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THE RESILIENCE SHIFT

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ARUP

THE CITY WATER RESILIENCE APPROACH

CITY CHARACTERISATION REPORT

CAPE TOWN

ACKNOWLEDGEMENTS

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CONTENTS

EXECUTIVE SUMMARY

The City Water Resilience Approach (CWRA) helps cities plan and implement actions to build resilient urban water systems. A critical first step in this process is understanding the local water system, and the factors that contribute to or detract from resilience.

This report details research undertaken in Cape Town,South Africa with the goals to:

1. Define the city water basin including natural basin(s), the urban water system and its governance structure, and the interdependencies with other systems.
2. Identify the factors contributing to the resilience of the city water system and those increasing its vulnerability.

In developing this characterisation report, the team collected desktop data on the biophysical characteristics of the basin and key actors in the water system. A field mission was undertaken in Cape Town 18–30 June 2018 to build on the desktop work by engaging in-person with stakeholders.

UNDERSTANDING CAPE TOWN'S BASIN

With four million inhabitants, Cape Town is the second most populous city in South Africa and one of its main economic centres and contributes about 9.4% to the country's GDP. The city has a R44.3 billion budget for the financial year 2017/2018. 34.4% of this budget is allocated to the Informal Settlements, Water and Waste Services Directorate to provide basic services to all Capetonians and to improve infrastructure for the poor. The Constitution of the Republic of South Africa, 1996, provides for three spheres of government: national, provincial, and local (municipal). The three spheres of government share a mandate for governing the water system (National Water Act, 1998).

Cape Town's water supply is derived mostly from the mountainous areas of western South Africa where rainfall is highest, often exceeding 2,000 mm. The Western Cape Water Supply System (WCWSS) uses fourteen dams and their reservoirs to supply its consumers. Cape Town is growing and on average, has 8,500 new customers annually (CCT, 2017b).

Cape Town treats its water at 12 treatment works ranging in capacity from 3 MLD, at Constantia Nek to 500 MLD at the state-of-the-art Faure Treatment Works (CCT, 2017b). The City of Cape Town operates 17 wastewater treatment works (sewerage works) and six smaller wastewater facilities (CCT, 2017b).

Within the city, surface runoff either infiltrates sand flats and recharges the aquifers, or it drains into channels, ponds, and rivers—ultimately draining into the Atlantic Ocean (CCT, 2017b).

KEY STAKEHOLDERS

The City of Cape Town (CCT) serves as the Water Services Authority (WSA) and often also as Water Service Provider (WSP). At the national level, the Minister of Water and Sanitation and the National Department of Water and Sanitation (DWS) are responsible for water and sanitation policy, regulation of water supply and sanitation provisions, oversight of water sector institutions, water resources planning, regulation of water use, and collection and assessment of water data (DWS, 2018a; DWS, 2018b). The CCT along with the DWS (formerly the Department of Water Affairs and Forestry (DWAF) at the time), commissioned the Western Cape Reconciliation Strategy Study (WCRSS) to facilitate the reconciliation of predicted future water requirement scenarios with supply from the WCWSS for a 25-year planning horizon. The CCT also developed the New Water Programme which sets out a plan to diversify water supply and a demand management strategy.

DWS are responsible for operation and maintenance of 342 large dams and associated bulk water supply networks nationally. Cape Town is primarily responsible for water treatment and reticulation as well as wastewater treatment and managing rivers and stormwater systems (DWS, 2018a).

DWS are responsible for meeting the water demands of cities, industries, mining and agriculture.

SHOCKS AND STRESSES

Climate change is a major stress in the region, and Cape Town is particularly vulnerable to its impacts, which are expected to become more frequent and intense.
Key stresses and shocks affecting Cape Town include drought, groundwater depletion / over-exploitation, flooding, fire and habitat loss. Most notable, is the severe three-year drought that Cape Town has experienced, which had significant impacts on businesses, residents and the environment in Cape Town. The people in Cape Town had to respond to the possibility of what has come to be known as "Day Zero" by curtailing consumption by more than 50% compared to pre-drought consumptions levels.

Poverty and inequality, lack of hygiene and sanitation, failure of regional and local governance and lack of investment were identified as stresses that inhibit the resilience of the city following the formerly identified shocks and stresses.

BUILDING RESILIENCE

Through engagement with Cape Town's stakeholders, it was identified that resilience engineering, citizen communication and engagement, strengthening local governance and improving social equality would all positively contribute to the resilience of the city's urban water system.

One of the main focuses of the CWRA is to understand who the city engages, not just within the basin it resides in but also the other sectors that rely on water and that influence the use of water. The key interdependencies between the water system and city systems identified within Cape Town are solid waste and sanitation / drainage system, city planning and livelihoods and economy. This is due to the disposal of solid waste using the combined sewer and stormwater system, lack of planning has resulted in dwellings still being constructed within flood plains and the significant impact of the recent drought the cities, resulting in job losses and restrictions on water.

1

BACKGROUND

Cape Town is world renowned for its stunning natural beauty and biodiversity, making it one of the most popular tourist destinations in the world. It is located on South Africa's southwest coast. It is the location of the Table Mountain—one of the New Seven Wonders of Nature—and two UNESCO World Heritage sites—the Cape Floral Region and Robben Island (CCT, 2018c). Climate change is a major stress in the region, and Cape Town is particularly vulnerable to its impacts, which are expected to become more frequent and intense. The city, as well as the surrounding province, are currently confronted with a severe three-year drought, with recent annual rainfall levels being among the lowest in recorded history. The people of Cape Town have responded to the possibility of what has come to be known as "Day Zero" by curtailing consumption by more than 50% compared to pre-drought consumptions levels (CCT, 2018d).

Table top mountain, Cape Town

POPULATION

Comprising four million inhabitants, Cape Town is the second most populous city in South Africa and is one of its fastest growing cities marked by a population increase of 1.6% between 2015 and 2016 (CCT, 2018c). Cape Town is the capital of Western Cape Province and is also the seat of South Africa's parliament and its legislative capital. Due to Cape Town being an employment hub, it attracts many migrants but struggles to keep up the pace of migration. (SA, n.d.)

ECONOMY

Cape Town is one of South Africa's main economic centres and contributes about 9.4% to the national GDP and roughly 83% of the economy is in the formal sector (CCT, 2018c). At the same time, however, there is a high rate of unemployment (22.7%), especially among young people and a steady decline of employment opportunities for low and semi-skilled workers. There are high levels of poverty and economic inequality in Cape Town, with a wide gap between rich and poor. About 20% of the population lives in informal settlements. The city's Gini coefficient which is the most commonly used measurement of inequality, like South Africa's, remains high and is currently at 0.62 (CCT, 2018c).

The city has a R44.3 billion (USD 3.23 billion budget for the financial year 2017/2018 (CCT, 2018c). 34.4% of this budget is allocated to the Informal Settlements, Water and Waste Services Directorate to provide basic services to all Capetonians and to improve infrastructure for the poor (CCT, 2018c).

The drought has put significant pressure on Cape Town's budget due to reduced revenue, additional costs for water supply augmentation schemes, business impacts within the city, and external investment. In March 2018 Moody's Investor Service (Moody's) gave Cape Town a Baa3 rating with a 'negative outlook' due to what it termed "the current challenges associated with the water crisis" (CCT, 2018c).

GOVERNANCE

The Constitution of the Republic of South Africa, 1996, provides for three spheres of government: national, provincial, and local (municipal). The Constitution describes the spheres of government as distinctive, interdependent, and interrelated (The Constitution of the Republic od South Africa, 1996). Each of these spheres of government is made up of executive and administrative components. The executive components consist of the elected government for that specific sphere of government.

The Western Cape Government is the relevant provincial government. The City of Cape Town (CCT) is a metropolitan municipality and the relevant local government authority.

At the national level, the Minister of Water and Sanitation and the National Department of Water and Sanitation (DWS) are responsible for water and sanitation policy, regulations, oversight, and data collection. It is the local government that act as Water Services Authorities (WSAs) and often also as Water Service Providers (WSPs) for all communities in their areas of jurisdiction. (DWS, 2018a) (DWS, 2018b) .

Relations between the three spheres of government are governed by the principles of co-operative government and intergovernmental relations. However, the City of Cape Town acknowledges room for improvement in intergovernmental relations between the city and national government regarding water.

Coordination across government, the agricultural sector and other water users are undertaken at a catchment or regional level, through the Catchment Management Agencies (CMAs). CMAs also have a duty to involve local communities within the framework of the national water resource strategy. Where CMAs are not established, the national government undertakes management functions. Only two of nine CMAs have been established and functional, in terms of the National Water Act (DWS, 2018b).

