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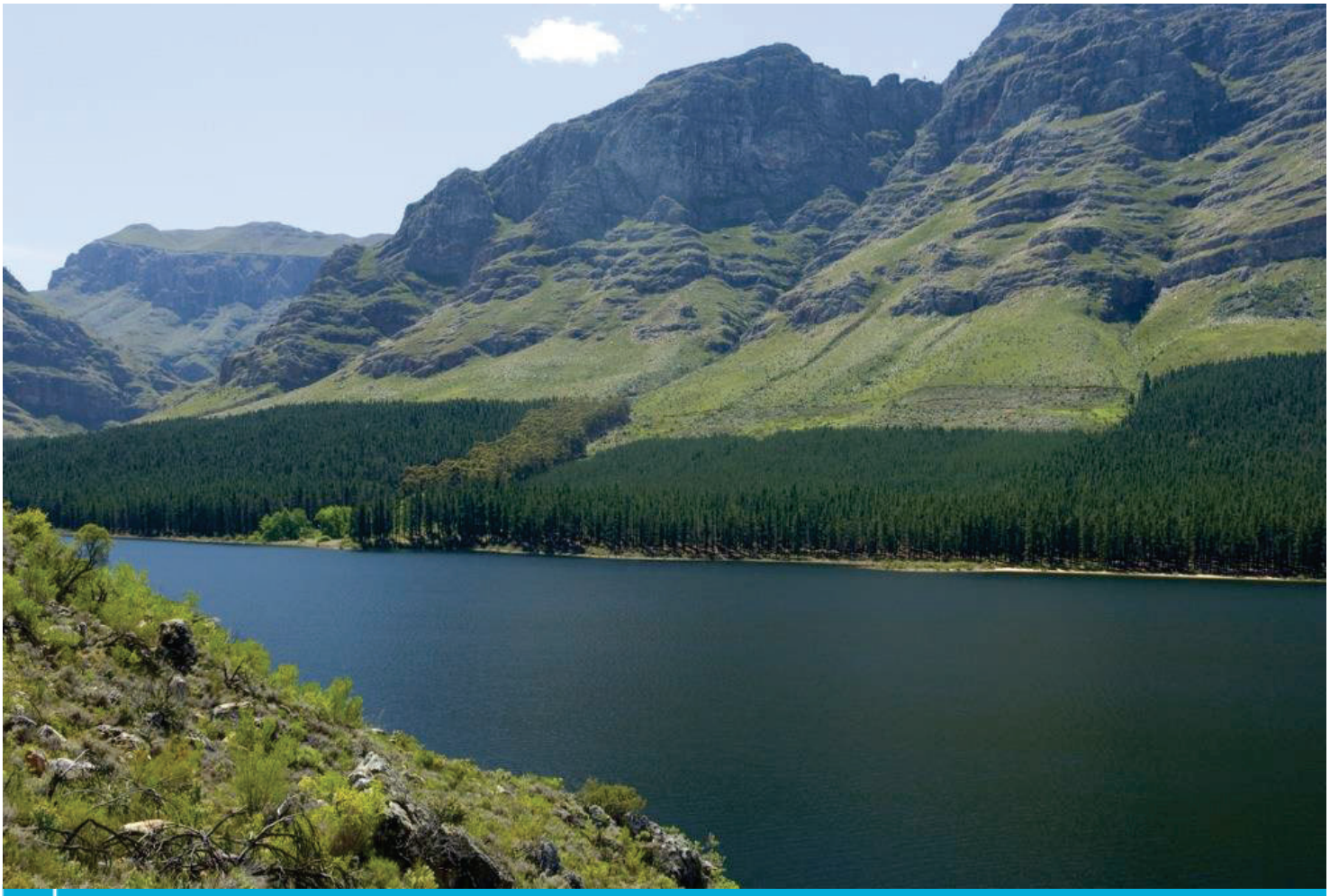


WATER OUTLOOK 2020 REPORT

Updated October 2020

Produced by Department of Water and Sanitation

City of Cape Town

Making progress possible. Together.

Water Outlook

October 2020

Our Shared Water Future

This water outlook focusses on water availability and the resource augmentation programmes either underway or planned. It explores the enduring impacts of the recent severe drought on overall water use and provides a brief synopsis of the City's water resource planning approach which includes allowances for climatic and other uncertainties.

Introduction

Since 2015 the City of Cape Town has been dealing with the consequences of an unprecedented multi-year drought which dramatically reduced surface runoff into the main water supply dams (Figure 1) severely impacting on water availability for both the urban and agricultural sectors of the region.

