STELLENBOSCH MUNICIPALITY

BULK WATER RESOURCES:
DROUGHT INTERVENTION PROJECTS
(Draft)

June 2018

gls consulting
an EOH company

STELLENBOSCH MUNICIPALITY

DROUGHT INTERVENTION PROJECTS

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TABLE OF CONTENTS

Pp

LIST OF TABLES

Pp

LIST OF FIGURES

Pp

LIST OF ABBREVIATIONS & ACRONYMS

AADD	-	Annual average daily demand
BPT	-	Break pressure Tank
CCT	-	City of Cape Town
d	-	Day
DWS	-	Department of Water and Sanitation
EGL	-	Energy Grade Line (in m a.s.l.)
ELU	-	Existing Lawful Water Use
GIS	-	Geographic Information System
GLS	-	GLS Consulting Engineers (Pty) Ltd
h	-	Hour
ha	-	Hectare
IB	-	Irrigation Board
IMQS	-	Infrastructure Management Query Station (software)
kℓ	-	Kilolitre
kℓ/d	-	Kilolitre/day
kℓ/y	-	Kilolitre/year
km	-	Kilometre
kW	-	Kilowatt
kWh	-	Kilowatt-hour
ℓ	-	Litre
ℓ/day/UE	-	Litre/day/unit erf
ℓ/h/connection	-	Litre/hour/connection
ℓ/min	-	Litre/minute
ℓ/s	-	Litre/second
m	-	Metre
m a.g.l.	-	Metres above ground level
m a.s.l.	-	Metres above mean sea level
m b.g.l.	-	Metres below ground level
m/s	-	Metres per second
Mℓ	-	Megalitre
Mℓ/a	-	Megalitre per annum
mm	-	Millimetre
P & G	-	Preliminary and general
PDF	-	Peak day flow

PHF	-	Peak hour flow
PRV	-	Pressure Reducing Valve
PWF	-	Peak week flow
s	-	Second
SCADA	-	Supervisory Control and Data Acquisition
SG	-	Surveyor General
SM	-	Stellenbosch Municipality
SSE	-	Specialist System Engineering
SU	-	Stellenbosch University
SWIFT	-	Sewer Water Interface For Treasury systems (software)
TCTA	-	Trans Caledon Tunnel Authority
TWD	-	Total annual water demand
TWL	-	Top Water Level (in m a.s.l.)
UAW	-	Unaccounted-for-water
uPVC	-	Plasticised polyvinylchloride
UWD	-	Unit Water Demand (e.g. ℓ/stand/d, or kℓ/ha/d)
V&V	-	Verification and Validation
VAT	-	Value Added Tax
WADISO	-	Water Distribution System Optimization program (software)
WARMS	-	Water Use Registration Management System
WCWSS	-	Western Cape Water Supply System
WMA	-	Water Management Area
WSA	-	Water Services Authority
WTP	-	Water Treatment Plant (potable water)
WUA	-	Water Users Association
WULA	-	Water Use License Application
WWTP	-	Wastewater Treatment Plant (sewage)

1. INTRODUCTION

1.1 BRIEF

GLS consulting engineers (GLS) were appointed by Stellenbosch Municipality (SM) to assist them with drought intervention planning to manage water demand and supply during the drought that is experienced in the Western Cape Province.

The project entails an analysis of the existing available water resources, analysis of the existing and future water demand, monitoring of existing bulk water supply and demand, planning of pressure management projects to reduce water demand and losses and the planning of bulk water augmentation projects to augment bulk water supply to SM.

This drought intervention planning report lists the analyses and findings of the study on the bulk and reticulation systems of all the towns within the Stellenbosch Municipality.

1.2 STUDY AREA

The location of SM within the Western Cape is shown on Figure SW1.1. The water supply systems and towns within the boundary of the Stellenbosch Municipality are:

- Stellenbosch system (Stellenbosch town, including Jamestown and De Zalze)
- Dwars River system (Pniel, Kylemore, Johannesdal and Lanquedoc)
- Greater Franschhoek system (Franschhoek, La Motte and Wemmershoek)
- Klapmuts system (Klapmuts)
- Rural supply systems (Faure/Raithby system, Polkadraai system, Koelenhof system, Muldersvlei system and Meerlust, Croydon & Helderberg systems)

Figure SW2.1 shows the various supply systems with their respective supply areas. The total area of these supply systems indicates the study area of this investigation.

1.3 PREVIOUS DROUGHT INTERVENTION PLANNING

This is the first document for SM to plan for a scenario where the available water from the current surface water resources are under pressure and should be augmented with water from alternative resources. The following supporting documents were available for SM and used as background information for this study:

- Stellenbosch Municipality Water Master Plan (GLS, dated June 2017)
- Stellenbosch Municipality Water Services Development Plan (WorleyParsons, dated June 2011).
- Bulk Water Supply Improvements for Stellenbosch Municipality (WorleyParsons, dated September 2011).
- Comprehensive Bulk Infrastructure Master Plan: Water and Waste Water (Element, dated November 2010)
- Stellenbosch Water Resource Study (GLS, dated September 1994)

Information of all these previous studies were updated where relevant.

1.4 DEFINITIONS

1.4.1 Water supply system

In this report the term *water supply system* is used to describe the reticulation system downstream of the clean water reservoir or bulk water connection point and upstream of individual consumer meters; it is also often termed the internal water reticulation system. Capital expenditure relating to this system is the responsibility of the Municipality.

In order to further distinguish between capital expenditure by the Municipality and by other role-players the following terms are defined:

- *Bulk water supply system* is used to describe the system upstream of the clean water reservoir, yet belonging to the Municipality, while the term,
- *External bulk water supply system* - is used to describe those parts of the water supply system that are owned by third parties.

1.4.2 Water management zones

Management zones are often termed bulk zones, distribution zones, or water pressure zones. Following the notation of the Water Demand Cookbook (McKenzie et al, Nov 2003) the following terms are used in this report. *A water management zone* can be either a district, a sub-district or a zone, where:

- a *district* is a unique area with individual bulk supply and boundaries usually fixed by topographical constraints. This would include various consumer categories (typically about 30 000 connections).
- a *sub-district* is a subdivision of a district and is identified by a reservoir, tower, pump, or PRV zone (typically 2000 to 10 000 connections). This would include various consumer categories.
- a *zone* is a subdivision of a district, identified by areas of similar characteristics (typically not larger than 2000 connections).

The set-up (identifying and installing, where necessary, zone valves) and maintenance of zones (training maintenance staff to understand why these zone valves should not be opened) is a particular challenge to many towns in South Africa.

1.4.3 Unaccounted-for-water (UAW)

The acronyms UAW and UFW are used in literature for the term *unaccounted-for-water*. In this report UAW is used. Generally speaking UAW is the difference between the volume of water purchased by a water service provider (or bulk supply to the town) and the volume of water sold to consumers (recorded by consumer meters and billed to consumers). However, the definition of UAW and the topic is much more involved - UAW is best described by a table and detailed report such as the one by McKenzie et al (2002), where a detailed table is provided to illustrate the different components of UAW.

In this report the term UAW is used to describe the non-revenue water, that is, all water use that is not recorded in the treasury system of the Municipality is considered to be “unaccounted-for”, whether it is metered or not. Unless metered unbilled water use is specifically pointed out it is not included in the analysis in this investigation.

1.4.4 Stand

In this report *stand* is used to denote a piece of ground identified in the database of the Surveyor General (SG) as a unique property. A stand could have one or more (or no) metered connections to the water supply system. The words property, site, erf (or erven), and lot are also sometimes used elsewhere to describe a stand.

1.4.5 Treasury record

A *treasury record* is a consumer's account that is recorded in the treasury database of the Municipality. Each treasury record normally represents a water meter forming a consumer's connection to the water supply system. Some treasury records might not pertain to a water connection (or customer meter).

