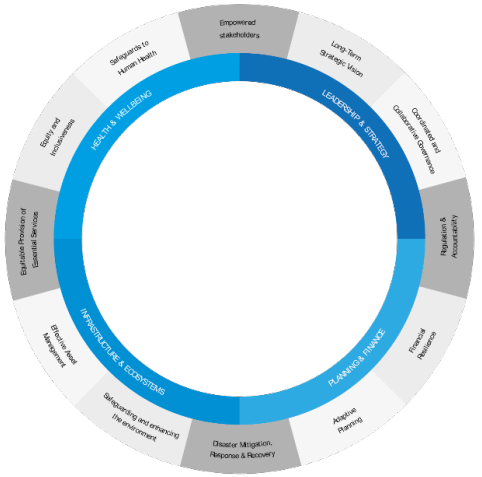
1577
factors

56
sub-goals

12
goals



City Water Resilience Framework



62 qualitative indicators
40 quantitative indicators

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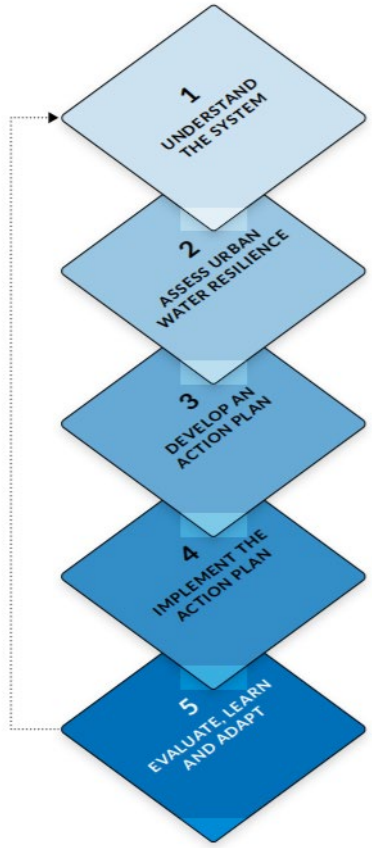
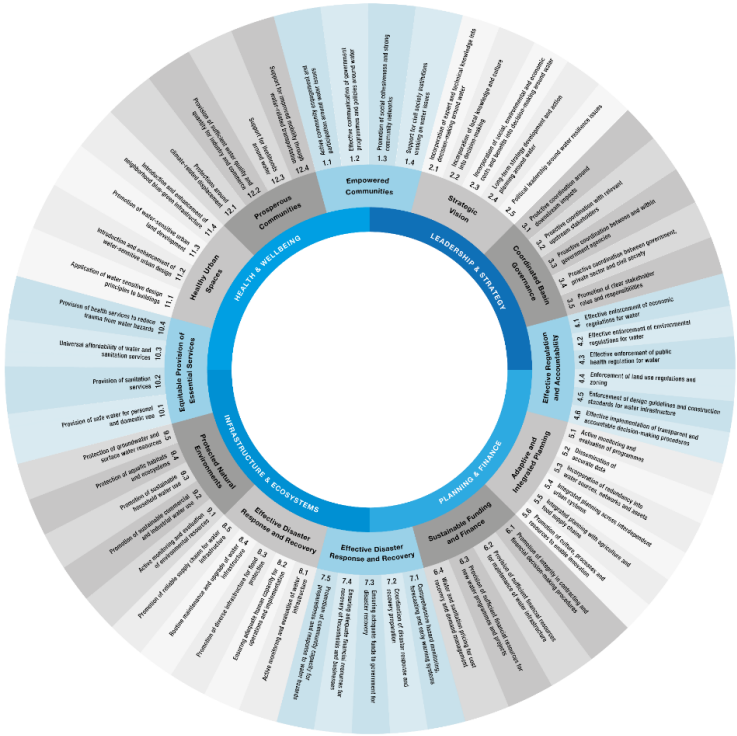
City Water Resilience Approach



City Water Resilience Approach



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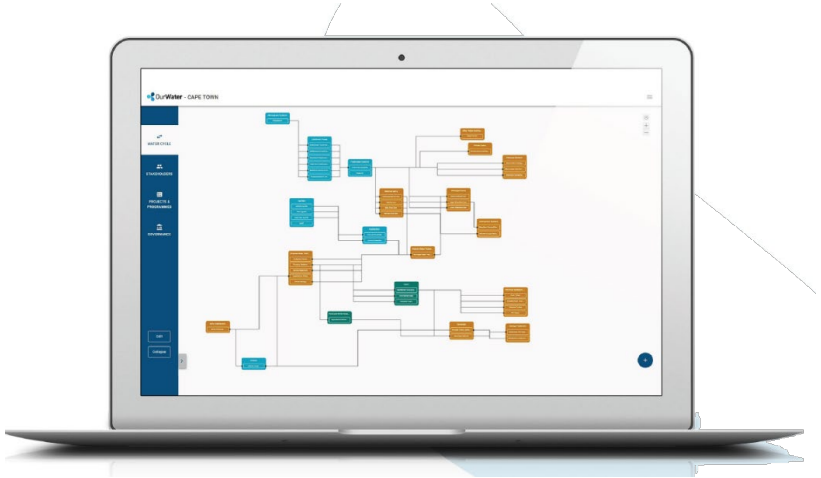

