CITY WATER
RESILIENCE FRAMEWORK

Capacity-building Hub @ COP 24
December 7, 2018

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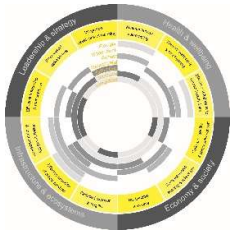
Ove Arup & Partners

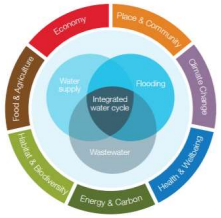
- We are an **employee owned** engineering consulting firm with more than 70 years of experience.
- Our mission is **“to shape a better world”**.
- We are more than 14,000 specialists, working across **90+ disciplines** in more than 34 countries.
- We developed the **City Resilience Approach** with support from The Rockefeller Foundation and The Resilience Shift.

A Collaborative Approach

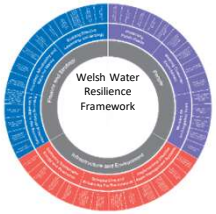
Arup Experience Building Resilience

2012 2013 2014 2015 2016 2017 2018





Unilever
The Future of Urban Water Management



SYDNEY COASTAL COUNCILS GROUP
NSW Office of Environment & Heritage
Sydney WATER

PIONEERED BY THE ROCKEFELLER FOUNDATION
100 RESILIENT CITIES

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Why Water Resilience?

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 m^3
The amount of water the 100 largest cities in the world transfer approximately 5,700km through artificial channels per day.[2]

Why Water Resilience?

Change in Precipitation by the end of 21st Century
(inches of liquid water per year)

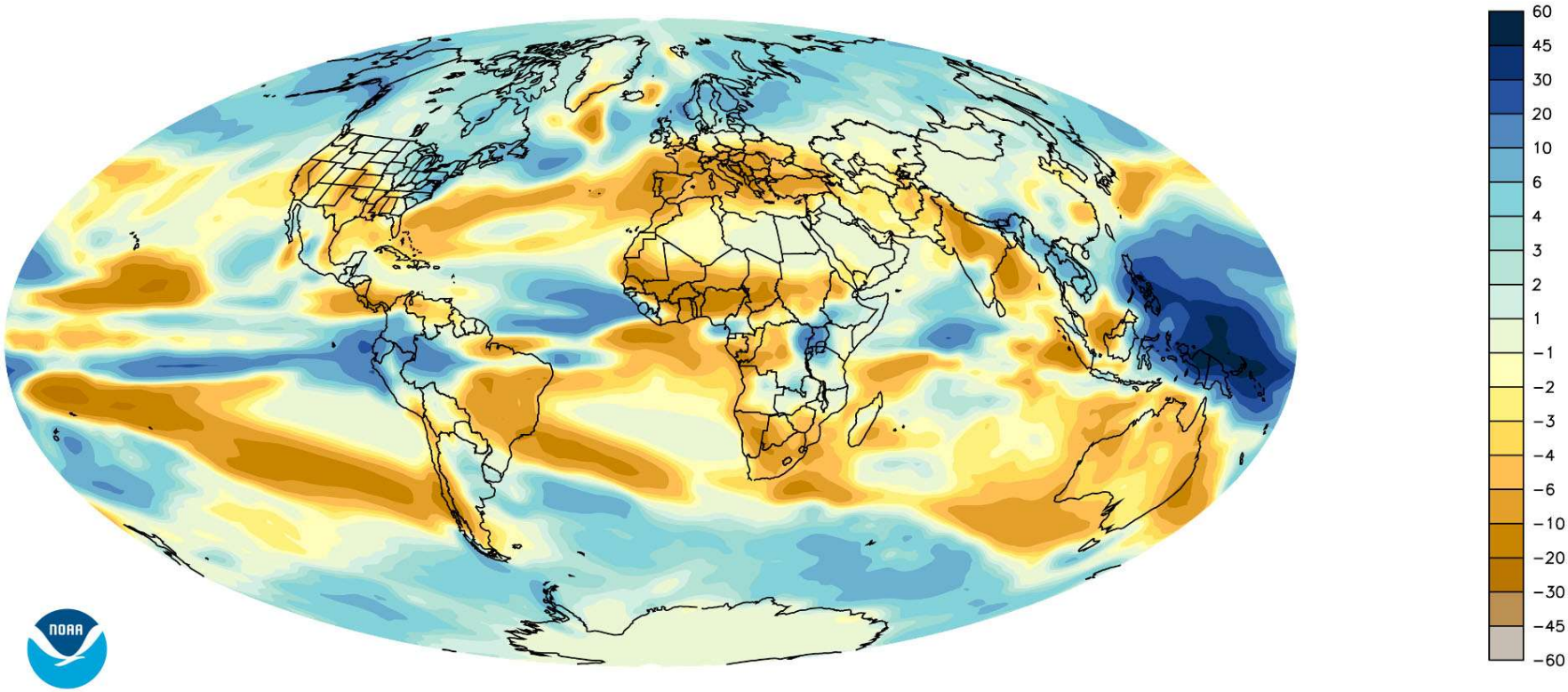
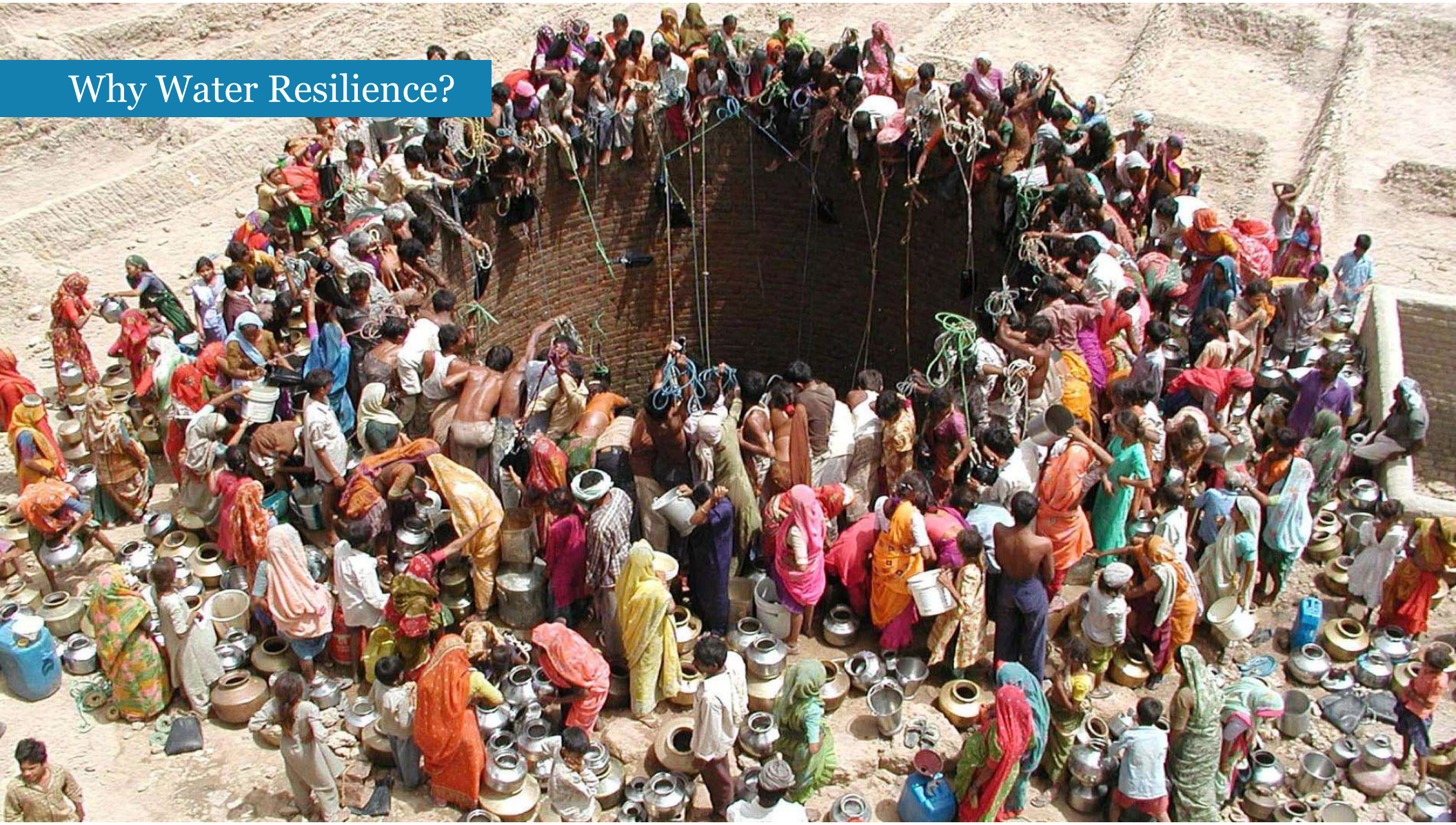


