Water

–

2016
Market Intelligence Report

–

GreenCape

GreenCape

GreenCape is a non-profit organisation that supports and promotes the green economy - low carbon, resource efficient and socially inclusive - in the Western Cape, South Africa. We assist businesses and investors focusing on green technologies and services to remove barriers to their establishment and growth.

Acknowledgements

We thank Raymond Siebrits for the time and effort that went into compiling this Market Intelligence Report.

Subscribe to receive e-mail alerts or GreenCape news, events and publications by registering as a member on our website: www.greencape.co.za

For the latest updates on the water sector, visit the water pages on the GreenCape website or email water@greencape.co.za.

GreenCape

18 Roeland Street, Cape Town, 8001, South Africa

Editorial and review:	Salomé Bronkhorst, Chris Millson, Andrew Payne, Claire Pengelly and Helen Seyler.
Images:	Raymond Siebrits, GreenCape
Cover:	Western Cape Department of Agriculture
Layout and design:	Deep Design

Contents

List of acronyms

CMA	Catchment Management Agency
CO2	Carbon dioxide
CoCT	City of Cape Town
DBSA	Development Bank of South Africa
DEA	Department of Environmental Affairs
DM	District Municipality
DMR	Department of Mineral Resources
DOE	Department of Energy
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DWS	Department of Water and Sanitation
e-WULAAS	Electronic water use licence application and approval system
GIZ	German International Cooperation Agency
ICT	Information and communications technology
IDC	Industrial Development Corporation
IDP	Integrated development plan
kW	Kilowatt
kWh	Kilowatt hour
LM	Local Municipality
MW	Megawatt
NRW	Non-revenue water
NWA	National Water Act (Act 36 of 1998)
NWAA	National Water Amendment Act
NWRS2	National Water Resources Strategy 2
R&D	Research and development
SALGA	South African Local Government Association
SEZ	Special economic zone
SUDS	Sustainable urban drainage systems
SWWTW	Small wastewater treatment works
TMG	Table Mountain Group
UCT	University of Cape Town
WC/WDM	Water conservation and water demand management
WCWSS	Western Cape Water Supply System
WMA	Water management area
WRC	Water Research Commission
WSA	Water Services Act (Act 108 of 1997)
WWF	Worldwide Fund for Nature
WWTW	Wastewater treatment works

List of figures

List of tables

Executive summary

The GreenCape 2016 Water Market Intelligence Report highlights business opportunities for water in the green economy in the Western Cape. It targets investors and entrepreneurs interested in the business of water, and seeks to promote the Western Cape as the leading place to do business in the green economy.

The predominant policy environment and legal framework of water resource management is presented and provides a snapshot of key market forces. Investors and businesses will find insights into the state of water resources and use, key policy and public sector programme activities and green economy opportunities. Horizon technologies, grants and incentives, as well as the role of business in water stewardship, are also unpacked.

Water demand is increasing at a higher rate than population growth, as income levels of towns rise and demands for food and services increase. Water availability, on the other hand, is declining due to competing demands from agriculture and industry, and from deteriorating water quality and climate change. This rising demand and diminishing supply will require careful management of the province's water resources, and carefully placed investments.

The complex water supply system in the Western Cape relies mostly on surface water, which is dominated by a matrix of rivers, dams, pipelines, tunnels and reticulation networks. Different state institutions and private businesses are active and have invested along the value chain. New supply interventions, as well as demand-side mechanisms and green technology, need timeous implementation to avoid constraints on development. Varied business opportunities exist to solve these needs.

The imperative to improve agricultural irrigation efficiency offers large technology and water supply opportunities. Suppliers to public and private alien invasive clearing services and products will also be interested in the growing Western Cape demand for these interventions. Shifts in the approaches to wastewater management (including stormwater and urban drainage, as well as domestic wastewater and treated effluent) to consider artificial recharge, recycling, reclamation, decentralisation and resource recovery are opening new markets and business opportunities. This is at a municipal and private user scale, and green technology applications are steadily increasing.

Further opportunities in the energy-efficiency and water services markets are opening up as renewable energy generation technology becomes viable and energy scarcity increases. These market shifts also hold potential for novel desalination opportunities. Water loss reduction and non-revenue water have become a national priority, providing opportunities for distribution system technologies and new management programmes, as well as smart, integrated metering and billing systems.

GreenCape's Water Sector Desk, which produced this report, serves as a platform for the industry to access relevant information, source assistance in identifying business opportunities and overcoming barriers, and connect to other stakeholders. The Water Sector Desk is part of GreenCape's Resources Programme, which supports the uptake of technologies and practices that enable more productive and sustainable use of natural resources — primarily water and land — in the Western Cape economy.

1 – Introduction

This report seeks to further the development of the green economy within the Western Cape by exploring business opportunities in the water sector and providing a snapshot of the main market forces within this landscape.

Investors and businesses will find snapshots and insights into the state of water resources and use, major policy and public sector programme activities and key green economy business opportunities. Horizon technologies, grants and incentives as well as the role of business in water stewardship are also unpacked.

GreenCape engages in a multitude of events, forums and leadership circles and builds relationships with companies, regulators, investors and entrepreneurs.

This report has been developed through insights from local and global thought leaders and practitioners. Baseline literature and benchmark research has been used to further these insights, while essential resources for deeper guidance and understanding have been provided.

For questions or queries, or to access GreenCape's services contact our Water Sector Desk: water@greencape.co.za

For the latest updates on the water sector, visit the water pages on the GreenCape website: www.greencape.co.za

© Raymond Siebrits, GreenCape

2 – Overview

While water is a finite resource, it is also a catalyst for economic growth.

This growth and development depends largely on water quality and availability, which are affected by competing demands between people, industry, food security, the environment and development. The interrelationship between these aspects must be considered in strategic planning, particularly when there is a paradigm shift in economic growth. The green economy is seen by many governments as an opportunity to meet growth projections and, in turn, reduce poverty and create much-needed jobs.

Rising demand and diminishing supplies of water will require careful management of our water resources. New supply interventions as well as demand-side mechanisms and green technology need to be in place timeously to avoid a constraint on development. The cost of water provision could become a constraint on economic development, but cost varies depending on the local availability of water, the distance of distribution, and the raw water quality.

2.1. Resource overview

The Berg Water Management Area (WMA) and associated urban areas (Cape Town, Stellenbosch, Paarl and Saldanha) and infrastructure accounts for over two thirds of the province's population, and most of its economic outputs. Towards the east of Cape Town, the Breede WMA provides more than one fifth of its water resources to augment the Western Cape Water Supply System (WCWSS) and produces over 70% of South Africa's table grapes, apples and fynbos for international export (BOCMA 2011). The majority of the business opportunities for water in the green economy therefore fall within the context of these two WMAs due to the relatively high-impact potential for economic development, resource efficiency and cleaner production.

Most water-related business opportunities fall within the Berg and Breede Water Management Areas. It is projected that water demand will surpass supply by 2019 in the WCWSS that supplies greater Cape Town and the province's west coast, unless effective measures are taken to manage water supply and demand.

South Africa is ranked as the 30th driest country in the world, with extreme climate and rainfall fluctuations. The Western Cape province, in the south-western corner of the country, is classified as a water-stressed region. Under the current planning scenarios, it is projected that water demand will surpass supply by 2019 in the WCWSS that supplies greater Cape Town and the province's west coast, unless effective measures are taken to manage water supply and demand (DWS 2015a).

The driving forces and pressures that influence water and water supply in the Western Cape are:

- population growth and economic development
- growing urbanisation
- land-use policies changes and increasing impermeable surfaces
- encroachment of invasive alien vegetation and fauna
- increasing pollution from agriculture, industry, urban runoff, insufficient sanitation
- overutilisation of riparian zones.

The province's water resources are becoming increasingly vulnerable to climate variability, with climate models indicating that the Western Cape will become hotter and dryer (leading to reduced availability), and will experience more intense rainfall events. Given the potential impact on the agricultural sector, this growing scarcity could potentially have a negative effect on the country's economy (IPCC 2014 and ACDI 2015).

The complex water supply system in the Western Cape relies predominately on surface water and is dominated by a matrix of dams, pipelines, tunnels and distribution networks. The largest of these is the WCWSS. Some of the various facilities are operated by the South African Government's Department of Water and Sanitation (DWS), and others by the City of Cape Town (CoCT) and directly neighbouring municipalities — the largest and fastest-growing urban areas in the province (Drakenstein, Overstrand, Stellenbosch and Saldanha Bay).

Five main dams currently feed the WCWSS (servicing the Berg WMA) and provide approximately 580 million cubic metres (m^3) of water per year for agriculture and urban use. Efforts to implement solutions to water supply, demand and access issues are well underway and are orchestrated by agencies of the national, provincial and municipal governments, with support and input from non-governmental organisations, private businesses and other stakeholder groups. Due to the complexity of the entire system, solving problems is not easy and involves managers and users from all sectors.

The main recommendations below follow from the latest WCWSS assessment of the current water requirements and updated scenario planning (DWS 2015a) — known collectively as the Intervention Implementation Programme (7-13 years). These interventions are in different stages of development, and relevant business opportunities are discussed in later sections of this report:

- Berg River-Voëlvlei Augmentation Scheme (phase 1)
- desalination of seawater
- large-scale water reclamation
- other possible interventions to be considered for implementation at a later stage include:
  - large-scale Table Mountain Group (TMG) aquifer development
  - Langebaan Road Aquifer Artificial Recharge Scheme
  - Cape Flats aquifer development
  - Mitchells Pass Diversion
  - raising of Steenbras Lower Dam
  - development of the Lourens River Diversion.

© Raymond Siebrits, GreenCape

The 2014 World Economic Forum Global Risks Report identified the top 10 global risks that have 'systemic impacts', which could be significant if not addressed. In this report, environmental and economic-related risks are identified as 'high impact and high likelihood'. This recent report indicates a rising trend where water-related risks have risen to be ranked third, up from 10th in 2011 (WEF 2014).

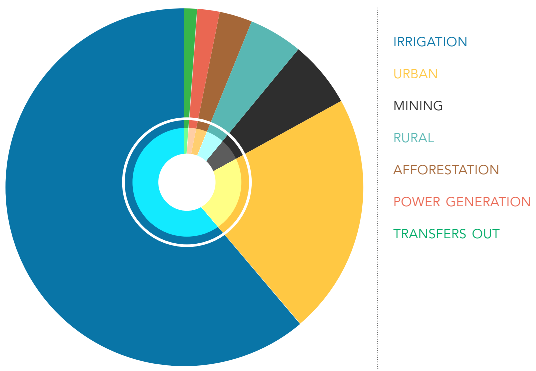

Figure 1: Water demand by type in South Africa

On a national scale, it is estimated that by 2030 South Africa will experience a 2,97 billion m³ per annum supply-demand gap. However, through timely and smart investments using the appropriate levers, this can be resolved and realise positive financial returns and savings from other inputs.

2.2. Water use

A large proportion (66%) of South Africa's water use is for agricultural purposes, specifically irrigation. Figure 1 shows the proportional differences of the current water demand in South Africa (DWS 2013a).

The agricultural activity of the Western Cape covers an area of 11.5 million hectares. Although this is only approximately 12.4% of the total agricultural land available in South Africa, the Western Cape produces between 55% and 60% of South Africa's agricultural exports (WRC 2014).

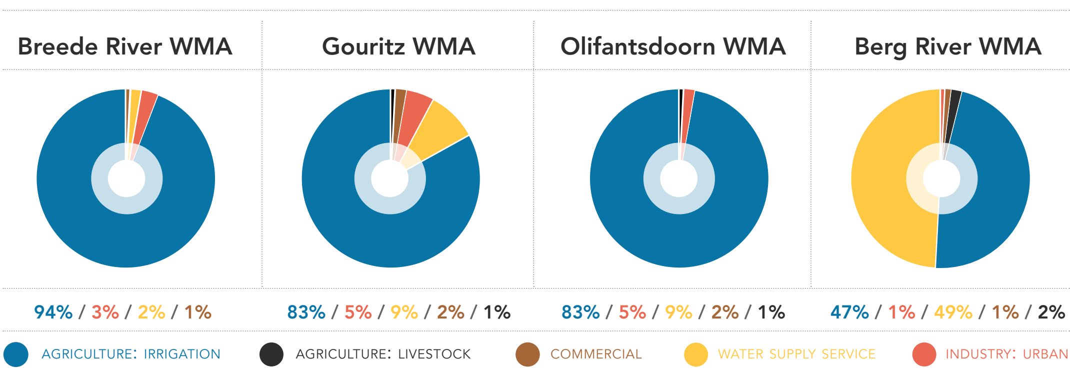

Figure 2: Water use by type for the four Western Cape WMAs[1]

[1] Source: GreenCape 2015 Water Market Intelligence Report

South Africa's water is drawn from a variety of sources. Typically, 77% is surface water, 9% is groundwater and 14% is drawn from reusing return flows (DWS 2013a). In the Western Cape, irrigation to support agriculture is the major water use in the four currently designated WMAs, as shown in Figure 2 (StatsSA 2010). In the Berg WMA, however, water supply service to the metropolitan area of Cape Town also represents a major source of consumption.

Consideration of the nature of water as a development catalyst or possible constraint on economic growth and social development has prompted the establishment of the Water for Growth and Development Framework of the DWS (2010a). This implies a shift from water for the economy to water in the economy. The framework explores the way in which the water sector contributes to economic, social and environmental imperatives, also considering the relationship between government and the private sector.

In early 2005, the then-Department of Water Affairs and Forestry, as custodian of the country's water resources, in partnership with the CoCT, commissioned the Western Cape Reconciliation Strategy Study to facilitate the reconciliation of predicted future water requirements with supply available from the WCWSS, for a 25-year planning horizon. The strategy is used as a decision-support framework for making timeous and informed recommendations on those interventions that should be implemented to meet future water requirements (DWS 2015a). Further, the All Towns Reconciliation Strategy was initiated to include other towns and villages in the country, and examines the water balances and resource details for each urban node. This market intelligence report focuses on the areas predominantly serviced by the WCWSS and the Breede WMA, but also addresses certain elements of the broader All Towns Reconciliation Strategy databases and approaches.

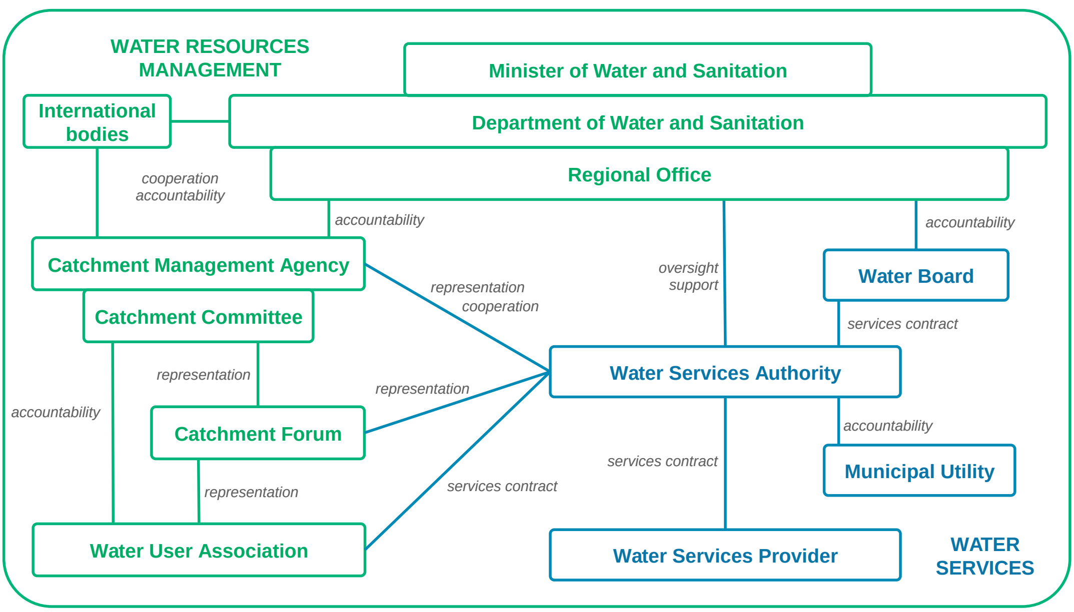

Figure 3: Water resource governance organisations in South Africa[2]

[2] Source: GreenCape 2015 Water Market Intelligence Report

2.3. Institutional structure

The water sector is highly complex. Accordingly, managing water resources involves contributions from various stakeholders at different points in the value chain. The value chain comprises eight broadly defined stages, as follows: basin/catchment management; abstraction; storage; treatment; distribution; use; wastewater treatment; and discharge.