OurWater Governance Tool

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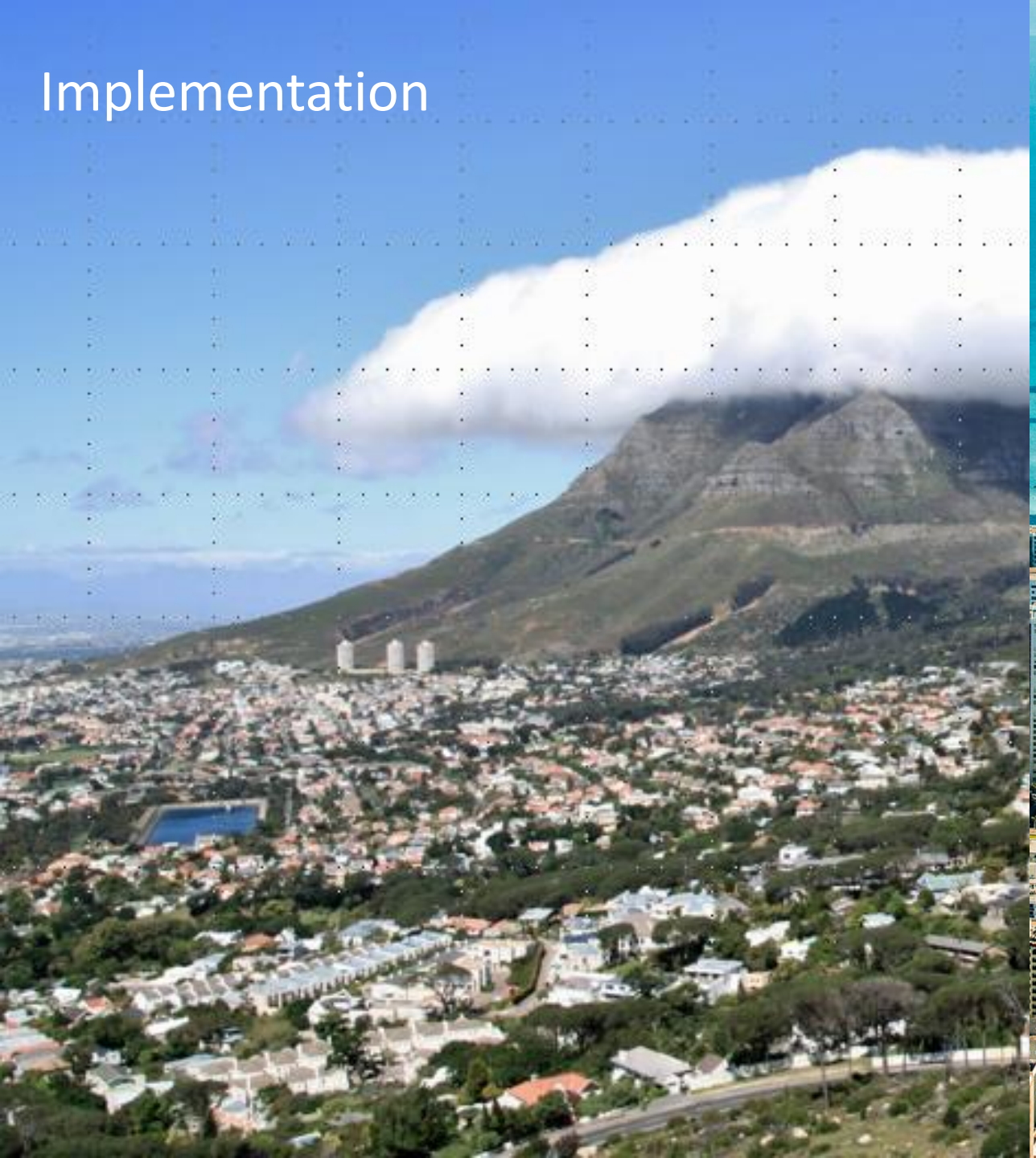