Image: Modified from NOAA GFDL

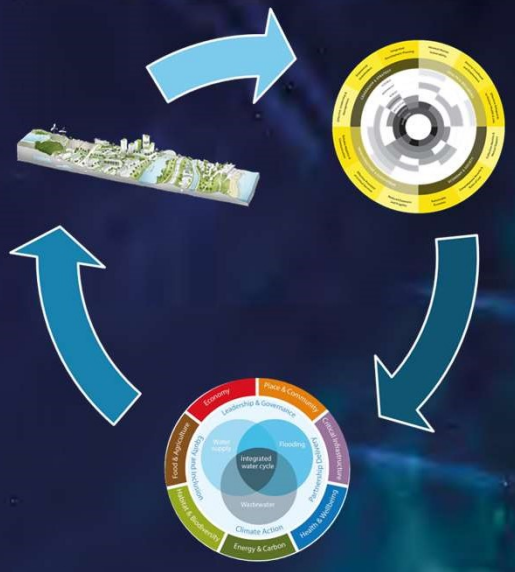
Why Water Resilience?



Why Water Resilience?

"Saving our planet, lifting people out of poverty, advancing economic growth… these are one and the same fight. We must connect the dots between climate change, water scarcity, energy shortages, global health, food security and women's empowerment. Solutions to one problem must be solutions for all."

Ban Ki-moon, United Nations
Secretary General 2007-2016



Why Cities?

68% of the world's population will live in cities by 2050.

Water is fundamental to inclusive, safe, resilient and sustainable cities.

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Why Cities?


Water resources
Ecosystem services
Demand management
Buildings and public realm
Asset management
Catchment management
Planning and urban design
Green infrastructure
Urban retrofit
Resilient infrastructure
Rivers and waterways
Smart infrastructure
Coasts
Economy
Place & Community
Climate Change
Health & Wellbeing
Energy & Carbon
Habitat & Biodiversity
Food & Agriculture
Water supply
Flooding
Integrated water cycle
Wastewater
Catchment interventions
Specialist Services
ARUP

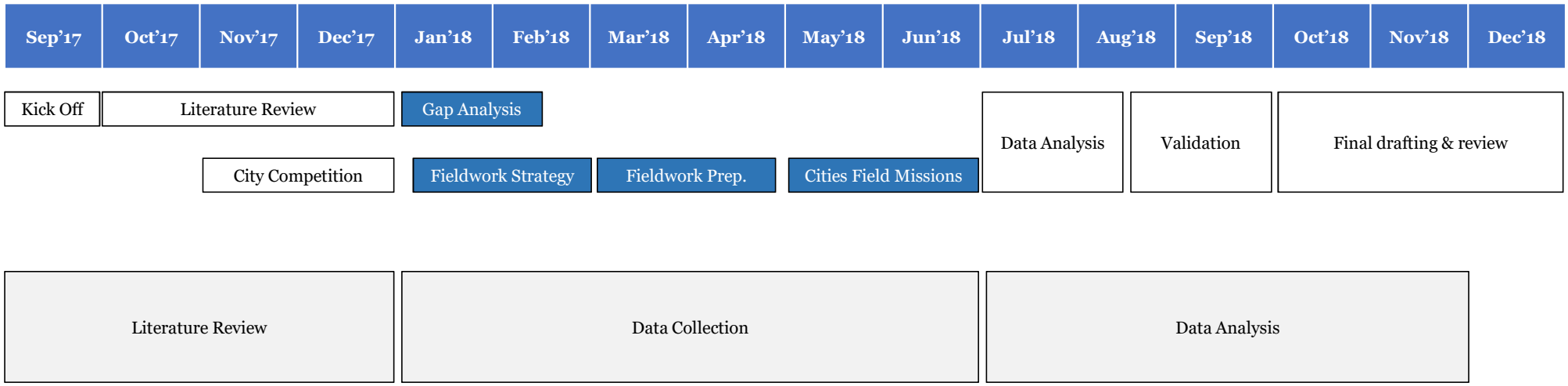
Why Cities?

Image: (l) SuSanA Secretariat (r) Johndal

The Challenge

How can we help cities provide equitable, safe and reliable water resources, and ensure protections in place from water-related shocks and stresses?

The Methodology



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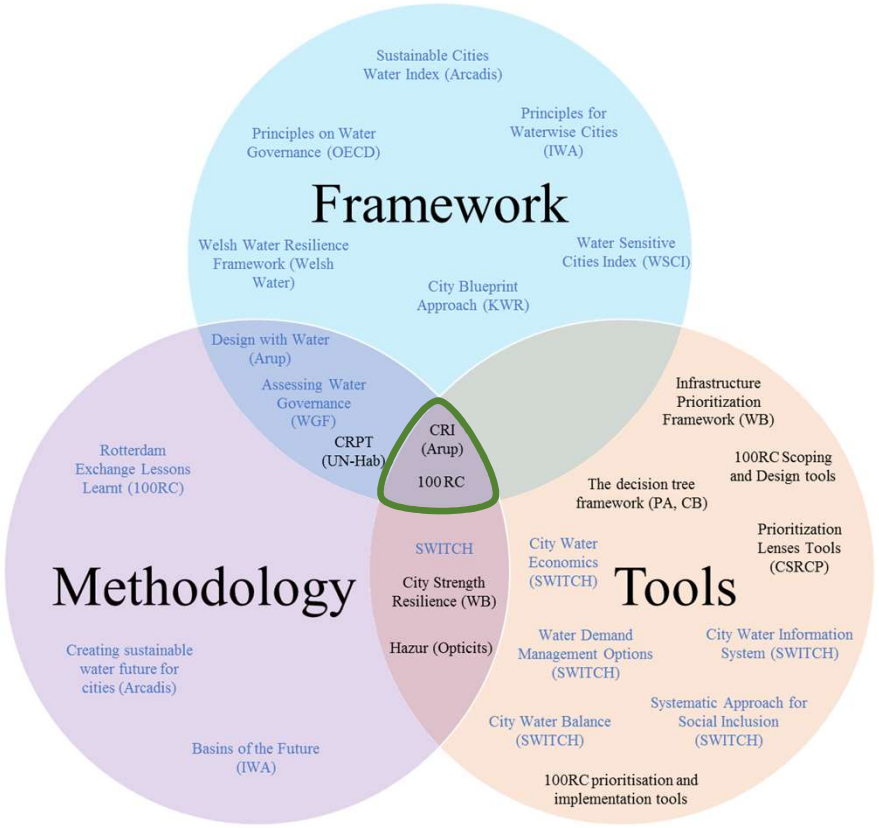
Literature review

OBJECTIVES

1. Global water Trends, Shocks and Stresses
2. Characteristics of Urban Water Resilience (Factors)
3. Definition of Urban Water Resilience
4. Boundaries of the City Water Resilience Framework
5. Key stakeholders in urban water systems.
6. Review existing governance approaches used in urban water systems.
7. City water resilience frameworks and methodologies and tools

Literature review: Findings

- **Global water trends:** 23 shocks, 60 stresses, and 28 trends
- **Characteristics of Urban Water Resilience:** A database of 750 resilience factors has been created (from more than 50 sources reviewed)
- **Governance** is a main theme in water and city resilience literature - included in 390 of 750 'factors of resilience'.
- **Framework needs to result in action.** To achieve this, some frameworks include a decision-making or implementation approach.
- Accompanying **methodologies and tools** makes some frameworks more accessible and useable.