The National Water Resources Strategy 2 (NWRS2) (DWS 2013b) outlines the institutional structure of the sector, and highlights the roles played by water services authorities, water services providers, regional water utilities, catchment management agencies (CMAs), catchment management forums and water user associations through the sector value chain. Figure 3 describes the national organisational structure of water resource management, while this section further describes the roles and responsibilities of the different forms of governance.

The value chain comprises eight broadly defined stages, as follows: basin/catchment management; abstraction; storage; treatment; distribution; use; wastewater treatment; and discharge.

Catchment management agencies

To facilitate water resource management, South Africa is in the process of being divided into nine WMAs. In turn, these are managed by CMAs. The CMAs are responsible for water resource management within the defined WMAs. As such, they:

- serve as the first port of call for all water resource management issues;
- are responsible for delegating water resource management at the regional or catchment level while involving local communities with water management where appropriate;
- contribute towards progressively decentralising national management and realising the National Water Act's (NWA) integrated water resource management ethos (WC-DEADP 2013).

The Western Cape will have two WMAs in which CMAs will be established: the Berg-Olifants (currently managed by the DWS as a proto-CMA) and the established Breede-Gouritz[3] (BOCMA 2011, 2014). Figure 4 shows South Africa's designated CMAs.

Catchment management forums

The NWRS2 (DWS 2013b) highlights that catchment management forums will be established to act as non-statutory bodies to democratise participation in water resource management and to support CMAs. They provide the means to engage with stakeholders on the formation of CMAs and will assist in implementing catchment management strategies.

Water user associations

The NWA provides for water user associations 'to operate at a restricted localised level and in effect be co-operative associations of individual water users who wish to undertake water related activities for their mutual benefit'.

Water services authorities

Water services authorities are municipalities that have the constitutional responsibility for planning, ensuring access to and regulating the provision of water services (including water supply and sanitation) within their area of jurisdiction (DWS 2013a). The water services authorities are responsible for securing licences from the DWS (or from CMAs, where these are established and power has been delegated or transferred) to abstract and discharge water.

[3] www.breedegouritzcma.co.za

The water services authorities may provide services themselves, or may contract out to water services providers. In the Western Cape, the Cape Metro and 24 municipalities are designated water services authorities, while the 278 municipalities in the country as a whole include 152 designated water services authorities.

Water boards

Water boards are categorised as national government business enterprises. They are separate legal entities that have their own governance structures and assets, and are required to be self-funding. The Minister of Water Affairs appoints board members and chairpersons. Water boards provide bulk potable water services to the municipalities in which they operate, and to other water services institutions and major customers within designated service areas (DWS 2014a).

The NWRS2 (DWS 2013b) points out that the 12 existing water boards will be consolidated into nine viable regional water utilities. These regional water utilities will manage bulk water services infrastructure and supply bulk water to water services authorities and their water services providers, and to bulk water consumers. They will also manage bulk sanitation infrastructure for wastewater treatment, operate existing regional water resources infrastructure, develop new regional water resources infrastructure, and provide support to water services authorities and CMAs.

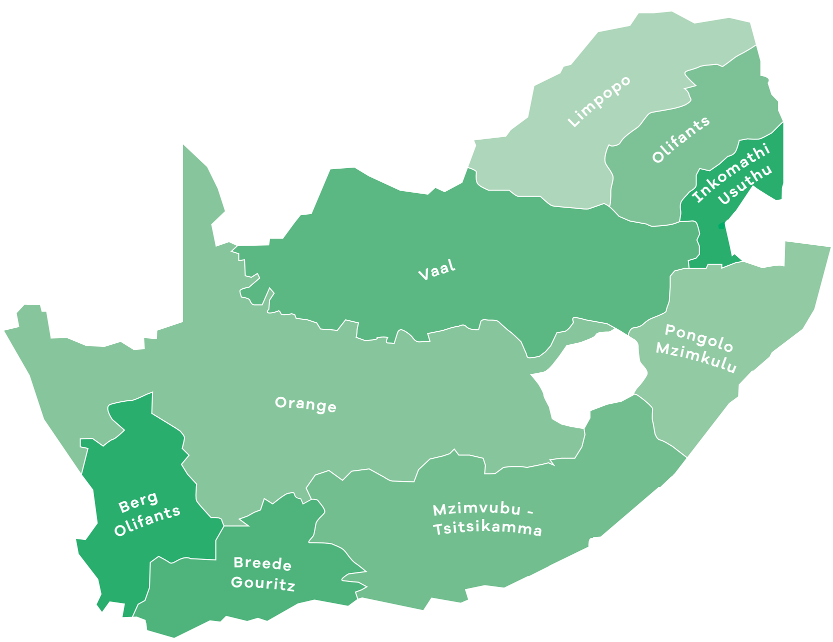

Figure 4: Designated catchment management agency boundaries in South Africa[4]

[4] Source: GreenCape 2015 Water Market Intelligence Report

3 –
Policies and regulation

This section provides a brief introduction to the regulatory frameworks and public sector activities related to the water sector, including a focus on updates made in the past year. These are expected to inform or affect investment decisions made by potential investors and businesses in the water sector.

3.1. Water law in South Africa

The DWS formulates and implements policies to regulate the water sector and provides strategies for sector support. It does this by operating across the water value chain as a national government entity. However, the DWS does not execute all functions, because some are constitutionally assigned to appropriate sector partners, such as CMAs.

The GreenCape Water Market Intelligence Report 2015[5] describes the main legal mechanisms for water in South Africa — the National Water Act (Act 36 of 1998) (NWA), the Water Services Act (Act 108 of 1997) (WSA) and the NWRS2 (DWS 2013b) — in greater detail. However, the National Water Amendment Act (NWAA) has recently been promulgated. Key summary updates are as follows:

- The National Development Plan requires that regulatory impediments to growth be urgently addressed.
- The DWS has as its primary objectives two key aspects: (1) decreasing the time frames for processing licence applications; and (2) alignment of the appeal process for water licences — to include an internal appeal authority, as both the Department of Environmental Affairs (DEA) and the Department of Mineral Resources (DMR) currently have internal appeal panels.
- The agreed time frame for the processing of the respective authorisations is the cumulative period of 300 days, and a further 90 days for the internal appeal process.
- Both the NWAA and its regulations reflect the formal agreement between the DWS, DEA and DMR — i.e. to give effect to 'the one environmental system' — and further gives rise to the integrated water use licensing process, with a shortened time frame and an aligned internal appeals process (DWS 2015b).

The above legislative developments can be construed as means to a smoother and expeditious licensing process, as well as measures that eradicate some of the problems currently faced with the ineffective and costly nature of the existing independent Water Tribunal, which is currently still in the process of being reconstituted.

Since the promulgation of the NWA, around 4 000 water use licences have been successfully issued, amounting to just under 6 billion m^3 per year being formally allocated. Of this, around 54% has been for agricultural irrigation, totalling approximately 314 000 hectares of land.

Table 1 highlights the sectoral and volumetric breakdown of issued water use licences in South Africa (DWS 2015b).

The DWS is currently setting up its electronic water use licence application and approval system (e-WULAAS).[6] The e-WULAAS system will radically transform water use licensing and is to be fully implemented by late 2015. It is designed to be flexible and adaptable to any configuration of the business process, and will be the platform for direct application.

---

[5] www.greencape.co.za/news/greencape-publishes-market-intelligence-reports
[6] www.dwa.gov.za/ewulaas

Table 1: Water use licences issued in South Africa

Water use sector	Number of licences			Million m3 allocated		
	2001-2015	2001-2010	2011-2015	2001-2015	2001-2010	2011-2015
Agriculture	1 981	1 327	654	3 141.55	921.02	2 220.53
Mining	360	92	268	1 134.10	860.94	273.17
Local government	473	133	340	612.52	170.18	442.34
Industry	213	61	152	823.18	703.94	119.24
Housing	136	38	98	97.48	2.32	95.17
Forestry	766	427	339	0.03	0.02	0.02
TOTAL	**3 929**	**2 078**	**1 851**	**5 808.88**	**2 658.41**	**3 150.46**

This will reduce delays and make the entire authorisation process transparent. The Western Cape had around 190 water use licence applications outstanding as of June 2015 (DWS 2015c). The clearing time for problematic applications nationally is between one and two years.

3.2. Public sector activities

Water management, services and regulation are primarily public sector activities in South Africa. Recent and relevant policies, strategies, activities, shifts in direction and initiatives are discussed where they may be of interest to investors, decision-makers and businesses in the green economy.

Western Cape Sustainable Water Management Plan

The Sustainable Water Management Plan for the Western Cape Province was developed in 2009. Its development was undertaken collaboratively by the Western Cape Government and the DWS: Bellville Regional Office (WC-DEADP 2012a).

Short-term (1-5 years), medium-term (6-15 years) and long-term (16+ years) actions to guide the implementation of projects and activities were developed, as a means towards achieving integrated and sustainable management of water in the Western Cape. The overall aim of the water plan is to guide sustainable water management towards meeting the growth and development needs of the region. The four strategic goals of the plan are as follows:

1. Ensure effective cooperative governance and institutional planning for sustainable water management.
2. Ensure the sustainability of water resources for growth and development.
3. Ensure the integrity and sustainability of socio-ecological systems.
4. Ensure effective and appropriate information management, reporting and awareness-raising of sustainable water management.

In 2012, the Berg River Improvement Plan was implemented under the Berg River Partnership to address water quality concerns in the Berg River. This concern is particularly relevant given the importance of the Berg River to agricultural exports. The plan highlights the current status of pollution sources and the various interventions that have been or are currently being undertaken in the Western Cape.

Possible short-term (five-year) and long-term (5-30 years) measures have been identified, and these focus on six tasks:

- Task 1: Implement a Berg River water quality monitoring regime.
- Task 2: Upgrade wastewater treatment works (WWTW) and train process controllers.
- Task 3: Upgrade informal settlements.
- Task 4: Advocate best practice in agricultural and agro-industrial processes.
- Task 5: Implement riparian zone rehabilitation and bio-remediation.
- Task 6: Inform water pricing in the Berg River catchment.
- Task 5: Implement riparian zone rehabilitation and bio-remediation.
- Task 6: Inform water pricing in the Berg River catchment.

Western Cape Water Supply System
The WCWSS is an important system of planning and infrastructure for water in the Western Cape economy. At its core are the dams located in the upper regions of the Berg River and Breede River catchments. The system supplies water for the following (DWS 2015a):

- raw water to the CoCT (raw treated water from the CoCT's treatment works is provided to several towns close to the treatment works and bulk transfer pipelines);
- West Coast District Municipality (DM) for domestic supply to the Swartland Local Municipality (LM), Saldanha Bay LM and Bergrivier LM;
- Stellenbosch LM to augment the supply to Stellenbosch; and
- Agricultural users downstream of the Berg River Dam, Voëlvlei Dam and Theewaterskloof Dam.

The total 'adjusted' water consumption from the WCWSS in 2014/15 (based on releases from the dams and the capped allocation for the agricultural sector) was about 575 million m^3. Two-thirds (391 million m^3) was for urban and industrial use, and the remainder was allocated for irrigation (Table 2).

Table 2: Overview of WCWSS allocations in 2015

Allocation type	Volume (m^3/annum)
Total allocations	609.1
Total agricultural allocations (capped)	216.2
Total domestic allocations	392.9
City of Cape Town	357.9
West Coast DM	22.8
Drakenstein LM	2.1
Stellenbosch LM	3.0
Overberg Water	4.0
Piketberg	1.5
Other	1.6
System yield	582.0

Figure 5 presents different water requirement scenarios. Solid lines show different demand projections based on various growth scenarios and years of calculation. Under the current planning scenarios, it is projected that water demand will surpass supply by 2019, unless effective measures are taken to manage water supply and demand.

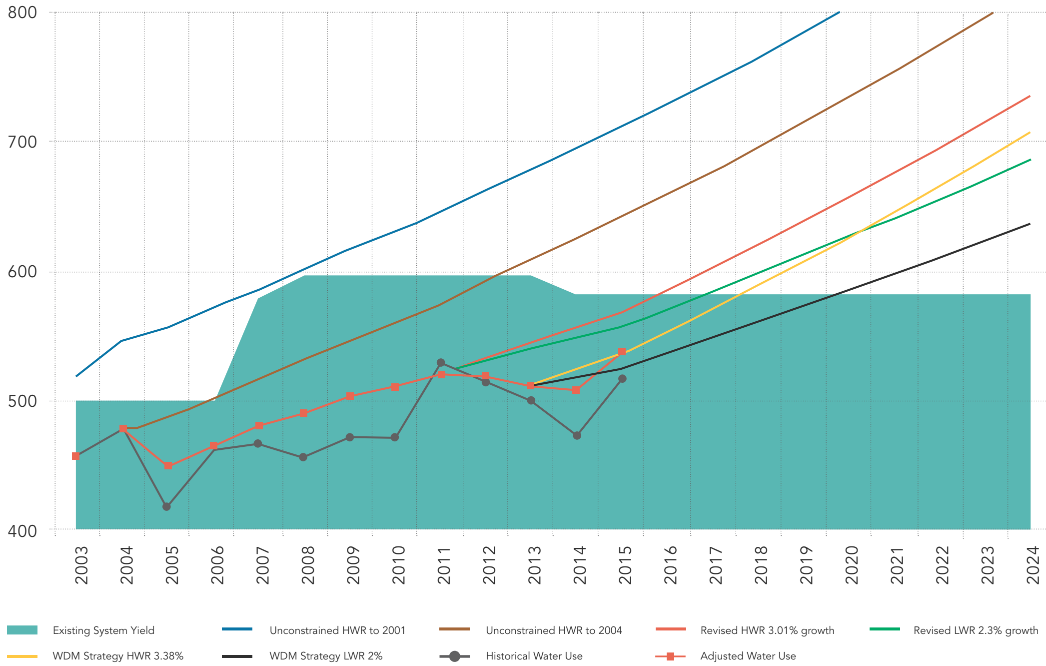

Figure 5: Water requirement scenarios for the WCWSS

Table 3 describes the possible intervention implementation programme for the planning scenarios, along with actual yields for the different interventions. The raising of the Voëlvlei Dam (an off-channel dam located adjacent to the Berg River) by two metres will only provide further supply by 2021, and is the only confirmed project. Other interventions are at various planning and feasibility study stages.

Future infrastructure projects

The DWS long-term infrastructure and other capital plans (DWS 2014a) in the Western Cape — outlining the infrastructure investment needs for the next 10 years, which total just under R1 billion — are shown below in Table 4. These present the major investments in water infrastructure by national government planned for the next decade that will unlock economic development, potentially provide opportunities for green technology implementation and enhance water security.

Table 3: Water intervention possibilities for the WCWSS

Intervention selection		Yield (Mm^3/a)	Lead time (years)
1	Voëlvlei phase 1	23	6
2	Reclamation option 1	40	7
3	TMG scheme 1	20	8
4	Reclamation option 2	40	7
5	TMG scheme 2	30	10
6	West Coast aquifer storage	14	10
7	Desalination 1	50	8
8	Desalination 2	50	8
9	Desalination 3	50	8
10	Voëlvlei phases 2 and 3	110	15

Table 4: DWS long-term infrastructure projects planned for the Western Cape

Project name	Project stage	Outputs	Projected total cost (R'000)
Citrusdal WWTW	F	B	35 603
Clanwilliam water treatment works	D	W	16 000
Clanwilliam regional water supply	C	W	67 500
Tulbagh bulk water supply (Witzenberg)	C	W	78 000
Drakenstein WWTW	D	B	29 000
Stellenbosch WWTW	C	B	61 000
Worcester bulk water supply	C	B	67 800
Grabouw WWTW	C	W	14 000
Hermanus bulk water supply	D	W	20 579
Hermanus WWTW	C	B	31 104
Swellendam WWTW	C	W	21 600
Struisbaai WWTW	C	B	11 366
Oudtshoorn groundwater supply	V	W	78 000
Beaufort West bulk water supply	C	W	30 000
Vanrhynsdorp raw water supply	C	W	37 957
Klawer bulk water supply	F	B	17 661
Paarl bulk sewer	F	B	58 756
Calitzdorp and Ladismith WWTW	D	B	18 400
Kannaland dam relocation	D	B	22 800
Bitou cross-border bulk water supply	C	W	120 000
George bulk water supply augmentation	F	W	129 000
			966 126
F=feasibility; D=design; C=construction; B=bulk water supply; W=wastewater services			

The only mega project (over R1 billion total cost) currently underway in the province is the raising of the Clanwilliam Dam, which commenced in 2014 (known as the Olifants-Doorn River Water Resources Project). Initial work included realigning the adjacent N7 national road, part of which will be flooded by the rising water level. The project is scheduled for completion in March 2017, at an estimated cost of R2.5 billion.