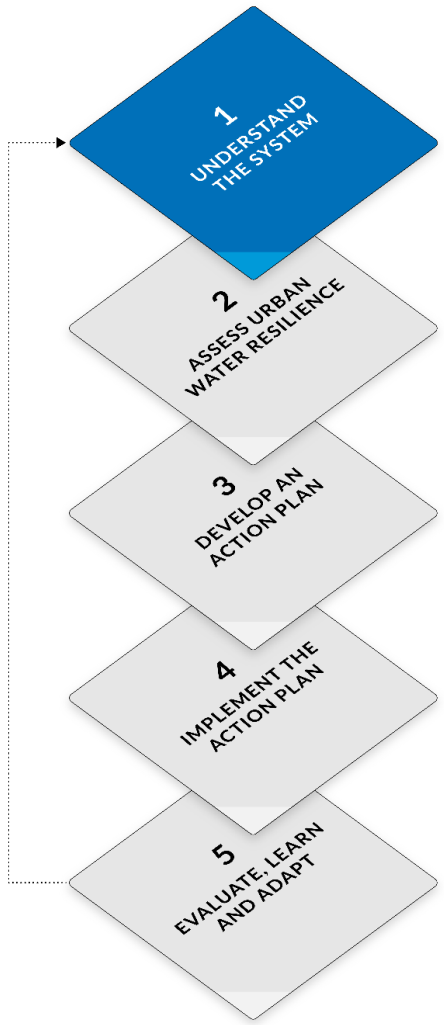
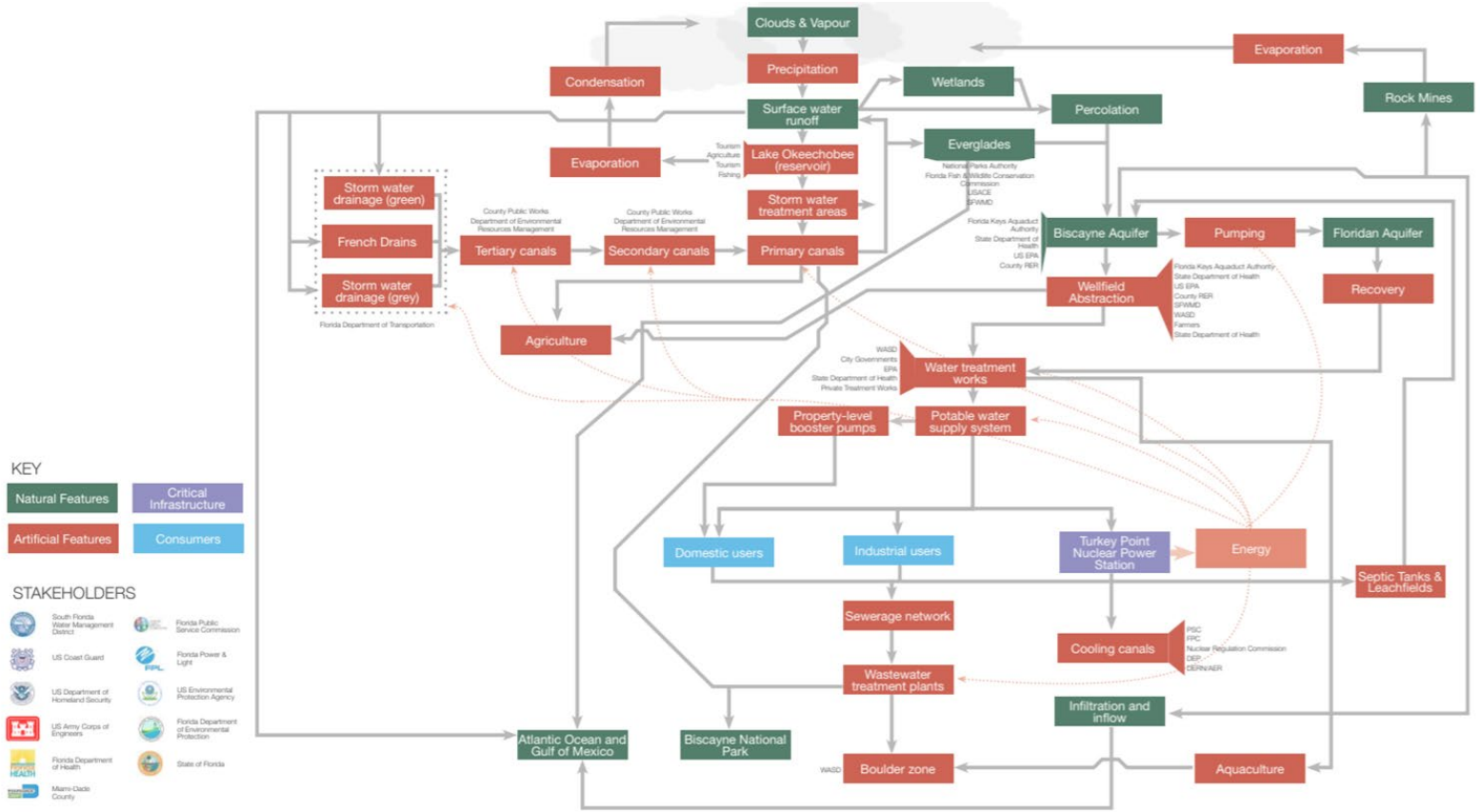
Implementation