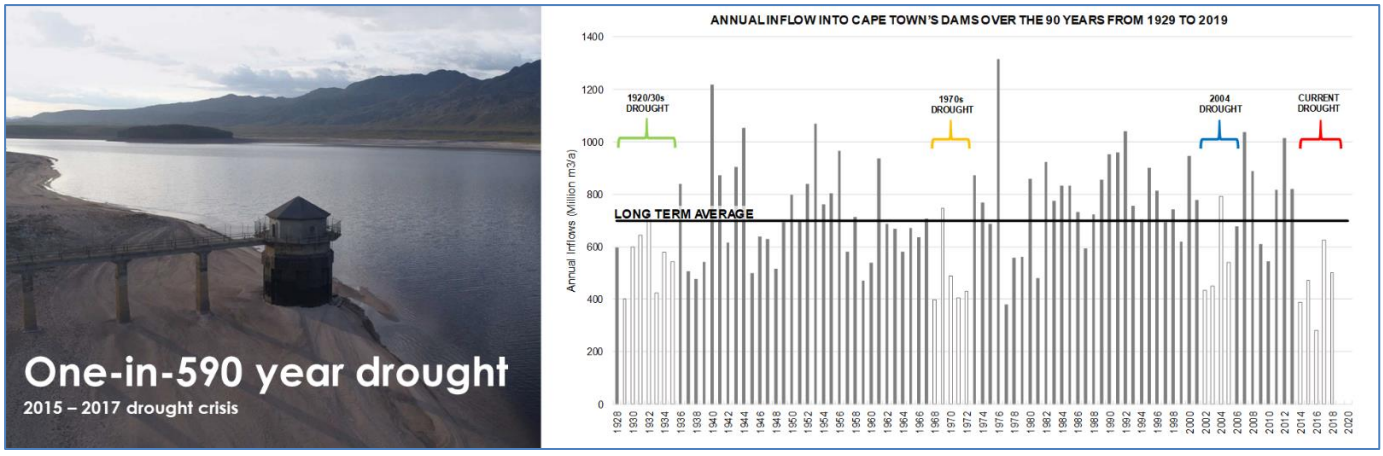


Figure 1- Annual Inflows into the Large Water Supply Dams

Although Cape Town became known around the world as a city that nearly ran out of water in 2018, a combined effort by residents, business and government helped avoid a potential catastrophe through dramatic reduction of water use. Effective management of the crisis has now ultimately earned us the title of "Number One Water Saving City in the World".

Notwithstanding the steady recovery in dam storage over the last three rainfall seasons (2018 – 2020) the City continues to work hard at conserving water resources and increasing available water supply so we can more easily withstand future droughts as outlined in the City's Water Strategy (2019).

Figure 2 - Water Strategy Front Cover

Planning for Climatic Uncertainty

Cape Town is one of several global cities experiencing water scarcity. In fact, 130 large cities were hit by drought disasters between 2010 and 2015. In 2018, as the city approached and narrowly avoided Day Zero, Theewaterskloof Dam (Figure 3) which is the largest dam in the supply system dipped down to just 10% of storage capacity.

Figure 3: Theewaterskloof Dam in Summer of 2018

Given global climate change, future rainfall patterns are likely to be less predictable and recent research initiated by the City incorporates the potential for an increase in multi-year droughts. Findings based on three different climate change scenarios suggest a moderate chance of a 23% reduction in water availability from the six large dams by 2050. This is being factored into our water planning which seeks to increase drought resilience through diversification of resources including groundwater, reuse and desalination whilst continuing to maintain focus on our acclaimed water conservation and demand management initiatives.

Exclusive reliance on rainfall fed dams is no longer wise over the longer term and we must continue to adopt a precautionary approach to water resource management in dealing with climatic uncertainty.

A New Relationship with Water embeds Wise Use

Growth in water consumption coming out of the recent drought has remained relatively benign, due to continued saving efforts by residents and businesses. This can be ascribed to permanent behaviour change, use of alternative sources such as private boreholes and rainwater tanks and impact of water tariffs in driving increased water use efficiency. It is also worth mentioning that since March 2020, the global COVID–19 pandemic also served to temporarily depress water use (Figure 4).

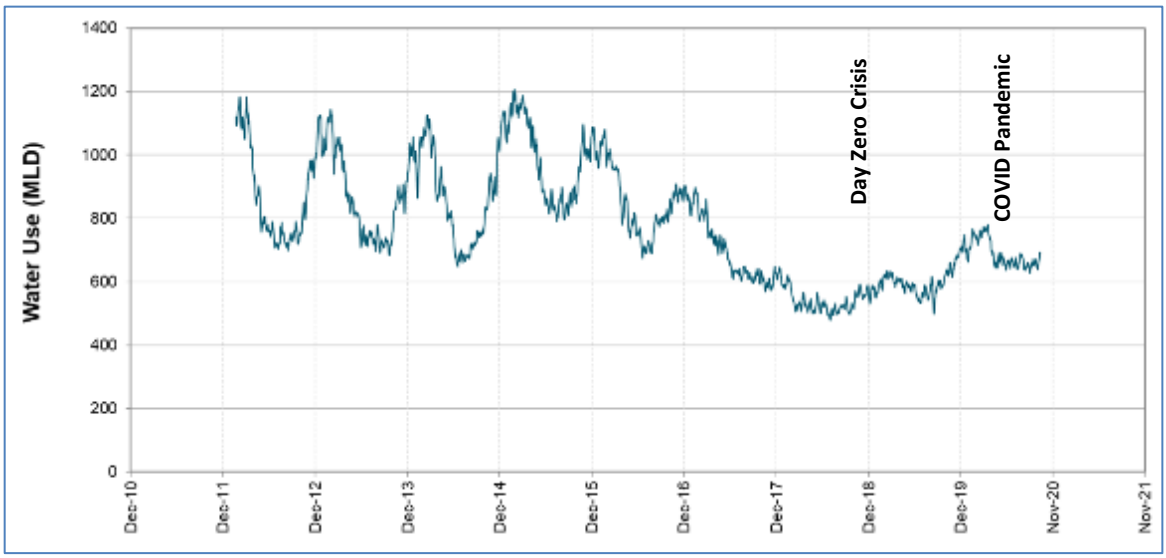


Figure 4- Overall Water Use by City of Cape Town (Million litres per day)

These factors combined have contributed to a recovery in dam storage thereby increasing our safety net. This does however make it difficult to accurately predict future water demand and by the end of October 2020 the City will have utilised approximately 30% less water than that which is allocated to the City from the large dams, a truly remarkable achievement.