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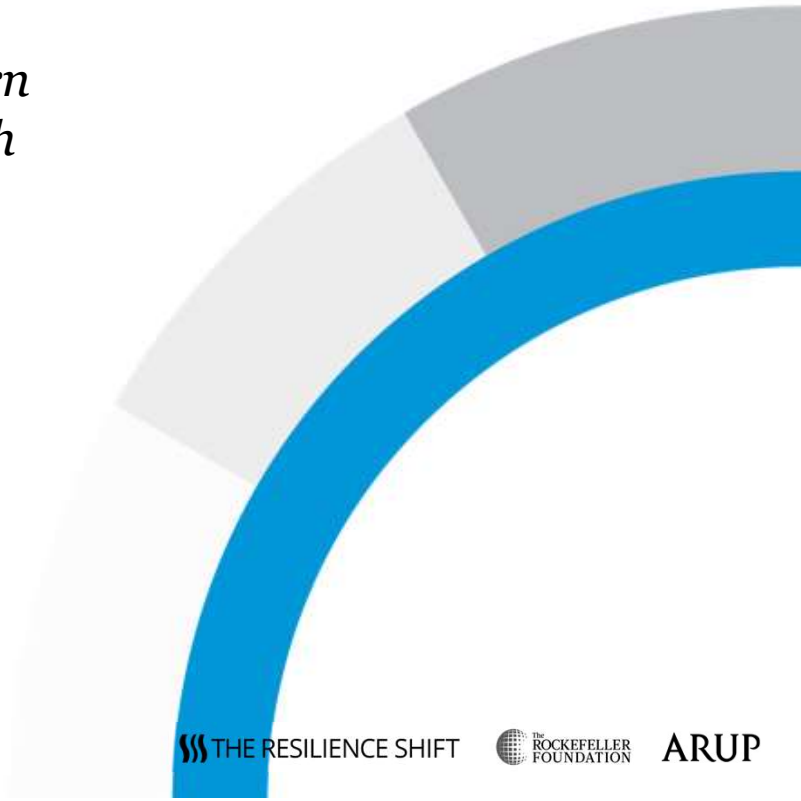
Defining Urban Water Resilience

"The capacity of the urban water system - including the human, social, political, economic, physical and natural assets - to anticipate, absorb, adapt, respond to, and learn from shocks and stresses, in order to protect public health and wellbeing, the natural environment and minimise economic disruption."

Resilience includes key functions and the policies, programmes and infrastructures that:

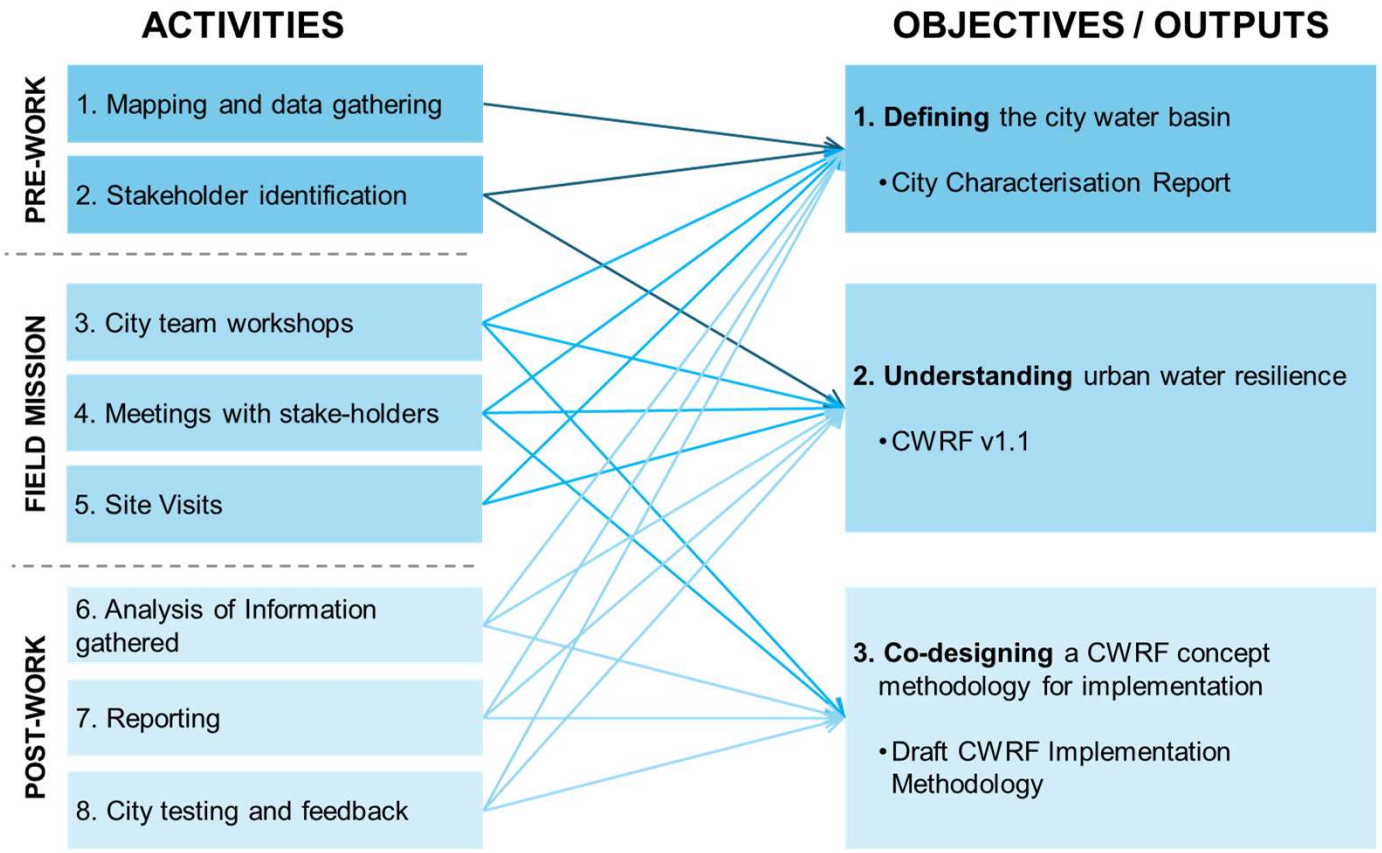
- **Provide** affordable access to water and sanitation for all
- **Protect** residents from water-related shocks and stresses
- **Connect** people to opportunities through transportation



Literature review: Gap Analysis

OBJECTIVES	GAP ANALYSIS
1. Global water trends (Shocks and Stresses) 2. Characteristics of Urban Water Resilience (Factors) 3. Definition of Urban Water Resilience	UNDERSTANDING URBAN WATER RESILIENCE
4. Boundaries of the City Water Resilience Framework 5. Key stakeholders in urban water systems. 6. Review existing governance approaches used in urban water systems.	DEFINING THE CITY WATER BASIN
7. City water resilience frameworks and methodologies and tools	IMPLEMENTATION METHODOLOGY

Fieldwork Strategy



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Co-Creating the City Water Resilience Approach

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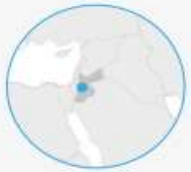
Engaging with City Stakeholders

▲ Hull flood

Amman

Water challenge: located away from sources of water and regularly suffers drought. Experiences unusually heavy rain causing flash floods in low-lying areas of the city.

Jordan's water scarcity is largely seen as the foremost restriction on the country's sustainable economic growth, especially in consideration of the rapid population growth of approximately 3.22% a year.