Step 1: Understand the system





OurWater Governance Tool

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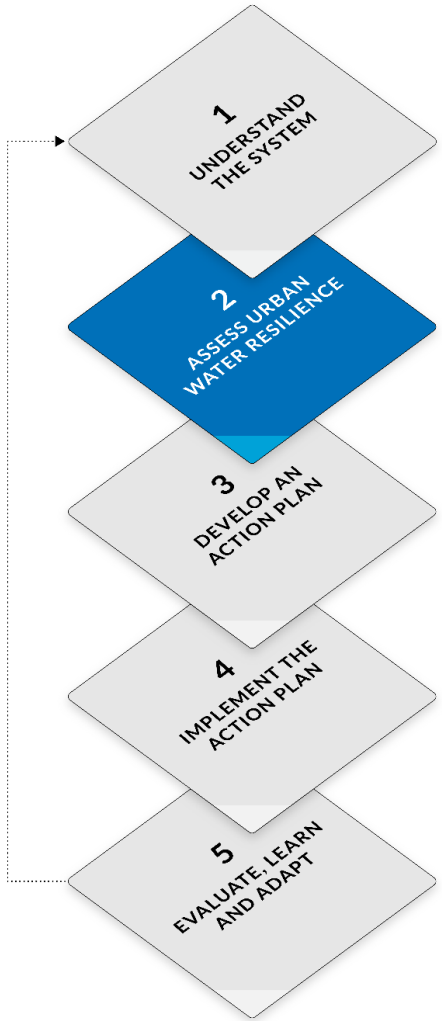
Step 2: Assess urban water resilience



sub-goal

indicator #

indicator name

guiding criteria

12 CITY WATER RESILIENCE FRAMEWORK

DIMENSION: Infrastructure & Ecosystems | GOAL: 6. Effective Disaster Response and Recovery | SUBGOAL: 6.1 Comprehensive hazard monitoring, forecasting and early warning systems

6.1

INDICATOR:

All population has sustainable access to safe drinking water.

GUIDING CRITERIA / GUIDING QUESTIONS:

Access to drinking-water is defined based on the five normative criteria of the HRWS:

- **Availability:** The water supply for each person must be sufficient and continuous for personal and domestic uses.
  Key concepts: acceptable quantity for domestic uses; continuity
- **Physical Accessibility:** Water facilities must be physically accessible for everyone within, or in the immediate vicinity of, each household, health or educational institution, public institutions and places, and workplace.
  Key concepts: Distance from the dwelling to the water point; time spent on hauling water; source-to-person ratio; safe and convenient path for all; easy-to-use and adapted technology; etc.
- **Quality / safety:** Water must be of such a quality that it does not pose a threat to human health.
  Key concepts: Safe drinking quality; guidelines for drinking-water quality
- **Affordability:** Water facilities and services must be available for use at a price that is affordable to all people. Measures must be in place to ensure that such users are not deprived of access to safe water to meet their most basic personal and domestic needs.
  Key concepts: Reasonable price (water connections and water services) for all; capacity of people to pay for water in addition to acquiring other basic goods
- **Acceptability:** Perspectives differ with regard to which water supply solutions are acceptable in a given context. In particular, water should be of an acceptable colour, odour, and taste.
  Key concepts: Colour; odour; taste; cultural issues related to the service.

NOTES:

13 WORKSHOP MATERIAL

DIMENSION: Leadership and stragey | GOAL: 12. Empowered Communities | SUBGOAL: 12.2 Effective communication of government programmes and policies around water

12.2

INDICATOR:

Ucium qui bea il ipisquas quia voles eat. Aximpos corro dit eum quiUciet undicil et fuga. Od quissimolo eaquam, consequae.

GUIDING CRITERIA / GUIDING QUESTIONS:

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NOTES:

5 OPTIMAL	4 GOOD	3 FAIR	2 LOW	1 POOR	N/A
The indicator fully reflects current conditions in the city. No improvement is required.	The indicator mostly reflects conditions in the city. Minimal improvement is required.	The indicator somewhat reflects conditions in the city. Some improvement is required.	The indicator mostly does not reflect conditions in the city. Significant improvement is required.	The indicator does not at all reflect current conditions in the city.	The indicator is not relevant to the city.