Planning for the Future

Referring to Figure *5* below, our future water resource planning considers:

- **Water Availability [1]** from existing sources at a 0.5% annual probability of failure adjusted for changes in allocations as prescribed by the national department including probable losses due to climate change and the continued spread of invasive alien plants in the catchment areas.
- **Anticipated Water Demand [2]** by the City over a 20 year planning horizon. Allowance has been made in our planning for a gradual rebound in water demand with a built in permanent saving of between 10 and 20% relative to pre-drought water use. Longer term growth of approximately 2% is assumed to cater for future economic growth on a City wide basis.
- Contribution of the planned W**ater Augmentation Programme [3]**. The committed portion of this programme will continue to be implemented no matter how full the dams are in an effort to build drought resilience.

- Optimal use of existing water resources through the application of sophisticated computer models to predict a range of draw down and filling scenarios.

The graphic below (Figure *5*) adapted from the Water Strategy illustrates the impact of the above variables on the phasing of the augmentation programme. It is important to note that this it will not completely insulate us from drought and our planning contemplates restrictions of no more than 30% during severe events. In this regard, the water restriction methodology has been simplified into three levels with associated target network pressures to reduce losses. Further details are available at Think Water.

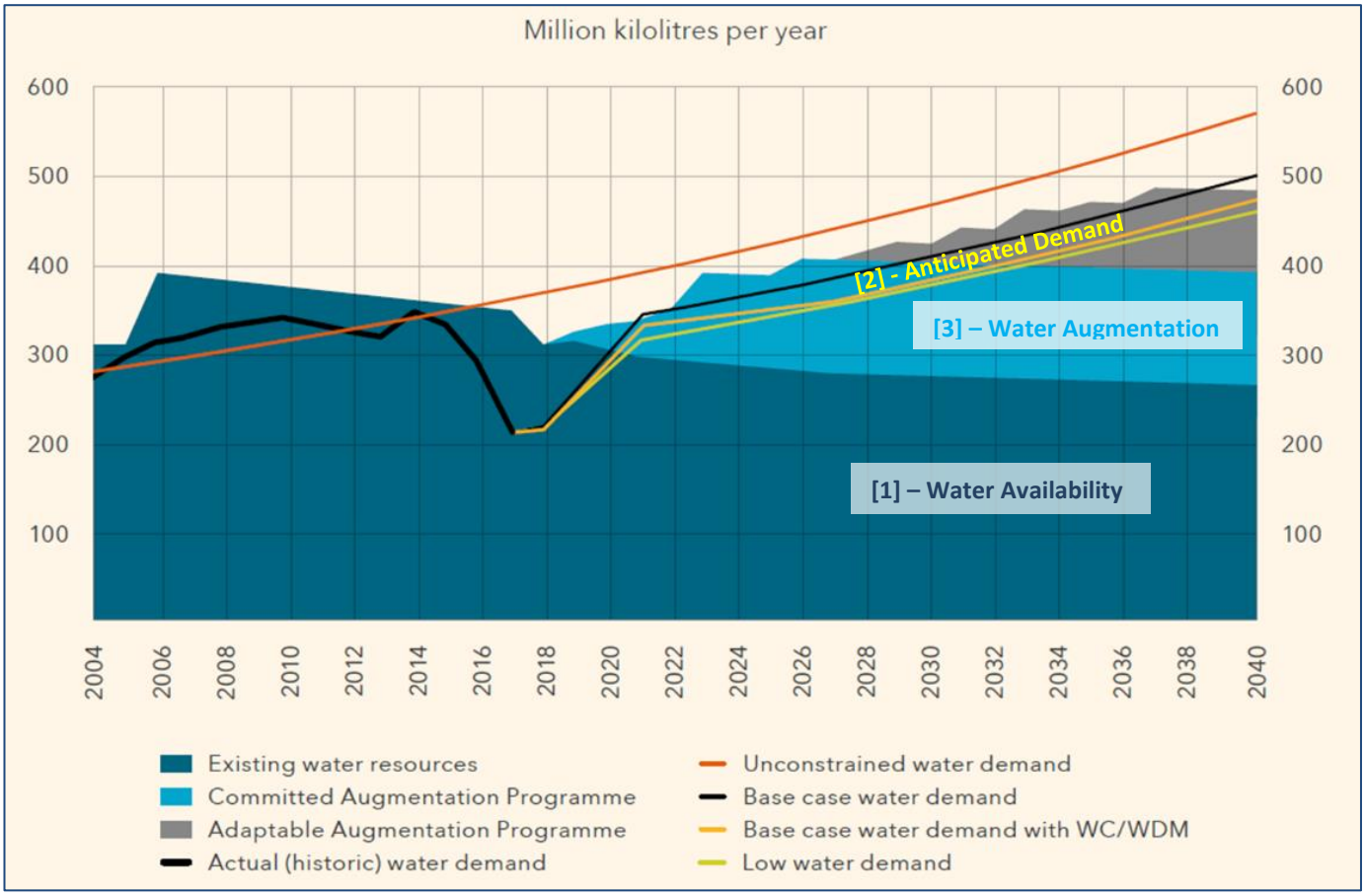


Figure 5 - Water Availability, Anticipated Demand and the Augmentation Programme

New Water Programme

The City continues to prioritise implementation of the various commitments in the Water Strategy underpinned what is termed the New Water Programme (NWP). We are committed to significantly reduce reliance on rain fed dams over the planning period and aims at achieving a level of water resilience by 2028. Currently, about 95% of our water comes from six large dams collectively called the Western Cape Water Supply System (WCWSS). These dams are managed in partnership with the National Department of Water and Sanitation (DWS). Planned augmentation schemes will reduce our reliance on the WCWSS by about 25% when these projects are running at full capacity.