LOCATION: Amman, Jordan
POPULATION: 4 million

Hull

Water challenge: 90% of Hull lies below the high-tide line. Consequently, the city is highly vulnerable to sea-level rise and has recently experienced extensive flooding. A recent study on the well-being benefits of a 'blue-green approach' to food alleviation concluded that improved access to, and availability of, blue and green infrastructure could reduce NHS spending on mental health medication and therapies by between £12m and £61m in Hull over a 100 year period.[23]

LOCATION: Hull, UK
POPULATION: 323,000

Engaging with City Stakeholders

▲ Mexico City

▲ Miami flood

LOCATION: Mexico City, Mexico
POPULATION: 21.3 million

Mexico City

Water challenge: Historically a lake, Mexico City is prone to flooding. The rapidly growing city is also reliant on depleted underground aquifers for their water supply.

Large volumes of water are drawn from neighbouring states and virtually all its wastewater is discharged through an expensive drainage system into rivers. These rivers flow through arable land which in turn provides the city with its food.

Miami

Water challenge: Its coastal location makes the city vulnerable to increasingly frequent tidal floods. Sea level rise is also a major threat, especially in conjunction with the high groundwater table and complex canal system.

A report by the National Wildlife Federation[24] estimated that Miami stands to lose US$3.5 trillion in financial assets from coastal flooding by 2070. This makes it the most vulnerable city in the world, beyond even Guangzhou and New York, and a prime candidate for coastal adaptation measures.

LOCATION: Miami, USA
POPULATION: 5.9 million

Engaging with City Stakeholders

▲ Theewaterskloof dam

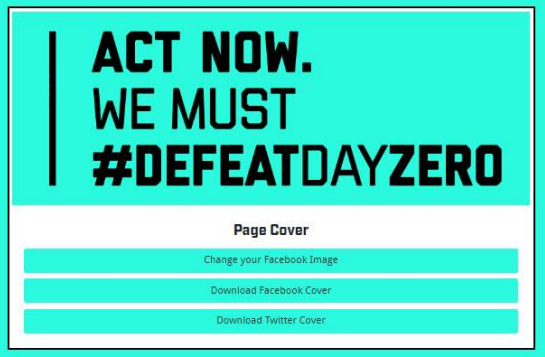
LOCATION: Cape Town, South Africa

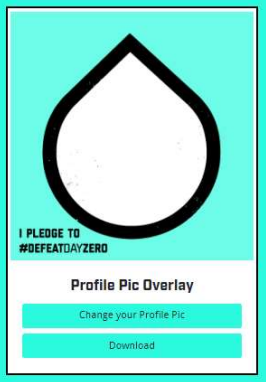
POPULATION: 3.7 million

Cape Town

Water challenge: Severe drought conditions, especially due to low rainfall since 2015. 'Day Zero', when household taps will run dry from lack of resources, was at one time predicted to occur on April 12th 2018 but was pushed back to 2019 as residents used less than 50 litres a day.

The city has previously been lauded for its environmental and sustainability practices and, in 2008, was voted one of 10 cities in the world most likely to become a global sustainability centre by 2020.





Engaging with City Stakeholders

Fieldwork in eight cities with direct engagement of more than

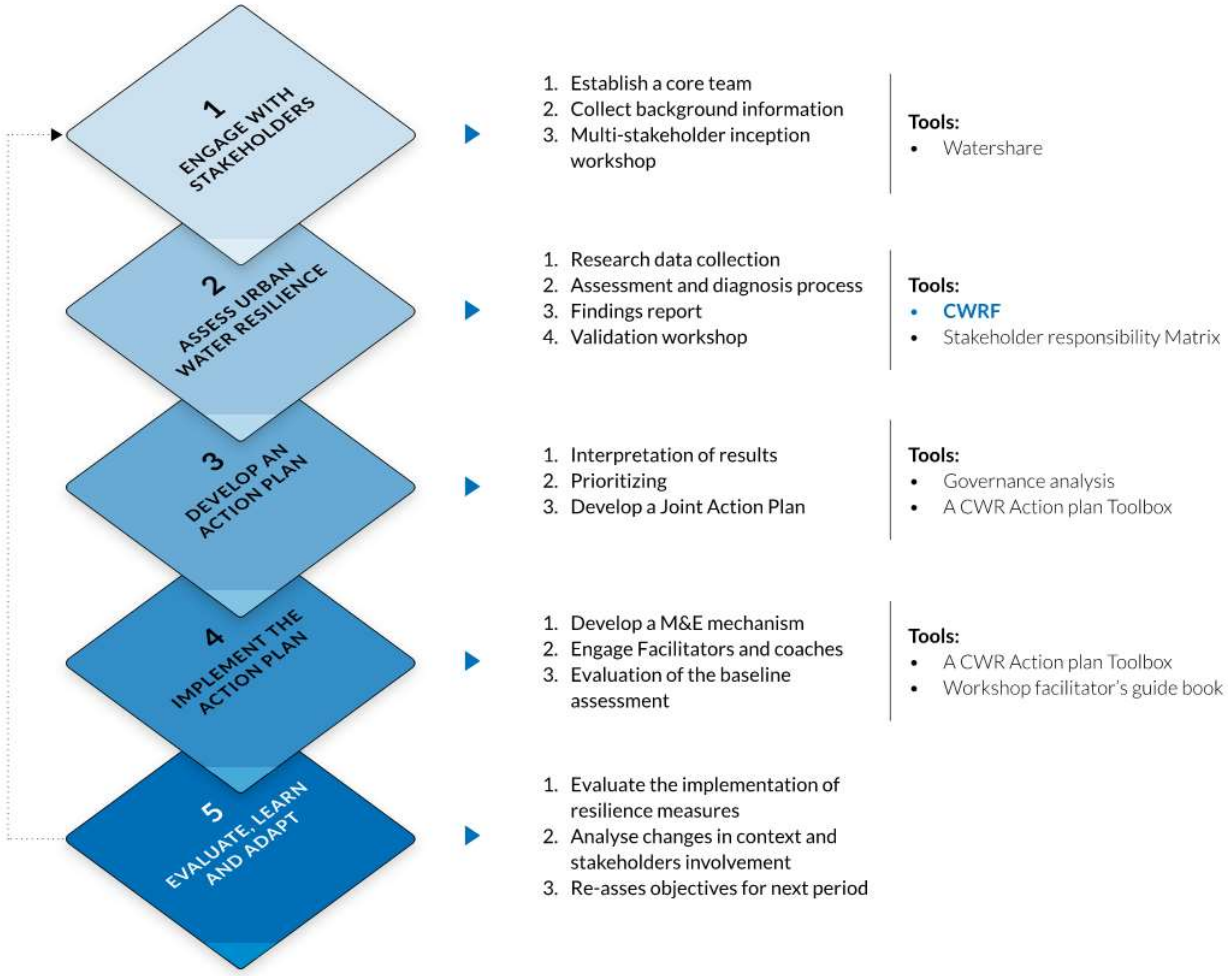
700 people

- 38 Interviews
- 34 Focus Groups Discussions
- 12 Workshops
- 16 Site Visits

From Objectives to Outputs

OBJECTIVES	GAP ANALYSIS	OUTPUTS
1. Global water trends (Shocks and Stresses) 2. Characteristics of Urban Water Resilience (Factors) 3. Definition of Urban Water Resilience	UNDERSTANDING URBAN WATER RESILIENCE	**City Water Resilience Framework (CWRF)**
4. Boundaries of the City Water Resilience Framework 5. Key stakeholders in urban water systems. 6. Review existing governance approaches used in urban water systems.	DEFINING THE CITY WATER BASIN	**WaterShare**
7. City water resilience frameworks and methodologies and tools	IMPLEMENTATION METHODOLOGY	**City Water Resilience Approach (CWRA)**

City Water Resilience Approach



The City Water Resilience Approach is a multi-step process that moves from stakeholder engagement and city assessment, to creating and implementing action plans, and then monitoring the results of interventions. It has been developed with the goal of helping cities achieve safer and more secure water resources, and protections in place from water-related shocks and stresses.