1.5 STRUCTURE AND SCOPE OF REPORT

This report addresses the sufficiency of the existing water resources of SM to supply the existing and future water demand, the monitoring of existing bulk water supply and demand, the planning of pressure management projects to reduce water demand and losses and the planning of bulk water augmentation projects to augment bulk water supply to the SM.

The contents of each chapter is arranged so that all of the text is grouped together, followed by the tables and then the figures if applicable to the chapter.

1.6 DISCLAIMER

The investigation has been performed and this report has been compiled based on the information made available to GLS. All efforts, within budget constraints, have been made during the gathering of information to ensure the highest degree of data integrity. The information supplied to GLS by SM and other consultants at the outset of this drought intervention planning process is assumed to be the most accurate representation of the existing system up to date hereof.

Subsequent to the completion of the data capturing, the layout plans including the relevant attributes, were handed back to the Municipality so that the information could be verified by the Client.

Weekly progress meetings were held by SM and GLS throughout the project where progress, planning and new data were discussed and GLS can therefore under no circumstances be held accountable by any party for any direct, indirect, special or consequential damages as a result of inaccurate information received pertaining to the components of the existing system.

The information in this report is intended for use by the Stellenbosch Municipality only.

Figure SW1.1: Locality plan - Stellenbosch Municipality

2. BULK WATER RESOURCES

2.1 WATER SOURCES

2.1.1 Background

SM is supplied with water obtained from the municipality's own surface and groundwater sources within the Water Services Authority (WSA) area of jurisdiction, as well as water obtained from external sources (e.g. Department of Water and Sanitation (DWS) and the City of Cape Town (CCT)).

Water from the municipality's own sources are from the Eersterivier in Stellenbosch, the Perdekloof source in Franchhoek and boreholes in Stellenbosch and the Dwars River area. The balance of the water is supplied to SM from the Western Cape Water Supply System (WCWSS). Water from the WCWSS is supplied directly to SM through the Theewaterskloof tunnel, or indirectly through water bought from the CCT.

2.1.2 The Western Cape Water Supply System

The WCWSS supplies water to the CCT, Stellenbosch Municipality, Drakenstein Municipality, as well as to towns on the West Coast and in the Swartland region. Irrigators along the Berg and Eerste rivers, irrigators and urban users in the Riviersonderend catchment and irrigators in the Breede Water Management Area (WMA) also receive water from the system. The major water user from the WCWSS is however the urban sector within the CCT.

The WCWSS is a complex water supply system comprising of an inter-linked system of dams, pipelines, tunnels and distribution networks. The main storage dams of the WCWSS are the Theewaterskloof and Voëlvlei dams (owned and operated by the DWS), the Berg River Dam (owned by the Trans Caledon Tunnel Authority (TCTA) and operated by the DWS) and the Wemmershoek, Upper Steenbras and Lower Steenbras dams (owned and operated by the CCT). The dams are operated as an integrated system to minimise spillage and maximise storage during drought months.

2.1.3 Existing SM treated water systems

Urban water users within the SM are supplied with purified water through the following water supply systems:

- Stellenbosch system
- Dwars River system
- Franschhoek system
- Klapmuts system
- Rural systems

2.1.4 Stellenbosch system

The Stellenbosch purified water system (owned and operated by the SM) supplies water mainly to the urban water users in Stellenbosch town. The system is supplied with raw water from two sources, namely the municipality's own source from the Eerste River/Idas Valley and water supplied from the WCWSS through the Theewaterskloof tunnel. In 1998 a bulk water transfer scheme was commissioned where 12,5 Mℓ/d of purified water could be transferred between the two sources.

During the winter months the Eerste River in the Jonkershoek Valley supplies water directly to the Idas Valley WTP. Surplus water from the Eerste River is transferred to the Idas Valley dams (564 Mℓ and 1 818 Mℓ). In the dryer summer months there is a shortage from the Eerste River and water is supplemented from the Idas Valley dams. Water from the Idas Valley dams and the Eerste River is purified at the Idas Valley Water Treatment Plant (WTP) from where it is supplied into the Stellenbosch network. SM has a water license from DWS to abstract 7 224 Ml/a from this source.

Stellenbosch Municipality also has an allocation of 3 000 Ml/a from the Theewaterskloof tunnel. Raw water from this source is purified at the Paradyskloof WTP from where it is supplied into the distribution network.

The total water allocation to Stellenbosch town from the DWS is 10 244 Ml/a. The water demand for the Stellenbosch system for the 2016/17 financial year was 8 718 Ml/a, or 85,1 % of the existing allocation.

The combined treatment capacity of the Idas Valley and Paradyskloof water treatment plants in the Stellenbosch system is 33 500 kl/d. Peak monthly demand for the system for the 2016/17 financial year was 29 290 kl/d, or 87,4 % of the existing treatment capacity.

Note: In Stellenbosch town there are currently 6 municipal boreholes that are registered on the DWS WARMS database. These boreholes are used for irrigation purposes and do not form part of the current potable water system. Stellenbosch town also has 3 unregistered boreholes of which only the Kayamandi borehole is operational (also for irrigational purposes). The registration of the Kayamandi borehole at DWS is currently in process.

2.1.5 Dwars River system

The Dwars River system (owned and operated by the SM) supplies water to the Dwars River area (Pniel, Kylemore, Johannesdal & Lanquedoc) and purchases water in bulk from the CCT. This water from the CCT is purified water from the Wemmershoek scheme. SM also has a water license from the DWS to abstract water from the Pniel borehole, the Pniel water stream and the Pniel spring. Water from these sources are currently not used.

SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

The water license from the DWS is for abstraction of 79 Ml/a from the Pniel borehole, 25 Ml/a from the Pniel spring and 53 Ml/a from the Pniel water stream. The combined water allocation from DWS is 157 Ml/a.

The water demand for the Dwars River system for the 2016/17 financial year was 713 Ml/a.

Note: In Kylemore and Lanquedoc there are currently 4 existing municipal boreholes that are not registered on the DWS WARMS database. These boreholes are used for irrigation purposes and do not form part of the current potable water system. Of these 4 boreholes only the Lanquedoc borehole is operational.

2.1.6 Franschhoek system

The eastern part of Franschhoek is supplied with water from its own source in the adjacent mountains, the so-called Perdekloof source. The western part of Franschhoek, La Motte and Wemmershoek are supplied with water purchased from the CCT. The water from the CCT is purified water from the Wemmershoek scheme while the raw water from the Perdekloof source is purified at a package plant. The Franschhoek system is owned and operated by the SM.

The SM has water licences from DWS to abstract raw water from the Perdekloof source through the Mont Rochelle fresh water fountain (221 Ml/a registered usage), through the upstream Perdekloof weir (577 Ml/a registered usage) and from the Du Toits River pump station (104 Ml/a registered usage). The quality of the raw water is good. The allocation of these sources amounts to 901 Ml/a (2,47 Ml/d). The pipeline system between the

Perdekloof source and the package plant in Franschhoek has however a capacity constraint of 2,25 Ml/d. The capacity of the package plant is 2,70 Ml/d.

SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

The water demand for the Franschhoek system for the 2016/17 financial year was 1 290 Ml/a.

Note: The SM has 2 existing irrigation boreholes at the Wemmershoek and La Motte sport fields. These boreholes are currently not registered on the DWS WARMS database, are used for irrigation purposes and do not form part of the potable water system.

In Franschhoek water was supplied to the town from the Groendal water source before the Wemmershoek scheme was implemented in the early 2 000s. Water from this source is currently not used and it is proposed that the water rights from this old source is registered at DWS to be used in future to augment bulk water supply to the Franschhoek system.

2.1.7 Klapmuts system

The Klapmuts system (owned and operated by the SM) supplies water to the urban users in Klapmuts and purchases water in bulk from the CCT. This water from the CCT is purified water from the Wemmershoek scheme.

SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

The water demand for the Klapmuts system for the 2016/17 financial year was 531 Ml/a.