Three quarters of the additional water made available by the project will be reserved for new, resource-poor farmers. The wall height is being raised and will allow for a yield increase from around 122 to 190 million m^3 per annum. Other upgrades will include a small hydropower station, and a new intake and outlet structure.

Municipal performance
Municipal plans and strategies for water-related investments are outlined per municipality in integrated development plans (IDPs) and water services development plans, or water master plans. These are available from municipal websites or upon request from the relevant municipal manager. By means of an example, the Mossel Bay IDP (2012-2017) outlines the following strategies related to sustainable water resources:

- the removal of invasive plants;
- the artificial recharge of aquifers, rehabilitation of wetlands and clean-up campaigns of rivers;
- targets for reducing unaccounted-for water and water inefficiencies;
- consumer/end-use demand management: public information and education programmes;
- leak and meter repair programmes;
- Working for Water Programme.

In 2008, the DWS introduced the Blue Drop and Green Drop certification programmes for auditing and managing drinking water and wastewater quality respectively. Water services authorities are audited and receive a score for their overall performance. The 2013 Blue Drop and Green Drop summaries (DWS 2013c) show the favourable performance of Western Cape systems when compared to other provinces.[7] The following record is acknowledged:

- Western Cape Blue Drop score overall — 94.2%:
  – Number of drinking water supply systems assessed nationally: 1 009.
  – Number of water systems audited in the Western Cape: 117.
  – CoCT is the best-performing municipality in the Western Cape province, with a municipal Blue Drop score of 98.14%.
  – Matzikama LM was cited as the most improved area.
  – Top 20 scores nationally include 9 LMs from the Western Cape.
- Western Cape Green Drop score overall — 84.5%:
  – Number of drinking water supply systems assessed nationally: 824.
  – Number of water systems audited in the Western Cape: 158.
  – 84.2% of plants (133) in low-risk and medium-risk positions.
  – Wastewater systems with scores lower than 30% score: 9.

One of the greatest short-term opportunities to enhance water security within a water user area is in the application of water conservation and water demand management (WC/WDM) strategies. Such interventions include:

- implementing pressure management;
- replacing non-functional water meters;
- reusing treated effluent;
- installing flow-limiting devices;
- launching leak repair projects in schools and houses;
- hosting awareness and education workshops.

Some of these interventions are explored further in the Opportunities and Barriers chapter, as they are key interest areas for many water sector businesses. The CoCT consumes 59% of the total WCWSS and is therefore one of the greatest opportunity systems for efficiency gains and impact in the system and province. The CoCT updated its long-term strategy to include the following five goals:

The City of Cape Town consumes 59% of the total Western Cape Water Supply System and is therefore one of the greatest opportunity systems for efficiency gains and impact in the system and province

[7] Visit www.greencape.co.za for the latest update on the Blue Drop and Green Drop results.

- A: By 2015/2016, reduce and maintain water losses to below 15% of the total average annual water requirement and within accepted international benchmarks.
- B: Ensure an ongoing effective management system and implementation of the Integrated Water Leaks Repair Project.
- C: Align investments made according to the WC/WDM strategy requirements.
- D: By 2020, reduce and maintain non-revenue water (NRW) to below 20% of the total average annual water requirement and within accepted international benchmarks.
- E: Reduce the projected potable water requirement to an average growth rate of no more than 2% per annum for the next 10 years.

The strategy aims to save up to 50 million m^3 of water over the planning horizon of 10 years until 2020/2021, with an annual budget of between R150 million and R400 million. Goals A and D were achieved in the 2012/2013 financial year and NRW was reduced to 19.8%, while water losses were contained below the target of 15%. In addition, the CoCT was able to sustain the annual growth in water requirements below the target of 2%, despite the estimated increase in population of about 3.5% per annum. The number of metered connections increased from 617 323 in 2010/11 to 634 071 in 2013/14, and 640 992 in 2014/15.

The strategy aims to save up to 50 million m^3 of water over the planning horizon of 10 years until 2020/2021, with an annual budget of between R150 million and R400 million. City of Cape Town was able to sustain the annual growth in water requirements below the target of 2%, despite the estimated increase in population of about 3.5% per annum.

The decrease in the overall *adjusted water use*, seen in 2014 in Figure 5, shows the recent success of implemented WC/WDM strategies within the WCWSS as a whole. Key challenges will lie in (1) how to deliver on Goal E while still ensuring strong regional economic growth; and (2) realising successful WC/WDM strategies in other municipalities.

Water pricing

The DWS has gazetted a new pricing strategy for raw water (DWS 2015d). This strategy replaces a previous strategy from 2007, and is expected to come into effect in 2017. The draft strategy seeks to reform the sector so that pricing is more transparent and predictable. It also seeks to ensure that the management of our water resources is more effective and efficient. Major changes from the previous strategy include an increase in the number of water use categories (for which there are different tariffs levied) and some changes to the actual water use charges. The water use categories will now include:

1. agriculture
2. municipal
3. industry and mining
4. hydropower
5. high-assurance use (e.g. energy generation)
6. stream flow-reduction activities.

Changes to the water use charges include the Future Infrastructure Build Charge for new infrastructure or the improvement of existing infrastructure, an Economic Regulator Charge to fund the activities of a proposed pricing regulator, and a hydropower charge for existing and planned hydropower plants.

The draft strategy has been published and is currently under consultation. It is not yet clear what the impact will be on water tariffs for water users in terms of whether they can expect increased tariffs, and at what magnitude. It is apparent, however, that there is a significant focus on improving water efficiency, water quality and the financial sustainability of water management. The pricing strategy will incentivise users to improve water use efficiency, and therefore may provide opportunities for businesses that operate in the WD/WCM sector.

4 –
Opportunities and barriers

At the heart of green economy activities are the technologies and the business opportunities available. Developing this economy is highly dependent on the transfer of applicable technologies.

It is not only a process of supplying capital equipment from one entity to another, but also includes the transfer of skills and know-how, understanding the technology and seeking viable business cases (WRC 2013a).

Understanding the development and application of various green technologies can help to direct focus and enable market forces ultimately to increase adoption. The business opportunities and focus areas identified and described further within this report are divided into the following sections:

- clearing invasive alien vegetation
- agricultural irrigation
- rainwater harvesting
- groundwater and artificial recharge
- desalination
- water-sensitive cities
- end-user efficiency
- reducing municipal losses
- small or decentralised treatment
- resource recovery from wastewater
- water reclamation
- energy and water
- smart metering and information and communications technology (ICT) in water.

This report considers the business opportunities within the water sector value chain presented in Figure 6. There are various private sector opportunities — and barriers to taking advantage of them —- within the sector's value chain that occur in one defined node, or which cover many different stages.

While this report focuses largely on the corporate and economic value of water, it is acknowledged that water has broader social and ecological values that form part of the accounting. Figure 7 describes the spread of water value from monetary to societal (WWF & IFC 2015). However, the opportunities described in this report are mostly framed within the corporate and economic value creation side — although value may be derived across the accounting spectrum.

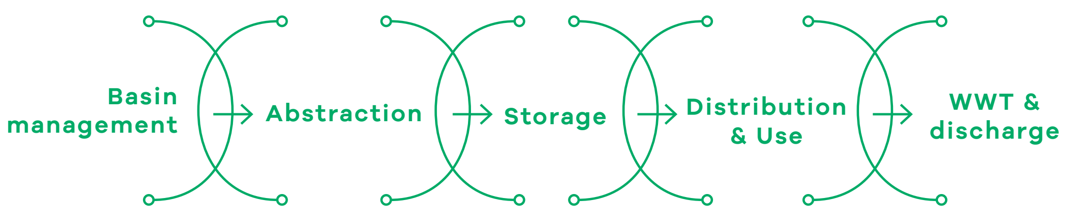

Figure 6: The water sector value chain for green economy business opportunities

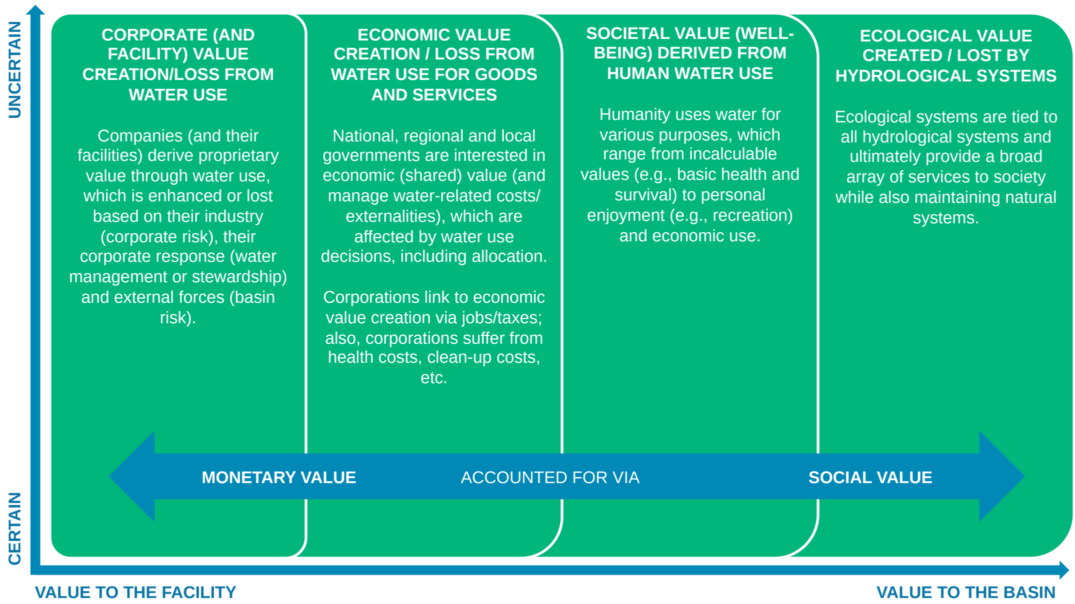

Figure 7: The value of water to a company, economy, society and nature

4.1. Clearing invasive alien vegetation

The 2015 national budget for the Working for Water Programme is R1.3 billion, and is mainly spent on employment creation and downstream uses and beneficiation for the biomass extracted during clearing programmes. The programme regularly procures operational equipment and machinery from the private sector through competitive tenders. Opportunities for monitoring and reporting on the progress and follow-up of clearing programmes also exist, with new solutions being considered regularly.

The Working for Water Programme offers the private sector numerous potential opportunities when it comes to using waste biomass in, for example, manufacturing and energy production, among other areas. However, further work is required to determine the financial viability of these business models.

Invasive alien plants cover up to 10% of the country, and their distribution is increasing. In the Western Cape, over 170 000 hectares of land is covered by invasive alien plants, predominantly in riparian zones (WC-DEADP 2012b). The Breede-Gouritz WMA is the most severely affected, with approximately 7% of water being used by alien invasive species (BOCMA 2011). The Western Cape Department of Environmental Affairs and Development Planning points out that clearing the invasive plants will make land available for use, but subsequent users must be sensitive towards the ecological integrity of the area (WC-DEADP 2013).

4.2. Agricultural irrigation

Skills shortages and lack of expertise in agricultural irrigation technologies and applications are still considerable barriers for the local market growth of irrigation solution and product providers. Regular assessments on water infrastructure and opportunities for agriculture and agri-processing are performed by the Western Cape Government.

Table 5: Agricultural potential and water availability for Western Cape district municipalities

	West Coast	Cape Wine-lands	Overberg	Eden	Central Karoo	CoCT
Average rainfall (mm/annum)	200--400	100-800	200-1 200+	200-1 000	0-400	200-1 200+
Municipal supply allocation availability	Exceeding allocation	Some water available	Water available	Some water available (coastal zones only)	Inadequate yield	Water available
Options for increased municipal supply	- Desalination - Possibility of ground water in certain areas	- Reclamation - Some surface water available	- Groundwater - Some surface water available	- Surface water - WC/WDM	Limited	- Reclamation - WC/WDM - Desalination
Ground water availability (stress and quality)	- Stressed supply - Salinity levels mixed (high range)	- Limited supply (stressed in certain areas) - Salinity fair	- Available supply - Augmenting municipal supply	- Limited supply - Varied potential across region	- Available supply - Varied stress across region	- Moderately stressed supply - Good quality
Existing dominant sectors	**- Livestock** **- Poultry** **- Dairy** **- Olive oil**	**- Fruit juice** **- Wine and brandy** **- Poultry** **- Dairy** **- Olive oil** **- Essential oils**	**- Fruit juice** **- Wine and brandy** **- Livestock** **- Poultry** **- Dairy** **- Essential oils**	**- Livestock** **- Poultry** **- Dairy** **- Olive oil** **- Essential oils**	**- Livestock**	**- Poultry**
Sector for potential growth	**- Olive oil** **- Essential oils**	**- Berries** **- Fruit juice** **- Wine and brandy**	**- Olive oil** **- Essential oils**	**- Dairy** **- Essential oils** **- Olive oil**	**- Livestock** **- Olive oil**	**- Fruit juices** **- Livestock (pork)** **- Speciality dairy**

High water use Medium water use Low water use

The most recent results for district municipalities are seen in Table 5. This figure highlights the availability of further water resource development in the Overberg and CoCT for agriculture, as well as possible sectors for growth going forward (WC-DEADP 2015).

More than two thirds of the agricultural irrigation product producers and solution providers that trade in South Africa are based in the Western Cape. This is an industry that has large growth potential and employs both highly skilled and unskilled staff (from production floor staff to plastic-mould engineers and system designers). Access to agricultural development projects in other African countries are their largest growth opportunities, but experienced representatives in these territories are a challenge.

To further the development of this market, the South African Irrigation Institute[8] provides a variety of technical training opportunities and qualifications across the irrigation sector. In addition, the recently launched GreenAgri portal[9] s fast becoming the central location for all agricultural practitioners to access resources, contacts and case studies regarding sustainable farming and new technologies.

4.3. Rainwater harvesting

Rainwater harvesting involves the small-scale collection, capture and storage of rainwater runoff for various productive purposes, including irrigation, drinking and domestic use.

[8] www.sabi.co.za
[9] www.greenagri.org.za

Initiatives such as rainwater harvesting can contribute to meeting rising water demand. The DWS has budgeted to fund and install 7 500 rainwater harvesting systems for rural households through competitive tenders in the current 2015-2020 Medium Term Strategic Framework (DWS 2014b). Further government systems will originate from municipalities, state entities and housing development schemes.

Polyethylene plastic storage tanks manufacturer, JoJo Tanks, has experienced a year-on-year increase in demand for information on rainwater harvesting, as well as a surge in the sales of rainwater harvesting systems — to the point that it has trained about 40 preferred rainwater installers across the country to keep up with the demand (Moodley 2015). This growth exhibits strong signals for further market uptake. Rainwater harvesting can be used for irrigation and household use, and can replace around 30% of domestic consumption (mainly irrigation, washing of clothes and dishes, etc.). With a properly designed system, it can also be used as potable water.

Opportunities for the private sector include manufacturing, selling and installing household and office rooftop rainwater harvesting systems. Water-related legislation does not, however, provide a clear legal framework for the adoption of rainwater harvesting, hampering national expansion. Currently, the direct job creation potential in the long term (25 years) for rainwater harvesting is 1 275 (total net direct employment potential) and 181 (net direct manufacturing employment potential) (ASSAF 2014).