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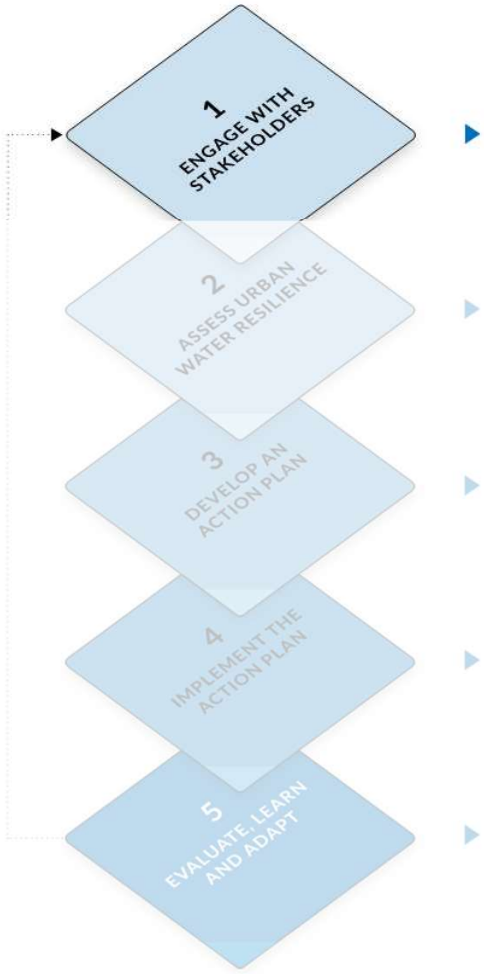
City Water Resilience Approach – 1 Engage with stakeholders



1. Establish a core team
2. Collect background information
3. Multi-stakeholder inception workshop

Tools:
- Watershare

1. Research data collection
2. Assessment and diagnosis process
3. Findings report
4. Validation workshop

Tools:
- CWRF
- Stakeholder responsibility Matrix

1. Interpretation of results
2. Prioritizing
3. Develop a Joint Action Plan

Tools:
- Governance analysis
- A CWR Action plan Toolbox

1. Develop a M&E mechanism
2. Engage Facilitators and coaches
3. Evaluation of the baseline assessment

Tools:
- A CWR Action plan Toolbox
- Workshop facilitator's guide book

1. Evaluate the implementation of resilience measures
2. Analyse changes in context and stakeholders involvement
3. Re-asses objectives for next period

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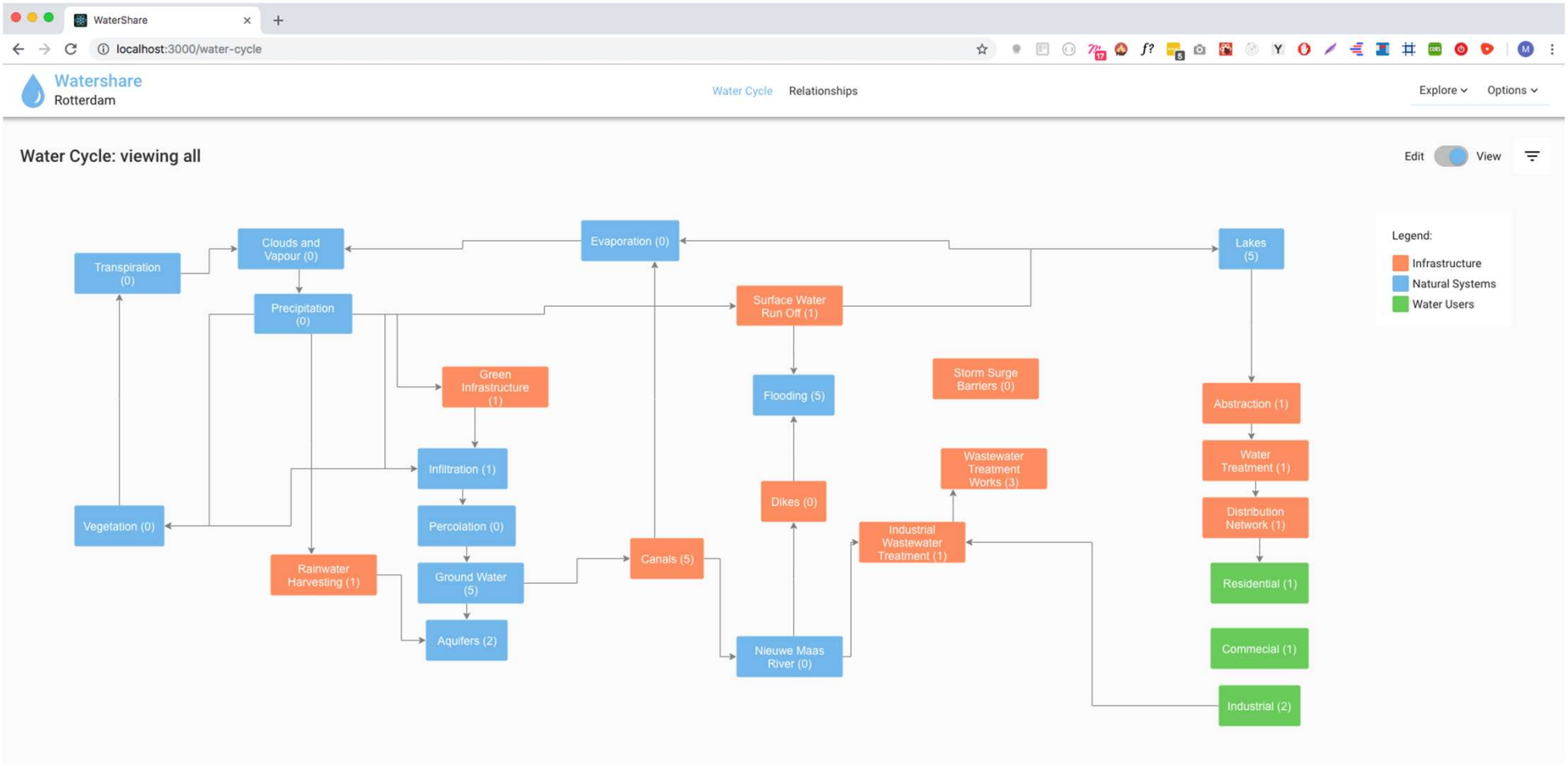
WaterShare