Note: Klapmuts used to be supplied with bulk water from 2 boreholes in town (before the town was supplied with water from the CCT Wemmershoek source). These 2 boreholes are currently not operational (both have collapsed).

2.1.8 Rural systems

The following rural supply systems are operated in SM to supply purified water to rural consumers within the boundary of SM:

- Faure/Raithby/Jamestown system
- Polkadraai system
- Koelenhof system
- Muldersvlei system
- Meerlust, Croydon & Helderberg systems

SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

The Faure/Raithby/Jamestown system (owned and operated by the SM) supplies water to the urban users in Raithby, rural consumers along the pipeline and can also supply water to the De Zalze Estate and Jamestown in Stellenbosch. The system is supplied with bulk water purchased from the CCT. This water from the CCT is purified water from the Faure WTP.

The water demand for the Faure/Raithby/Jamestown system for the 2016/17 financial year was 325 Ml/a.

The Polkadraai system (owned and operated by the SM) supplies water to the rural consumers in the Polkadraai area along the pipeline. Water can also in emergency conditions be supplied from the Faure system to the Polkadraai system. The system is supplied with bulk water purchased from the CCT. This water from the CCT is purified water from the Blackheath WTP.

The water demand for the Polkadraai system for the 2016/17 financial year was 284 Ml/a.

The Koelenhof rural water supply scheme (owned and operated by the SM) supplies treated water to the urban users in the Koelenhof rural area and purchases water in bulk from the CCT. This water from the CCT is purified water from the Wemmershoek scheme.

The water demand for the Koelenhof system for the 2016/17 financial year was 627 Ml/a.

The Muldersvlei rural water supply scheme (owned and operated by the SM) supplies treated water to the urban users in the Muldersvlei rural area and purchases water in bulk from the CCT. This water from the CCT is purified water from the CCT Bloekombos reservoir (supplied from the Wemmershoek pipeline).

The water demand for the Muldersvlei system for the 2016/17 financial year was 107 Ml/a.

The Meerlust, Helderberg and Croydon systems supplies water to the urban users in these areas and purchases water in bulk from the CCT. The Meerlust area is supplied with bulk water from the Wemmershoek scheme and the Helderberg and Croydon areas with bulk water from the Steenbras dam through the CCT's reticulation network.

The combined water demand for the Meerlust, Helderberg and Croydon systems for the 2016/17 financial year was 19 Ml/a.

Note: Raithby and Meerlust used to be supplied with bulk water from boreholes (before Raithby was supplied with water from the CCT Faure source and before Meerlust was supplied with water from the CCT Wemmershoek source). Both these boreholes are currently not operational (boreholes have collapsed). It is proposed that the water rights from the Raithby and Meerlust boreholes are registered at DWS.

2.1.9 Main supply areas

The respective water supply systems within the SM can be divided into 2 main supply areas, i.e.

- Stellenbosch town (supplied with water from its own source and water from the WCWSS through the Paradyskloof tunnel), and
- all other urban and rural areas (the Dwars River system, Franschhoek system, Klapmuts system and rural supply areas, supplied with bulk water mainly from the CCT).

The main water supply areas within the municipal boundary of SM are shown on Figure SW2.1.

2.1.10 Summary of existing available water resources

Table SW2.1 gives a summary of the existing sources of water that are currently available to SM.

The main water supply areas within the municipal boundary of SM, the locations of the existing water resources and the relevant water infrastructure (municipal and external bulk water pipes, internal water network, reservoirs and location of bulk water meters) are shown on Figure SW2.1.

2.2 EXISTING WATER DEMAND

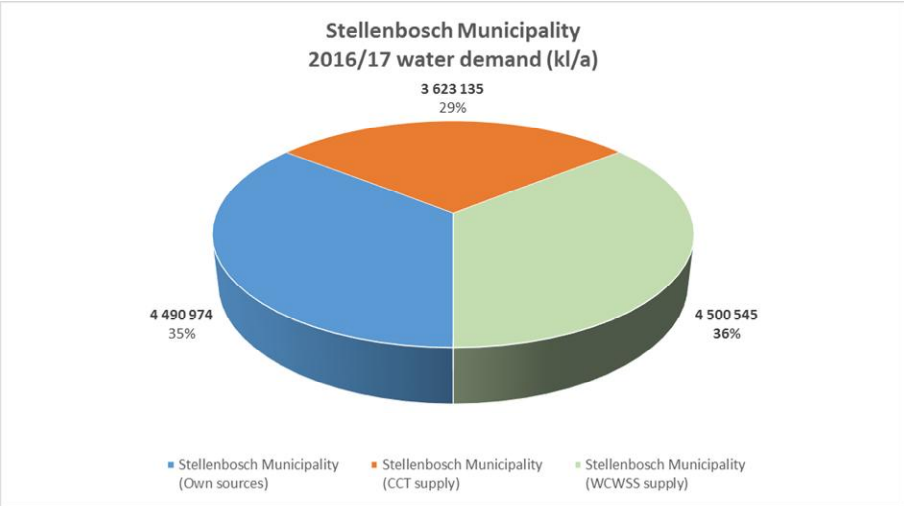
Reliable bulk water demand readings were available for SM from 2006 to 2018 and were used as base information for the analysis of the existing water demand for SM.

2.2.1 Stellenbosch Municipality

The water demand for SM for the 2016/17 financial year (July 2016 to June 2017) was 12 615 Ml/a (AADD of 34,6 Ml/d). The total demand for SM supplied from the relevant available water resources is as follows and shown in Figure SW2.2a below:

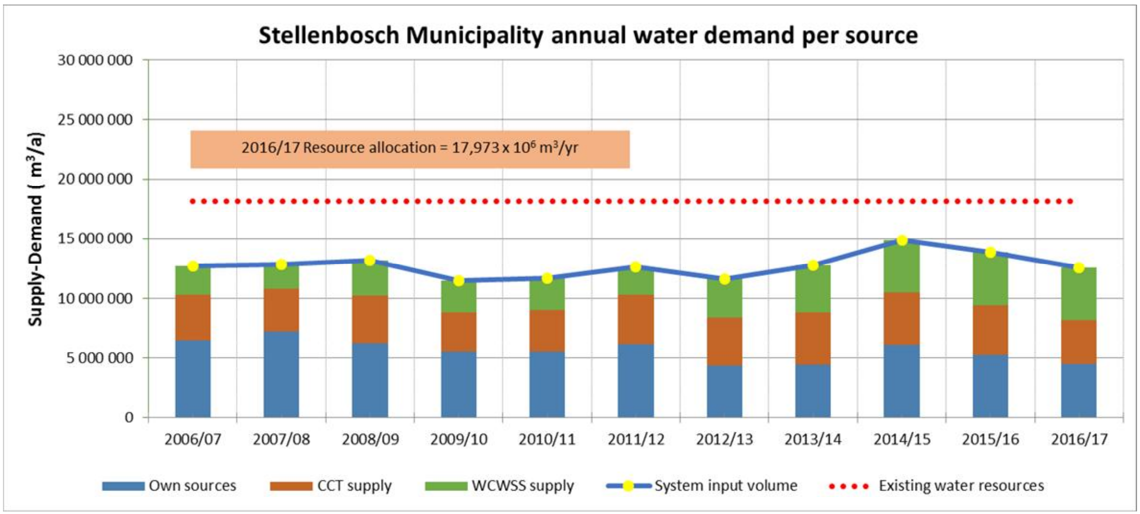
- SM own sources (4 491 Ml) - 35,6 %
- CCT supply (3 623 Ml) - 28,7 %
- WCWSS (4 500 Ml) - 35,7 %

Figure SW2.2a: Water demand per source for Stellenbosch Municipality



The water demand for SM from 2006 to 2017 are shown in Figure SW2.3a below:

Figure SW2.3a: Stellenbosch Municipality annual water demand per source



The historic water demand readings shows the following:

- The existing water resources available for SM from 2006 to 2017 is more than the water demand recorded for SM. The total annual demand of 12 615 Ml for the 2016/17 financial year is 70,2 % of the existing available water resources for SM.