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RESEARCH METHODOLOGY

Engagement with Cape Town occurred over three stages:

STAGE 1	The first step was desktop data collection on the biophysical characteristics of the basin and identification of key water governance actors. Data and information on the city's basin(s) and governance was collected and a spatial map of the city's basin and a stakeholder map produced.
STAGE 2	Arup undertook a fieldwork mission in Cape Town 18–30 June 2018 to build on the desktop work by engaging in-person with stakeholders. The fieldwork involved 139 people from various government organisations, businesses, academia and community groups. The fieldwork included: - Organising two workshops: one on the development of the resilience assessment tool and one on the governance of Cape Town's water system; - Interviewing eight decision-makers and water experts from the Western Cape Province and City of Cape Town; - Managing seven focus group discussions and 23 questionnaires; - Participating in site visits to Block 6, Marruy and Tshatshalaza informal settlements; the Strandfontein desalination plant and the Phillipi horticultural village; the Steenbras and Theewaterskloof reservoirs and farms in the Elgin agricultural area; and the Source to Sea river project in the Zandvlei Estuary; - Attending the C40 Event on Water Resilience; the Adaptation Futures Conference Building Water Resilience in Cities Session; and a presentation by the Danish Environmental Protection Agency on 'Augmenting bulk water supply with private borehole water: a feasibility study'.
STAGE 3	This report summarises initial findings from the Cape Town fieldwork and the desktop study to inform development of the City Water Resilience Framework (CWRF).

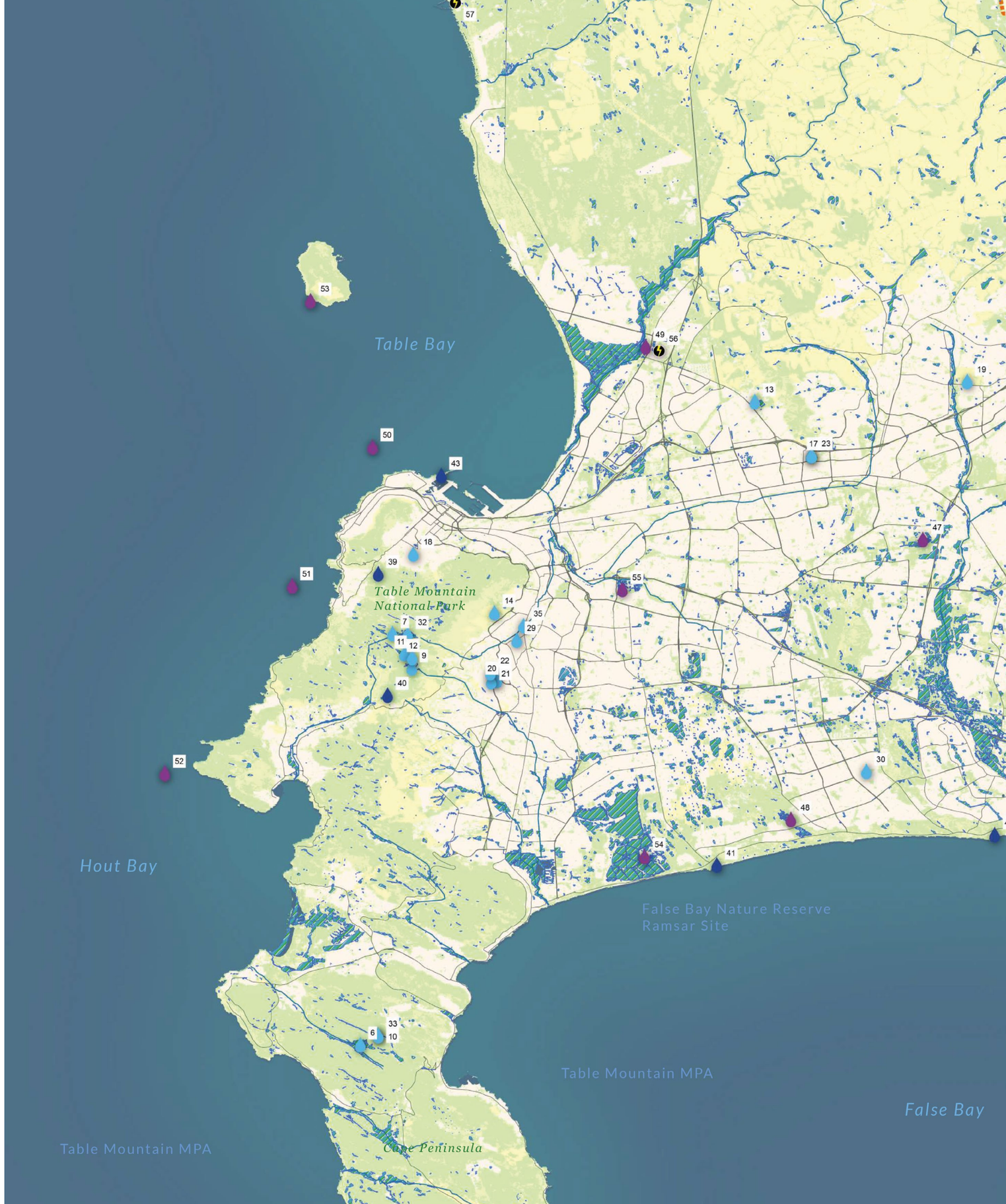
Engagement with 'Wave 1' cities included a two week field mission, where workshops, focus groups and interviews were conducted.

Engagement with 'Wave 2' cities included remote support to city partners where surveys and interviews were conducted.

3

UNDERSTANDING CAPE TOWN'S WATER SYSTEM

Cape Town water basin map



WATER SUPPLY

Rainfall is highest in the mountainous areas of western South Africa, often exceeding 2,000 mm compared to parts of Cape Town that only receive 300 mm (CCT, 2017b). This area, called the Mountain Fynbos Catchment, includes the Hottentots Holland, Riviersonderend, Wemmershoek, Wellington, and Porterville mountain ranges. Located north and east of Cape Town, these mountains are the source for almost all the water supply for the City of Cape Town (CCT) and the surrounding area. This network is called the Western Cape Water Supply System (WCWSS).

The WCWSS uses fourteen dams and their reservoirs to supply its consumers. The six largest dams supply 99.6% of the water supply and the remaining dams supply 0.4% (CCT, 2017b). WCWSS provides 64% of its water to Cape Town, 29% to the agricultural sector, and 7% to other municipalities, including Drakenstein, Stellenbosch and Witzenburg within the Western Cape Province.

The reservoirs operate as a system—connected by pipelines, canals and tunnels—that allows water to be transferred between reservoirs to help optimise water resources across the WCWSS (CCT, 2017b). For example, the Steenbras Upper Reservoir is kept as full as possible due to its high elevation, thus providing water distribution over a wider geographic area.

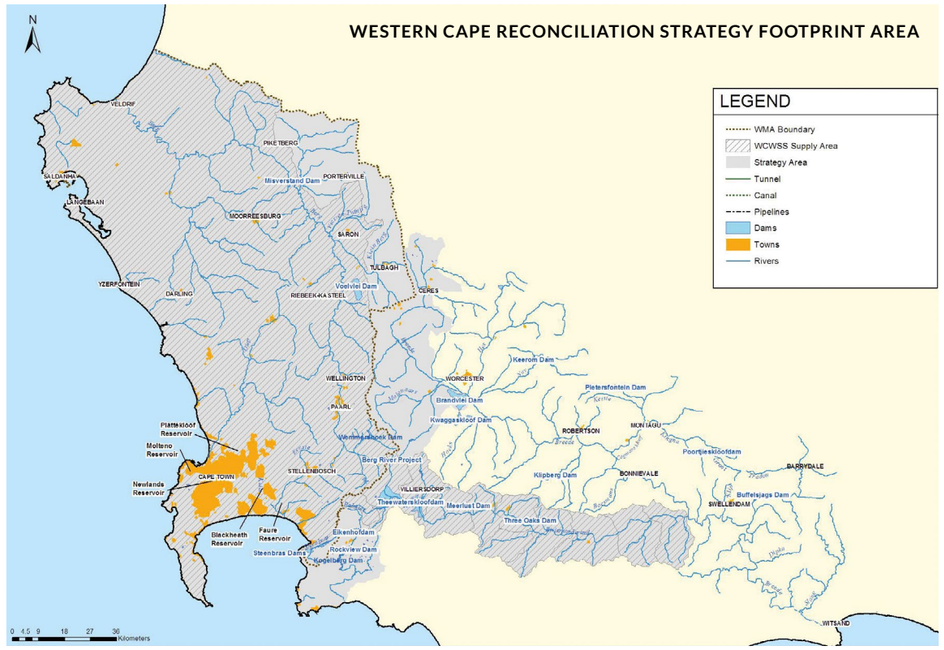
Within the City of Cape Town, 98% of the bulk water supply comes from the WCWSS (CCT, 2017b). The remaining 2% of water is supplied through alternative sources. Currently the city is abstracting groundwater from the Atlantis Aquifer, however, Cape Town are in the feasibility stages of exploring water sources from the Table Mountain Group (TMG) Aquifers and Cape Flats Aquifers (CCT, 2018d). The City of Cape Town has also recently begun to use springs (Albion spring, 3MLD; Oranjezicht, 1MLD) and rivers (Lourens River, 3.5MLD) as a water source (CCT, 2018d). Cape Town has also constructed temporary desalination plants at Strandfontein, V&A and Monwasbi and is considering whether to invest in permanent desalination (CCT, 2018d).