Our future water resource mix will comprise the following sources:

Surface water

There are 6 major storage dams serving the City. These all rely on rainfall for replenishment but are connected in an integrated network so that we can reliably supply all users by drawing from different dams.

Groundwater

We are already successfully managing our aquifers to make sure they are properly replenished and that no sea-water ingress occurs are implementing new projects to withdraw water from these to increase our water supply.

Desalination

Cape Town already has experience of operating a few demonstration-scale seawater desalination plants and other larger projects are expected. While these are costly and energy-intensive, they provide a reliable alternative to supplement our supply as a coastal city.

Reuse

Water reuse is a cost-effective, reliable and environmentally responsible option. Adopting reuse will position Cape Town as one of the leading cities in the world in sustainable water management.

The tabulation below (Table 1) illustrates the current phasing and costing for the various initiatives currently in implementation with the costs reflected in the Water Strategy having been updated to reflect the impact of inflation and technical changes to the various schemes over the past two years. Timeous implementation of large scale reuse and desalination schemes are pivotal in the outer years, given that surface water options are limited, and there are constraints on groundwater availability. Clearing of alien vegetation is furthermore essential to arrest environmental water losses of both surface and subsurface water. The timing of certain NWP schemes is currently being reassessed due to budgetary implications brought on by COVID-19 crisis and the associated impact will be reported on in the next Water Outlook. The target of achieving a good level of resilience would still be achieved within the next 10 years.

Description	Water Strategy Completion Date / First water (Nov 2018)	Revised Completion Date / First water (Feb 2020)	Water Strategy Capacity (Nov 2018) MLD	Revised Capacity (Feb 2020) [ML]	Water Strategy CAPEX 2018 (R million)	Revised CAPEX 2020 (R million)	Water Strategy 2018 R million /MLD	Revised 2020 R million /MLD	Water Strategy 2018 Operating Cost (R/kl)	Revised 2020 Operating cost (R/kl)	URV (R/m3)
Table Mountain Group Aquifer - Steenbras Wellfield	2020	Jul-20	15	25	375	468	25	18.7	5	5.5	9.3
Table Mountain Group Aquifer - Nuweberg Wellfield	2022	Jul-23	15	15	335	523	22	34.9	5	5.5	12.5
Table Mountain Group Aquifer - Groenlandberg Wellfield	2022	Nov-23	20	12	326	376	16	31.3	2	2.2	9.1
Cape Flats Aquifer - Strandfontein Wellfield	2020	Jul-21		5		378		75.6		6.5	22.5
Cape Flats Aquifer - Hanover Park Wellfield	2021	May-22		4		158	varies	39.4		8.5	17
Cape Flats Aquifer - Strandfontein North and East Wellfield	2021	Dec-22	45	15	1060	772	betwwen	51.5	5	6.5	17.7
Cape Flats Aquifer - Philippi Wellfield	2021	Dec-24		6		434	18 and 31	72.3		8.5	24.7
Cape Flats Aquifer - Mitchells Plain Wellfield	2021	Jul-25		20		673		33.7		8.5	16
Atlantis Aquifer Rehabilitation and Expansion	2021	Jul-22	10	16	290	314	29.0	19.6	8	8.5	12.7
Berg Voelvlei River Augmentation Scheme (BVRAS)	2023	Jul-23	40	40					3-5	4.62	4.62
Water Reuse - Faure New Water Scheme	2024	Jul-25	70	70	1360	1882	19.4	26.9	5	5.7	11.7
Desalination	2026	Dec-26	50	50	1650	1800	33-40	33-40	9	9	17.3
Alien Vegetation Clearance						372					1.2-2.4
Improved Supply System Management (WCWSS)	To be confirmed once more detailed information becomes avaialble										
Water Conservation/Demand Management											

Table 1- Water Scheme Phasing and Costing

Note that Unit Reference Value (URV) is routinely used in water resource planning studies to compare the financial efficiency of water schemes. The URV considers the present value of water supplied over the cost of scheme development as well as the estimated value of water in the scheme after an operational period of 20 years.

To date we have developed an additional 19 million litres per day (MLD) of augmented capacity, primarily at the Steenbras TMG Scheme, against a planned 30 million litres per day (MLD) as indicated below (*Figure 6* and Figure 7).

	2020	2021	2022	2023	2024	2025	2026
Capability Yield/installed capacity	19.27						
Water Strategy Yield -Nov 2018	35	70	85	105	175	175	225
Revised Yield - Feb 2020	30	50	65	92	98	188	238

Figure 6 - Planned and Actual Augmentation by Capacity

Figure 7 - TMG Steenbras Wellfield First Water – August 2020

Key Projects and Initiatives under New Water Programme

The following sections provide further context and briefly outline progress on key projects and initiatives under the New Water Programme (NWP) to increase long term water security.

TMG Aquifer Scheme

Three rock fracture zones are currently being targeted for wellfield development in the Table Mountain Group (TMG) Aquifer at Steenbras, Nuweberg (Grabouw) and Groenlandberg (Theewaterskloof).

To date, work has focussed on the Steenbras wellfield (Phase 1) which will be capable of abstracting an estimated 25MLD for pre-treatment to remove high concentrations of iron and manganese prior to discharge into the adjacent Steenbras Upper Dam. The scheme targets water in both the Nardouw and deeper Peninsula aquifers. Borehole depths into the Nardouw are typically 300m while those into the Peninsula vary from 700m to 1000m in depth.