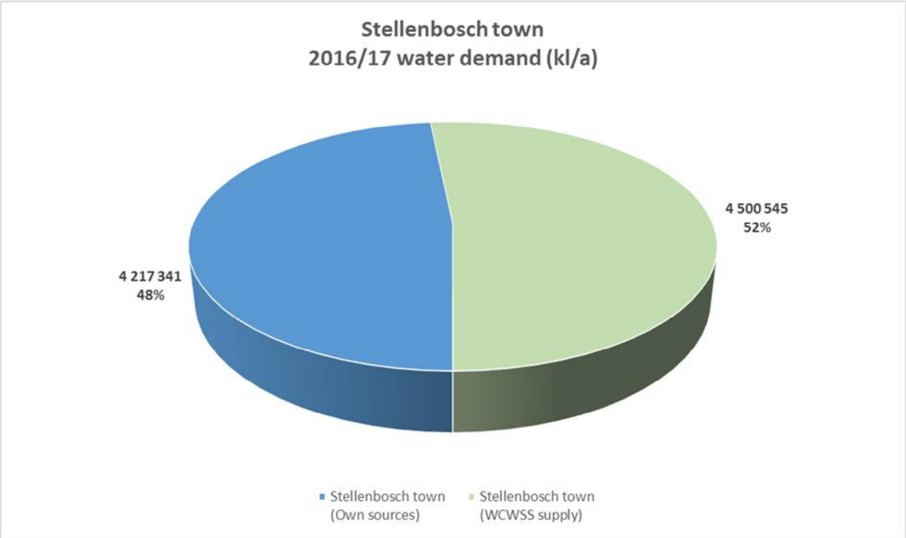
- From 2014/15 to 2016/17 the water demand for SM decreases on an annual basis. This is due to water restrictions that were imposed on consumers and awareness of the current drought that is experienced in the Western Cape.
- Water demand for the 2014/15 financial year was the highest for the recorded period and is seen as the last year were normal water consumption occur (no reduction in demand due to drought conditions). The water demand from the 2014/15 financial year is also used in this document as the baseline demand for future water projections and to determine the target water demand for drought conditions.

2.2.2 Stellenbosch town

The water demand for Stellenbosch town for the 2016/17 financial year (July 2016 to June 2017) was 8 718 Ml/a (AADD of 23,9 Ml/d). The total water demand for Stellenbosch town supplied from the relevant available water sources is as follows, and shown in Figure SW2.2b below:

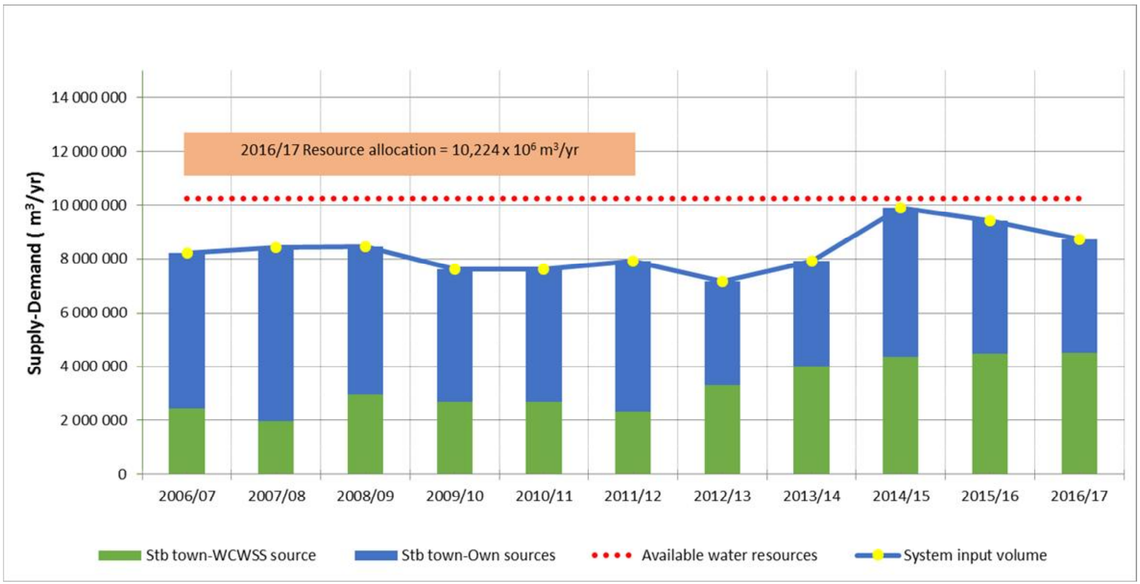
- Stellenbosch town own sources (4 217 Ml)
- WCWSS (4 501 Ml)

Figure SW2.2b: Water demand per source for Stellenbosch town



The water demand for Stellenbosch town from 2006 to 2017 is shown in Figure SW2.3b below:

Figure SW2.3b: Stellenbosch town annual water demand per source



The historic water demand readings for the Stellenbosch town system shows the following:

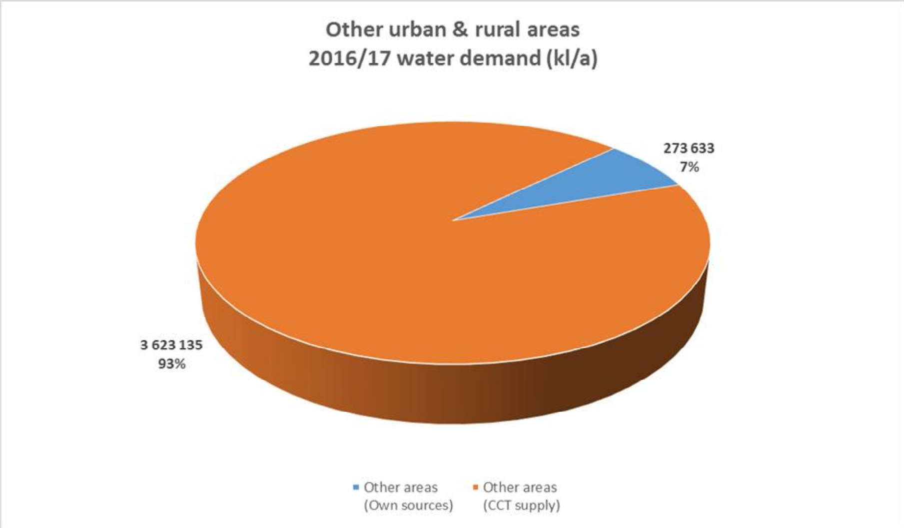
- The existing water resources available for Stellenbosch town from 2006 to 2017 is more than the water demand recorded for Stellenbosch. For the 2014/15 financial year the demand of the town has however almost exceeded the available resources for the town. The total annual demand of 8 718 Ml for the 2016/17 financial year is 85,3 % of the existing available water sources for the Stellenbosch town system.
- From 2014/15 to 2016/17 the water demand for the Stellenbosch town system decreased on an annual basis. This is due to water restrictions that were imposed on consumers and awareness of the current drought that is experienced in the Western Cape.
- Water demand for the 2014/15 financial year was the highest for the recorded period and is seen as the last year where normal consumption occurred (no reduction in demand due to drought conditions). Demand from 2014/15 is also used in this document as the baseline demand for future water projections for Stellenbosch town and to determine the target water demand for Stellenbosch town for drought conditions.