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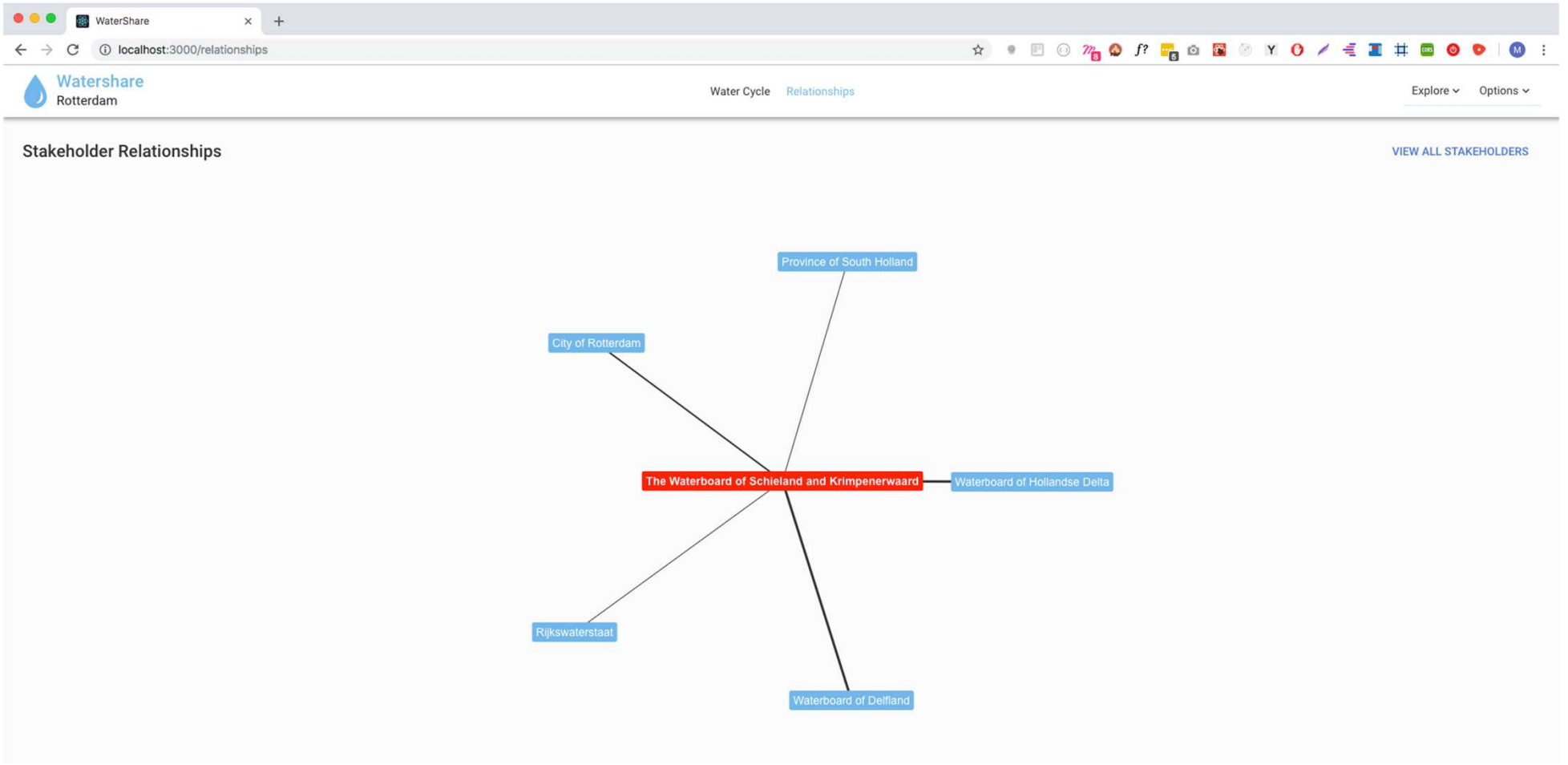
WaterShare



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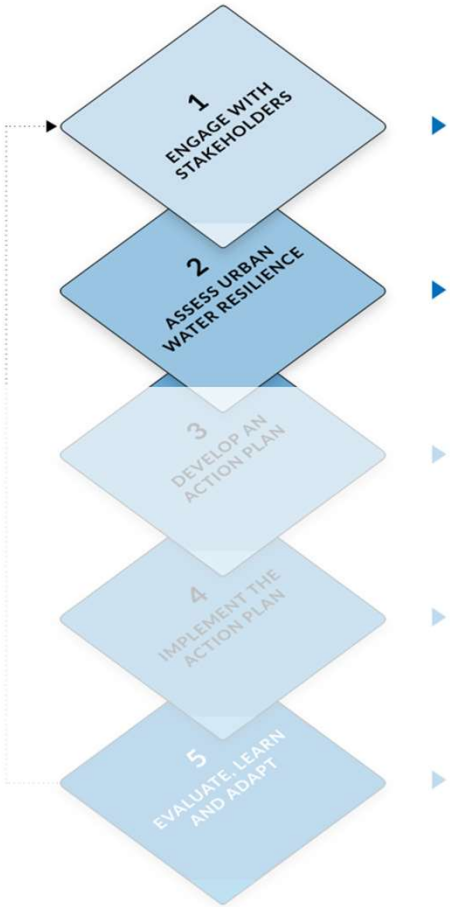
City Water Resilience Approach – 2 Assess Urban Water Resilience



1. Establish a core team
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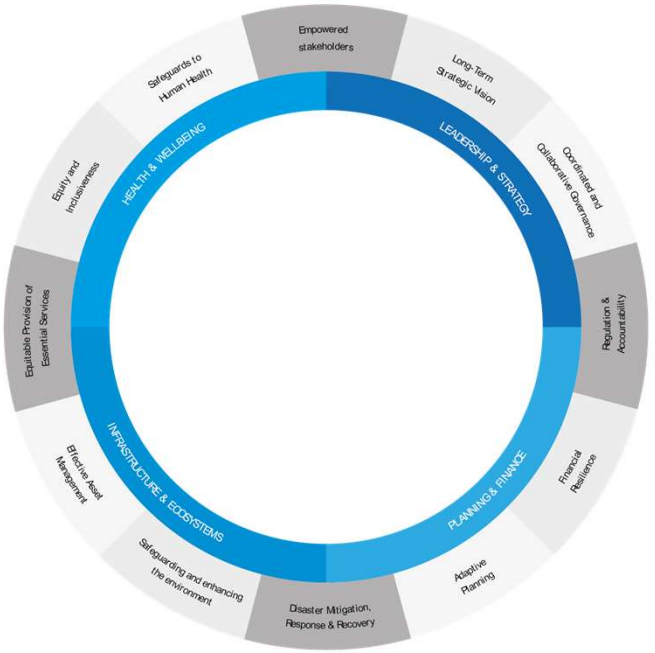

City Water Resilience Framework

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Co-created from Fieldwork records – Data collection and data input

All 5 field mission Interviews, Focus Groups and Workshops data was inputted by:

- Shocks
- Stresses
- Things that helped or hindered

1,577 factors

- Key city findings & characteristics

Fieldwork Report

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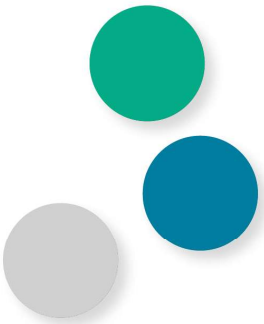
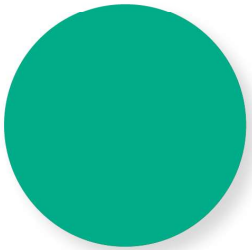
Incorporating Stakeholder Feedback

1577 (+750)
factors

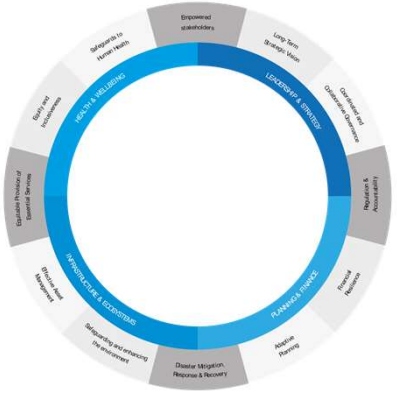
84
sub-goals



12
goals



City Water Resilience Framework



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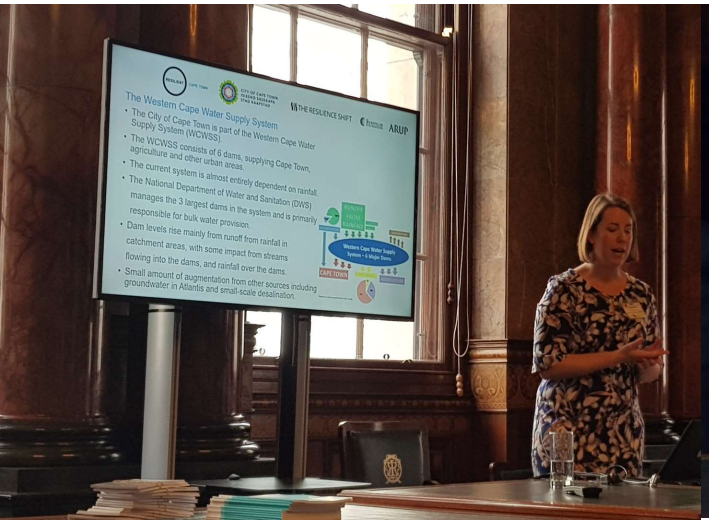
Validating Results: Global Knowledge Exchange 2018



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City Water Resilience Framework

4 Dimensions

Leadership & Strategy

Planning & Finance

Infrastructure & Ecosystems

Health & Wellbeing

What **objectives** you need to achieve water resilience?