The City of Cape Town provides water and sanitation services to more than 3.74 million people via water and sewer connections that supply nearly 650,000 properties (CCT, 2017b). Customers are industrial, commercial, and domestic—both formal and informal settlements. The city provides treated drinking water to Drakenstein (Paarl) and Winelands (Stellenbosch) municipalities (CCT, 2017b). However, Cape Town is growing and on average, DWS provides connections to 8,500 new customers annually (CCT, 2017b).

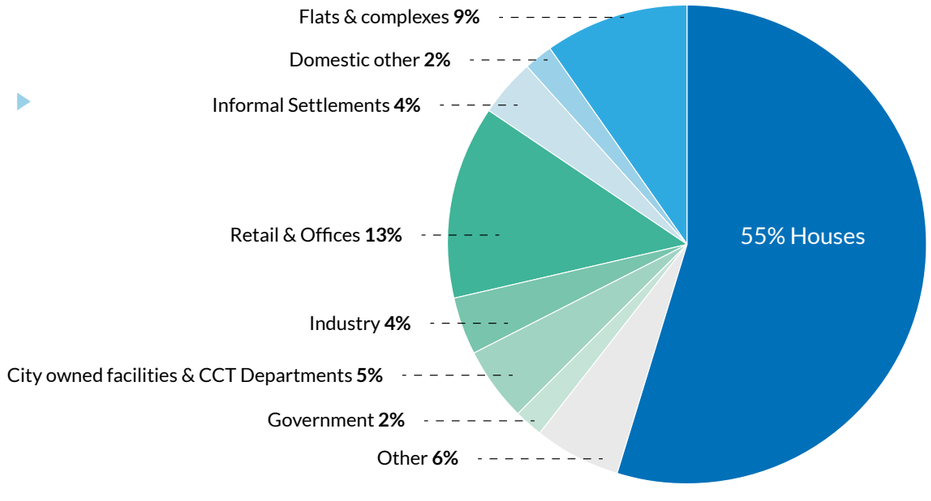
In addition to the water that WSD supplies, there are many consumers (both domestic and commercial) that have private boreholes. The quantity of water abstracted by private boreholes is currently unknown, however, from existing licenses, it is estimated at 63 MLD.

Underdeveloped upstream catchment areas provide excellent water quality. However, poor catchment management can have a negative effect on the quality and quantity of the water supply: poor agricultural practices can impact water quality while alien invasive species exacerbate water scarcity because they use more water than indigenous species (CCT, 2018c).

Water Basin for Cape Town (DWAF, 2007)



Water Usage in 2016/2017 by Consumer Type in Cape Town (CCT, 2017b)



WASTEWATER

The City of Cape Town treats its water at 12 treatment works ranging in treatment capacity from 3 MLD, at Constantia Nek to 500 MLD at the state-of-the-art Faure Treatment Works (CCT, 2017b). The City of Cape Town operates 17 wastewater treatment works (sewerage works) and six smaller facilities (CCT, 2017b). Wastewater undergoes a closely monitored treatment process including screening, filtration, primary and secondary treatment and disinfection) before being discharged into rivers, canals, vleis (temporary wetlands), underground water bodies called aquifers, or the sea (CCT, 2017b).

In locations where there is more effluent than the wastewater works can treat, the City of Cape Town operates three pumped marine outfalls that discharge wastewater deep underwater far out to sea where the effluent is dispersed. Effluent is screened prior to discharge (CCT, 2017b).

Treated effluent, or recycled water, is wastewater first treated at wastewater treatment (sewerage) works and then piped (via a separate network of pipes) to various consumers. In Cape Town, recycled water is used only for irrigation and industrial purposes. Cape Town recycles 5% of all water used (CCT, 2017b).

SURFACE WATER

Within the city, surface run-off either infiltrates sand flats and recharges the aquifers, or it drains into channels, ponds, and rivers—ultimately draining into the Atlantic Ocean (CCT, 2017b). Many of the rivers in Cape Town have been channelized to increase flow volume capacity and move more efficiently during floods. However, channelisation reduces its biodiversity benefits. During the rainy season temporary wetlands, called vleis, occur. In vleis, water is stored temporarily and then infiltrates the ground to recharge the aquifer or drains into rivers (CCT, 2018a). Some of the vleis in Cape Town have permanently changed. They have either been drained or filled for housing development or become permanent lakes for stormwater drainage (CCT, 2018a).

Theewaterskloof Reservoir

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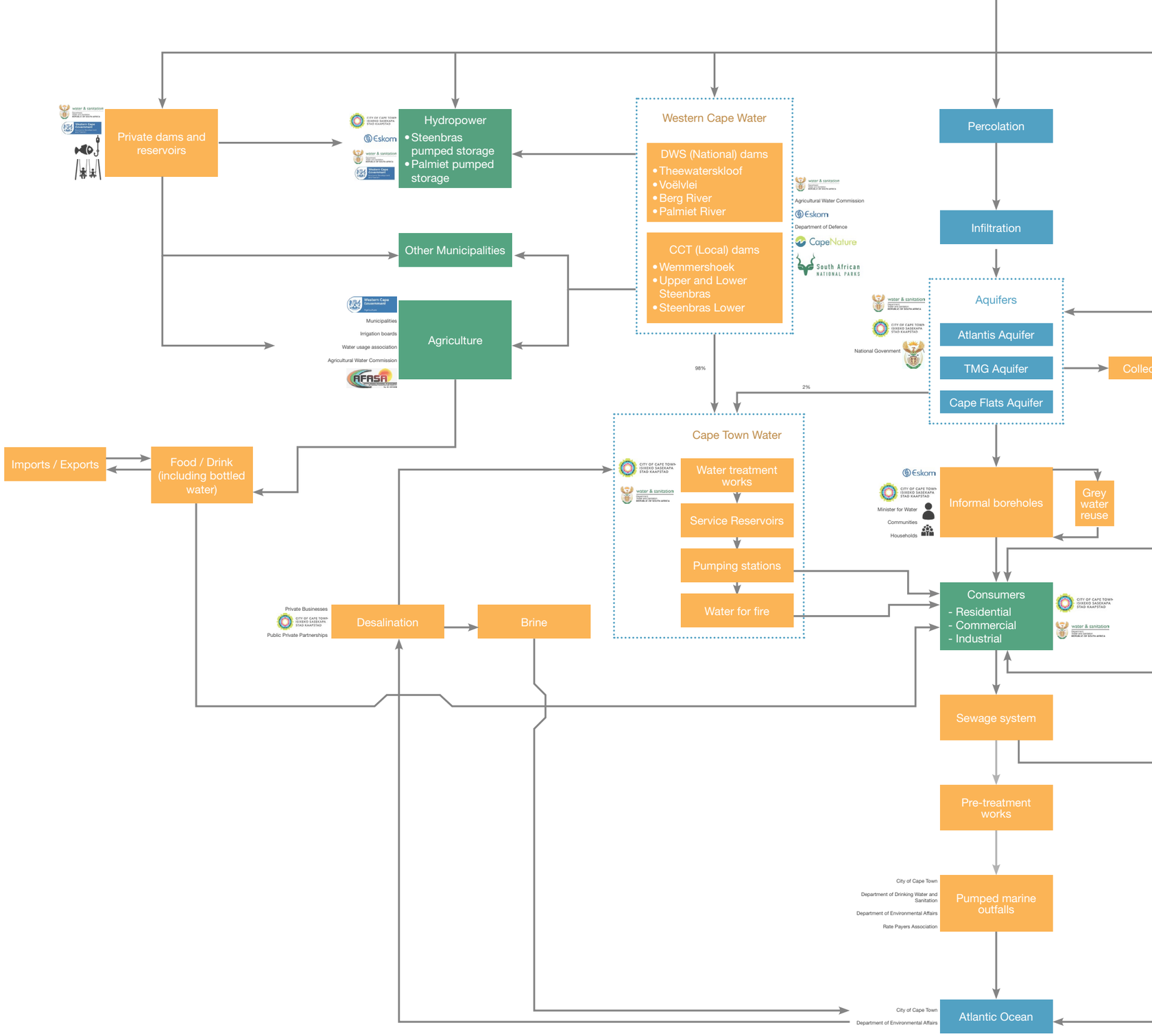
ENGAGEMENT WITH KEY STAKEHOLDERS

The Arup team conducted a series of workshops with stakeholders to better understand the shocks, stresses, opportunities and challenges confronted in Cape Town. During workshops, participants were asked to describe actors involved in each component of the system. Participants identified lead and supporting actors against eight governance functions for three shocks and stresses: drought, flooding, and inadequate water supply and sanitation. This enabled governance gaps to be identified, for example, lack of a leading institution or lack of an adequate oversight. The joint exercise of mapping the water system and identifying the institutional arrangement of the water system was for mutual learning: to understand the water system and understand the institutional arrangement of the city water system. It was also seen as the first step in aligning the objectives of different institutions.