2.2.3 Other urban and rural areas

The water demand for the other urban areas (Franschhoek, Dwars River area, Klapmuts and the rural water supply schemes) for the 2016/17 financial year (July 2016 to June 2017) was 3 897 Ml/a (AADD of 10,7 Ml/d). The total demand for these areas supplied from the relevant available water sources is as follows, and shown in Figure SW2.2c below:

- SM own water resources (274 Ml)
- CCT supply (3 623 Ml)

Figure SW2.2c: Water demand per source for other urban and rural areas in SM

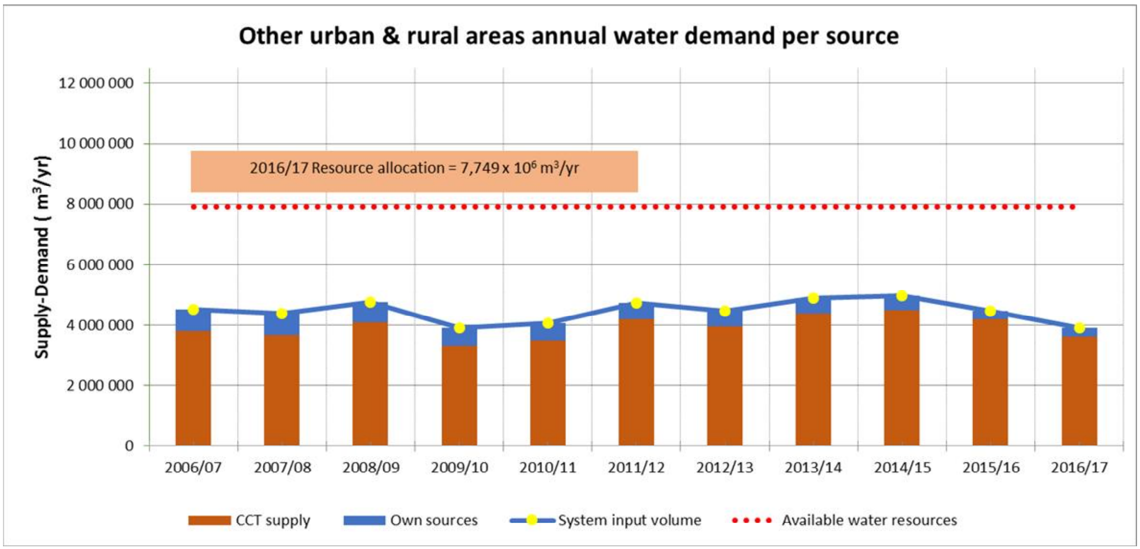


The total annual water demand of 3 897 Ml/a for the 2017/17 financial year can be attributed to the various supply schemes as follows:

- Franschhoek system (1 290 Ml)
- Dwars River system (713 Ml)
- Klapmuts system (531 Ml)
- Rural supply systems (1 363 Ml)

The water demand for the other urban areas and rural areas in SM from 2006 to 2017 is shown in Figure SW2.3c below:

Figure SW2.3c: Annual water demand for other urban and rural areas



The historic water demand readings for the other urban areas and rural areas in SM shows the following:

- The existing water resources available for the other urban areas and rural areas in SM from 2006 to 2017 is more than the water demand recorded for these systems. The total annual demand of 3 897 Ml for the 2016/17 financial year is 50,3 % of the existing available water resources for these areas.
- From 2014/15 to 2016/17 the water demand for the other urban areas and rural areas in SM decreased on an annual basis. This is due to water restrictions that

were imposed on consumers and awareness of the current drought that is experienced in the Western Cape.

- Water demand for the 2014/15 financial year was the highest for the recorded period and is seen as the last year where normal consumption occurred (no reduction in demand due to drought conditions). Demand from 2014/15 is also used in this document as the baseline demand for future water projections for the other urban areas and rural areas in SM and to determine the target water demand for these areas for drought conditions.

2.3 TARGET WATER DEMAND FOR DROUGHT SCENARIO

Under normal water demand conditions SM is supplied roughly with 30% if its water demand from the CCT, 30% from DWS through the Paradyskloof tunnel and 40% from its own sources. SM is therefore dependant on approximately 60% of its normal water consumption from external water providers (CCT & WCWSS).

In order to manage the current drought that is experienced in the Western Cape SM has set a target to reduce their normal water consumption by 45%. The water demand for the 2014/15 financial year is used as base demand because it was the last financial year where no water restrictions were enforced on the SM water users (normal water consumption patterns were followed by the SM consumers).

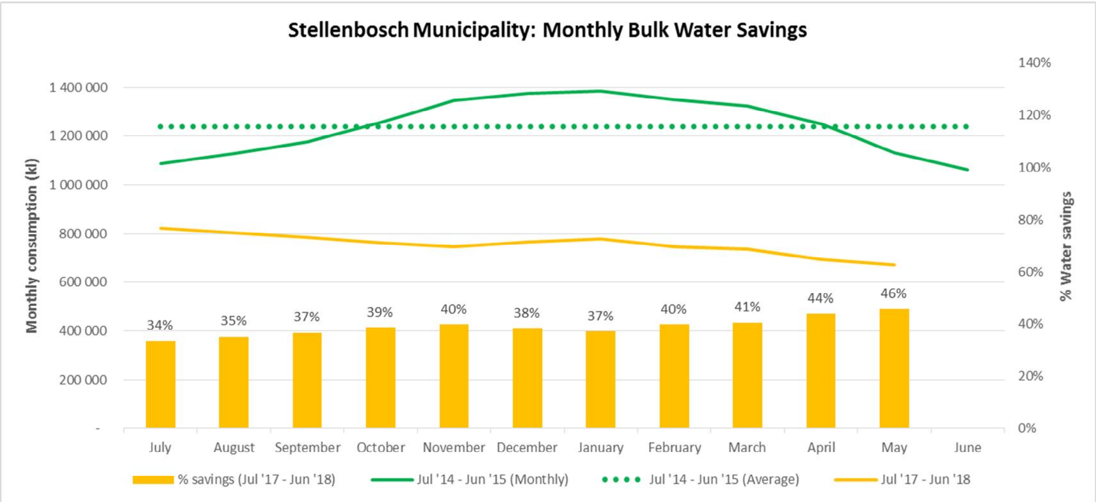
2.3.1 Stellenbosch Municipality

The 2014/15 baseline water demand for SM was 14 876 Ml/a (AADD of 40,8 Ml/d). The target water demand for a drought scenario for SM is calculated at 8 182 Ml/a (AADD of 22,4 Ml/d). The target water demand for each supply system is as follows:

- Stellenbosch town system : 5 449 Ml/a (AADD = 14,93 Ml/d)
- Franschhoek system : 820 Ml/a (AADD = 2,25 Ml/d)
- Dwars River system : 469 Ml/a (AADD = 1,28 Ml/d)
- Klapmuts system : 305 Ml/a (AADD = 0,84 Ml/d)
- Rural supply systems : 1 138 Ml/a (AADD = 3,12 Ml/d)

Figure SW2.4a below shows the monthly water demand and percentage savings for SM for the 2017/18 financial year against the target water demand (based on the 2014/15 demand as a baseline):

Figure SW2.4a: Monthly water consumption and savings for Stellenbosch Municipality



From Figure SW2.4a above it can be seen that demand for SM has decreased during the 2017/18 financial year and the target demand of 22,4 Ml/d (monthly demand of 680 Ml) has been reached during May 2018.

On a system for system basis the Dwars River system is the only system that currently does not reach their target demand, as can be seen in Table SW2.2a below.