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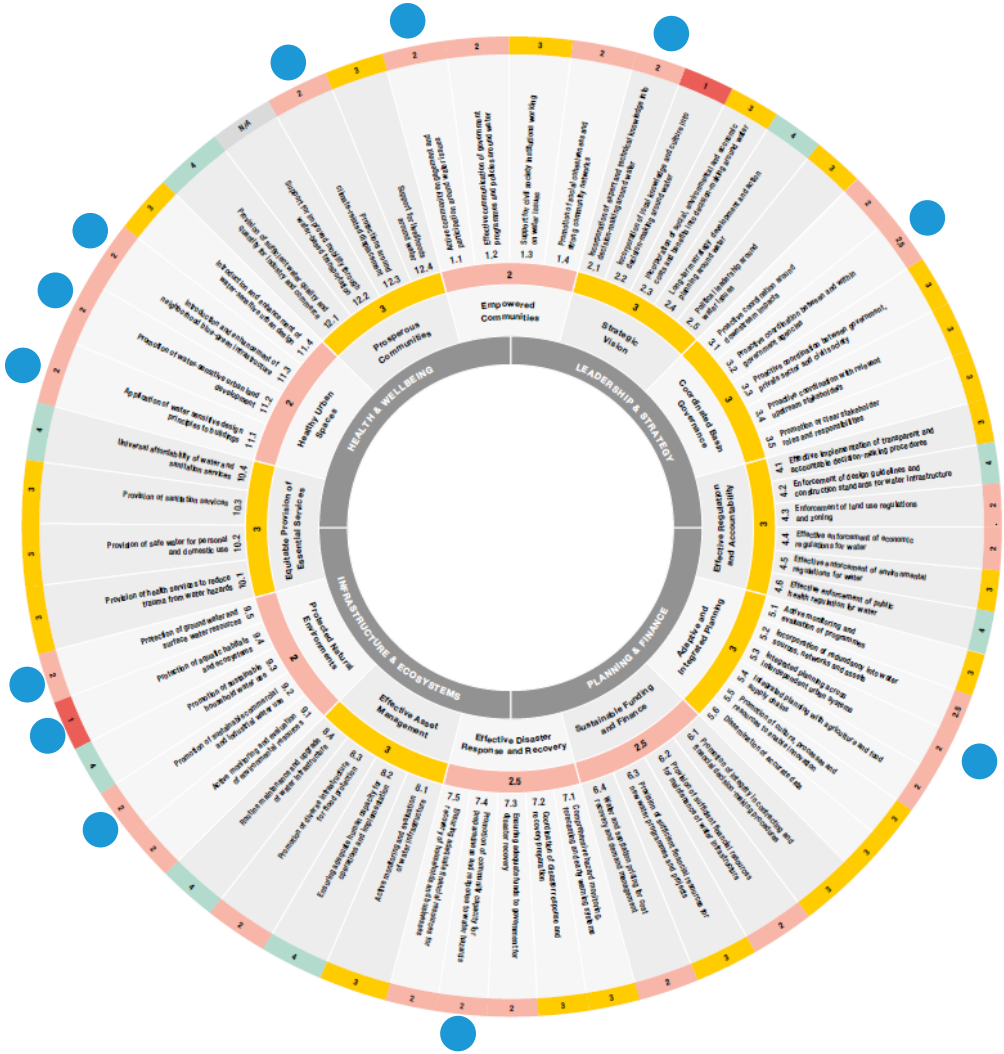
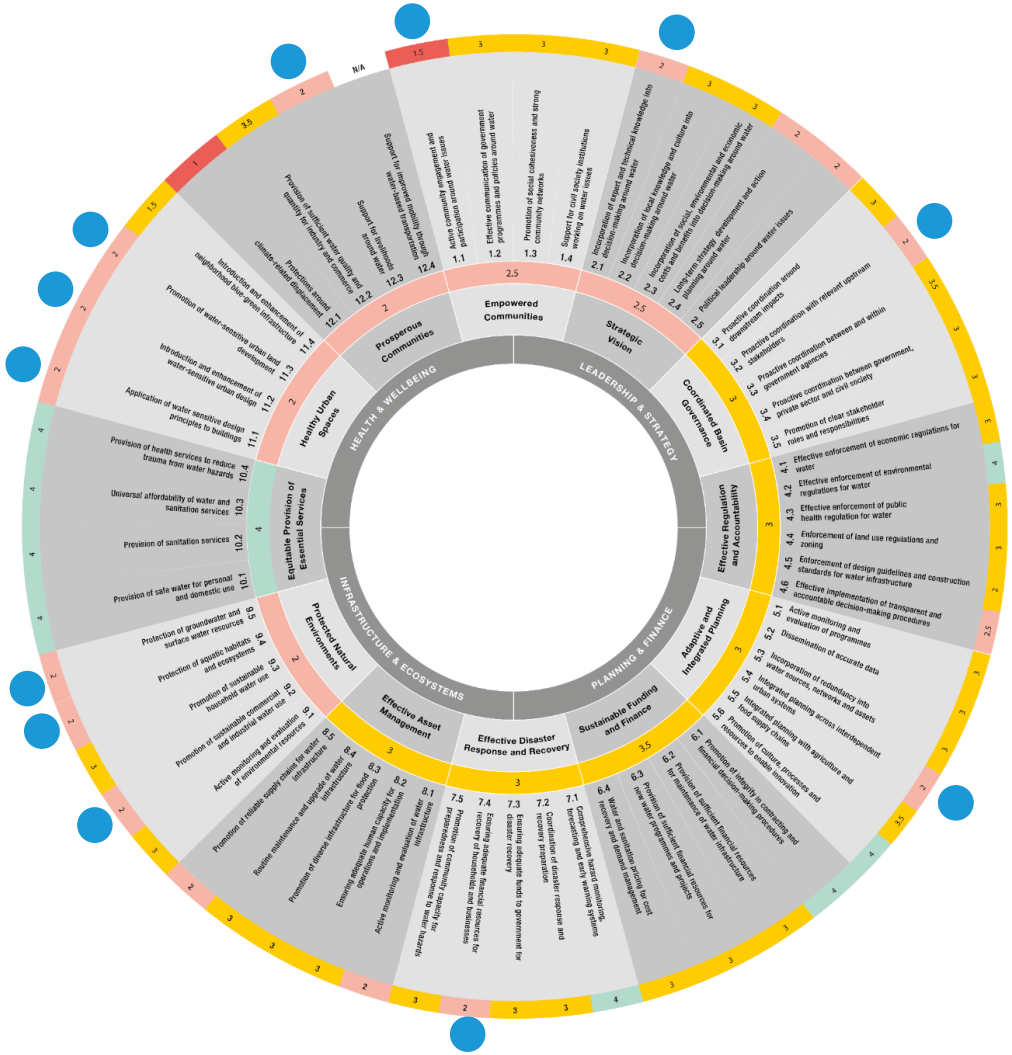
Step 2: Assess the urban water resilience