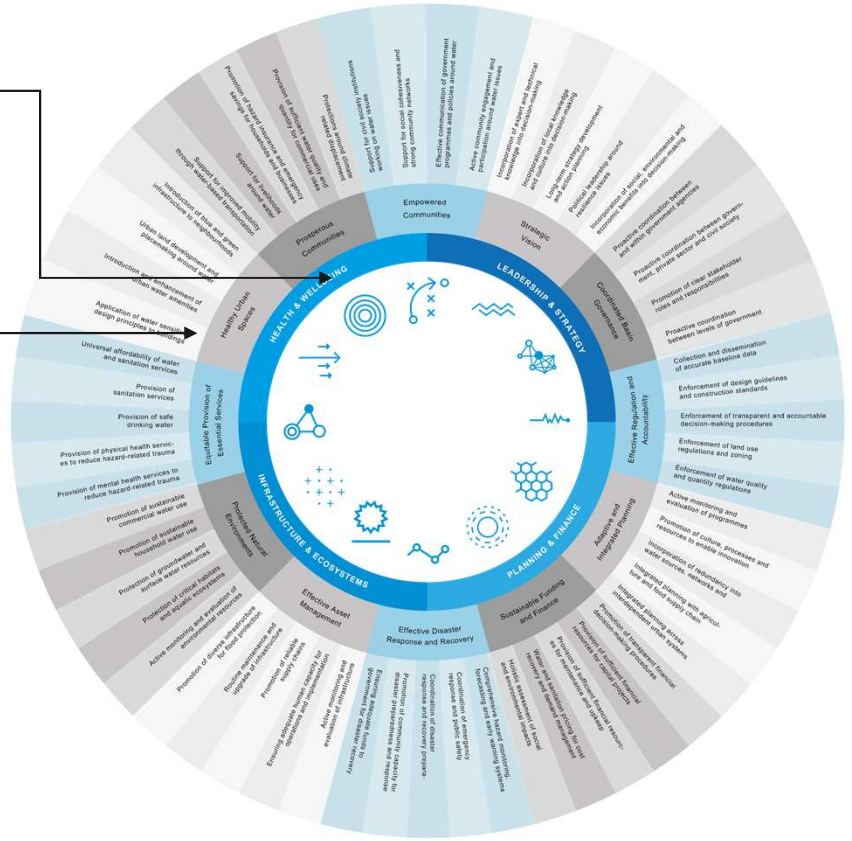
12 Goals

Which **factors** should you observe ?

57 Sub-Goals

Qualitative Indicators

Quantitative Indicators



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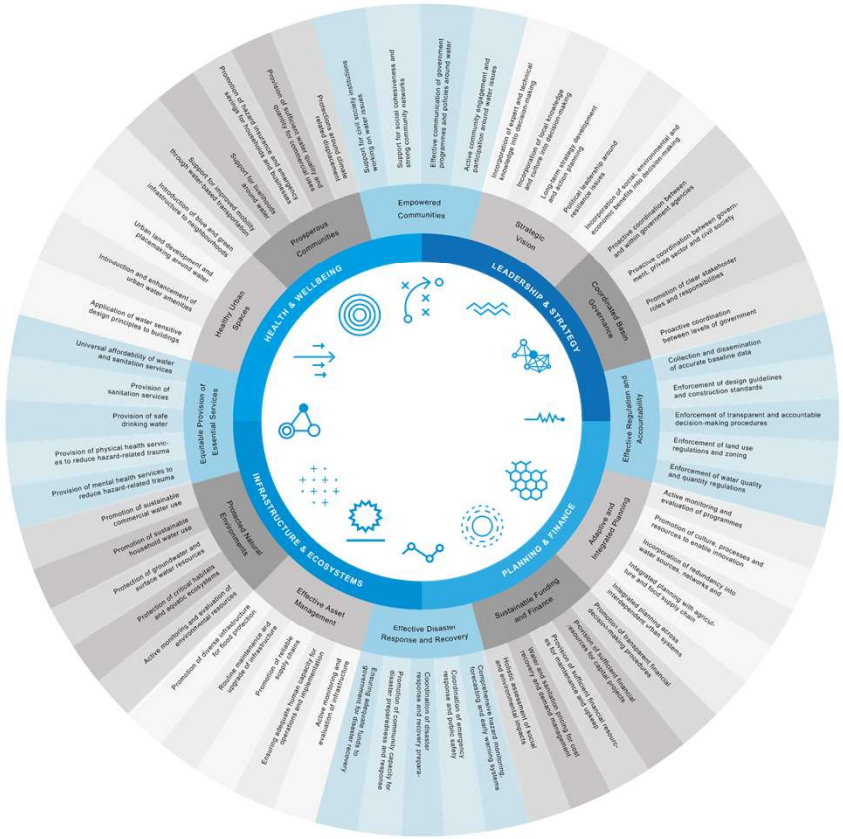
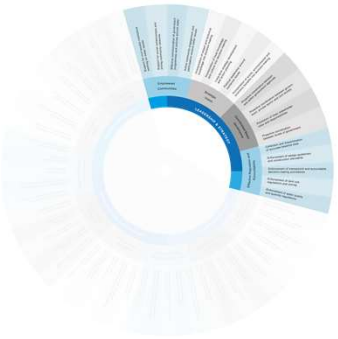
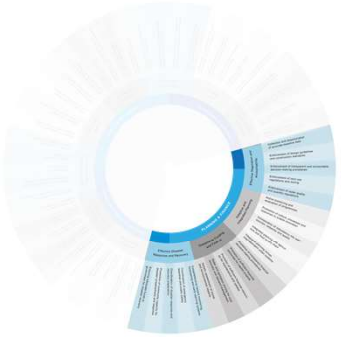
City Water Resilience Framework