Table SW2.2a: Stellenbosch Municipality: Bulk water savings per supply area

Stellenbosch Municipality: Bulk water savings per supply area:			
Town/ supply area	**Baseline demand** (2014/15) ML/d	**Current demand** (May 2018 volumes) ML/d	**% Reduction** (Target = 45%)
Stellenbosch town	**27.2**	**14.7**	**46.0%**
Franschhoek area	**4.1**	**2.1**	**48.5%**
Dwars River area	**2.3**	**2.4**	**-1.1%**
Klapmuts	**1.5**	**0.9**	**42.2%**
Rural areas	**5.7**	**2.1**	**62.4%**
Total	**40.8**	**22.1**	**45.7%**

The Dwars River system is currently (May 2018 readings) using more water than what they did in 2014/15. This is also the reason that the target savings on the CCT source is currently only 42,9%, as can be seen in Table SW2.2b below:

Table SW2.2b: Stellenbosch Municipality: Bulk water savings per source

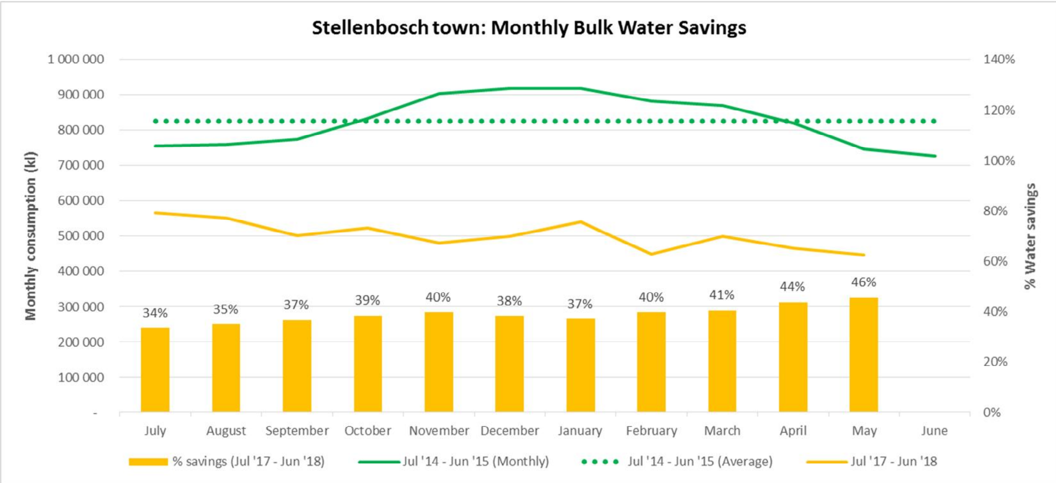
Stellenbosch Municipality: Bulk water savings per source:			
Water resources	**Baseline demand** (2014/15) ML/d	**Current demand** (May 2018 volumes) ML/d	**% Reduction** (Target = 45%)
CCT	**12.3**	**7.0**	**42.9%**
SM + WCWSS	**28.5**	**15.1**	**46.9%**
Total	**40.8**	**22.1**	**45.7%**

2.3.2 Stellenbosch town

The target water demand for a drought scenario for Stellenbosch town is calculated at 5 449 Ml/a (AADD of 14,93 Ml/d).

Figure SW2.4b below shows the monthly water demand and percentage savings for Stellenbosch town against the target demand (based on the 2014/15 demand as a baseline):

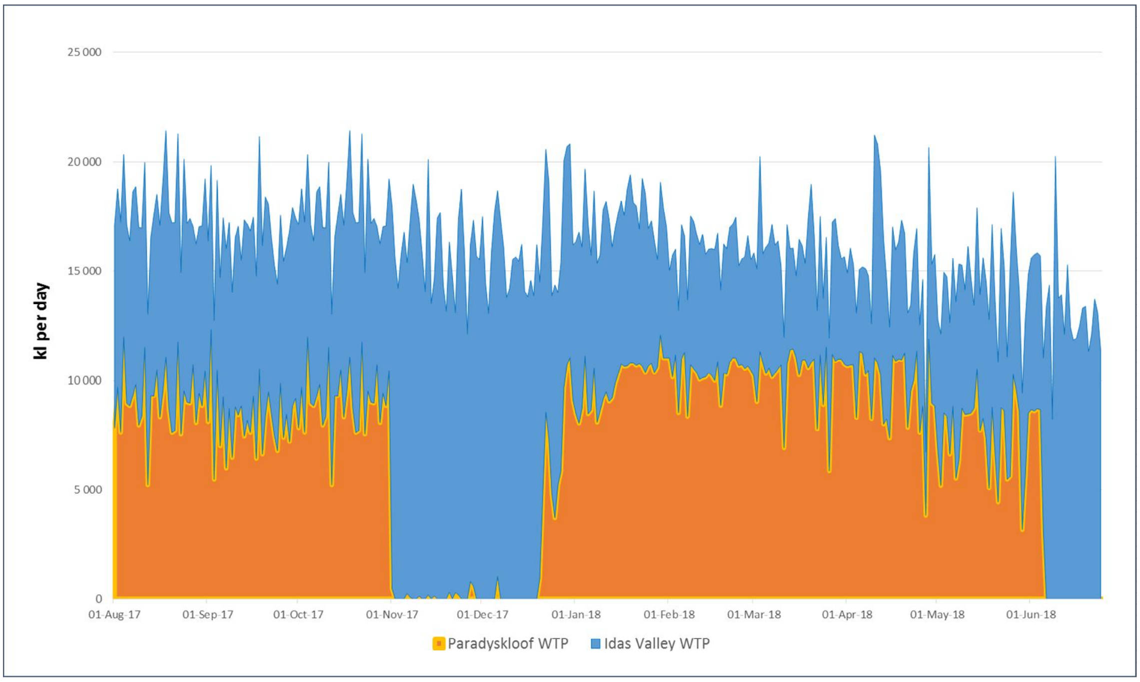
Figure SW2.4b: Monthly water consumption and savings for Stellenbosch town



From Figure SW2.4b above it can be seen that the water demand for the Stellenbosch town system has decreased during the 2017/18 financial year and the target demand of 14,93 Ml/d (monthly demand of 454 Ml) has been reached during May 2018.

Water supply to the Stellenbosch town system from the Idas Valley and Paradyskloof WTPs is shown in Figure SW2.5 below:

Figure SW2.5: Water production for Stellenbosch town



2.3.3 Other urban and rural areas

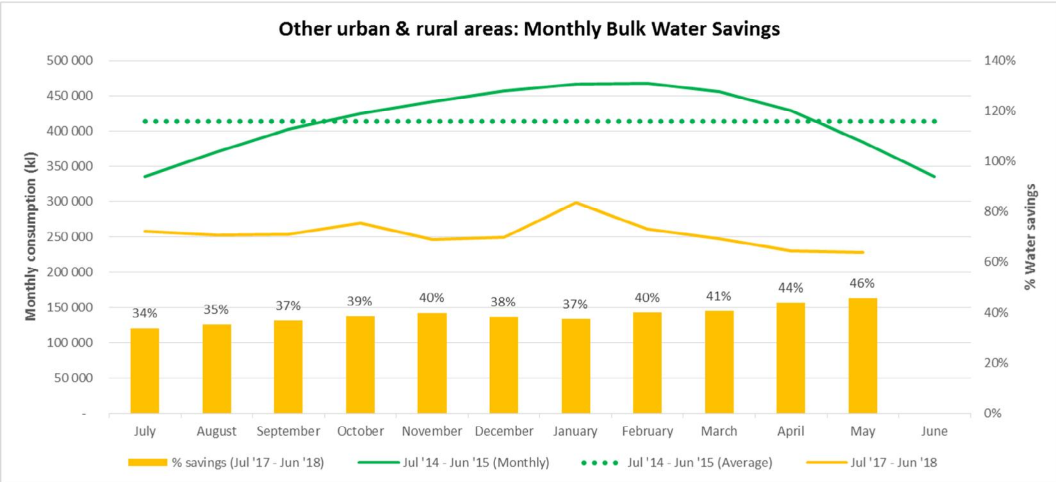
The target water demand for a drought scenario for the other urban areas in SM (Franschhoek, Dwars River area, Klapmuts and the rural water supply schemes) is calculated at 2 733 Ml/a (AADD of 7,49 Ml/d). These areas are all currently supplied with bulk water from CCT, except for a portion of Franschhoek that is supplied with water from the mountains. The target water demand for each system is as follows:

- Franschhoek system : 820 Ml/a (AADD = 2,25 Ml/d)
- Dwars River system : 469 Ml/a (AADD = 1,28 Ml/d)
- Klapmuts system : 305 Ml/a (AADD = 0,84 Ml/d)
- Rural supply systems : 1 139 Ml/a (AADD = 3,12 Ml/d)

TOTAL : 2 733 Ml/a (AADD = 7,49 Ml/d)

Figure SW2.4c below shows the monthly water demand and percentage savings for the other urban areas and rural areas in SM against the target demand (based on the 2014/15 baseline demand):

Figure SW2.4c: Monthly water consumption and savings for other urban and rural areas in SM



From Figure SW2.4c above it can be seen that demand for the other urban and rural systems in SM has decreased during the 2017/18 financial year and the target demand of 7,49 Ml/d (monthly demand of 228 Ml) has been reached during May 2018.