Cape Town Water Resilience Profile



Greater Miami and Beaches Water Resilience Profile

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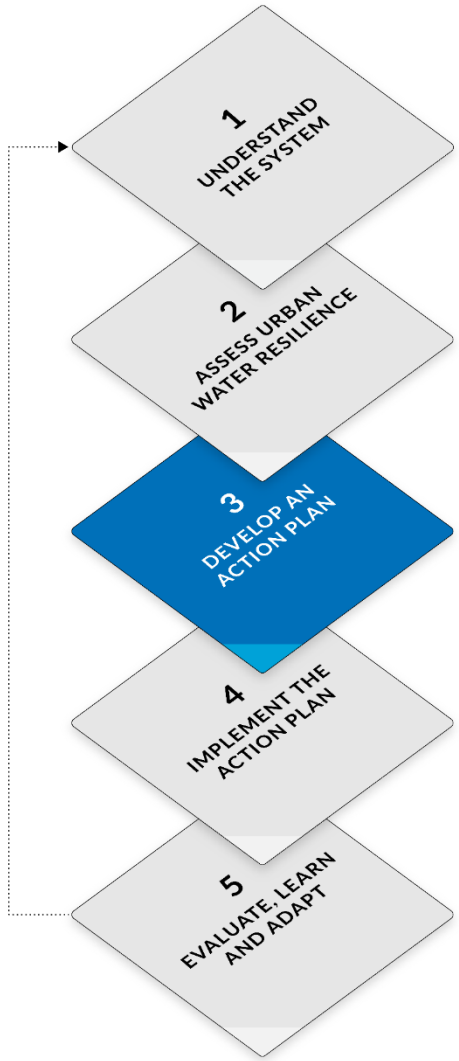
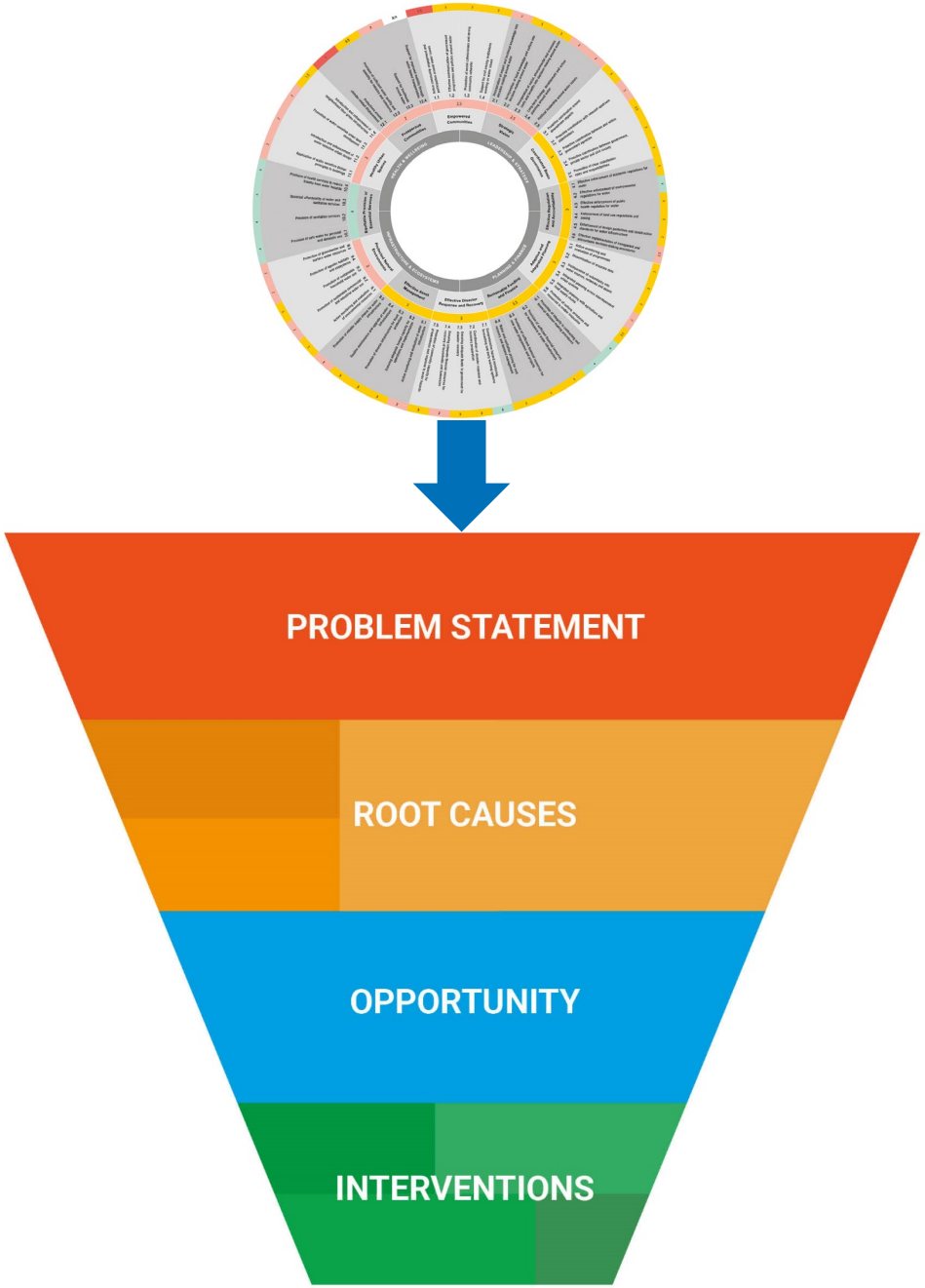
Step 3: Develop an action plan