The Climate Systems Analysis Group, together with the Water Research Commission (WRC), have recently developed an online tool[10] for planning and decision-making for rainwater harvesting systems for many different roof types. This tool looks at location-specific climate conditions, types of installations and potential water savings to help inform the financial implications of rainwater harvesting. Further reading and advice is also available on this online platform. This web tool will be extended to the planning and site selection of small dams. It will look at location-specific climate conditions, slope and altitude factors depending on where a site is examined to see how much a dam could hold, and potential water savings, to inform the financial implications of small dam construction capital outlay.

Opportunities for the private sector include manufacturing, selling and installing household and office rooftop rainwater harvesting systems.

4.4. Groundwater and artificial recharge

Groundwater resources in the Western Cape are managed sustainably on the whole, while recharge opportunities are underexploited. Artificial groundwater recharge has seen increasing amounts of research in the past two years. The most balanced picture of groundwater recharge and management is found in the DWS monitoring reports[11] of the Western Cape.

The DWS recently published a 20-year review on groundwater research and implementation across South Africa (DWS 2014c). Further to this, there are currently over 20 studies in the Western Cape exploring groundwater development, extraction, sustainability and hydrology, led by a number of groups and institutions. No commercial pumped (forced injection) recharge schemes have been implemented in the Western Cape, while aquifer recharge schemes in Langebaan, Prince Albert, Plettenberg Bay and Calvinia are being discussed or explored as pilots or feasibility studies. Notable commercial-scale sites elsewhere include Windhoek and Polokwane (DWS 2010a).

[10] cip.csag.uct.ac.za/webclient2/waterharvest
[11] www.dwa.gov.za/groundwater

The Western Cape does, however, exhibit an interesting recharge system at a municipal level. Initially prompted by the need to find an alternative to wastewater discharge into the marine environment, Atlantis began recharging its stormwater and treated wastewater into its sandy soils in 1979, through seepage ponds rather than forced injection. With the recognition that the natural groundwater yield of the aquifer was not sufficient to meet the long term needs of the town, the focus shifted to recharging the aquifer and recycling water. A core component of the Atlantis Water Resource Management Scheme is the artificial groundwater recharge system therein, which uses a series of constructed surface recharge basins. This scheme has been running for over 30 years and is managed by the CoCT. It is estimated that, on average, approximately 7 500 m^3/day of stormwater and wastewater is recharged at a higher gradient of the extraction wellfield, augmenting the water supply by more than 2.7 million m^3/year (approximately 25-30% of Atlantis's groundwater supply is augmented through artificial recharge). Figure 8 shows the principle design behind the scheme, which has pioneered the application of artificial groundwater recharge as a water management tool for bulk water supply in Southern Africa. The general observations from extensive and ongoing monitoring is that groundwater is used sustainably across the region. Over-abstraction in parts of the Sandveld and Klein Karoo only have local impacts, and the establishment of monitoring committees to collect data and source management solutions for these localities is recommended. The aquifer in the general area of Vanrhynsdorp is, however, overexploited for agriculture (DWS 2015e). The users are supported by specialists in the monitoring and provision of management advice, but it has been recommended that no further groundwater use licences are issued in the stressed parts of this aquifer.

The groundwater levels in the primary aquifers of the Berg WMA near Langebaan appear to be on a declining trend (DWS 2015e), but recent observations are showing a slight recovery. This may be the result of climatic changes and/or increasing abstraction, and better research and management of this aquifer is needed to ensure that the aquifer is optimally used. Further resources for businesses interested in recharge options can be found on the DWS's artificial recharge information centre.[12]

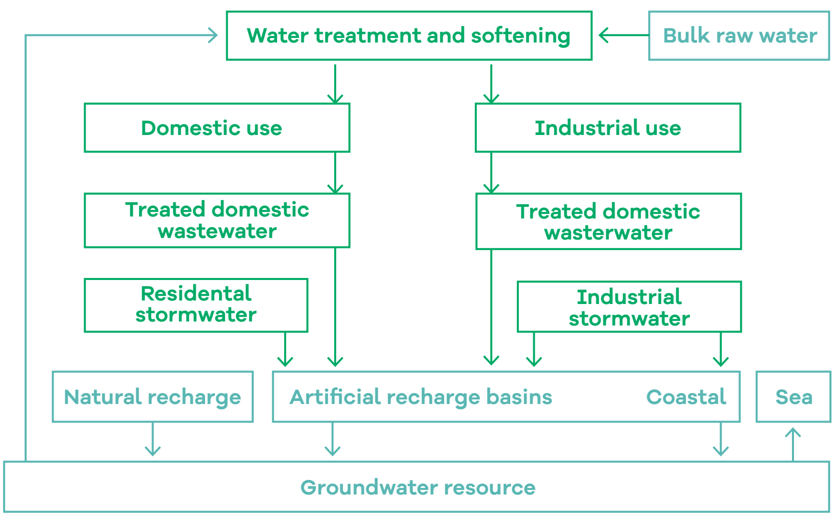

Figure 8: Typical municipal groundwater recharge system

[12] www.artificialrecharge.co.za

4.5. Desalination

Recent indications are that by 2030, up to 10% of the country's urban water supply could come from water desalination plants. However, the desalination process has a high energy demand. South Africa is currently experiencing an electricity crisis, and the water-energy nexus has many carbon emission implications. A solution to overcome the energy constraints would be to take advantage of the growth in the South African renewable energy industry, particularly in the Western Cape.

Globally, the desalination market has returned to a growth path after a period of decline. This technology will play a major role in certain regions (particularly Africa) in supporting how resources can potentially be recovered from wastewaters (Frost & Sullivan 2015). Large-scale desalination plants have already been constructed in Mossel Bay and Lamberts Bay, while planning for the CoCT and Saldanha Bay is in progress.

Although not a typical green technology water solution, desalination is considered because of its potential to work alongside renewable energy opportunities, as well as being at the forefront of membrane technology and alternative supply application. Desalination plants have been constructed in response to increased water demand and to reduce the risk of drought. The 15 million litres per day (Ml/day) desalination plant in Mossel Bay — the largest in the country — was commissioned in November 2011, at a cost of R191.4 million, with emergency funds from national government. However, this plant has never operated at full capacity, as it was completed after the drought was over. The cost of maintaining this asset is around R1 million/month before productive use (Turner 2015).

More recently, the Cederberg LM decided to supplement the Lamberts Bay water supply by adding a seawater desalination plant. In 2012, Veolia Water Solutions and Technologies SA won the multimillion rand contract, which was completed and commissioned in November 2013 (Water Wheel 2014).

The West Coast DM has also proposed constructing and operating a 25.5 Ml/day seawater desalination plant in the Saldanha Bay area, using reverse osmosis technology. The plant and associated infrastructure would cost an estimated R500 million — R300 million more than earlier estimates (DWS 2015a). Funding is currently a major challenge, as the West Coast DM is not in a position to fund a project of this size, and a grant application to the DWS has not yet been successful. Until such a time as a source of funding can be secured, it appears unlikely that this project will be taken towards realisation.

The CoCT is conducting a feasibility study into using seawater desalination to augment Cape Town's water supply. Worley Parsons was appointed in July 2012 to conduct this study (DWS 2015a). The most likely site identified is near the Koeberg power station. The design capacity of the plant will be 150 Ml/day, with the option of upgrading it to 450 Ml/day, with a R15 billion capex budget (excluding VAT, with a 30% contingency). A lead time of approximately eight years — including the feasibility study (to be completed in mid-2016), environmental impact assessment, construction and linking it to the current water distribution network — can be expected, according to current projections.

The City of Cape Town is conducting a feasibility study into using seawater desalination to augment Cape Town's water supply. Worley Parsons was appointed in July 2012 to conduct this study (DWS 2015a). The most likely site identified is near the Koeberg power station.

Figure 9 shows the actual or planned operational costs for selected desalination plants operating in the Western Cape. These are represented to provide guidance on some of the modelled and actual costs of desalination at different scales (installation has taken place for various reasons).

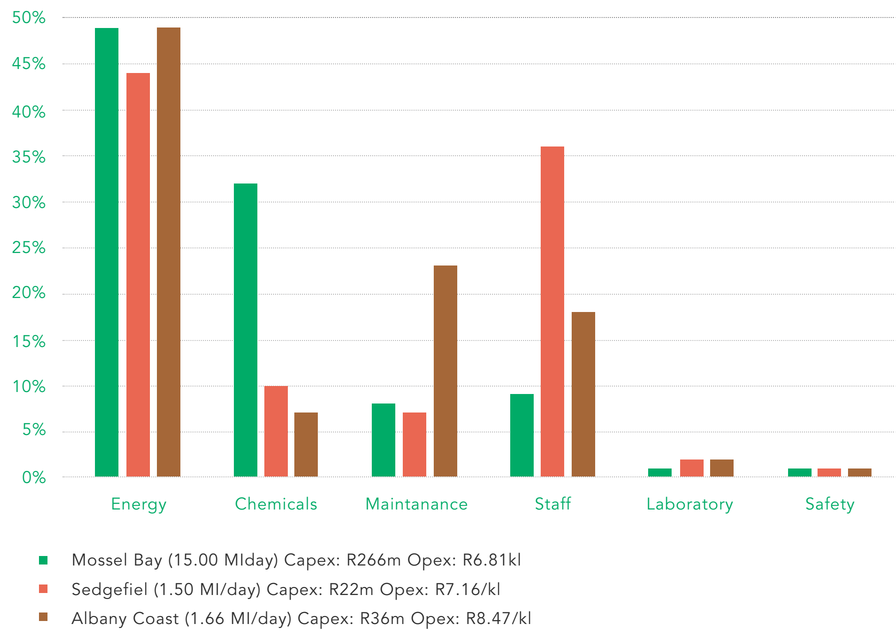

Figure 9: Costs and design parameters of selected Western Cape desalination plants

4.6. Water-sensitive cities

Green infrastructure is becoming increasingly recognised as an important opportunity for addressing the complex challenges of water management. Green infrastructure refers to the natural or semi-natural systems that provide services for water resource management, with equivalent or similar benefits to conventional (built) greywater infrastructure. The United Nations Environment Programme has developed a comprehensive guideline and technology cost-benefit assessment for green infrastructure. Table 6 presents an overview of green infrastructure solutions, relevant for the water resource management that is discussed in the guide. Solutions marked with an asterisk ('*') consist of built or 'grey' elements that interact with natural features and seek to enhance their water-related ecosystem services (UNEP 2014).

Conventional urban stormwater management focuses largely on quantity (flow) management, by collecting runoff and channelling it to the closest watercourse. This has led to the erosion of natural channels and pollution, resulting in environmental degradation. Sustainable urban drainage systems (SUDS) offer an alternative approach through designing systems for water quantity management, water quality treatment, enhanced amenity and the maintenance of biodiversity. The approach has been widely adopted overseas; however, there is still some degree of scepticism as to its effectiveness in South Africa. The CoCT has established an interdepartmental task team to explore sustainable drainage opportunities, and is becoming a leading agency in the implementation of green infrastructure.

The growing approach towards greener urban infrastructure and softer stormwater management and recovery is becoming an increasing area of focus by private development and technology providers and designers. The recently published reports on alternative technology for stormwater management (WRC 2013b, 2013c) are the first of their kind locally, and also outline technologies that have already been implemented. These include:

- **Permeable paving** is the most commonly implemented SUDS option in South Africa. This is most likely due to its promotion by the Concrete Manufacturers Association. The Cape Town Grand Parade — situated next to the Town Hall in the centre of Cape Town — was the first major permeable paving scheme in the Western Cape. There are currently only a handful of suppliers manufacturing these products in South Africa.
- **Green roofs** are vegetated roofs that act as excellent source water controls. They are relatively easy to retrofit onto commercial buildings in high-density areas, where other SUDS options would be inappropriate. Two interesting retrofit projects that have been undertaken are the Western Cape Department of Environmental Affairs and Development Planning Green Roof in Cape Town and the Green Roof Pilot Project in eThekwini.
- **SUDS treatment trains** use multiple low-technology and green treatment methods in an integrated manner. Two new developments in South Africa — Cotswold Downs and Hawaan Forest Estate — have implemented SUDS treatment trains and present interesting case studies.
- The **Century City wetlands** collects stormwater runoff from the Century City and neighbouring Summer Greens developments, and channels it into the adjoining Tygerhof detention pond. The Wingfield outfall, located at the north-eastern end of Century City's bounds, is the stormwater outfall for the development.

Table 6: Green infrastructure solutions for water resource management

<table>
<tr><th colspan="2" rowspan="2">Water management issue (primary service to be provided)</th><th rowspan="2">Green infrastructure solution</th><th colspan="4">Location</th><th rowspan="2">Corresponding grey infrastructure solution (at the primary service level)</th></tr>
<tr><th>Watershed</th><th>Floorplan</th><th>Urban</th><th>Coastal</th></tr>
<tr><td colspan="2" rowspan="7">Water supply regulation (including drought mitigation)</td><td>Re/afforestation and forest conservation</td><td>X</td><td></td><td></td><td></td><td rowspan="7">Dams; groundwater pumping; water distribution systems</td></tr>
<tr><td>Reconnecting rivers to floodplains</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Wetlands restoration/ conservation</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Constructing wetlands</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Water harvesting*</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Green spaces (bioretention and infiltration)</td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>Permeable pavements*</td><td></td><td></td><td>X</td><td></td></tr>
<tr><td rowspan="6">Water quality regulation</td><td rowspan="6">Water purification</td><td>Re/afforestation and forest conservation</td><td>X</td><td></td><td></td><td></td><td rowspan="6">Water treatment plant</td></tr>
<tr><td>Riparian buffers</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Reconnecting rivers to floodplains</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Wetlands restoration/ conservation</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Constructing wetlands</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Green spaces (bioretention and infiltration)</td><td></td><td></td><td>X</td><td></td></tr>
</table>

Water management issue (primary service to be provided)		Green infrastructure solution	Location				Corresponding grey infrastructure solution (at the primary service level)
			Watershed	Floorplan	Urban	Coastal	
Water quality regulation	Water purification	Permeable pavements*			X		Water treatment plant
Water quality regulation	Erosion control	Re/afforestation and forest conservation	X				Reinforcement of slopes
		Riparian buffers		X			
		Reconnecting rivers to floodplains		X			
	Biological control	Re/afforestation and forest conservation	X				Water treatment plant
		Riparian buffers		X			
		Reconnecting rivers to floodplains		X			
		Riparian buffers	X	X	X		
		Constructing wetlands	X	X	X		
	Water temperature control	Re/afforestation and forest conservation	X				Dams
		Riparian buffers		X			
		Reconnecting rivers to floodplains		X			
		Wetlands restoration/ conservation	X	X	X		
		Constructing wetlands	X	X	X		
		Green spaces (bioretention and infiltration)			X		
Moderation of extreme events (floods)	Riverine flood control	Re/afforestation and forest conservation	X				Dams and levees
		Riparian buffers		X			
		Reconnecting rivers to floodplains		X			
		Wetlands restoration/ conservation	X	X	X		
		Establishing flood bypasses	X	X	X		
	Urban stormwater runoff	Green roofs			X		Urban stormwater infrastructure
		Green spaces (bioretention and infiltration)			X		
		Water harvesting*	X	X	X		
		Permeable pavements*			X		
	Coastal flood (storm) control	Restoring mangroves, marshes and dunes				X	Sea walls
		Protecting/restoring reefs (coral/oyster)				X	

* Built or 'grey' elements that interact with natural features and seek to enhance their water-related ecosystem services

4.7. End-user efficiency

To drive improvements to water efficiency in agriculture, Fruitlook[13] (a project established by the Western Cape Department of Agriculture) supports farmers in making decisions on their water use. The web-based system provides information on nine growth parameters for each registered plot, using satellite imagery. These parameters include evapotranspiration deficit, crop factor, biomass developed, biomass water-use efficiency and nitrogen content.

Fruitlook[13] (a project established by the Western Cape Department of Agriculture) supports farmers in making decisions on their water use. The web-based system provides information on nine growth parameters for each registered plot, using satellite imagery.