The targeted demand of 1 139 Ml/a (AADD = 3,12 Ml/d) for the rural supply systems can be break down for the various sub-systems as follows:

- Faure/Raithby : 396 Ml/a (AADD = 1,09 Ml/d)
- Polkadraai : 229 Ml/a (AADD = 0,63 Ml/d)
- Koelenhof : 413 Ml/a (AADD = 1,13 Ml/d)
- Muldersvlei : 82 Ml/a (AADD = 0,23 Ml/d)
- Meerlust : 9 Ml/a (AADD = 0,03 Ml/d)
- Croydon & Helderberg : 8 Ml/a (AADD = 0,02 Ml/d)

TOTAL : 1 139 Ml/a (AADD = 3,12 Ml/d)

2.4 FUTURE WATER DEMAND

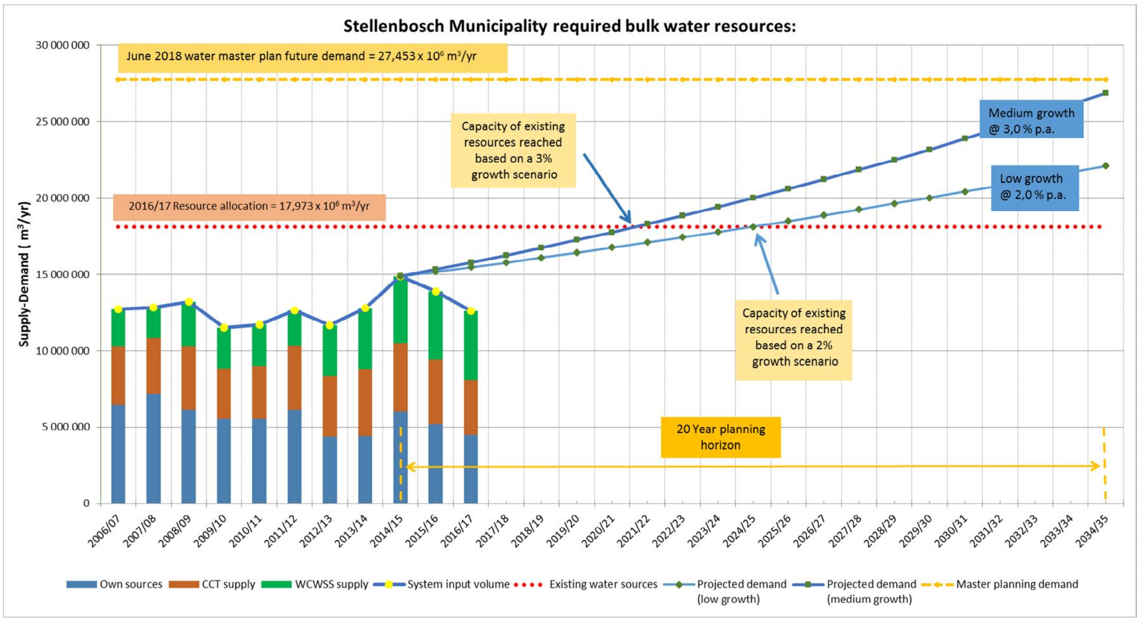
In the June 2017 Water Master Plan for SM the potential future AADD for SM is calculated at 75,21 Ml/d. The future AADD of the SM system is summarised in Table SW2.3.

The future AADD (modelled as the future system) represents an increase of ± 84% over the baseline AADD of 40,8 Ml/d for the 2014/15 financial year. This AADD will be realised in the year ± 2036 if the demand increases at a compounded growth rate of ± 3,0% per year (a growth rate of 3,0 % was used as a medium growth rate for planning of the bulk water resources for SM). At a lower growth rate of 2,0% per year this AADD will be realised in the year ± 2046.

2.4.1 Stellenbosch Municipality

The current water resources available for SM is calculated at 17 973 Ml/a. The potential future resources required for SM is calculated at 27 453 Ml/a. Figure SW2.6a below shows the existing SM demand, projected demand based on a low and medium growth in water demand of 2,0% and 3,0% respectively (for normal demand conditions, no restrictions), the existing available resources, and the future required resources as calculated in the latest Water Master Plan.

Figure SW2.6a: Stellenbosch Municipality required bulk water resources



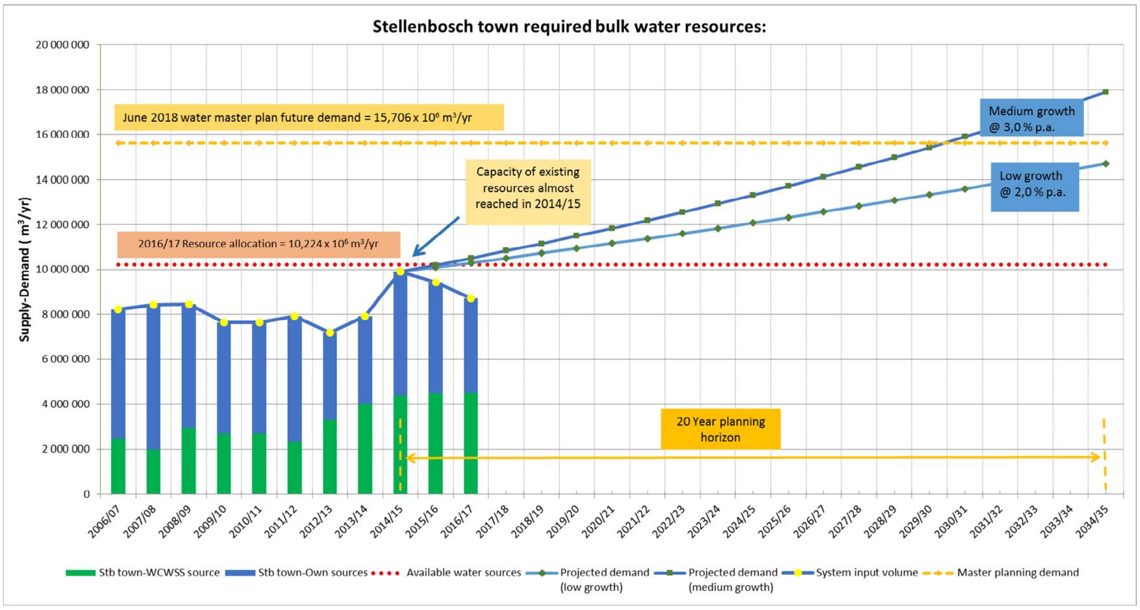
From Figure SW2.6a it can be seen that:

- The capacity of the existing SM water resources will be reached in 2021 if water demand in the municipality increases at a growth rate of 3,0% under normal demand conditions.
- If a lower growth rate of 2,0% is realised, the existing water resources will be reached by 2025.
- Additional water resources of 9 480 Ml/a will be required to supply the future water demand of SM as calculated in the latest Water Master Plan.