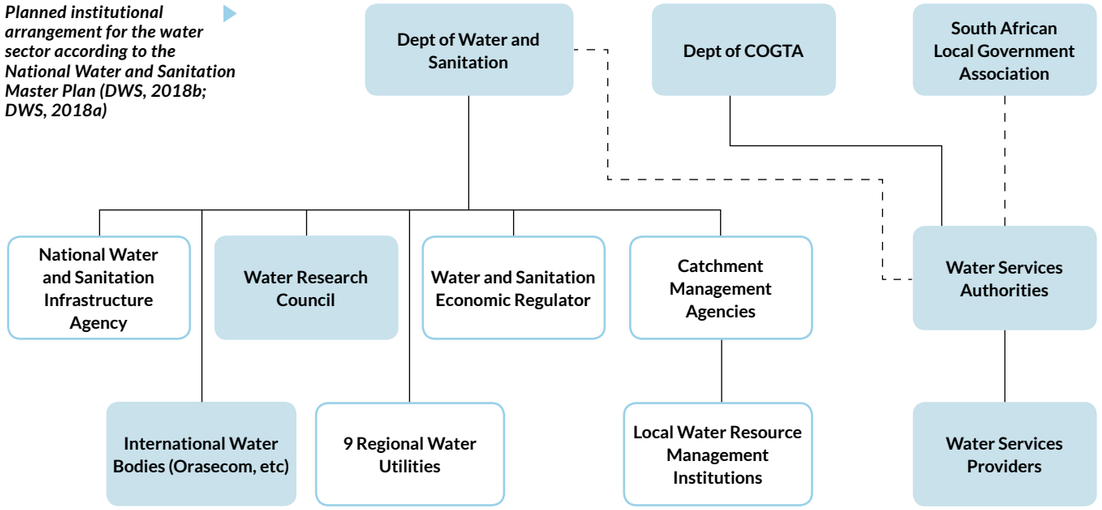
Attendees were also asked about key shocks and stresses confronted in Cape Town, and how various shocks or stresses would impact the water system. This step allowed reflections on the interlinkages between the components, but also between the different stakeholders and how they need to work together during a shock or stress.



For complete Water Cycle Governance diagram see Annex A

STAKEHOLDER COMMENTARY

Planned institutional arrangement for the water sector according to the National Water and Sanitation Master Plan (DWS, 2018b; DWS, 2018a)



Regulatory responsibilities for the water and sanitation sector as per the National Water and Sanitation Master Plan (DWS, 2014)

Cabinet	Develops national policy and sets national development framework
Parliament	Develops legislation; reviews implementation of legislation
Dept of Environmental Affairs	Regulates solid waste management, wetlands protection, biodiversity/ conservation protection, etc; EIAs for major projects, including dams
Provincial depts of environment	Set provincial norms and standards approve EIAs
Dept of Transport	Regulates water-based transport
Dept of Agriculture	Regulates lad-use, alien invasive plants
National treasury	Regulates use of public funds
Courts	Adjudicate water-related cases
SABS	Sets national standards for water sanitation
Water service authority	Regulates provision of water supply and sanitation in its area of jurisdiction; enforces by-laws
Water tribunal	Adjudicates cases brought by water users against CMA/DWA
Catchment Management Agency	Develops catchment management strategy; regulates water use in WMA (quality and quantity) and issues water and authorisations where functions have been delegated by DWS
Dept of Water and Sanitation	Regulates and authorises raw water use and waste discharges; regulates dam safety; regulates all water sector institutions; regulates the provision of water supply and sanitation and tariffs through national norms and standards

BASIC SERVICE PROVISIONS

For Cape Town, it is the City of Cape Town (CCT) that serves as the Water Services Authority (WSA) and often also as Water Service Provider (WSP). At the national level, the Minister of Water and Sanitation and the National Department of Water and Sanitation (DWS) are responsible for water and sanitation policy, regulation of water supply and sanitation provisions, oversight of water sector institutions, water resources planning, regulation of water use, and collection and assessment of water data (DWS, 2018a; DWS, 2018b). Established to fund the Lesotho Highland Water Project, the Trans Caledon Tunnel Authority (TCTA) now funds, implements and manages the debt of variety of water resources projects as an implementing agent for DWS (DWS, 2018a).

RISK MANAGEMENT

The Minister of Water and Sanitation and DWS are responsible for operation and maintenance of 342 large dams nationally. Cape Town is primarily responsible for water treatment and reticulation as well as wastewater treatment and managing rivers and stormwater systems (DWS, 2018a). In the future, according to the National Water and Sanitation Master Plan of 2018, a National Water and Sanitation Infrastructure Agency (NAWASIA) will be established with the primary responsibility of developing, operating and managing national water infrastructure and will develop new capability around bulk sanitation provision (DWS, 2018b). As an institution for research, development and innovation (RDI) on water and sanitation issues, the Water Research Commission (WRC) undertakes water-related research activities for DWS (DWS, 2018a). CCT and DWS each oversee some of the reservoirs used by Cape Town.

ECONOMIC AND SOCIO-CULTURAL

The Minister of Water and Sanitation and DWS are responsible for meeting the water demands of cities, industries, mining and agriculture. Community Organisation Resource Centre (CORC).

Case study

GreenCape Organisation

GreenCape is a non-governmental organisation (NGO) that supports green economy businesses and investors in the Western Cape and governments in building a resilient green economy. CCT and the Western Cape Government fund GreenCape. During the drought, GreenCape in collaboration with Wesgro, Cape Town and the Western Cape's Tourism, Trade and Investment Agency, has supported businesses to become more water efficient and adapt to water scarcity in the long run. The organisation developed a 'Sustainable Water Use Journey', a four-step plan for businesses to follow. The plan provides differentiated information and support on water conservation and water efficiency targeted at different types of businesses and their different needs (GreenCape, 2018). The programme also provides workshops for businesses on coping with drought plus additional information on how to get involved with the water sector, how to adapt to the 'new normal', and how to access an information sharing and networking platform for businesses (GreenCape, 2017).

KEY PROGRAMMES

Some key existing projects and programmes related to water and resilience have been identified:

1. Western Cape Water Supply System Reconciliation Strategy Study (WCRSS)

The Department of Water Affairs and Forestry (DWAF), together with the City of Cape Town, commissioned the Western Cape Reconciliation Strategy Study (WCRSS) to facilitate the reconciliation of predicted future water requirement scenarios with supply from the Western Cape Water Supply System (WCWSS) for a 25-year planning horizon. The 2007 study seeks to provide a decision support framework to facilitate timely decision making about the appropriate water resources, water conservation, and water demand management interventions necessary to ensure that the future water requirements can be met on a sustainable basis. A 2014 status report on the programme has been completed.

2. New Water Programme

In response to the current three-year drought that Cape Town is facing, CCThas developed a New Water Programme (CCT, 2018e). This programme includes:

- An augmentation plan to diversify water supply, including short-term temporary desalination, groundwater abstraction, springs, and water re-use to avoid the severe restrictions experienced in 2017 and 2018.
- A demand management strategy using water restrictions, leak management, district metering, pressure reduction and water management devices, as well as the Day Zero communication and education campaign and its enforcement.
- The Critical Water Shortages Disaster plan (CCT, 2017a), which is CCT's operational blueprint in the unlikely event of critical water shortages.

3. Cape Town's Water Strategy

The City of Cape Town is developing a long-term water strategy to ensure that the City has reliable and cost-effective access to water to meet the needs of its customers. The strategy is expected to be passed by the council in the first quarter of 2019.