The DWS (2015a) highlights the potential for improved efficiency in agriculture, helping to maintain crop yields and lower water demand while reducing costs. These savings accrue by reducing water and pumping costs, cutting fertiliser costs and improving yields by maintaining soil quality. Interventions to achieve this include optimising crop selection, irrigation scheduling, irrigation methods, soil enhancement measures and reviewing water source selection. More information on green and efficient agricultural opportunities and market research can be found in the GreenCape 2016 Agriculture Market Intelligence Report.

There are also opportunities to improve water efficiency in industry, as well as in agriculture. For example, SABMiller has succeeded in reducing its breweries' water footprint by around 25% since 2008 by implementing improvements to water efficiency in its manufacturing process (SABMiller 2015). However, the company concedes that although water efficiency in its breweries is important, improving water efficiency across the agriculture sector would help to achieve more significant water savings. Other options for improving water efficiency, particularly in the industrial, commercial and residential sectors, include installing permanent products to detect excess consumption or unusual use amounts (e.g. leaks).

These automatically cut off the supply and alert maintenance staff accordingly (and are controversial, in some instances, due to the right to access to water). For example, a recent project in 2014 involved installing leak detection and control systems in over 60 schools in the Western Cape, with water losses reduced significantly.

4.8. Reducing municipal losses

The Western Cape currently leads South Africa's provinces with the lowest NRW (around 90 million m^3) as a percentage of the urban reticulation system input volume (around 480 million m^3), at approximately 19% compared to the national average of around 40% (DWS 2015f).

© Raymond Siebrits, GreenCape

[13] www.fruitlook.co.za

While the Western Cape municipalities — specifically the CoCT — lead the country in fixing leaks, numerous opportunities still exist in the province for the private sector. These opportunities lie particularly in the installation of leak detection systems and in leak repair. NRW is water lost through physical leakage, commercial losses through meter under-registration, billing errors, theft and unbilled authorised consumption. An estimated R7.2 billion in potential revenue is lost every year through NRW (DWS 2013a).

The DWS has developed an excellent web tool to search and understand the differences in NRW across the country (DWS 2015f). This will hopefully help service providers and municipalities to understand where interventions are required most urgently.

Relevant studies show how provincial NRW in the Western Cape has reduced in the past five years, while holding per capita consumption between 201 litres/day and 250 litres/day (DWS 2014d). George, Stellenbosch and Paarl/Wellington are constantly in the top-performing secondary cities (DWS 2013d) with regard to water loss prevention, and maintain their system input volumes despite constant population growth. Water balance calculations are used to calculate and account for water in a distribution system. The CoCT's 2013/2014 water balance is shown in Figure 10 (DWS 2015g). Water production cost during this period was around R8/kl. As with all municipalities and towns, business opportunities lie in reducing losses and improving metering and billing, and in sound asset management.

As with all municipalities and towns, business opportunities lie in reducing losses and improving metering and billing, and in sound asset management.

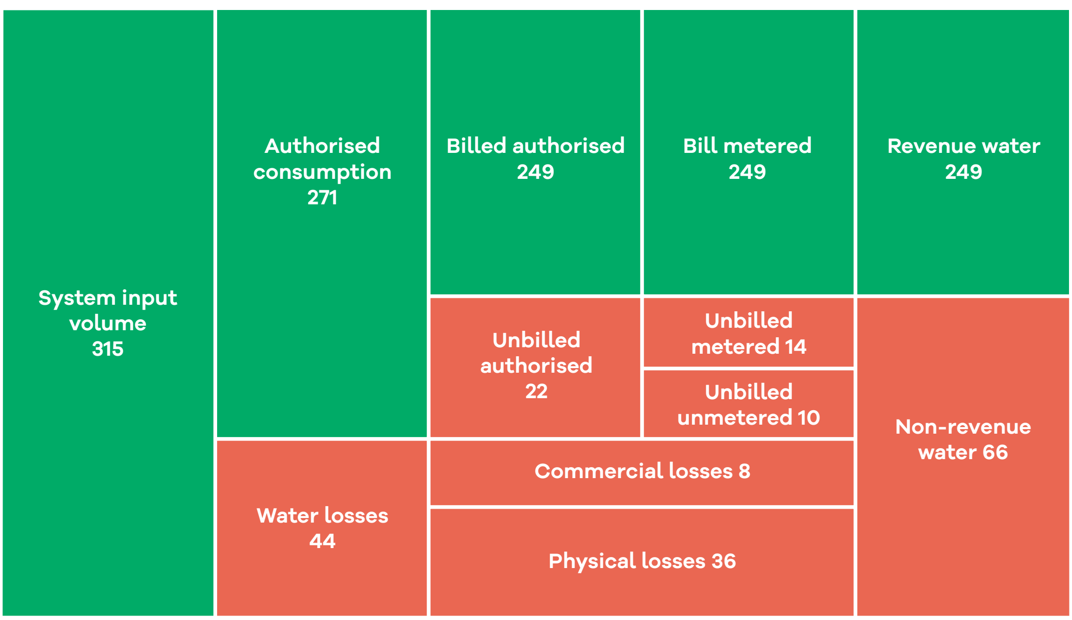

Figure 10: Cape Town water balance 2013/2014 (million m^3)*

* For the Cape Town water balance visit the water pages on the GreenCape website, www.greencape.co.za

Leak detection technology for pipelines is also advancing at a healthy pace. Some of the latest radio hydrophone systems are now being used by South African companies and utilities, often allowing a single point of access to locate leaks far from the detection station. Common types of leak detection methods and technology now include: metal detection, tracer gas, acoustic systems, thermal imaging, smoke generation, fluorescent dyes and 'crawler' or push cameras.

Another advancing technology space is the in-situ replacement or relining of pipes. Older or corroded pipes are calculated to be the cause of high water losses in reticulation systems, and also cause reduced flow rates and strain on pump and pressure systems. The latest technology uses non-invasive methods to either reline pipes or place new pipes within pipes, without the need to excavate. A single access point is used to pump polyvinyl chloride reliners, epoxy solutions or felt through the network using steam, pressure or hydraulic force. These methods have allowed for less network shutdown, cheaper access to systems and a faster turnaround time of system repair or maintenance.

A number of key actors have embarked on water loss reduction initiatives or programmes. Previous flagship activities in South Africa include the Nestlé milk factory in Mossel Bay; the Anglo American Thermal Coal, BHP Billiton Energy Coal South Africa and eMalahleni LM partnership; the South African Breweries and Coca-Cola production facility initiatives; and the Sasol plant water efficiency programmes.

The German International Cooperation Agency (GIZ), Sasol and Emfuleni recently completed a novel and wide-reaching water loss reduction programme. As a result of the collaborative effort from public and private entities, about R37 million and 6.8 million m^3 was saved between 2012 and 2014 while the programme was run. The programme had direct contact with over 105 000 households and focused on community education and raising awareness on the one hand, and physical loss reduction through leak fixing and pressure optimisation on the other. Figure 11 describes how the institutional relationships in the programme were structured (Civil Engineering 2015).

The Strategic Water Partners Network, GIZ, DWS and WRC have also collaborated on developing a model performance-based contract with associated guidelines of use, which can be used by municipalities or entities to procure service providers for similar water loss reduction projects or initiatives (SWPN 2015). The guidelines also include tools for the calculating of tender prices and performance bonuses, as well as a template for the evaluation of a performance-based WC/WDM project.

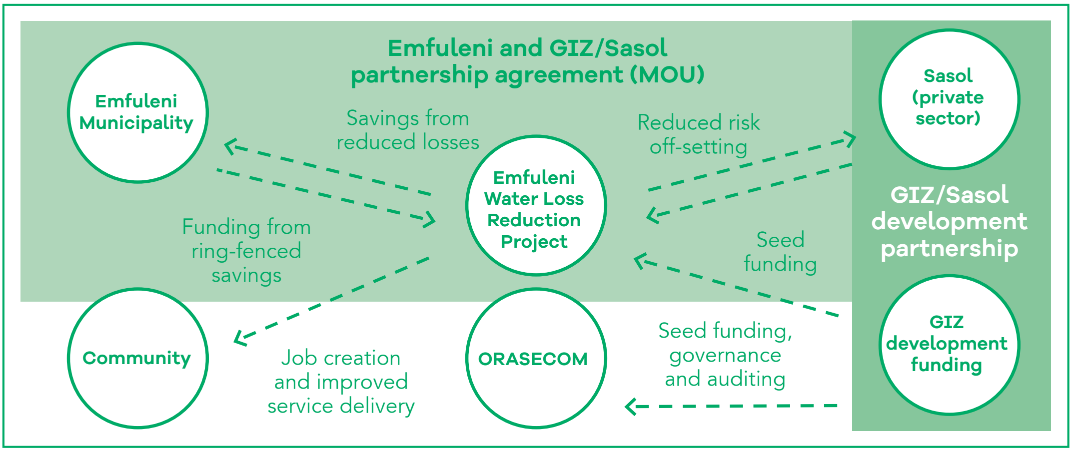

Figure 11: Institutional arrangements for the Emfuleni Water Loss Reduction Project

At a national level, The Presidency recently launched the training phase of the flagship War on Leaks campaign in mid-2015. The current budget is R680 million for the campaign, and young people will be trained in three phases:

- **phase 1**: 3 000 trained in the 2015/2016 financial year
- **phase 2:** 5 000 trained in the 2016/2017 financial year
- **phase 3:** 7000 trained in the 2017/2018 financial year.

Those who will qualify will be trained as fitters and turners, welders, instrument mechanics and electricians to fulfil the demand for repairs, retrofitting and replacements (DWS 2015h).

4.9. Small or decentralised treatment

Certain municipalities and private developers are seeking alternatives to large, centralised, capital-intensive wastewater treatment systems, due to plant capacity constraints and limited budgets. These alternatives include small-scale distributed solutions, which are particularly relevant to urban fringe areas. Apart from housing pressure, reasons for considering decentralised options include the high cost of pumping, which results from a low population density; a need for improved access to services; a need to reduce river pollution; and a need for solutions that can be rapidly implemented. These drivers act as motivation for municipalities to facilitate private sector investment in decentralised solutions to wastewater treatment.

These small-scale WWTW are particularly suitable for remote locations, farms, schools and housing estates that are not connected to the local sewerage infrastructure. Their attractive qualities include easy installation, the range of available treatment capacities, low power consumption and low maintenance costs.

Barriers to the uptake of decentralised WWTW include the lack of municipal bylaws to accommodate their installation; the need to monitor the quality of discharged effluent; negative perceptions about cost and maintenance requirements; and a perception that decentralised options are impractical to manage. Decentralised wastewater treatment options have long been regarded as inferior alternatives to large-scale systems. However, given the improvements in compact activated sludge systems, and given that strained municipal infrastructure is acting as a constraint on the development of certain urban fringe areas, local government and municipalities are reconsidering decentralised options.

The Western Cape Department of Local Government and the DWS are supporting municipalities in considering means to formalise the regulation — and allow the use of — small-scale decentralised WWTW. Overcoming this hurdle will create opportunities for the suppliers and installers of such plants. The consensus from around the country is that this will provide development opportunities where municipal services are unavailable. Critical elements for success are the ongoing operations and maintenance systems, creating a legitimate industry association for the private sector and supporting further research.

These types of systems and technologies are also being considered in overcoming sanitation backlogs, where large or centralised systems cannot be implemented rapidly enough or would be inappropriate for certain settlements. Table 7 outlines the required number of toilets and capital costs for developing centralised, waterborne sanitation to every household in the Western Cape (excluding WWTW construction) (WC-DHS 2015).

Certain municipalities and private developers are seeking alternatives to large, centralised, capital-intensive wastewater treatment systems, due to plant capacity constraints and limited budgets. These alternatives include small-scale distributed solutions, which are particularly relevant to urban fringe areas.

Table 7: Western Cape sanitation requirements by district municipality (May 2015)

Region	Informal settlements	Households	Existing toilets	Households per toilet	Required toilets	Estimated cost (R'000)*
Cape Winelands	80	22 449	2 141	17.91	3 063	61 260
Central Karoo	6	123	4	9.83	23	460
Eden	133	15 290	3 553	6.24	1 301	26 020
Overberg	40	9 372	788	13.26	1 250	25 000
West Coast	15	8 256	2 369	13.05	328	6 560
Total DM	**274**	**55 490**	**8 855**	**11.46**	**5 965**	**119 300**
CoCT	**203**	**158 673**	**23 898**	**7.45**	**11 262**	**225 240**
Grand Total	**477**	**214 163**	**32 753**	**9.45**	**17 227**	**344 540**

**personal communications and calculations*

The WRC and the DWS have been leading the research and guideline development for this market opportunity. Key resources are:

- the WRC technical report, entitled 'Self-regulation of the SWWTW industry', which focused on two parts:
  – development of a proposed framework of standards, a conceptual model for a test facility and an accreditation system for each 'new' technology provided by suppliers
  – development of a 'Green Droplet' accreditation system;
- the WRC/DWS technical reference document, entitled 'Guideline document: package plants for the treatment of domestic wastewater' (WRC 2015a, DWS 2009, DWS 2010b).

Private sector activities are attempting to increase the presence and viability of these technologies. The Small Wastewater Treatment Works (SWWTW) Suppliers Association[14] is a young industry body that is attempting to formalise and support the industry, and is further supported by the Water Institute of Southern Africa's SWWTW Division.[15]

4.10. Resource recovery from wastewater

Momentum is gathering in South Africa for developing resource recovery technologies from wastewater. Energy recovery is seen as a keen driver of this opportunity area, while business cases are opening up for resource extraction from sludge (e.g. fertiliser). The South African Local Government Association (SALGA) and the GIZ recently published a report on biogas potential in selected municipal WWTW. A key result is that there seems to be a definite viability to implement projects at larger WWTW, specifically where the inflow is in excess of 15 Ml/day. Most plants will generate thermal and electrical energy for their own internal usage, reducing operational demand significantly. In general, these biogas projects will require a long-term investment, with viable returns only possible over a 7-10 year period (SALGA & GIZ 2015).

Momentum is gathering in South Africa for developing resource recovery technologies from wastewater. Energy recovery is seen as a keen driver of this opportunity area, while business cases are opening up for resource extraction from sludge (e.g. fertiliser).

[14] www.sewpacksa.co.za
[15] www.wisa.org.za

Johannesburg Water has recently completed commissioning a biogas-to-energy project, and has commissioned two further projects — at its Northern Waste Raw Water Treatment Works near Diepsloot and at Driefontein WWTW. Overall, around 17 megawatts (MW) is planned to be developed at the city's largest facilities.

The CoCT is fast becoming active in the resource recovery market, with its wastewater department having received environmental authorisation for the development of a biosolids beneficiation facility. At present, the treated effluent from key plants is recovered for irrigation/industrial/golf estate use, and the majority of the sludge (biosolids) is applied to agricultural land. While the application of sludge onto farmlands has been ongoing for the past 12 years, the intention of the city going forward is to beneficiate the biosolids and recover energy/resources from these biosolids.

The regional biosolids beneficiation facility will treat approximately 80 tonnes/day of both primary and secondary sludge from nine of the CoCT's northern wastewater treatment facilities with advanced anaerobic digestion. (There will be another regional biosolids facility at a southern works.) Besides normal mesophilic anaerobic digestion, the facility will also pre-treat the sludge by means of thermal hydrolysis, to generate more biogas. The biogas will be used for the generation of electrical energy, for on-site and external use. The thermal energy will be used to sustain the digestion process. Essentially, the facility will be self-sufficient in its energy requirements.

Benefits of this project:

1. Class A biosolids, which can be used as a fertiliser (nitrates), will be produced.
2. Essential nutrients such as struvite (magnesium ammonium phosphate) will be recovered.
3. An estimated 3 MW will be recovered through the treatment process. This quantity of energy recovery can be equated to 45% of the electricity consumption used at all these WWTW
4. The project will generate around R200 million in new business sales for the CoCT and R76 million to the provincial gross domestic product, and provide over 350 permanent and sustainable job opportunities (Urban-Econ 2015).

Other institutions that are actively pursuing the resource recovery agenda by developing new technology and promoting the circular economy are the WRC, with many research projects underway and published; the South African Biogas Industry Association;[16] and the Centre for Bioprocess Engineering Research.[17]

4.11. Water reclamation

Water reclamation[18] and recycling takes on many types, forms and definitions. Figure 12 outlines most of the types of reclamation, and the relevant sources. Overall, water reclamation is broadly split into direct or indirect water reclamation. The majority of the technology innovations and business opportunities in this focus area are in recycling and direct reclamation.