The existing and planned wellfields are located in environmentally sensitive areas and a unique adaptive environmental management approach has been adopted to guide design and construction of the wellfield infrastructure. An extensive monitoring programme is being developed in parallel with implementation and this makes use of a detailed groundwater model that will be used to refine safe borehole yields to limit potential adverse impacts on the environment. In addition, a monitoring committee has also been established to oversee longer term operation of the wellfield.

Progress Highlights - TMG Phase 1 - Steenbras	
Abstraction System	**Treatment Plant**
• 8 / 12 Abstraction boreholes drilled • 6 / 12 pumps and structures completed • 7km / 11km pipelines laid • 9km / 14km electrical cables installed • First water date 25 June 2020 • Completion anticipated 21 February 2021	• Site selection underway

Cape Flats Managed Aquifer Recharge Scheme



The Cape Flats Managed Aquifer Recharge (MAR) groundwater scheme targets water contained in the shallow sandy aquifer underlying much of the Cape Flats. This environmentally sustainable scheme located in the heart of the urban area will store water during wetter years, remediate and improve the quality of water in the aquifer over time and enable integrated urban water management.

The scheme comprises the following elements:

- Managed injection of 40 MLD advanced treated water sourced from the Cape Flats Wastewater Treatment Works into the Cape Flats Aquifer through a total of 64 injection boreholes to store water as well as to create barriers to prevent ingress of sea water or pollutants from potential point sources.
- Abstraction of groundwater from 6 wellfield clusters via a total of 89 production boreholes.
- Treatment of the abstracted groundwater to potable standards at Hanover Park (4MLD), Phillipi (6MLD), Strandfontein West (5MLD), Strandfontein North/East (15MLD) and Mitchells Plain (15MLD) before injection into the water distribution water network.

Making use of sophisticated numerical models, airborne and ground geophysics as well as extensive exploration drilling at approximately 90 locations across a wide geographic area, the scheme has ultimately been consolidated around the Cape Flats Horticultural Area. Not only is this the thicker and most uniform part of the aquifer with relatively good water transmissivity, but it is also the only significant area that has not been overlain by urban development which will enable more effective protection of the aquifer production zones in the longer term. The scheme has been designed in terms of water use license conditions and requirements.

To date, work has largely been focused on aquifer exploration, drilling of production and recharge boreholes as well as the laying of interconnecting pipelines. The prevailing water quality at all abstraction zones other than Strandfontein West, require advanced water treatment including reverse osmosis to remove salts and other impurities during the initial first few years of operation. The aquifer water quality is however anticipated to improve once recharge commences.

Progress Highlights – Cape Flats Aquifer Managed Aquifer Recharge Scheme			
Intrusion Barriers	**Aquifer Recharge System**	**Abstraction System**	**Treatment Plants**
• 12 / 12 Coastal borehole drilled • 7 / 11 Inland point source control boreholes drilled	• 6 / 41 Recharge boreholes drilled • 0 / 2 Ponds constructed • 20km / 44km pipelines laid	• 69 / 89 Abstraction boreholes drilled • 6km / 26km pipelines laid • 0 / 89 boreholes equipped	• Construction of 5 MLD Strandfontein West WTP has commenced with completion by July 2021

Atlantis Managed Aquifer Recharge Scheme Refurbishment



The Atlantis groundwater scheme was developed in the 1970's to supply water to Atlantis, Pella and Mamre. Water is abstracted from two wellfield clusters and treated to potable standards at Witzands and Silwerstroom. Natural rain fed recharge of the shallow sandy aquifer is augmented by means of stormwater infiltration ponds and reclamation water sourced from the Wesfleur Wastewater Treatment works as indicated graphically below.

This project focusses on refurbishment of the existing groundwater scheme which has lost significant water production capacity due to biofouling of boreholes and aging process equipment. Capacity will be increased from the current approximate 10 MLD to 38 MLD to achieve independence from the surface water system on which the area had become reliant over the past 20 years.

Various tenders have been awarded and good progress has been made on the re-drilling and equipping of existing boreholes. Refurbishment of conveyance systems and pump stations is currently underway and work will soon commence on the upgrade of the Silverstroom treatment plant.

Progress highlights are as follows:

- Re-drilling and testing of 33 production boreholes has been completed
- Modification of Melkobos pipeline to allow pumping of water from Witzands to Melkbos reservoirs (reverse flow) underway
- Upgrading of pumping infrastructure between Silverstroom and Pella Reservoirs underway.
- Refurbishment of the Waste Pond at the Witzands Softening Plant to commence early August 2020.

Water Reuse



The Zandvliet Temporary Reuse Plant, although initially implemented as an emergency water supply scheme during the height of the drought crisis, now forms an important aspect of the key stakeholder engagement process to demonstrate and build confidence in reuse technology and treatment processes. It utilises proven multi-barrier technology to purify treated wastewater sourced from the Zandvliet Wastewater Treatment Works to a quality that exceeds current drinking water standards. International experience has shown that demonstration plants can be an

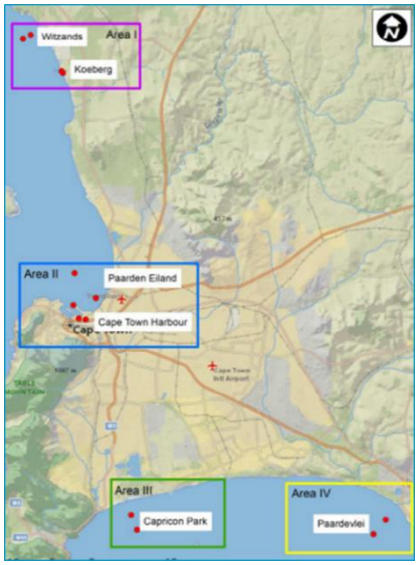
effective way of building community trust in the ability of a water authority to master the new technology and meet drinking water quality standards.