4. Cape Town Resilience Strategy

In May 2016, Cape Town was selected to be a part of 100 Resilient Cities (100RC), pioneered by the Rockefeller Foundation. 100 Resilient Cities is a global network of cities committed to building urban resilience in the 21st Century (Cape Town's Resilience Challenge, 2018). As part of this journey, each city is creating its own city resilience strategy, which will cover a broad range of shocks and stresses and city systems. Cape Town is embarking on the development of a resilience strategy through a combined City Resilience Framework and City Resilience Index process. CCT completed its Preliminary Resilience Assessment in April 2018 (CCT, 2018c) and is planning to launch its strategy in December 2018. The Preliminary Resilience Assessment identified four discovery areas which will underpin Cape Town's Resilience Strategy, as shown in table on the right.

City of Cape Town's Discovery Areas (CCT, 2018c)

		ENABLERS: SOCIAL COHESION	FUNDING RESILIENCE	MAINSTREAMING RESILIENCE IN CITY DECISION MAKING	KNOWLEDGE MANAGEMENT AND DATA
Fire **Rainfall flooding** **Storm surge** **Heatwave** **Drought**	- Food insecurity - Traffic congestion - Rapid urbanisation - informal settlements - Inadequate public transport - Lack of affordable housing	▶ CONNECTED, CLIMATE ADAPTIVE CITY			
Civil protest **Disease outbreak**	- Crime & violence - Poverty - Substance abuse - Lack of social cohesion - Racism - Trauma	▶ COMPASSIONATE, HOLISTICALLY HEALTHY CITY			
Infrastructure failure **Power outage** **Financial/ economic crises** **Cyber attack**	- Unemployment - Poverty - Inadequate public transport	▶ CAPABLE, JOB CREATING CITY			
Drought **Cyber attack** **Rainfall flooding** **Fire** **Disease outbreak** **Nuclear incident**	- Food insecurity - Climate change - Poverty - Lack of social cohesion	▶ COLLECTIVELY, SHOCK-READY CITY			

DISCOVERY AREAS

Case study

Slum/Shack Dwellers International (SDI / CORC)

Slum/shack dwellers international (SDI) is a network of community-based organisations of the urban poor that is active in 32 countries (SDI, 2018). The South African-based Community Organisation Resource Centre (CORC) is an affiliate of SDI. CORC supports social processes in community-based organisations and facilitates engagements with formal actors, e.g. the local and provincial governments. CORC facilitated the self-organisation of water committees across some of Cape Town's informal settlements, thus enabling these communities to learn from one another and to create solidarity and unity to broker deals with formal institutions. CORC and SDI have several ongoing projects within informal settlements in Cape Town (CORC, 2018). These include:

Re-blocking
Blocking out or re-blocking refers to the reconfiguration and repositioning of shacks in very dense informal settlements, allowing residents to better use the available space, as well as allowing for better service provision to these areas. Re-blocking is done in clusters identified by the community itself and strives to create publicly used 'courtyards' within the clusters, creating a safer environment for residents and space to install better water, electricity, and sanitation services; access for emergency services; and primary and secondary road hierarchies. In addition to improving the physical infrastructure, these projects strengthen social cohesion within settlements and build stronger partnerships with local government and social mobilisation. These projects also limit internal displacements and increase tenure security (SDI South African Alliance, 2013).

A cluster of 20 households and 50 inhabitants was re-blocked in 2014 in the Kuku Town settlement in Cape Town. The ground was cleared and levelled. Then old homes were taken down, rebuilt with inverted box-rib (IBR) steel sheets for higher fire resistance, and raised to mitigate flooding. The new arrangement created a L-shaped pathway in the middle of the cluster for public use. The project was financed through a three-year collective savings scheme by residents and was implemented in partnership with SDI, CORC and the CCT, with the city funding and installing one-on-one water and sanitation services in the cluster (SDI South African Alliance, 2014).

KnowYourCity
A joint initiative of SDI, Cities Alliance and UCLG-A, KnowYourCity focusses on empowering informal communities through data. The initiative supports the use of community driven data to facilitate partnerships for collaborative planning and development for and with the communities. Within the project, communities collect data that tracks and demonstrates living conditions in informal settlements. The initiative focusses on collecting data on socio-demographic dynamics, types of land occupied and the condition of infrastructure. The data documenting conditions are a tool to empower informal settlement dwellers to proactively engage in changing their communities, to provide the community with a stronger position when negotiating with authorities, and to inform bottom-up policy formation (World Urban Forum, 2018).

5

CHARACTERISING RESILIENCE

CRITICAL INTERDEPENDENCIES

The urban water system does not exist in a vacuum. In fact, one of the main focuses of the City Water Resilience Approach is how the water system within the city engages not just with the full basin it belongs to but also the other sectors that rely on water and that influence the use of water. There are key interdependencies between city systems and the water system within Cape Town.

SOLID WASTE AND SANITATION/ DRAINAGE SYSTEM

Inadequate solid waste management provision has resulted in inappropriate disposal of solid waste using the combined sewer and stormwater system. Such actions block and overflow the sewer systems, causing health hazards and pollution. The additional burden of clearing these blockages increases operational costs, which ultimately leads to higher service charges. CCT experiences 300 sewer blockages every day. There is also a lack of provision in Cape Town's Integrated Development Plan for space to build green infrastructure for stormwater management.

CITY PLANNING

Fieldwork participants reported that in Cape Town dwellings are still constructed within flood plains due to inaccurate flood prediction and continued land pressures.

LIVELIHOODS AND ECONOMY

The drought has had a significant impact on the agriculture sector in the Western Cape Province. Agricultural production has declined by 20% due to the drought, corelating to job loss. The drought restrictions, increased water tariffs, and uncertainty about the legality of alternative water sources, has resulted in uncertainty for businesses. Companies hardest hit have been those in food and beverage production, construction, manufacturing, tourism and pharmaceuticals. For example, the construction group Calgro M3 scaled down the development of residential units to conserve water.

KEY SHOCKS AND STRESSES

When analysing current vulnerabilities and understanding future risks scenarios for Cape Town, many stresses and shocks already impacting citizens were identified. Gathered below is a list of the top factors that currently hinder resilience.

Drought

Cape Town has experienced a three-year drought due to lack of rainfall and the resulting availability of surface water sources. This has had significant impacts on businesses, residents and the environment in the city of Cape Town.

Groundwater Depletion/Over-Exploitation

The significant number of private boreholes drilled in Cape Town during the current drought has led to concerns about over-abstraction and pollution of groundwater. Currently, at least 22,000 private boreholes exist in Cape Town. Managing groundwater supplies faces challenges of limited city regulation and enforcement and limited availability of groundwater data and modelling.

Flooding

Surface water and fluvial flooding have been identified as regular occurrences in the wet season in Cape Town. Much of Cape Town is at risk of flooding due to combination of annual winter storms and heavy rains, the steep mountainous slopes generating high amounts of runoff, the large expanses of low-lying land (the Cape Flats), and a high water table. Flooding across Cape Town is exacerbated by contributing stresses of increasing impervious nature of catchments and channelisation of water courses, land pressure resulting in construction in flood plains and flood models that have not been updated to reflect climate change.

The city experiences differing frequency and intensity of flooding. Flooding is less frequent in parts of the city where the land use is regulated and stormwater infrastructure is provided. In informal settlements, flooding is a continuous stress, particularly in the wet season due to a lack of formalized stormwater drainage, wetlands and low-lying lands with water logged sandy soils, and the erection of structures in marginal lands including detention and retention ponds.

Poverty and Inequality

Cape Town is also grappling with the challenge of overcoming its divided past. Twenty-four years since the end of Apartheid and the establishment of a democratic government, Cape Town has made progress in certain aspects of human development, for example, access to water, electricity, basic education and healthcare (CCT, 2018c). However, a large number of Capetonians still live with the legacy of Apartheid on a daily basis through chronic stresses such as high unemployment, poverty, crime, substance abuse, lack of availability of affordable housing, and unequal access to basic services such as water and sanitation (CCT, 2018c). For example, CCT cannot provide basic services (electricity, drinking water, sanitation) where informal settlements are located within wetlands and detention and retention basins and are therefore at a high risk of flooding. One in five Cape Town inhabitants lives in an informal settlement.

The socio-economic inequalities in the city lead to different challenges within the same city, for example, in informal settlements, the major challenge is flooding, where as in formal communities, drought was the major challenge.

Fire

During the dry season, wildfires are a risk in Cape Town. The majority are caused by human activities such as cooking, reckless disposal of cigarettes, and burning waste. Sometimes, however, lightning strikes are the cause. In 2015 significant wildfires across the Cape Peninsula resulted in one death, 13 damaged properties, 56 injuries, and over 6,900 hectares of burnt land.