The DWA developed a National Strategy for Water Reuse to better inform decision-making for the implementation of water reclamation projects (DWS2013b). There is general consensus that South Africa has the potential to be a leading innovator in water reclamation technology (particularly in acid mine drainage, where most of the commercial developments in water reclamation have already take place). There is, however, still a limited local base of knowledge and expertise, as well as limited projects in existence.

[16] www.biogasassociation.co.za
[17] www.ceber.uct.ac.za
[18] This report uses the term reclamation instead of re-use.

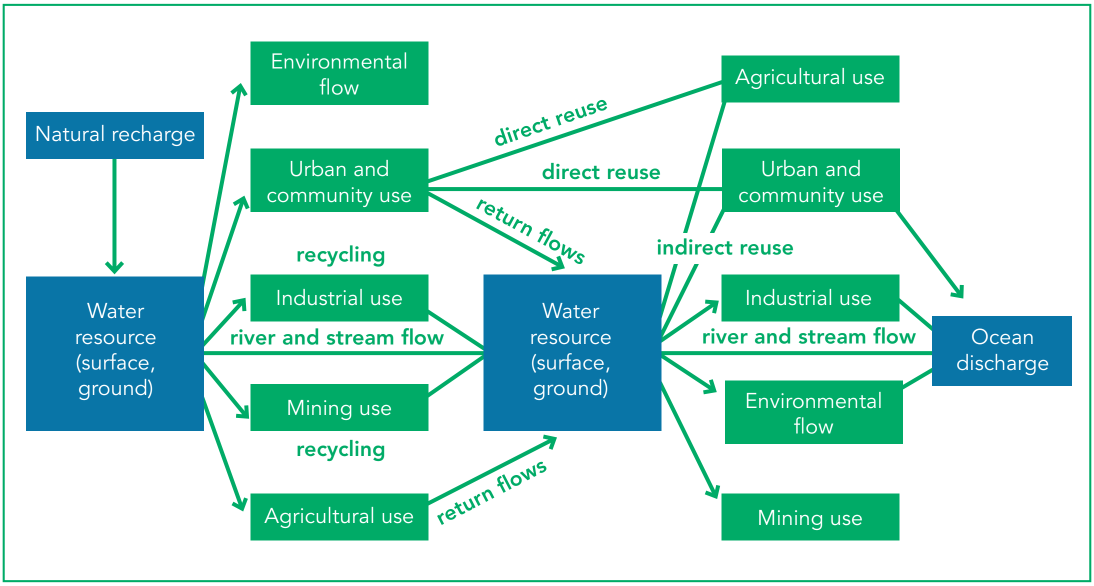

Figure 12: Types of water reclamation

However, this landscape is rapidly changing as the business case for investing in reclamation and recycling technologies grows. Excellent research has been completed for different components of water reclamation, while further studies are underway led by water services authorities, the Water Institute of Southern Africa Water Reuse Division and the WRC. The research includes topics such as:

- Implementation plan for direct and indirect water reclamation for domestic purposes.
- Investigation into the cost and water quality aspects of South African desalination and reclamation plants.
- Wastewater reclamation for potable reclamation.
- An investigation into the social, institutional and economic implications of reusing reclaimed wastewater for domestic application in South Africa.
- Decision-support model for the selection and costing of direct potable reuse systems from municipal wastewater.

Numerous municipalities across the country are asking how to access reclamation opportunities, and a fair number are implementing simple indirect systems or have had certain basic types of reclamation operational for a few years. There are also multiple feasibility studies being conducted, including by the CoCT. The Western Cape Government is exploring the feasibility of a water exchange network for the Saldanha Bay area, while the Saldanha Bay LM is investigating a number of water reclamation options. A sample of projects that have already been implemented in South Africa are:

- Glencore's Optimum Water Reclamation Plant in Middleburg, which releases clean drinking water to the Steve Tshwete LM (Tancott 2014).
- the eMalahleni Water Reclamation Plant, operated jointly by BHP Billiton and Anglo American, which employs advanced treatment technology and disinfection to supply drinking water to the town of eMalahleni.
- Optimum Collery's Hendrina multistage ultrafiltration and reverse osmosis plant, which treats mine water with a 98% water recovery, most of which is utilised by the local Hendrina municipality (Tancott 2014).
- Hatch Goba's scaled demonstration plant of 2 Ml/day in Durban, which will use a portion of final effluent from the secondary clarifiers at the Darvill wastewater treatment plant. It will use advanced oxidation, biologically activated filters and ultrafiltration membranes to demonstrate water reclamation opportunities (Breytenbach 2015).

A global leader in water reclamation for a large urban system is the city of Singapore, which is a densely populated region with limited surface area and no natural aquifers. This geography has created a water-stressed country that has resulted in Singapore developing alternative methods of water supply. Currently, reclaimed wastewater supplies up to 30% of Singapore's potable water demand, and there are plans to expand this scheme to 50% of the country's water demand by 2060.

South Africa's first direct potable reuse plant in Beaufort West was built during an emergency drought. Treated wastewater effluent is conveyed directly to a water treatment facility for further treatment to drinking water standard. Built in 2010 for R24 million and using reverse osmosis, ultrafiltration, ultraviolet, sand and chemical treatment technologies, the plant is still operational (Water Wheel 2015a). Figure 13 shows the treatment processes used at southern Africa's two most advanced water reclamation facilities — New Goreangab Water Reclamation Plant (Namibia) and the Beaufort West Reclamation Plant.

4.12. Energy and water

A number of water and energy interdependencies have been highlighted globally in the past few years, with the water-energy-food nexus receiving significant attention from the research and policy sectors. Figure 14 describes some of the basic interconnectedness of water and energy, while two novel projects finding solutions in this space in South Africa are described further.

A recent study (WRC 2009) has quantified the energy potential from wastewater in South Africa, as seen in Table 8. Around 8 700 MW of thermal energy and 2 600 MW of electrical energy could be recovered/produced, using a range of technologies and sources.

The largest conduit hydropower installation in South Africa officially launched at Bloemwater's Brandkop reservoir in the Free State in March 2015 (Water Wheel 2015b). This collaborative partnership between the WRC, University of Pretoria and sector partners such as the City of Tshwane, Bloemwater and eThekwini, has led to the successful development and demonstration of conduit hydropower in South Africa.

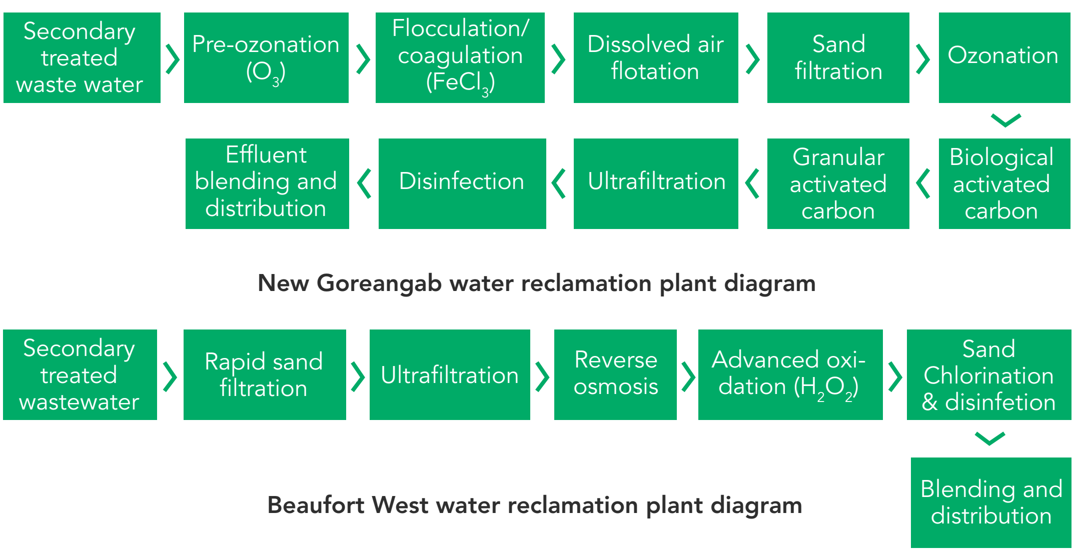

Figure 13: Treatment processes for two operational water reclamation facilities

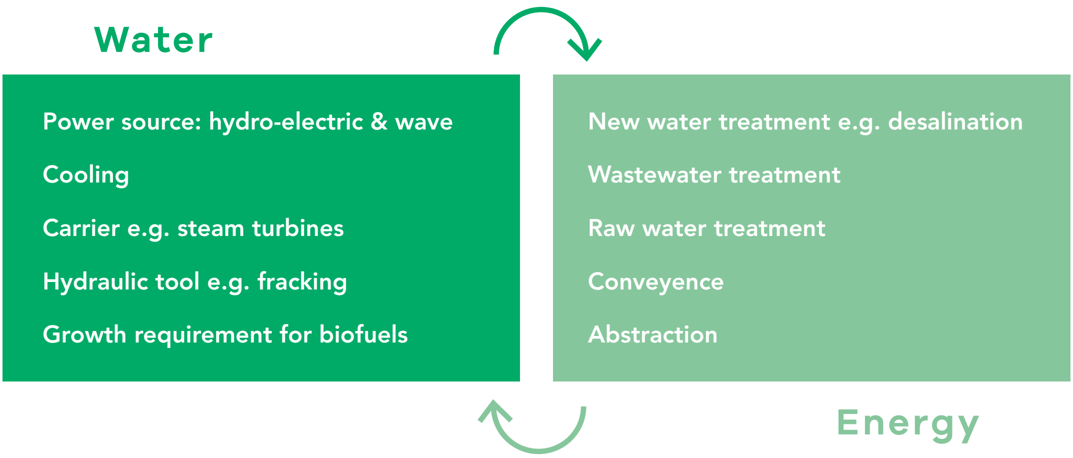

Figure 14: The interdependence of water and energy

The largest conduit hydropower installation in South Africa officially launched at Bloemwater's Brandkop reservoir in the Free State in March 2015 (Water Wheel 2015b). This collaborative partnership between the WRC, University of Pretoria and sector partners such as the City of Tshwane, Bloemwater and eThekwini, has led to the successful development and demonstration of conduit hydropower in South Africa.

Conduit hydropower is the extraction of available energy from existing water supply and distribution systems. The technology involves tapping into an unutilised source of hydropower by using excess energy in pressurised conduits to produce hydroelectric power. The Bloemwater installation involves the Caledon-Bloemfontein potable water supply system, which supplies the majority of the water for Bloemfontein.

The water is supplied to the Brandkop reservoir, where the Bloemwater water utility's head office is located. The conduit hydropower technology involves tapping excess energy through pressure control valves before the water is discharged into the reservoir. In this manner, 96 kilowatts per hour (kW/h) of energy is generated (enough to power Bloemwater's head office). The Minister of Water and Sanitation, Nomvula Mokonyane, noted at the launch in March 2015: 'Water supply utilities introducing enhanced in-house energy generation will alleviate, to some extent, dependency on the already-stressed national grid and keep their energy costs down. It requires a small capital investment and has a short return on investment period. As long as people use water, renewable electricity can be generated.' WRC research has explored conduit hydropower potential in South Africa — and three plants are currently operational (WRC 2015b):

- **City of Tshwane** Crossflow: 14.9 kW (islanded, on-site only)
- **Bloemwater** Crossflow: 96 kW (islanded, supplying Bloemwater head office)
- **eThekwini Municipality** Pelton: 2 kW (islanded and grid-connected).

Emerging research and experimentation for wave energy reverse osmosis pumps and embedded generation is another locally growing interest area. A functioning wave energy system has been established and is operational in Cape Town, with plans to produce the first commercially operated plant in coming years. Potential sites are remote coastal communities or metropolitan amenities outside of the municipal supply system.

Table 8: Energy potential from wastewater in South Africa

Wastewater type	Description	MW (thermal)	MW (electrical)
Domestic black water	Municipal WWTW	842	253
Animal husbandry	Feedlots (solids and liquids)	215	65
	Rural cattle (kraaled at night, solids only)	3 445	1 035
	Dairies (solids and liquids)	121	36
	Piggeries (solids and liquids)	715	215
	Poultry (solids only)	2 976	894
	Red meat and poultry abattoirs (liquids only)	55	17
Olive production		4	1
Fruit processing	Wastewater only (no pulp or pomace)	68	20
Winery		3	1
Distillery	Grain, grape and sugarcane (molasses)	70	21
Brewery		17	5
Textile industry		22	7
Pulp and paper		100	30
Petrochemical waste		48	14
TOTAL		**8 701**	**2 614**
		11 315	

4.13. Smart metering and ICT in water

Over the last decade, ICT systems have become known as a potential solution for developing countries and their information needs. The wide distribution of mobile phones in even the most rural environments has created the suggestion that cellphones are far more than a mere communication tool. Cellphone systems used for data collection, mobile payment and crowd-sourcing initiatives to improve governance, and other applications, are offering a new way of using technology to improve access, and might have the potential to improve service delivery.

Over the last five years, there has been a substantial increase in ICT usage in the South African water sector. Broadly, the applications envisaged or currently implemented in development can be categorised into the following areas:

- customer management
- operational management
- financial and control management.

In all of these areas, ICT applications are used to collect information, streamline information flow and improve work processes. The majority of the systems highlighted as successful showed two key aspects: the system integrated into existing structures, and the municipalities had made financial commitments to maintain the system. Barriers to successful ICT adoption are identified as:

- misuse of the technology
- bureaucracy of procurement
- failure to understand project incentives
- uncertainty about how much effort a new system will result in
- politicising of new technologies
- shortage of technical skills
- risk avoidance.

Enablers are identified as:

- an increase in job satisfaction
- moving away from paper
- consistency of records
- better management and collection of data.

The University of Cape Town (UCT) is currently hosting a leading research facility focusing on ICT in multiple sectors where water is a primary focus.[19] The water meter industry has seen substantial developments in the last two decades, with many new capabilities added to water meters. These advanced water meters (also called intelligent meters or smart meters) have additional functionality, such as the ability to communicate with the municipality or user, monitor consumption patterns, dispense prepaid water or sound a leakage alarm.

The WRC is leading research funding in this technology frontier by reviewing ICT's technology in the market (WRC 2013d) and publishing key work on smart metering for municipal systems in 2011 (WRC 2011). A recent report provides an evaluation framework for advanced water metering projects and encourages a holistic approach to metering technology adoption (WRC 2015c).

The University of Cape Town (UCT) is currently hosting a leading research facility focusing on ICT in multiple sectors where water is a primary focus. The water meter industry has seen substantial developments in the last two decades, with many new capabilities added to water meters.

4.14. Horizon technologies

The list below is a non-exhaustive attempt at listing technology frontiers for water that are emerging in other territories. South Africa is currently pursuing many of these technologies — to varying degrees — across the research, development and innovation spectrum, while others are unique to a specific research or operational unit abroad:

[19] www.icomms.uct.ac.za

- **advanced wastewater treatment**: priority compounds, fluidised bed LED reactors, ultrasound treatment and deterministic ratchet technology;
- **algae: biofilms**, bio- and auto-flocculation and closing nutrient cycles;
- **applied water physics**: ultrafast fluorescence spectroscopy, neutron scattering, high-speed video imaging and analysis;
- **biofouling**: reduced susceptibility, nutrient limitation, cleaning advancements and biofilms;
- **biomimetic membranes**: ammonium recovery, lithium extraction and separation technology;
- **blue energy**: reverse electrodialysis, carbon dioxide (CO_2) reduction and membrane technology;
- **capacitive deionisation**: activated carbon, salt removal and low energy systems;
- **concentrates**: ion exchange and concentrated salts;
- **dehydration**: small-scale water production, selective membranes and food drying technology;
- **franchise models**: decentralised services, public-private partnerships and entrepreneurship;
- **genomic-based water quality monitoring**: next-generation sequencing, fingerprinting and precise treatment process controls;
- **membrane processes**: advancing wastewater treatment, reclamation, micro-membranes, ultra-membranes and nano-membranes;
- **phosphate recovery**: fertiliser production, higher value products and business models;
- **priority compounds**: ultraviolet degradation and natural organics;
- **protein from water**: high-quality microbial feeds and production systems;
- **resource recovery**: harvesting of energy and valuable compounds using microbial fuel cell and biocatalysed electrolysis;
- **sanitation alternatives**: low-technology, wet and dry;
- **sensors**: microfluidics, spectroscopy, laser optics and acoustics;
- **smart water grids**: magnetic wave and radar monitoring, control systems and optimisation;
- **source-separated sanitation**: solid, liquid, grey and medical waste streams;
- **sulphur**: volatile compound removal, scrubbers and bioreactors;
- **thermal hydrolysis**: rapid decompression, resource recovery, sludge dewatering;
- **virus control**: membranes, oxidation, ultraviolet disinfection, adsorption and affordable treatment.