The temporary reuse plant was commissioned in June 2019 and the treatment process is able to produce high quality drinking water for blending into the bulk water distribution system supplying the central and southern suburbs once the key stakeholder engagement process is sufficiently advanced and water quality testing has been completed.

Stakeholder acceptance is vital to the City being able to confidently commit to the estimated R2b investment in the proposed much larger permanent 70 million litre per day advanced water purification (to be known as the Faure New Water Scheme) facility to be co-located at Faure Water Treatment Plant. Design of this large-scale class leading facility contemplated in the Water Strategy is currently at an advanced stage with a target commissioning date of mid-2025.

Like the temporary plant, the proposed permanent Faure New Water Scheme will also utilize a rigorous multi-barrier purification process. Construction and operational costs are estimated to be half the cost of a comparable sea water desalination plant due to lower energy requirements and proximity to the large bulk water distribution systems. The advanced water purification process to be utilised is also environmentally friendly as it does not require a concentrated brine to be discharge out into the sea. A suite of communication materials is currently being developed and an independent advisory panel is soon to be established.

Sea Water Desalination

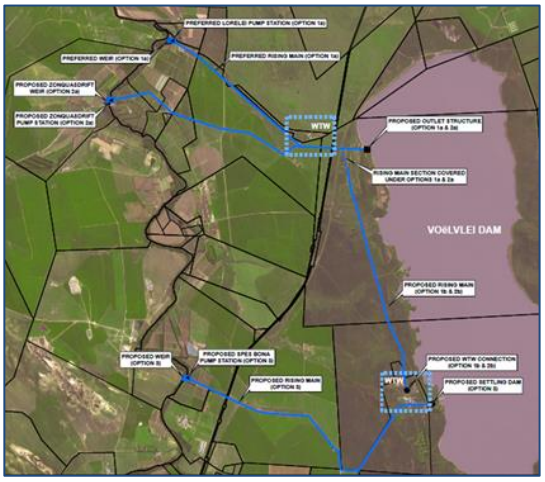


A technical feasibility study is currently underway considering the most appropriate site for the location of a permanent desalination plant of 50 MLD and larger as contemplated in the Water Strategy. This study will be completed towards middle 2021 and the project team is considering the most appropriate mechanism to implement the project. A full EIA for the project will commence towards the latter part of 2021. The anticipated first water date is scheduled for the end 2026.

The temporary desalination plants at Strandfontein and Monwabisi constructed as emergency water supplies at the height of the drought crisis have both been decommissioned by the contractor in terms of contractual requirements. The City also gained valuable knowledge and experience that will be incorporated into planning and operation of the larger planned permanent plant.

Berg River to Voelvlei Augmentation Scheme (BVRAS)

Although not a City funded water scheme, the Berg River to Voelvlei Augmentation Scheme was identified as the next surface water scheme in 2015 by the national Department of Water and Sanitation (DWS). It will form an integral part of the WCWSS and is being implemented by the Trans Caledon Tunnel Authority (TCTA) in terms of a ministerial directive issued in May 2017.

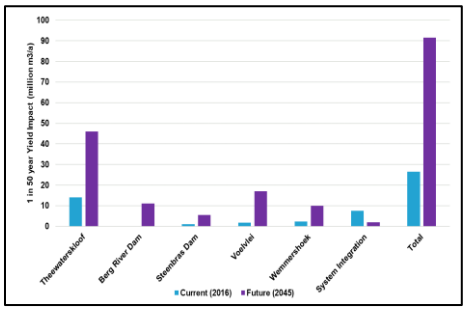


The project involves the abstraction of surplus winter water, after provision for the Environmental Water Requirements (EWRs) and downstream users, from the Berg River to increase the yield of the Voëlvlei Dam by approximately 23 million m3/a. The scheme consists of:

- A low-level weir, abstraction works and pump station on the Berg River at Sonquas Drift
- A 6.3 km long pipeline to deliver the water into Voëlvlei Dam

TCTA are currently in discussion with water users to formulate an institutional approach and decide on a funding model. Indications are that water users form the WCWSS, including the City of Cape Town, are supportive of the project, currently scheduled for completion by mid-2023.

Source Water Protection and Alien Invasive Plant Control



Research in South Africa, and elsewhere, has found that alien invasive plants can reduce stream flows, and consequently water availability from surface water supply systems significantly. It is clear from recent mapping and anecdotal observations that AIP's are spreading vigorously in certain of the WCWSS catchment areas with the estimated impact on water availability to be approximately 26.5 Mm3/a (70 MLD). If left unmanaged the loss in water availability could reach 90 million m3/a (250 MLD) by 2045 as indicated graphically above.

Preventing the future spread is as important as addressing the current impacts and also highlights the need for on-going maintenance clearing. Although land owners are legally responsible for the cost of removing IAS from their land, this has proved difficult to enforce due to the high costs involved.

By following the approach outlined in Resilience Strategy (Goal 2.3.3), the City will be establishing partnerships to clear the lower lying zones of catchments impacting its own dams and local aquifers in the short term. Internal resources are currently being utilised for follow-up clearing work. Felling of pine plantations in the Steenbras and Wemmershoek catchments is also still in progress. To date 70 and 60% of the pine plantations at Wemmershoek and Steenbras respectively have been felled, with the remainder scheduled for removal by 2022.

Improved Management of Regional Water Sources



The Water Strategy commits the City to working with key stakeholders and partners, including other urban and agriculture water users, and other spheres of government, to make the most of the opportunities to optimise the economic, social and ecological benefits of regional water resources, and to reduce the risks.