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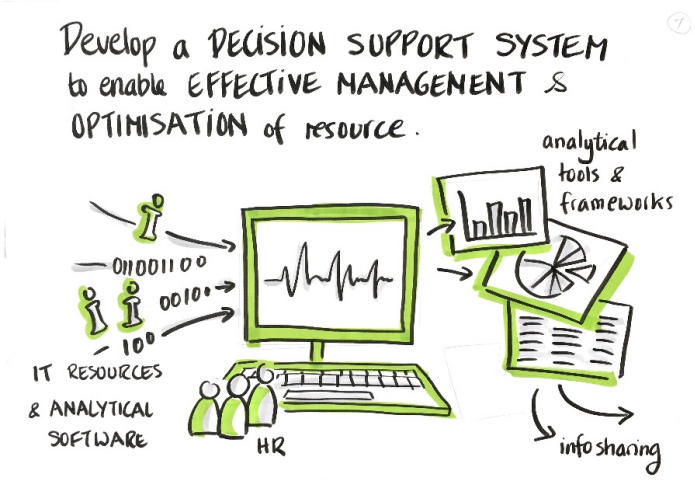
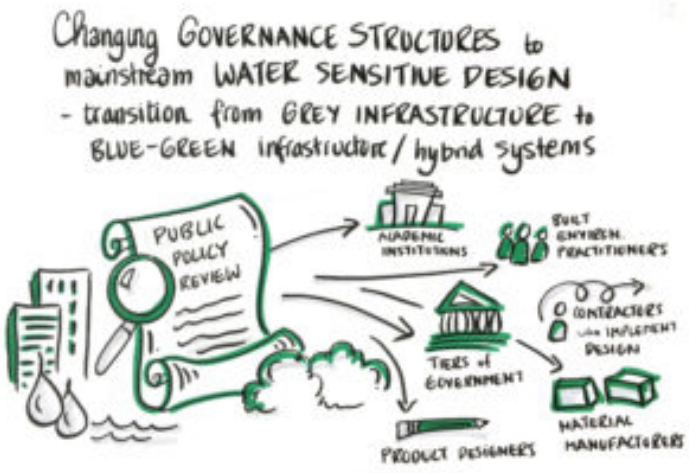
Step 3: Develop an action plan – Cape Town and Miami actions





- Challenge: Water and environmental data for evidence-based decisions.
- Action: Create an open-data portal to improve data accessibility and sharing between key stakeholders to support sound decision-making

- Challenge: Institutionalizing resilience
- Action: Establish a One Water Knowledge Platform to improve capacity and knowledge sharing around resilience, including online training, seminars, and case studies for water stakeholders.