4.15. Shared risk and corporate water stewardship

The concept of water stewardship has gathered traction as businesses have recognised the risk that water may have on their profitability and long-term viability. Water is a shared resource that requires businesses to look beyond their 'factory fences' and collaborate with a variety of different stakeholders to secure their water resources. The types of water risks that businesses typically face include:

- **physical risk:** water quantity and quality issues that impact on production;
- **regulatory risk:** the enforcement of regulatory powers that may result in changes in water pricing, supply, rights, standards and licence to operate;
- **reputation risk:** the impacts on the company brand from public perceptions of water resource and pollution management.

The steps in Figure 15 outline the Worldwide Fund for Nature's (WWF) suggested approach to water stewardship from a business perspective:

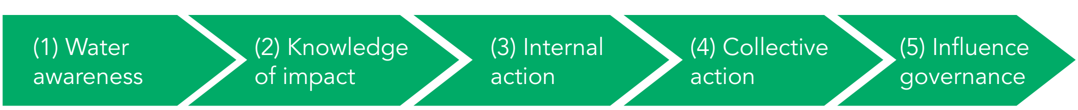

Figure 15: Business approach to water stewardship

1. **Evaluation:** The first step in the process is simply an evaluation of the water context in which the company is operating, as well as how it is perceived by others. This is the start of a discussion.
2. **Impact assessment:** The second step is to develop a deeper understanding of the impact that water plays within the business. It explores what its water footprint is, and what water risks its suppliers face.
3. **Action plan**: From this impact assessment, an action plan should be drawn up of how to tackle the water risks identified with employees, buyers and suppliers. This action plan should consider how to measure the improvements made by the implementation of the action plan to track progress. The first three steps are very internally focused; making the jump from step three to step four is a significant shift, where the concept of water stewardship comes into effect. This is where a company is looking beyond its own internal management of risk, and has identified that a broader leadership role is required to influence the sustainability of its water resources.
4. **Collective action**: The fourth step is where the business engages with external stakeholders, and forms partnerships with other stakeholders that provide complementary resources to address their shared risk.
5. **Influence**: The final and fifth step in the process is where a business looks to improve water governance through fulfilling a positive and supportive role, typically to government, where the business's interests align with the broader public interest. This may take various forms, such as lobbying or through risk mitigation in specific locations through direct investment in water infrastructure.

There are a number of water stewardship projects emerging within South Africa, and a variety of organisations dedicated to facilitating a business's path towards water stewardship. As the water risks within South Africa become more pronounced and water resources more constrained, this is an ideal time for businesses to evaluate their own water risks to assess the relevance of water stewardship to their business sustainability.

Key organisations to work with on this matter include:

- WWF[20]
- International Water Stewardship Programme of GIZ
- Alliance for Water Stewardship[21]
- United Nations Global Compact: CEO Water Mandate[22, 23]
- Strategic Water Partners Network (a multistakeholder platform chaired by the Minister of Water and Sanitation that bridges government, the private sector and civil society)
- National Business Initiative (a voluntary coalition of South African and multinational companies working towards sustainable growth and development in South Africa).

Key resources and tools available to begin exploring water stewardship opportunities are:

- Water Stewardship for Agriculture in the Western Cape[24]
- WWF Water Risk Filter[25]
- Water Stewardship Toolbox[26]
- United Nations Water Action Hub.[27]

---

[20] www.panda.org/what_we_do/how_we_work/conservation/freshwater/water_management
[21] www.allianceforwaterstewardship.org
[22] www.ceowatermandate.org
[23] www.wateractionhub.org
[24] www.aws.wwfsa.org.za/aws/home
[25] www.waterriskfilter.panda.org
[26] www.ceowatermandate.org/toolbox/discover-next-steps
[27] www.wateractionhub.org

Types and management of water risk and the relevant incorporation of stewardship are shown in Figure 16 (WWF & IFC 2015). These typologies are mapped according to value types and risk levels.

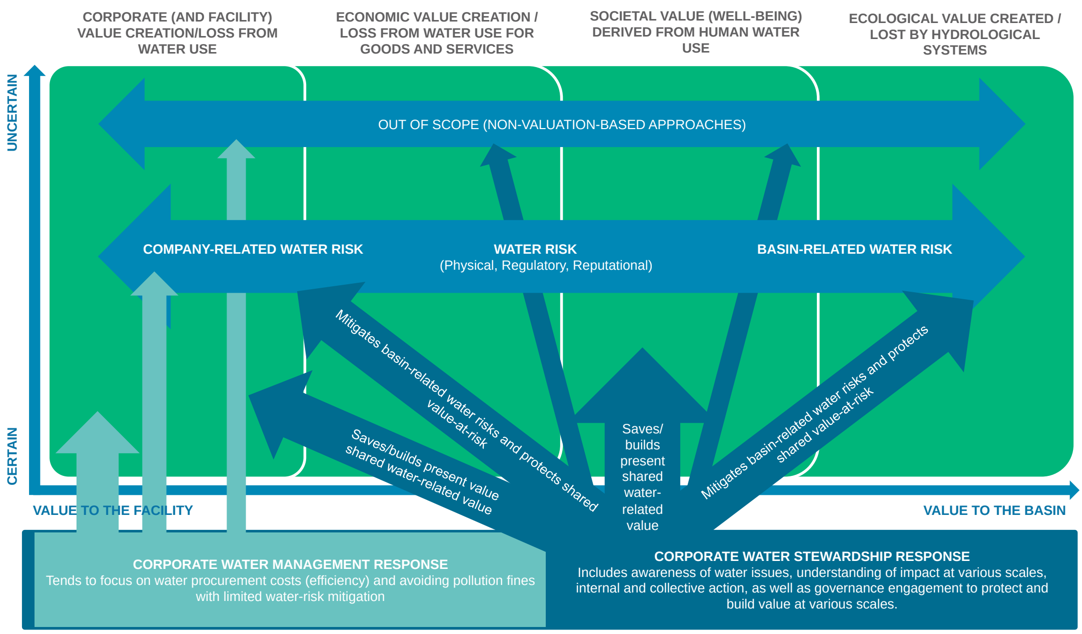

Figure 16: Overlaying water risks in corporate management and stewardship

5 –
Funding and incentives

There is a range of funding solutions, either focused on, or available to greentech manufacturers and service companies, as well as those who use such services. The selection below covers Development Finance Institutions, local public and private sector financiers and investors, and a considerable range of tax incentives.

According to the KPMG Green Tax Index, South Africa ranks 13th out of 21 countries to use tax as an incentive to drive the green growth agenda (ahead of Australia, Singapore and Finland). As well as understanding the various incentive and funding options available to them, investors and suppliers of greentech can also benefit from understanding those available to their customers or clients, as these can influence the viability and attractiveness of their products and projects.

The table below demonstrates a wide variety of these funding solutions. It is not exhaustive, but intends to be indicative of some of the more green-focused funds or incentives available, and provide potential leads or starting points to exploring various options. Further to those below, the full range of government investment incentives can be found at www.investmentincentives.co.za.

Table 9: List of funding solutions

Funding solution	Funding instrument	Details
Development Finance		
International Finance Corporation (IFC)	Loan, Equity	www.ifc.org
European Investment Bank (EIB)	Loan	Greater than R0.25 million
SouthSouthNorth / DBSA: Sustainable Settlements Facility (SSF)	Grant, Subsidy, Rebate	www.southsouthnorth.org/sustainable-settlements-facility-ssf
African Development Bank: Sustainable Energy Fund for Africa	Grant, Technical assistance, Equity	Grant for projects with total capital investments in the range of USD 30-200m. Equity for IPPs with an ideal size of between 5 and 50 MW and a commitment per project of between USD 10-30m.
United Nations Development Programme (UNDP): Global Environmental Facility (GEF)	Grant	Up to USD 50 000
Renewable Energy and Energy Efficiency Partnership (REEEP)	Grant	www.reeep.org
UK Prosperity Fund Programme	Grant	www.gov.uk/guidance/prosperity-fund-programme

German Federal Ministry of Environment: International Climate Initiative (IKI)	Grant	www.bmub.bund.de/en/topics/climate-energy/climate-initiative/general-information
German International Cooperation Agency (GIZ)	Feasibility studies	Bioenergy
Public Sector Funding		
Western Cape Government: Cape Capital Fund	Grant	50% of approved intervention
Eskom: Integrated Demand Management	Rebate	www.eskom.co.za/sites/idm/Pages/Home.aspx
Industrial Development Corporation: Green Energy Efficiency Fund	Loan, Technical support	R 1-50 m
Development Bank of South Africa: Green Fund	Grant, Loan	Green Cities and Towns; Low Carbon Economy; Environmental & Natural Resource Management.
dti: Critical Infrastructure Programme (CIP)	Grant	10% to 30% of the total qualifying infrastructural development costs, up to a maximum of R50 million
dti: MCEP - industrial financing*	Loan	Pre-and post-dispatch working capital facility of up to R50m at a fixed interest rate of 4% over a four-year term
dti: MCEP - production incentive*	Grant	Up to 25% of the manufacturing value added
dti: Manufacturing Investment Programme (MIP)	Grant	Investment grant of 30% of the investment cost of qualifying assets for new or expansion projects below R5 million. Investment grant of between 15% to 30% of the investment cost of qualifying assets for new or expansion projects above R5 million
Department of Small Business Development (DSBD: Co-operative incentive scheme (CIS)	Grant	R0.35 million
Municipal Infrastructure Grant (MIG)	Grant	www.westerncape.gov.za/general-publication/municipal-infrastructure-grant
Recycling and Economic Development Initiative of South Africa (REDISA)	Grant	Infrastructure and set-up costs for tyre recycling
South African National Biodiversity Institute: Global Adaptation Fund	Grant	www.sanbi.org/biodiversity-science/state-biodiversity/climate-change-and-bio-adaptation-division
Private Sector Funding		
ABSA	Loan, Rebate	15% of project
Nedbank	Loan	www.wwf.org.za/what_we_do/wwf_nedbank_green_trust
FNB	Loan	www.fnb.co.za/home-loans/getting-a-building-loan.html
Standard Bank	Loan	www.standardbank.co.za/standardbank

Development Finance		
Old Mutual Infrastructural, Developmental and Environmental Assets Managed Fund (IDEAS)	Loan, Equity	ww2.oldmutual.co.za/old-mutual-investment-group/boutiques/alternative-investments/our-capabilities1/infrastructure/our-products/ideas-managed-fund
Business Partners	Equity, Loan	R0.5-30 million
Edge Growth	Equity, Loan	R1-20 million
Inspired Evolution: Evolution One Fund	Loan	>R10 million
Atlantic Asset Management	Loan	>R15 million
POLYCO	Loan	Infrastructure for plastics: high-density polyethylene (PE-HD), linear/low-density polyethylene PE-LD/LLLD) and polypropylene (PP)
PETCO	Subsidy, Awareness & Training, Equipment	Infrastructure for polyethylene terephthalate (PET). Category A: R30m-R40m per annum, Category B: R4m per annum.
Tax Rebates		
12B accelerate depreciation incentive	Tax rebate	Accelerated depreciation of renewable energy investments at a rate of 50:30:20, as well as certain machinery, plants, implements, utensils and articles used in farming or production of renewable energy
12L energy efficiency incentive	Tax rebate	95c/kwh deduction on energy saved
12I tax allowance incentive for manufacturing investments	Tax rebate	35-55% or R550-R900m for greenfield projects 35-55% or R350--R550m for brownfield projects
Capital development expenditure	Tax rebate	Tax deduction for capital expenses incurred for farming operations (including game farming) which focus on sustainable agriculture.
37B environmental expenditure	Tax rebate	Deduction in respect of environmental expenditure for assets related to environmental treatment and recycling, waste disposal, and post-trade environmental expenses.
37C environmental maintenance expenditure	Tax rebate	Deduction in respect of environmental conservation and maintenance.

*The MCEP has been temporarily suspended owing to funding shortfall in 2015" to "Over R5 Billion was originally set aside for this programme and is now fully committed. A new application window will be opened in April 2016 pending availability of funds. All other incentives of the department will continue as normal.

5.1. Manufacturing incentives

The dti's special economic zone (SEZ) programme aims to increase industrialisation, economic development and job creation around the country. More specifically, the proposed Upington Solar Corridor SEZ (Northern Cape) and Atlantis Greentech SEZ (Western Cape) focus on solar energy generation and greentech manufacturing respectively. They provide significant incentives to manufacturers, IPPs, and other players in the relevant value chains. These development zones make ideal locations for the manufacturing of components that contribute towards local content. An example of this is the Gestamp Renewable Industry (GRI) wind tower manufacturing facility set up in Atlantis, Cape Town. Atlantis has also seen companies such as Skyward Windows and Kaytech expand to include green product lines, and local manufacturing of wind tower internals is expected soon.

The dti has proposed a number of incentives to attract investors into the proposed SEZs, which include:

- **Reduced Corporate Income Tax Rate:** qualifying companies will receive a reduced corporate tax of 15%, instead of the current 28% headline rate.
- **Employment Tax Incentive (ETI):** aimed at encouraging employers to hire young and less-experienced work seekers. It will reduce the cost to employers of hiring young people through a cost sharing mechanism with government.
- **Building Allowance:** qualifying companies will be eligible for an accelerated depreciation allowance on capital structures (buildings). This rate will equal 10% per annum over 10 years.
- **VAT and Customs Relief**: companies located within a customs-controlled area (CCA) will be eligible for VAT and customs relief as per the relevant legislation (dti, 2015).

  Other incentives available to investments into a designated SEZ will include:
- 12I Tax Allowance Incentive
- One-stop-shop facility within designated SEZ area
- SEZ fund for infrastructure development within the designated area.

Within Atlantis, the City of Cape Town has made vast tracts of land available at low cost for purchase or lease by greentech companies through an accelerated land disposal process. An application has now also been submitted by the Western Cape Provincial Government for the entire Atlantis Industrial area to be declared a Greentech SEZ, a decision on which is expected in the first quarter of 2016. GreenCape's Atlantis SEZ team can assist with information, and facilitate access to permits, licenses, planning and development approvals, incentives and finance. It is also worth noting that the dti has been willing to assure investors that investing prior to SEZ designation will not disqualify them from receiving benefits once the zone is designated.

5.2. Grants for water infrastructure and services

Four main state grant schemes are available for application by the relevant designated authorities for water infrastructure and services. While some have seen decreasing overall budgets, a large proportion of new systems are still funded through these channels:

- **Regional bulk infrastructure grant** to develop new and refurbish, upgrade and replace ageing infrastructure that connects water resources to infrastructure serving extensive areas across municipal boundaries; to develop new and refurbish, upgrade and replace ageing wastewater infrastructure of regional significance.
- **Water services operating subsidy grant** to subsidise, refurbish and restore the functionality of water service schemes previously owned by the DWS (or its agencies).
- **Municipal water infrastructure grant** to facilitate the planning, acceleration and implementation of various projects that will ensure water supply to communities identified as not receiving a basic water supply service.
- **Rural household infrastructure grant** to provide specific capital funding for the reduction of rural sanitation backlogs, and to target existing households where dependent services are not viable.

6 –
The Western Cape: Africa’s growing greentech hub

The Western Cape is a world-class investment destination offering prime locations, modern infrastructure, a skilled workforce, low operational costs and an abundance of natural resources.

It is a sought-after place to live, with unrivalled natural beauty, vibrant culture, excellent schools and universities, and an outstanding quality of life. It is also a prime location for green business.