Shack fires are a common occurrence in the informal settlements in Cape Town. They are generally started by cooking stoves, particularly in areas that do not have electricity. Shack fires spread quickly due to poor building materials and the close proximity of shacks, thus affecting many people due to high population densities in informal settlements. They are difficult to fight, as fire fighting vehicles can often not access the settlements, so low water pressures in some places makes shack fires difficult to fight. Additionally, when firefighters can respond there is a delay from the lack of formalised settlement names and addresses. In March 2017, a fire broke out in the Imizamo Yethu informal settlement in Cape Town, destroying 3,500 structures and displacing 15,000 people.

Lack of Hygiene and Sanitation

Most informal settlements have flush toilets; however, it is not always possible to place flush toilets in areas that are vulnerable to flooding, on private land, on unstable ground or so densely settled that there is no room for water infrastructure. If flush toilets cannot be provided, alternative toilets (for example, chemical toilets, portable flush toilets and container toilets) are provided and maintained by the city. CCT currently maintains over 50,000 toilets and over 100,000 communal standpipes in informal settlements throughout the city.

Residents of the informal settlements reported that there were often maintenance issues with the sanitation facilities provided, including frequent blockages and sewage spills and irregular servicing by service providers. The lack of adequate hygiene and sanitation, as well as faecal pollution in the informal settlements, results in higher incidence of diarrheal disease amongst residents.

Contrary to what some people believe, informal settlements use water very efficiently. Whilst they represent 15% of households in the city, they account for only 4% of Cape Town's water usage (CCT, 2018d).

Recognizing this as an issue, Cape Town has a target of one shared toilet to a maximum of five households and one tap to 25 households and within a maximum walking distance of 200 metres.

Loss of Ecosystem Services: Amenity Value of Ecosystem

Land pressures in Cape Town has resulted in increased development in valuable ecosystems—such as vleis—thus damaging wetlands and providing housing in unsuitable locations that suffer from regular flooding. There are a multitude of land owners in the catchment, and complexity is added by CCT's lack of authorization to spend municipal funds on land management outside of its municipal jurisdiction where some of these changes are taking place.

Habitat Loss

Limited investment and land management in the catchment management areas around the six large dams has meant that throughout the catchments invasive species have outcompeted natural flora and fauna. More invasive species, which use more water that local species, has decreased the yield of water into the dams, thus exacerbating water scarcity during low rainfall years (CCT, 2018d).

Failure of Regional or Local Governance

It is not clear that CCT is fully aware and focused on the other shocks and stresses in this list, which may hinder its ability to respond.

The city had limited planning in place for a scenario where there could be city-wide water shortages under severe drought conditions. This resulted in drought management plans and water shortages disaster plans being developed during the crisis. This resulted in a lack of readily available information for the public at certain stages during the drought.

There is also a lack of clarity on roles and responsibilities in relation to the provision of bulk water. The National Water Act 1998 states that the national government is responsible for the provision of bulk water (National Water Act, 1998). However, due to delayed action by the national government during the drought, CCT invested significantly in alternative sources of water during the drought. This investment includes temporary desalination and groundwater sources. The result may be a significant financial burden for Cape Town and its residents.

NGOs discussed the difficulty of progress on multi-disciplinary projects, such as re-blocking of informal settlements or getting water issues such as flooding addressed, because of CCT's siloed departments which shift responsibility to one another.

There is a lack of regulation and enforcement around water issues, for example, groundwater abstractions, alternative water sources and providers, and investment in private augmentation schemes for producing potable water. This hampers efforts to respond to the drought, including the efforts of well-meaning businesses to share their private water supplies. It is also impacting the development of business continuity plans for water-intensive industries, diminishing the confidence in Cape Town's businesses. Lack of regulations and enforcement is also potentially putting the groundwater under the City of Cape Town at risk from over-abstraction and pollution.

Lack of Investment

Although the national government of South Africa is responsible for adequate provision of water, it currently does not have adequate funding, resources, and capacity to fulfil their responsibilities. This has resulted in delays to ongoing water resource projects such as the Berg River Dam.

There is also a lack of contingency funding at a national level for the drought response. This has resulted in a delayed response, as well as additional financial pressure on residents and businesses in Cape Town through increased water tariffs. It also resulted in Moody's downgrading Cape Town's credit rating to Baa3—the lowest investment grade. In taking this measure, Moody's provided the following justification: "The City's credit profile is constrained by Cape Town's severe water shortages, the result of several years of drought, which will have a direct impact on the City's water revenue, as well as having indirect economic and societal effects. The City has increased its capital spending plans, largely because of spending on water-related infrastructure, which will substantially increase its debt."

Case study

Day Zero – A Concept in Mobilizing Collective Action

In January 2017, the threat of the city running out of water soon became a real possibility. On 18 January, the city announced the imposition of severe water restriction, warning that Day Zero—the day when taps would be turned off and Cape Town residents would have to start queueing for water rations—was now virtually unavoidable, with the predicted date set at 21 April 2018. This concern led to the Day Zero campaign to raise awareness of the issue and drive down consumer demands. The communication was multi-channel including TV, local radio, local newspapers, social media and via loud hailer cars. Credibility was provided to the information provided by the alignment of messages from experts of the Section 80 Water Resilience Advisory committee, who spoke on TV and the radio and wrote articles for newspapers. The campaign successfully conveyed a sense of urgency—that all citizens would be extremely negatively affected if the city reached Day Zero.

The campaign was backed-up by concrete data and information easily understood by Capetonians. It included

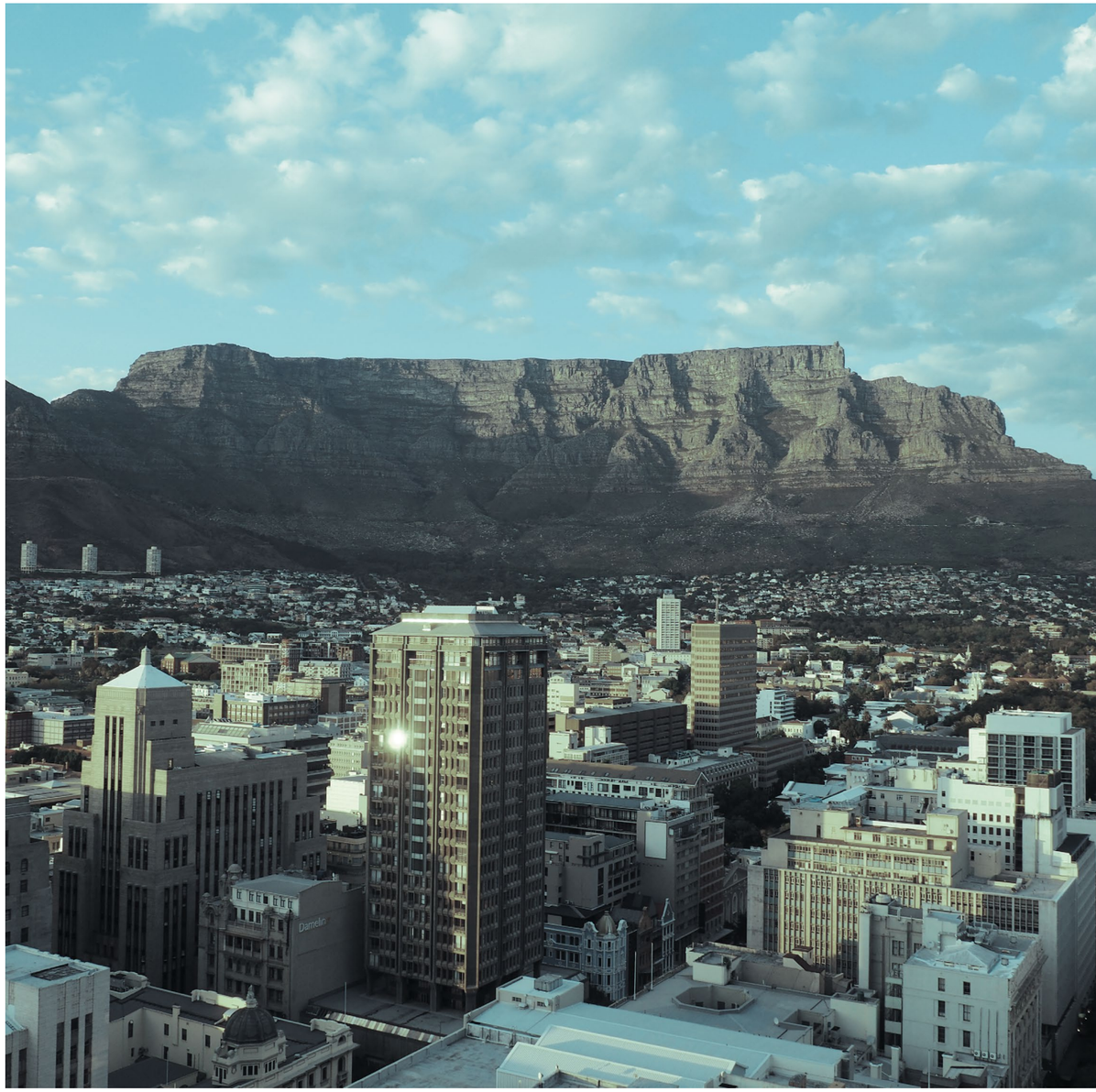
- *A dashboard updated weekly to show the anticipated date of Day Zero along with current dam levels and water consumption (CCT, 2018b);*
- *Widespread information on how to consume only 50 litres per person per day, including posters, a household water usage guide, and an online water use calculator;*
- *A Water Outlook report that identified key CCT interventions in the short and medium term to build trust and certainty with residents and the business community (CCT, 2018d); and*
- *A city water usage map showing individual properties meeting or exceeding restriction targets creating incentives for behavioural change (City Water Map, 2018).*