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Common resilience challenges and principles of resilient solutions

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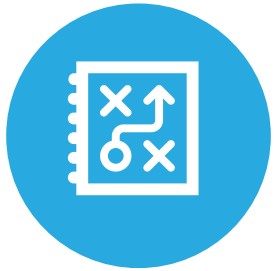
Common resilience challenges

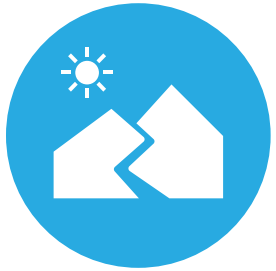
Coordination between water stakeholders

Community engagement including those in vulnerable circumstances



Long term resilience planning and making the case for resilience investment

Data-driven decision in times of disaster and in long-term planning



Protection of surface water and ground water

Incorporating the principles of water sensitive design

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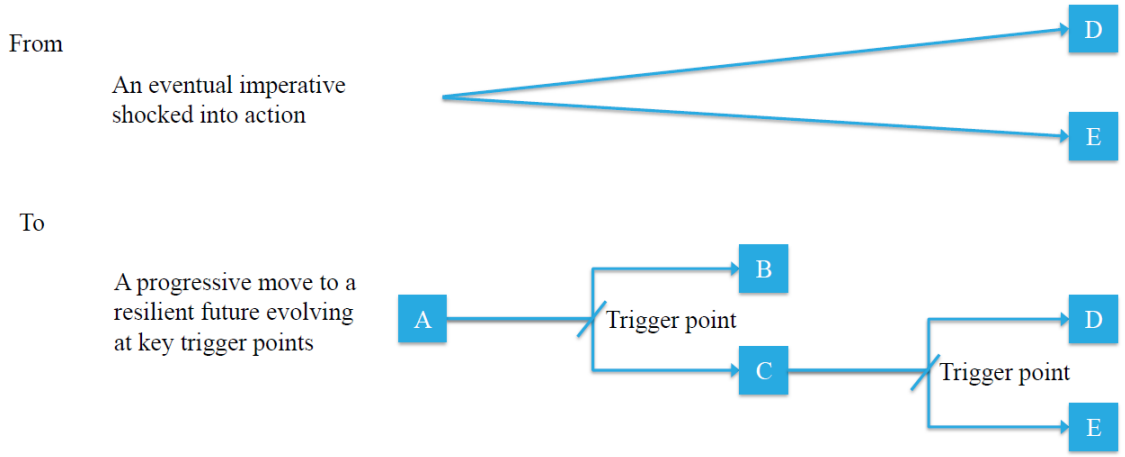
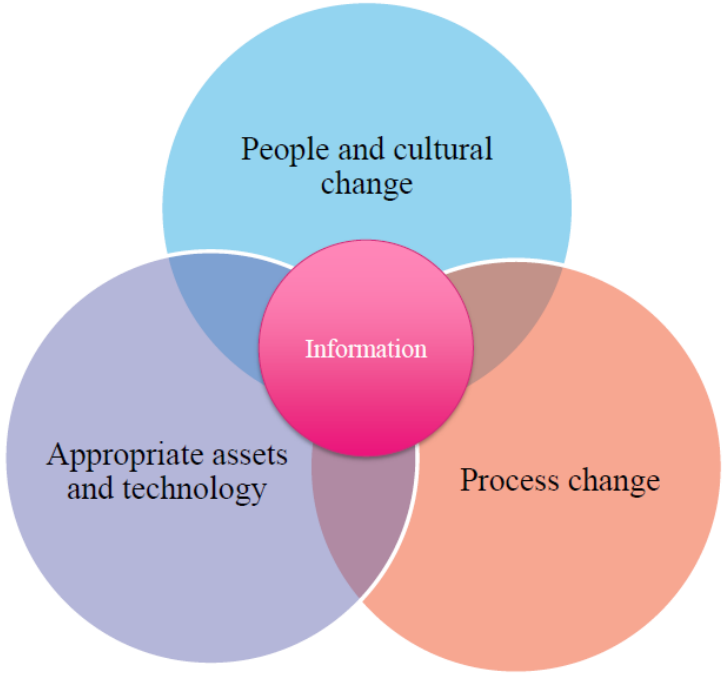
Principles of resilient solutions

- Understand organisational outcomes for the long term
- Horizon scan to identify future shocks and stresses
- Use data from past experiences as well as scenario planning to inform future decisions
- Adaptive planning to respond to changing circumstances
- Understand interdependencies with other systems
- Consider a multi-layered approach to improve resilience, e.g. 5Rs
- Multi-stakeholder engagement to create a shared ownership in planning and implementation
- Integration into organisational BAU through e.g. asset management





Thank you! Any questions?

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