The Cape Town area has emerged in the last five years as South Africa’s renewable energy and cleantech hub, with a critical mass of the leading local and global companies already present, including numerous original equipment manufacturers. The province has a strong local presence of major professional services firms and financiers, as well as a supportive government that has made ease of doing business and the green economy key priorities.

Coupled with these, is a strong and rapidly growing market for green technology and services in South Africa and the region.

Some of the major market opportunity areas in the next five years are outlined in the figure below. Notably, on utility scale wind and solar projects there is robust South African and African demand, with ±R200bn/US$20bn invested since 2011 and >1GW capacity procured per annum.

Renewable energy

- utility scale wind and solar projects
- rooftop solar PV
- component manufacture

Energy efficiency

- industrial
- commercial
- agricultural
- government
- residential

Waste

- bioenergy
- secondary materials
- value chains

Water

- reuse
- precision irrigation
- resource recovery
- advanced treatment
- use efficiency

Figure 17: Major market opportunities in the Western Cape (2015 – 2020)

The province also offers dedicated support for businesses and investors focusing on green technologies and services, including:

- GreenCape, providing dedicated support and market intelligence to green economy sectors
- Wesgro, the Investment and Trade promotion agency for the Western Cape
- SAREBI, a business incubator providing non-financial support to green entrepreneurs
- SARETEC, offering specialised industry-related and accredited training for the wind and solar industries

  The region's four universities - University of Cape Town, Stellenbosch University, University of the Western Cape, and the Cape Peninsula University of Technology - underpin all of this with comprehensive research and development (R&D) capabilities and dedicated green economy skills programmes.

A promising range of investment incentives are available in the proposed Atlantis Greentech Special Economic Zone (SEZ).

The City of Cape Town established a greentech manufacturing hub in Atlantis in 2011 in response to the government's focus on localisation of manufacturing as part of the Department of Energy's Renewable Energy Independent Power Producer Programme (REIPPPP). The City has made vast tracts of land available at low cost for purchase or lease by greentech companies through an accelerated land disposal process. A number of other financial and non-financial incentives are also on offer, including discounted electricity and rapid turnaround on development applications.

Finally, as discussed in Section 5, the City of Cape Town established a greentech manufacturing hub in Atlantis in 2011 in response to the government's focus on localisation of manufacturing as part of the Department of Energy's Renewable Energy Independent Power Producer Programme (REIPPPP). A promising range of investment incentives are available in the proposed Atlantis Greentech SEZ, including numerous financial and non-financial incentives, discounted electricity and rapid turnaround on development applications (see Section 5).


© GreenCape

7 – GreenCape's support to businesses and investors

GreenCape is a non-profit organisation that was established by the Western Cape Government and City of Cape Town to support the accelerated development of the local green economy – low carbon, resource efficient and socially inclusive – and help position the Western Cape as the green economic hub of Africa.

We assist businesses in this space to remove barriers to their establishment and growth by providing our members with:

- free, credible and impartial market information and insights
- access to networks of key players in government, industry, finance and academia
- an advocacy platform to help create an enabling policy and regulatory environment for green business

Since inception in 2010, GreenCape has grown to a multi-disciplinary team of over 40 staff members, covering finance, engineering, environmental science and economics.

We have facilitated and supported R13.7bn of investments in renewable energy projects and manufacturing. From these investments, more than 10 000 jobs have been created.

Our Market Intelligence Reports form part of a working body of information generated by sector desks and projects within GreenCape's three main programmes – energy, waste and resources. Figure 18 below shows the different focus areas within each of our programmes.

The Water Sector Desk[28]

GreenCape's Water Sector Desk, which produced this report, serves as a platform for the industry to access relevant information, source assistance in overcoming barriers, and connect to other stakeholders. The Water Sector Desk is part of GreenCape's Resources Programme, which supports the uptake of technologies and practices that enable more productive and sustainable use of natural resources — primarily water and land — in the Western Cape economy.

GreenCape water project

GreenCape's current three-year project aims to develop tools that enable local decision-makers within constrained catchments to allocate water more strategically, and to align economic development and water resource planning more effectively. The project is being funded by the WRC and the Western Cape Department of Economic Development and Tourism. It is focused on the Berg River catchment (specifically Saldanha Bay); however, the tools that are being developed could be replicated elsewhere. This examination of water constraints on development is seen as an ideal study location, due to the catchment being constrained (there is no further water for allocation), while there is significant industrial development planned for Saldanha Bay.

The tools include an integrated development planning guideline/approach, a cost benefit analysis of proposed economic developments, water allocations and resource interventions, and a regional tool to quantify the trade-offs and knock-ons of allocating water between sectors in the catchment. In addition, the project team is consolidating the expected industrial development for Saldanha Bay and what it implies in terms of water requirements. GreenCape has also proposed investigating the feasibility of a water exchange network,

[28] For the latest updates on the water sector, visit the water pages on the GreenCape website.

which would alleviate some of the water demands in the area by cascading water between industrial users. The project was officially initiated in April 2015, and is a collaboration between the African Climate and Development Initiative at UCT and GreenCape.

Benefits of becoming a GreenCape member

We currently have over 600 members, and offer free membership. Becoming a member of GreenCape will give you access to the latest information regarding developments in the various sectors; access to tools, reports, and project information; and offer you the opportunity – through our networking events – to meet and interact with various stakeholders in the green economy.

To register as a member, please visit our website, www.greencape.co.za

1 Renewable Energy

Utility-scale projects, small-scale embedded generation, and localisation of component manufacture.

2 Energy Efficiency

Energy efficient buildings and equipment, demand side management and financing contracting models.

3 Alternative Waste Treatment

Municipal decision-making and policy and legislative tools on alternative waste treatment options; small-scale biogas, recycling and reuse (dry recyclables, construction and demolition waste).

4 Western Cape Industrial Symbiosis Programme (WISP)

Free facilitation service that networks companies to exchange under-utilised resources (materials, energy, assets, logistics and expertise).

5 Water

Water provision and economic development; greentech opportunities for water use efficiency, treatment and reuse.

6 Agriculture and Bio-Based Value Chains

Sustainable agriculture, valorisation of wastes to high value bio-products, including bio-energy.

Figure 18: GreenCape's focus areas

8 – References and further reading

2030 Water Resources Group (WRG) 2009. Charting our water future: economic frameworks to inform decision-making. Available from: <http://www.mckinsey.com/client_service/sustainability/latest_thinking/charting_our_water_future>.

Academy of Science of South Africa (ASSAF) 2014. The state of green technologies in South Africa 2014. Available from: <http://www.assaf.co.za/wp-content/uploads/2015/01/8-Jan-2015-WEB-526305-ASSAF-Green-Tech-mail.pdf>.

African Climate and Development Initiative (ACDI) 2015. SmartAgri executive summary. Available from: <http://www.acdi.uct.ac.za/research/smartagri>.

Breede-Gouritz Catchment Management Agency (BOCMA) 2011. Breede-Overberg catchment management strategy. Available from: http://breedegouritzcma.co.za/content.php?page=Documents&subpage=Water%20Resource%20Management>.

BOCMA 2014. BOCMA annual report 2014. Available from: http://breedegouritzcma.co.za/content.php?page=Documents&subpage=Governance>.

Breytenbach, Mia 2015. Effluent reuse demo plant tested at KZN works. Engineering News, 9 October. Available from: <http://www.engineeringnews.co.za/article/effluent-reuse-demonstration-plant-tested-at-kzn-treatment-works-2015-10-09>.

Civil Engineering 2015. The Emfuleni lessons — how to deliver on water-loss reduction in a South African municipality. Civil Engineering, June 2015.

Department of Trade and Industry (dti) 2015. Industrial Development Financial Assistance (Incentives). Available from: <https://www.thedti.gov.za/financial_assistance/financial_incentive.jsp?id=59&subthemeid=25> [Accessed on 10/11/2015]

Department of Water and Sanitation (DWS) 2009. Guideline document: package plants for the treatment of domestic wastewater. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2010a. Artificial groundwater recharge: recent initiatives in southern Africa 2010. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2010b. Water for growth and development framework: version 7. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2013a. Strategic overview of the water sector in South Africa. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2013b. National water resources strategy: June 2013 (second edition). DWS, Pretoria. Available from: <https://www.dwa.gov.za/nwrs/NWRS2013.aspx>.

Department of Water and Sanitation (DWS) 2013c. Blue and Green Drop 2013 progress report. Pretoria, South African Government. Available from: <https://www.dwa.gov.za/dir_ws/dwqr/subscr/ViewComDoc.asp?Docid=387>.

Department of Water and Sanitation (DWS) 2013d. Secondary cities non-revenue water/water loss assessment: September 2013. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2014a. Strategic plan for the fiscal years 2015/16 to 2019/20. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2014b. Briefing the Portfolio Committee on Water and Sanitation on alignment of millennium development goals, sustainable development goals and national development goals, 12 November 2014. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2014c. 20 years of groundwater research, development and implementation in South Africa 1994-2014. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2014d. Assessment of non-revenue water and water losses in South Africa: August 2014. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2015a. Support to the continuation of the water reconciliation strategy for the Western Cape water supply system: status report October 2015. Prepared by Umvoto Africa (Pty) Ltd in association with WorleyParsons RSA on behalf of the Directorate: National Water Resource Planning. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2015b. Briefing to the Portfolio Committee on Water and Sanitation: progress report on the process of allocation of water use licences in different sectors to advance the developmental needs of South Africa, 5 August 2015. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2015c. Reply from the Minister of Water and Sanitation to Parliamentary question no. 3325 on 28 August 2015. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2015d. National pricing strategy for water use charges. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2015e. Groundwater status report: Western Cape region. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2015f. National Water Services knowledge system. Pretoria, South African Government. Available from: <https://www.dwa.gov.za/wsks>.

Department of Water and Sanitation (DWS) 2015g. Metropolitan municipality water balance assessment: November 2015. Pretoria, South African Government.

Department of Water and Sanitation (DWS) 2015h. Reply from the Minister of Water and Sanitation to Parliamentary question no. 2263 on 19 June 2015. Pretoria, South African Government.

Frost and Sullivan 2015. Analysis of the global desalination market September 2015: key findings. Frost and Sullivan, Cape Town.

Intergovernmental Panel on Climate Change (IPCC) 2014. Climate change 2014: synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change [core writing team: Pachauri, R.K. and L.A. Meyer (eds)]. Geneva, IPCC.

KPMG 2013. The KPMG green tax index: an exploration of green tax incentives and penalties. Available from: <https://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/green-tax-index.pdf>.

Moodley, Sashnee 2015. Rainwater harvesting can boost water security, but stimulatory legal framework required. Engineering News, 10 April. Available from: <http://www.engineeringnews.co.za/article/rainwater-harvesting-can-boost-water-security-but-clearer-legislation-needed-for-national-expansion-2015-03-27>.

SABMiller 2015. Sustainable development summary report 2015. Available from: <http://www.sabmiller.com/sustainability/reporting/sustainability-report>.

SALGA and GIZ 2015. Biogas potential in selected wastewater treatment plants: results from scoping studies in nine municipalities. Pretoria, South African Local Government Association.

Statistics South Africa (StatsSA) 2010. Water management areas in South Africa. Discussion document: D0405.8. Available from: <www.statssa.gov.za>.

Strategic Water Partners Network (SWPN) 2015. Guidelines for the model performance based contract for water conservation water demand management based on South African procurement law: version 01/1410. Available from: <http://www.wrc.org.za/Pages/KnowledgeHub.aspx>.

Tancott, Glen 2014. Water-stressed municipalities and reused mining water. Infrastructure News, 18 February. Available from: <http://www.infrastructurene.ws/2014/02/18/water-stressed-municipalities-and-reused-mining-water>.

Turner, Keith 2015. Mossel Bay seawater desalination plant case study. Presentation at the WRC Research Development and Innovation Symposium, 16-18 September 2015, Johannesburg, South Africa.

United Nations Environmental Programme (UNEP) 2014. Green infrastructure guide for water management: ecosystem-based management approaches for water-related infrastructure projects. Available from: <http://www.unepdhi.org/-/media/microsite_unepdhi/publications/documents/unep/web-unep-dhigroup-green-infrastructure-guide-en-20140814.pdf>.

Urban-Econ 2015. City of Cape Town biosolids beneficiation facility socio-economic impact assessment. Cape Town, Urban-Econ Development Economists.

Water Wheel 2014. New desalination plant to keep 'Diamond of the West Coast' shining. Water Wheel Magazine, 13 (1).

Water Wheel 2015a. Water reclamation: precious resource to be used again, and again and again. Water Wheel Magazine, 14 (3).

Water Wheel 2015b. Minister turns the valve on SA's largest conduit hydropower installation. Water Wheel Magazine, 14 (3).

Water Research Commission (WRC) 2009. Energy from wastewater: a feasibility study. Report to the Water Research Commission, project no. K5/1732, report no. TT399/09.

Water Research Commission (WRC) 2011. Introduction to integrated water meter management: edition 1. Report to the Water Research Commission, project no. K5/1814, report no. TT490/11.

Water Research Commission (WRC) 2013a. Discussion paper on the role of water and the water sector in the green economy within the context of the new growth path. Report to the Water Research Commission, project no. K8/1008, report no. KV307/13.

Water Research Commission (WRC) 2013b. Alternative technology for stormwater management: the South African guidelines for sustainable drainage systems. Report to the Water Research Commission, project no. K5/1826, report no. TT558/13.

Water Research Commission (WRC) 2013c. Alternative technology for stormwater management: report and South African case studies. Report to the Water Research Commission, project no. K5/1826, report no. 1826/1/13.

Water Research Commission (WRC) 2013d. ICTs in the water sector – where do we stand? Report to the Water Research Commission, project no. K8/1014, report no. TT571/13.

Water Research Commission (WRC) 2014. Water in the Western Cape economy. Report to the Water Research Commission, project no. K5/2075, report no. 2075/1/13.

Water Research Commission (WRC) 2015a. Self-regulation of the SWWTW industry: volume 1 & 2. Reports to the Water Research Commission, project no. K5/2193, report nos. TT620/14 and TT621/14.

Water Research Commission (WRC) 2015b. Water and energy: proving the effectiveness of conduit hydropower. Technical brief from a report to the Water Research Commission, 'Conduit hydropower pilot plants', report no. TT596/14.

Water Research Commission (WRC) 2015c. Evaluation framework for advanced water metering projects — user guide (November 2015 draft). Report to the Water Research Commission, project no. K5/2370.

Western Cape Department of Environmental Affairs and Development Planning (WC-DEADP) 2012a. Western Cape sustainable water management plan 2012. Available from: <http://eadp.westerncape.gov.za/news/western-cape-sustainable-water-management-plan-%E2%80%93-2012>.

Western Cape Department of Environmental Affairs and Development Planning (WC-DEADP) 2012b. Integrated water resource management action plan: status quo report. Available from: <http://eadp.westerncape.gov.za/news/western-cape-sustainable-water-management-plan-%E2%80%93-2012>.

Western Cape Department of Environmental Affairs and Development Planning (WC-DEADP) 2013. State of the environment outlook report for the Western Cape Province. Available from: <http://eadp.westerncape.gov.za/your-resource-library/reports-research/state-of-environment-outlook-report-for-the-western-cape-2013>.

Western Cape Department of Environmental Affairs and Development Planning (WC-DEADP) 2015. Water infrastructure and opportunities for agriculture and agri-processing. ISBN: 978-0-621-44169-7. Adapted from a presentation at the Agri-processing Open Day, Boschendal, 20 July. Available from: <http://eadp.westerncape.gov.za/your-resource-library/reports-research?page=3>.

Western Cape Department of Human Settlements (WC-DHS) 2015. Update on game changers: sustainable sanitation. Presentation at the Cabinet Bosberaad, 17 April.

World Economic Forum (WEF) 2014, World Economic Forum global risks report. Available from: <http://www3.weforum.org/docs/WEF_GlobalRisks_Report_2014.pdf>.

World Wide Fund for Nature (WWF) and International Finance Corporation (IFC) 2015. The value of water: a framework for understanding water valuation, risk and stewardship. August 2015 discussion draft. Geneva, World Wide Fund for Nature.

GreenCape