Fifteen months later (March 2018) despite the absence of rain, the date for Day Zero had been delayed until 2019. This delay was due to many changes in water demand. First, the catchment's commercial agricultural users were shut down once their water allocation was reached. Then, thanks to the Day Zero campaign, a large majority of citizens trusted that there were very few free-riders consuming water above their allocation, which led to a shift in mentality that everyone could contribute to positively impact the crisis. Water consumption was reduced from 930-million litres/day in December 2016, to 630-million litres/day in July and to 520-million litres/day in March 2018 (CCT, 2018b; CCT, 2018d).2,14 This drastic decrease in water consumption, along with farmers of a Water Users Association donating 10-billion litres of water to the city, and water production from alternative sources coming on stream. Overall, the campaign resulted in widespread engagement of citizens, hydro-solidarity, and a shift to collective prioritisation of water for human consumption.

However, the Day Zero campaign also had unintended consequences. The campaign was picked up by international media and as a result, there were negative impacts on tourism numbers and foreign direct investment queries in Cape Town.

6.1

Table top mountain, Cape Town



KEY FACTORS OF RESILIENCE

In each interview and focus group discussion, participants provided examples of factors that helped them coping with shocks and stresses. These factors have been grouped into the following themes of resilience.

RESILIENCE ENGINEERING

The highly connected and flexible nature of the Western Cape Water Supply System has helped Cape Town cope with the drought as CCT was able to move water from areas of surplus to those of deficit and thus minimise losses from reservoirs.

Technological solutions for demand management, such as pressure management and the installation of water management devices in properties, were considered the most-effective demand management interventions. In the rural areas of the catchment, irrigation innovations—such as the use of automated irrigation using soil moisture probes and pump loggers—helped reduce water demand. Another example of resilience engineering was the satellite imagery service, Fruitlook, which allows farmers to compare areas on their farms in terms of actual biomass production, evapotranspiration, and biomass produced per m3 of water consumed by the crop to determine whether they are overirrigating or under-irrigating in certain areas.

CITIZEN COMMUNICATION AND ENGAGEMENT

As mentioned in the Case Study section, the drought brought out more citizen communication and engagement like the 'Day Zero' campaign to drive down consumer water demand in Cape Town. However, participants cited the conflicting information regarding the drought from different spheres of government as hindering their ability to understand the challenge that Cape Town faced.

With the support of Community Organisation Resource Centre (CORC) based in South Africa, informal settlements self-organised into water committees to drive the re-blocking process where shacks are reconfigured and repositioned in very dense informal settlements to better use space and allow better access to basic services. This initiative has resulted in more resilient communities that have a sense of ownership and empowerment about their environment.

Due to the drought, the City of Cape Town has focused on demand reduction with positive results. In January 2018, domestic usage was 500 MLD, down from 1,200 MLD in the summer of 2015 (CCT, 2018d). This improvement has been achieved through active pressure management, leakage repairs, and demand reduction through education which engages the community.

STRENGTHENING LOCAL GOVERNANCE

The transfer of the stormwater management function from the Transport and Urban Development Authority to the Department of Water and Sanitation within the City, is seen as a positive step for a holistic approach to water management and the first step in viewing stormwater as a resource rather than a problem.

The implementation of the City of Cape Town's new Organisational Development and Transformation Plan (ODTP), which has introduced an area-based service delivery directorate and a dedicated Informal Settlement Department within CCT, could improve customer delivery and result in improved customer-centricity.

Cape Town is now strengthening its preparedness and the coordination of its immediate responses from these past experiences and learnings. CCT has focused on ensuring that they make 'no regrets' decisions throughout the drought. This has involved avoiding 'knee-jerk' investments and the development of a water strategy to plan future investments.

IMPROVING SOCIAL EQUALITY

The Critical Water Shortages Plan (Day Zero plan) for Cape Town was developed considering social vulnerability (for example, age of residents, access to transportation, current water demand and number of people sharing a tap). Such vulnerabilities were considered when deciding on which areas of the network to shut down and where to locate water collection points or pods.

Case study
Source to Sea

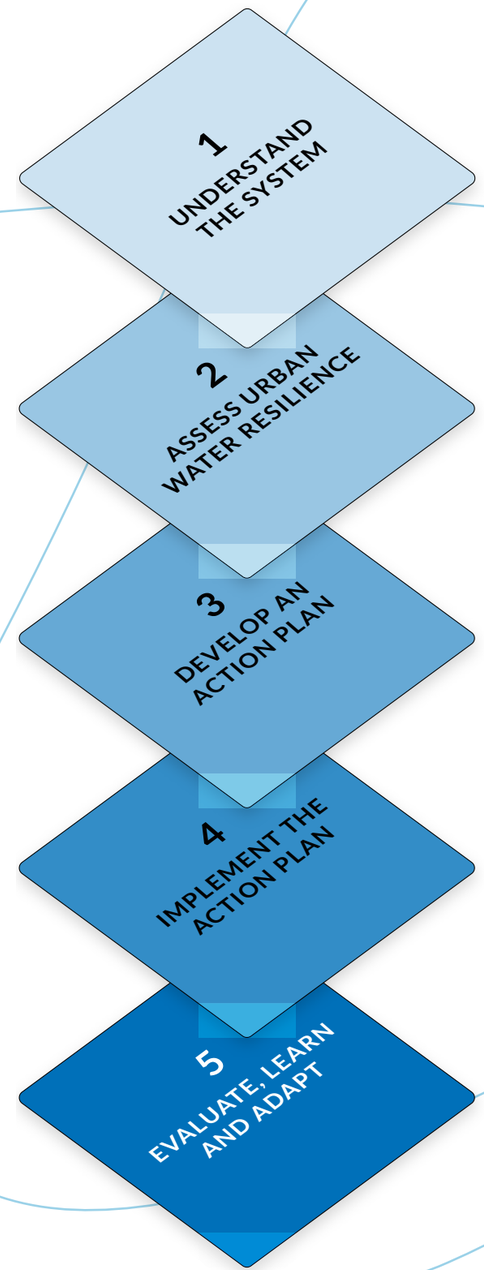
In the past, Cape Town's river systems were seen as a way to dispose of stormwater and pollutants into rivers and ultimately the ocean, which resulted in a hard engineering approach towards urban river management. As a result, these river courses have become negative open spaces—stormwater conduits carry high pollution loads, exotic vegetation has invaded watercourse habitats, and the river courses are now areas of high crime and negatively impact adjacent communities (Cape Town's Source to Sea Project, n.d.).

An initiative between the City of Cape Town, South African National Parks, the Wildlife and Environmental Society of South Africa, and ICLEI-Africa, the Source to Sea project envisions restoring river systems to "maximise urban natural recreational spaces, restoring degraded natural and open space corridors for healthy ecosystems, developing eco-heritage, educational, recreational and tourism opportunities and providing short and long-term local employment opportunities" (The Source to Sea Project, 2016). In other words, it hopes to reimagine how Cape Town's urban rivers function, and how citizens and custodians of the environment interact with them.

The CCT intends to adopt an ecosystems-based approach towards the management of river systems to unlock the many socio-economic and environmental benefits afforded by a healthy river system. The Source to Sea project is beginning with a focus on the Diep River and Prinskasteel/Keysers River, which connect Table Mountain National Park to the Zandvlei Estuary (Cape Town's Source to Sea Project, n.d.).

6

REFLECTIONS ON THE CITY WATER RESILIENCE APPROACH (CWRA)



PERSPECTIVES ON THE FRAMEWORK

In all interviews and focus group discussions, participants discussed the value proposition of the City Water Resilience Approach (CWRA) in the context of Cape Town. The following aspects were highlighted by attendees as being the most valuable.