Development of a Decision Support System to assist the City in managing water resources is currently underway and the department is actively engaging DWS on a range of issues, including water availability in the context of climate change, over allocation of the system and integration of the operation of the City's new water resources with the WCWSS.

A multi-disciplinary regional economic study has also been initiated to improve the analytical information-base on which to base water resource management decisions to more explicitly include socio-economic factors into decision making on restrictions drought periods. This study compliments other regional planning initiatives and will assist in building stronger relationships between key stakeholders in the regional water supply system.

The "Organisation for Economic Co-operation and Development" (OECD) has approached the City regarding a dialogue around the Governance and Economics of Water Security in Africa. This Policy Dialogue broadly looks at the South African context, with a specific focus on Cape Town to support the implementation of the Water Strategy. This event brings together many stakeholders and role-players to build a collective understanding of the challenges and advance a common agenda to collaborate on finding suitable sustainable solutions to secure a water future. The policy dialogue focuses on the City of Cape Town and will make recommendations to the City on policy and governance issues.

Water Outlook for 2021

The City has indeed been fortunate to have the water supply dams at full capacity for the first time since 2014 due to improved rainfall and continued water saving. Although harsh water restrictions needed to be implemented to manage available water during the height of the drought crisis, it was the unprecedented adaptation by our residents and businesses that avoided the taps running dry. For our part, we worked tirelessly in the background to manipulate and optimize water abstractions from the dams as well as to reduce network losses by means of large scale pressure management, network monitoring and leak repair programmes.

Figure 7- Wemmershoek Dam in October 2020

It is vital that Cape Town remains focused on building resilience in the face of climatic uncertainty and frame this within the anticipated post COVID-19 impacts on community affordability. A deficit in supply must be avoided at all costs and we must continue to live by the drought maximum to “rather save water while you have water”. Day Zero in 2018 was a close call and it took just three short years from 2014 to be in that unenviable position. This dictates that we continue to exercise restraint, use water wisely and adopt a precautionary approach to both the imposition and lifting of water restrictions.

The National Department of Water and Sanitation determines the need for restrictions on an annual basis in consultation with urban and agricultural users. A stochastic model computes a large number of possible dam inflow sequences and predicts the likelihood of differing storage levels after making deductions for water abstractions and evaporation losses from the dams. As rough guide, planning for a fall in dam storage to below 50% of capacity at a 50% likelihood (statistical median) at the onset of the winter rains is undesirable and may expose the supply system to adverse risk in the following season.

The output of stochastic modelling undertaken by the City for 2021 storage is illustrated below (Figure 8). It indicates a high likelihood that the dams will terminate at approximately 60% of total storage and subsequently fill again assuming average rainfall next winter.

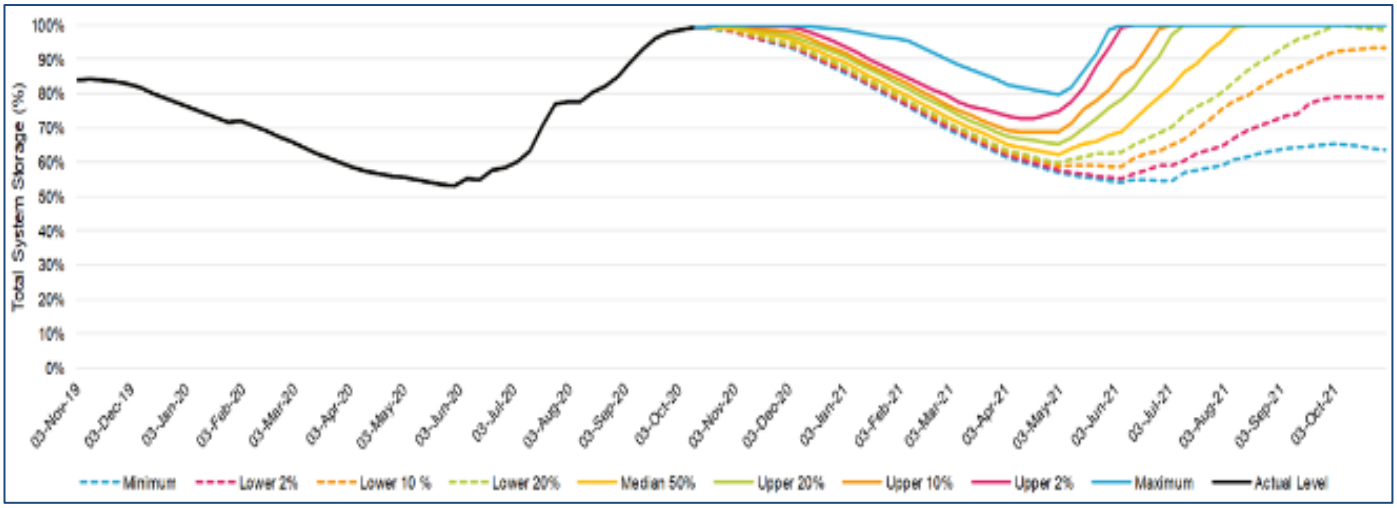


Figure 8- Anticipated Dam Drawdown in 2021 determined by Stochastic Modelling

Should the rainfall and associated streamflow into the dams be well below average (lower 2% probability) the dams will only fill to about 80% of capacity which would be a concern for the following season. Analysis of cumulative rainfall at a number of measuring stations (Figure 9) indicated a late start to the 2020 rainfall season (as for the 2017 drought year) with significant geographic variation when compared to long term averages.