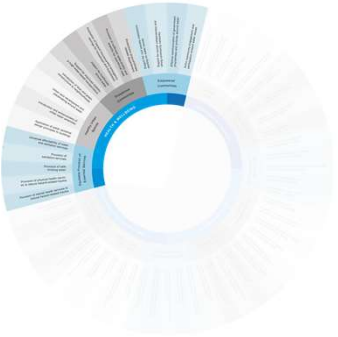
Leadership & Strategy



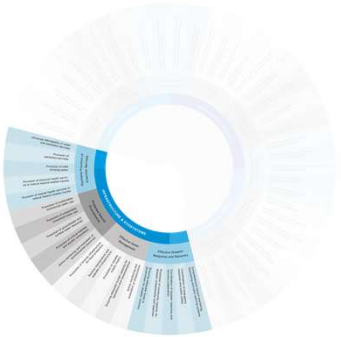
Planning & Finance



Infrastructure & Ecosystems



Health & Wellbeing



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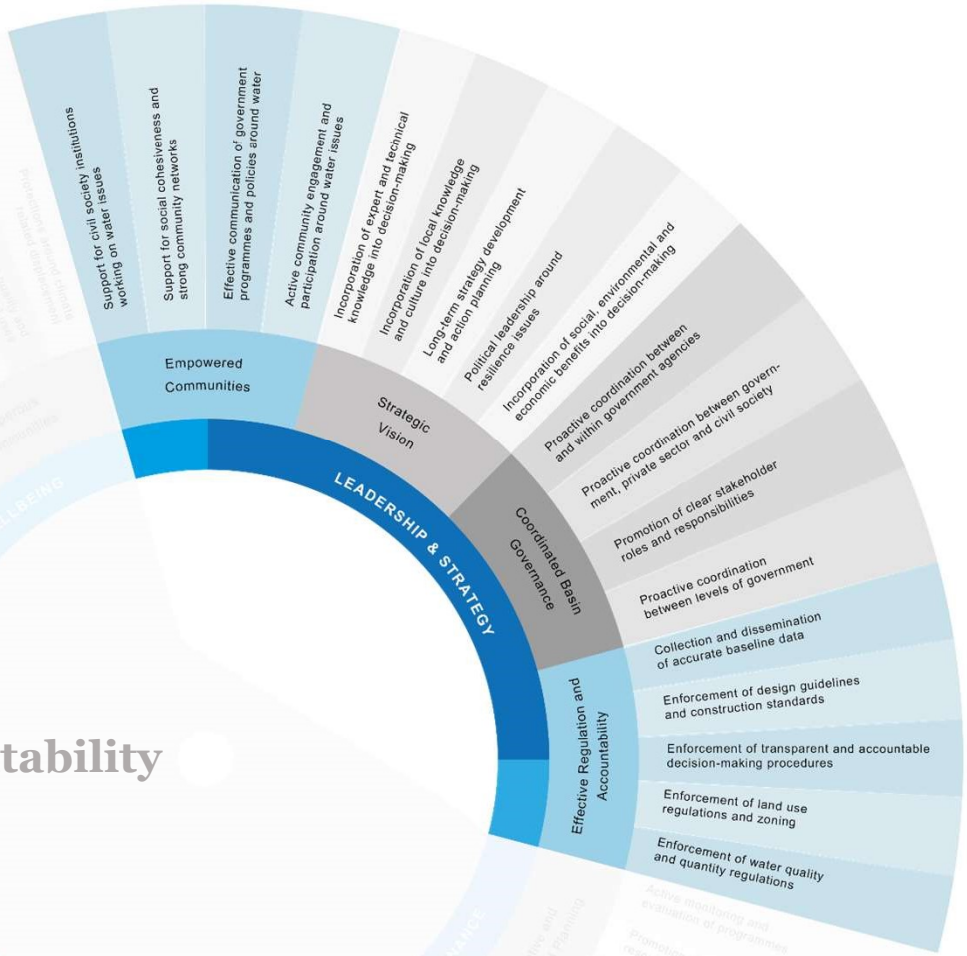
Leadership & Strategy

This dimension relates to the need for effective leadership and long-term strategies that drive decisions around water resources and services.

- **Empowered Communities**
- **Strategic Vision**
- **Coordinated Basin Governance**
- **Effective Regulation and Accountability**



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Planning & Finance

This dimension relates to the need for integrated processes around planning, regulating and funding water resilience programmes and projects.

- **Effective Regulation and Accountability**
- **Adaptive and Integrated Planning**
- **Sustainable Funding and Finance**
- **Effective Disaster Response and Recovery**

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Infrastructure & Ecosystems

This dimension relates to the infrastructure and ecosystems that enable cities to provide critical water services and that protect residents from water-related hazards.

- **Effective Disaster Response and Recovery**
- **Effective Asset Management**
- **Protected Natural Environments**
- **Equitable Provision of Essential Services**

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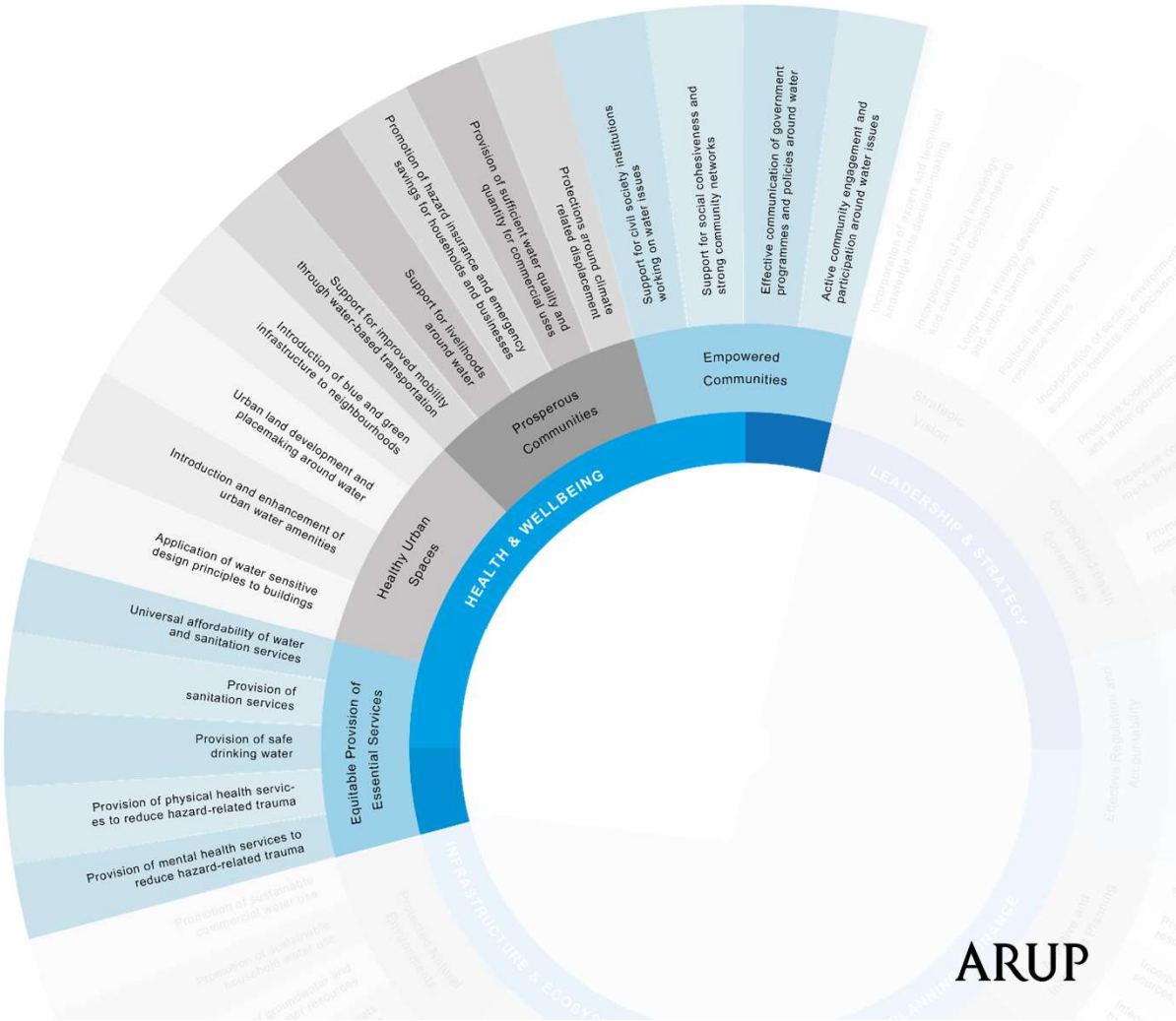
Health & Wellbeing

Health and wellbeing refers to the role of water in ensuring that humans survive and thrive. It addresses both the basic conditions that sustain human life – access to water, sanitation and healthcare – as well as ways to harness water as a driver of attractive, vibrant and prosperous communities.

- **Equitable Provision of Essential Services**
- **Healthy Urban Spaces**
- **Prosperous Communities**
- **Empowered Communities**




Questions
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Guided conversation 1 - Goals

- According to the CWRF, which are the three most important goals for the water resilience in your city and why?

Guided conversation 2 – Sub-Goals

- For the Goals identified previously: Could you use the sub-goals to assess how your city is doing and why? (Good, could be better, bad)

- Can you think of a specific example?

Guided conversation 3 – City Water Resilience Approach

- What benefits you think the CWRA or any of the tools explained could bring to your city and why?

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Literature review: Findings

Global Water Trends

- Global-level: good understanding of shocks and stresses for urban water.
- City-level: less individual understanding, similar global risks but different scale.
- Definition of trends, shocks and stresses in the concept of resilience were framed using the risk equation. (Risk = hazard x vulnerability)
- Long list of 23 shocks, 60 stresses, and 28 trends compiled and divided in 6 categories.

Definition of Urban Water Resilience

- In establishing a definition of urban water resilience the following elements were considered central to the definition: characteristics; boundaries; components of urban water system

Characteristics of Urban Water Resilience

- A database of 750 resilience factors has been created (from more than 50 sources reviewed)
- Resilience factor: assets, systems, practices or procedures that contributed positively or negatively to the urban water system's ability to prepare, recover, and adapt in the face of shocks or stresses.
- The factors fall into three typologies: asset-based factors; practices; attributes/qualities