COMMUNICATION AND ENGAGEMENT WITH CITIZENS AND COMMUNITIES

Participants noted the need for improved communication and knowledge sharing with citizens and communities about the water system. Information shared should focus on institutional roles and responsibilities, the value of water, the risks that Capetonians face, and the trade-offs between tariffs versus protection from those risks. One example would be levels of assurance of supply and how tariffs are a mechanism to ensure water supply during water scarcity times like droughts.

Participants wanted the CWRA to assist citizens and community groups to understand their role in the resilience of the urban water system. A holistic approach to building water resilience could empower citizens' activities and strengthen their impact by connecting other stakeholders doing similar work.

HIGHLIGHT THE VALUE OF WATER

Focus group discussions and workshops framed and perceived water as a problem. The environment focus group suggested CWRA could showcase the value of water in the urban context. For example, CWRA could highlight the environmental and social benefits of wetlands and healthy rivers in cities and thus provide a pathway towards a water-wise city.

MULTI-STAKEHOLDER ENGAGEMENT

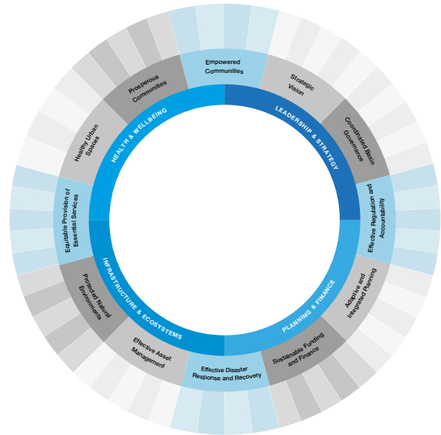
The CWRA brings together diverse stakeholders in the urban water system—government, agriculture, and business, NGOs, and the community—to collectively identify the shocks and stresses they face and to gain collective agreement on their resilience gaps and next steps. The project's value was seen in aligning agendas of different institutions, in highlighting the need for multi-stakeholder integration on projects, and in identifying the mutual benefits of proposed solutions. One suggestion was the CWRA could facilitate the role of Catchment Management Authorities.

RESILIENCE ASSESSMENT, PRIORITISATION AND FUTURE PLANNING

Participants also identified the value that the CWRA could provide in identifying resilience gaps, prioritising actions, and developing a water strategy that has agreement from all levels of government. This value was significant for the Business Focus Group, which emphasised that Cape Town businesses require assurance on water supply and certainty around water legislation.

INTEGRATION WITH OTHER PLANS AND PROGRAMMES

Participants felt the CWRA should be encourage flexibility to integrate existing plans, programmes, and activities of the city.



PERSPECTIVES ON THE CWRF ASSESSMENT TOOL

In the resilience assessment workshop, participants reviewed the City Water Resilience assessment tool and assessed its goals. Participants appreciated the utility of this tool for decision makers and endorsed how the four dimensions of the assessment tool would cover the water cycle from all perspectives.

Participants experienced difficulty in understanding the goals without further description, and feedback stated the goals could be more water focused to be distinct from the City Resilience Index.

The Resilience Department in the City of Cape Town, which recently completed an extensive process for the City Resilience Index, provided some methodological suggestions based on that process including:

- Dividing indicator assessment into focus groups;
- Requiring each participant to provide a comment to justify his/her score to improve the richness of scoring;
- Having a consistent member of the team oversee the focus group discussions and the data analysis;
- Ensuring that the wording of indicators is appropriate for the developed and developing world context (for example, the CRI interchanged the term 'minority groups' with 'vulnerable groups' yet, in developing countries, vulnerable groups may be the majority); and
- Ensuring that indicators are not 'layered' questions, referring to multiple aspects of a topic in one indicator (for example, a single indicator to account for employment, job security, and probability of unemployment).

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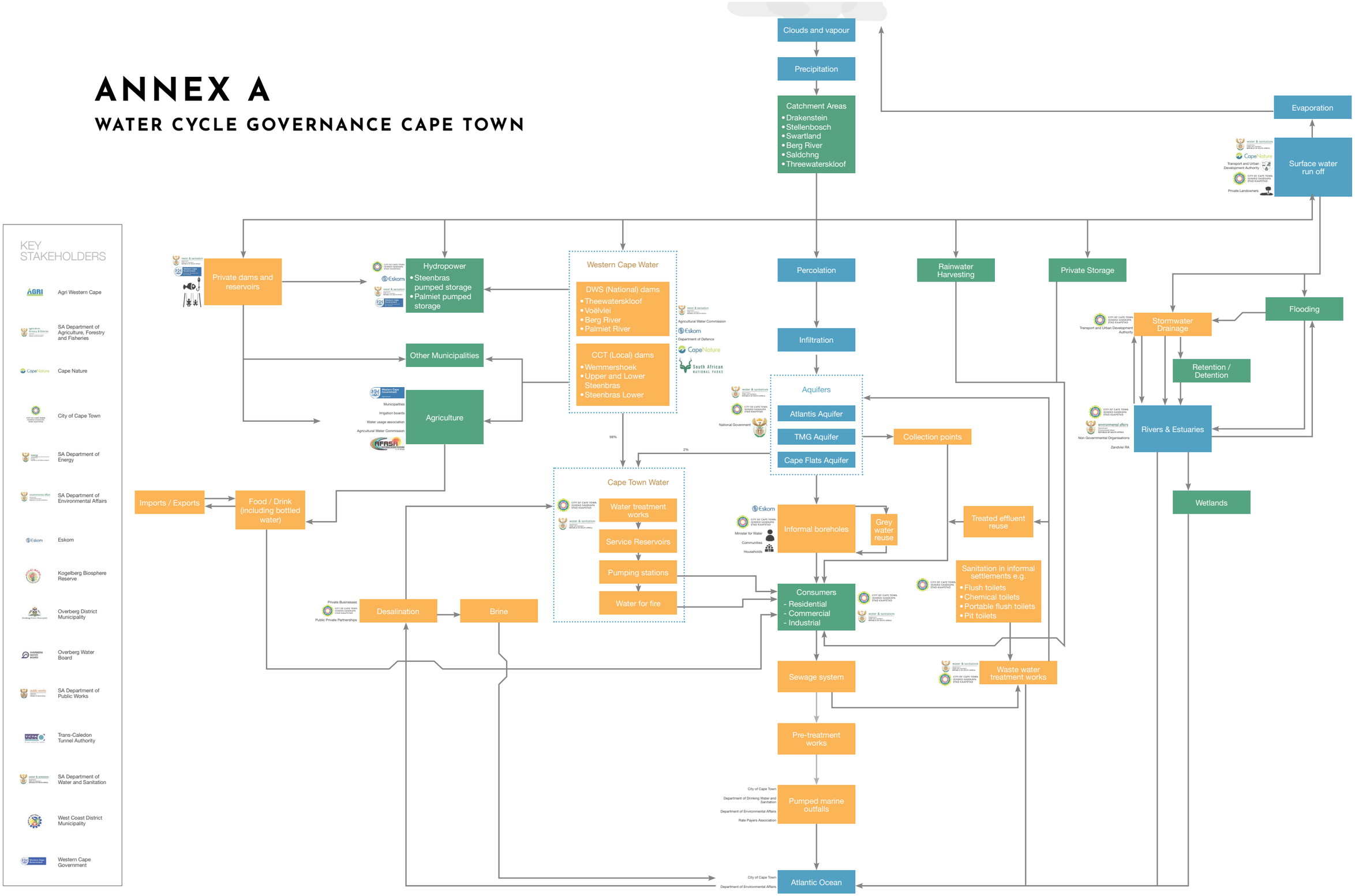
We would also like to thank all participants who gave up their time to share their experiences through the focus groups, workshops and interviews.

We enjoyed four fascinating field trips, and we would like to thank Charlton Ziervogel, Blessing Mancitshana, Moegsien Hendricks (CORC) for organising a visit to Block 6, Marruy and Tshatshalaza informal settlements and a community meeting; Nichilis Tredoux for hosting a tour of the Strandfontein Desalination Plant; Andre Roux for hosting a tour of the Elgin agricultural region, Steenbras and Theeswaterskloof reservoirs; and Stephen Granger for hosting a tour of the Source to Sea river project in the Zandvlei Estuary.
This Wave 1 Characterisation Report was made possible by the support and input from the Resilience Office at the City of Cape Town, Community Organisation Resource Centre (CORC) and Source to Sea Project.

ANNEX A

WATER CYCLE GOVERNANCE CAPE TOWN



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