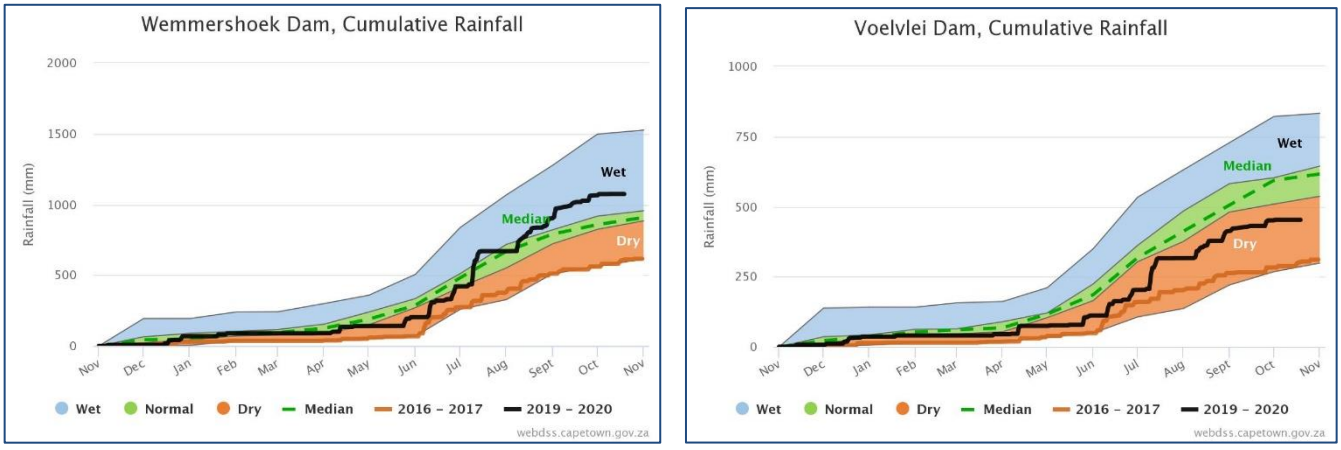


Figure 9 - 2019/2020 Cumulative Rainfall at Wemmershoek and Voelvlei

In addition, financial affordability related to COVID-19 may delay implementation of the vitally important augmentation programme by up to 3 years which is likely to result in a water availability deficit from 2022 based on current modelling which assumes a higher level of availability (2% probability of system failure). Unchecked demand will however render such a situation difficult to manage if we are again plunged into drought. It is furthermore important that the National Department of Water & Sanitation actively monitor and manage both urban and agricultural water use.

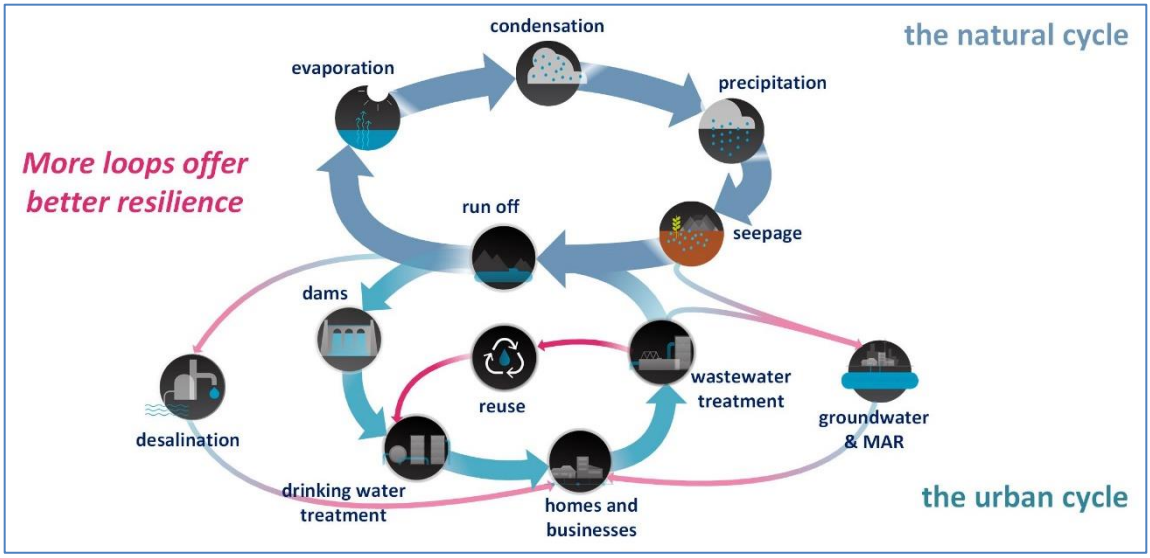
In summary, the water outlook for 2021 is significantly better than for this time last year and water restrictions will be lifted from 1 November 2020 with the tariff adjusted to the lowest “Water Wise” level. This decision is premised on confirmation received from the National Department of Water & Sanitation that restrictions on water abstractions from the Western Cape Water Supply System of shared dams are no longer necessary as well as own projections indicating dams were unlikely to drop below 50% by next winter. In addition, the anticipated higher water usage patterns for the coming summer are sufficient to allow for the lowering of the tariffs. It is important to

note that the City's water tariff must cover all costs associated with drinking water provision, including those associated with the development and maintenance of infrastructure.

In conclusion, we need to continue using water wisely, building long term drought resilience and improving management of the integrated supply system within the context of future climatic and other uncertainties.

Next Water Outlook

The next edition will feature information on the planned water demand study, an update of scheme cost and timing as well as more information on the decision support system aimed at improving water resource management and operation of the supply system.



Planned Enhancement and Integration of the Urban Water Cycle