2.4.2 Stellenbosch town

The current water resources available for the Stellenbosch town system is calculated at 10 224 Ml/a. The potential future resources required for the Stellenbosch town system is calculated at 15 706 Ml/a. Figure SW2.6b below shows the existing water demand for the Stellenbosch town system, the projected demand based on a low and medium growth in water demand of 2,0% and 3,0% respectively (under normal demand conditions, no restrictions), the existing available resources, and the future required resources as calculated in the latest Water Master Plan.

Figure SW2.6b: Stellenbosch town required bulk water resources



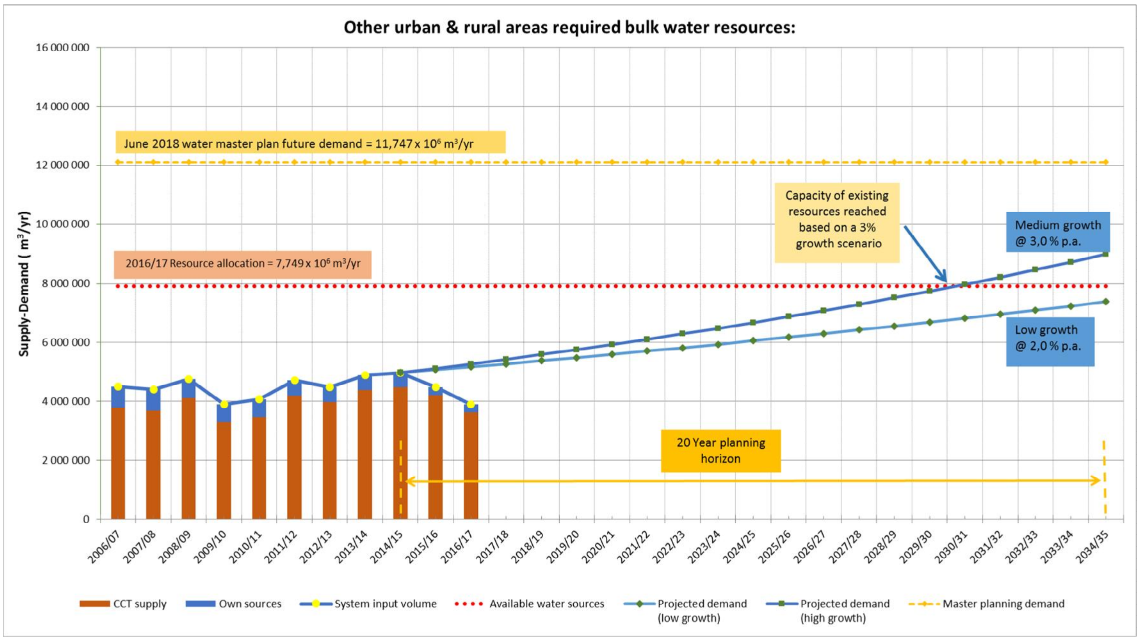
From Figure SW2.6b it can be seen that:

- The capacity of the existing water resources for Stellenbosch town was almost reached for the 2014/15 financial year.
- Water demand for the Stellenbosch town system is currently lower due to water restriction that is enforced. If water demand return to normal demand patterns after the restrictions are lifted, the demand for the Stellenbosch town system will exceed the current resource allocation.
- Additional water resources of 5 482 Ml/a will be required to supply the future water demand of these systems as calculated in the latest Water Master Plan.

2.4.3 Other urban and rural areas

The current water resources available for the other urban and rural systems in SM is calculated at 7 749 Ml/a. The potential future resources required for the other urban and rural systems is calculated at 11 747 Ml/a. Figure SW2.6c below shows the existing water demand of these systems, the projected demand based on a low and medium growth in water demand of 2,0% and 3,0% respectively (under normal demand conditions, no restrictions), the existing available resources, and the future required resources as calculated in the latest Water Master Plan.

Figure SW2.6c: Other urban and rural required bulk water resources



From Figure SW2.6c it can be seen that:

- The capacity of the existing water resources for the other urban and rural systems in SM will be reached in 2030 if water demand in the municipality increases at a growth rate of 3,0% under normal demand conditions
- If a lower growth rate of 2,0% is realised, the existing water resources will not be reached before 2035.
- Additional water resources of 3 998 Ml/a will be required to supply the future water demand of these systems as calculated in the latest Water Master Plan.

2.5 BULK WATER RESOURCE PLANNING

2.5.1 Background

Currently SM is dependent on surface water to supply the existing water demand of the Municipality. Although the SM has existing ground water resources available as part of their existing water resources, these groundwater resources are mainly boreholes that are used for irrigation purposes and cannot contribute to the potable water supply of the Municipality.

The SM's own sources from the Eerste River in Stellenbosch and the Perdekloof source in Franchhoek currently supply only 35% of the total water demand of the Municipality. The balance of the Municipality's water demand is dependent on water supplied from external sources (e.g. DWS and CCT) and during drought conditions SM has no control over these external sources. This poses a big risk for the Municipality to continue to supply a reliable bulk water service to its consumers.

During the first half of 2018 the existing WCWSS almost run out of water, which could resulted in large areas within the bigger SM being without water.

2.5.2 Water Resource Augmentation

In order to mitigate the current risk of being mostly dependent on surface water and having no control over water supplied from external sources, bulk water resources for SM should be augmented to include more supply from resources other than surface water. This can be water from the following resources:

- Extension of existing ground water sources.
- Transfer of irrigation water allocations (proposed increase in the allocation to the Paradyskloof WTP from DWS after existing water allocations from the Winelands Water Users Association (WUA) is transferred to SM in exchange for treated effluent from the Stellenbosch Wastewater Treatment Plant (WWTP)).
- Reclamation of water from the existing WWTPs.

It is proposed that the extension of the existing ground water resources should first be implemented in order to supply water to the Municipality for a scenario where reliable water supply is not available from the existing surface water resources.

In order to meet the future water demand for SM (as calculated in the latest Water Master Plan), the existing surface and groundwater resources should be augmented. This can be from the following resources (together with the groundwater, transfer and reclamation projects):

- Increase existing allocations from CCT (this can only be done after CCT has increased the reliability of their existing water resources).
- Increase existing allocation from DWS (from the Theewaterskloof tunnel).
- Rainwater harvesting (this option was not investigated as part of this report).

The required increase in the water resources for SM to meet the current drought demand and the potential future water demand is discussed for each system in the following paragraphs:

2.5.3 Stellenbosch town system

The current water resources available for the Stellenbosch town system is calculated at 10 224 Ml/a. The total available resources consist out of a 7 224 Ml/a water license from DWS to abstract water from the Eerste River (SM own source) and a 3 000 Ml/a water allocation from the Theewaterskloof tunnel (WCWSS supply).

Both these sources are however dependent on surface water. For the drought scenario the following assumptions were made regarding the available water resources and potential demand for the Stellenbosch town system:

- No water available from the Theewaterskloof tunnel (for a scenario where the Theewaterskloof dam is empty).
- Water from the Eerste River source is limited to the 1 in 100 year safe yield. This is calculated at 14 000 Ml/a.
- Water from the source is however limited to the capacity of the raw water pipeline between the source and the existing Idas Valley WTP, with a capacity of 750 Ml/month. The 1:100 safe yield from this source through the raw water pipeline is calculated at 6 600 Ml/a.
- Any excess water from the Eerste River source can be stored at the Idas Valley dams during winter. The combined capacity of the Idas Valley dams is 2 382 Ml.
- Existing groundwater resources cannot currently be incorporated in the existing potable water system.
- Water demand during drought conditions for the Stellenbosch system can be reduced by 45% on the 2014/15 baseline demand to a water demand of 5 449 Ml/a (AADD of 14,93 Ml/d).

Based on the assumptions above the Stellenbosch system has sufficient water resources available to supply the town with water during a severe drought. For the scenario above the total system will however still be dependent on surface water.

As part of the drought planning for Stellenbosch town it was decided to develop ground water resources in Stellenbosch to replace the areas that is currently supplied with water directly from the Paradyskloof WTP, i.e. Paradyskloof, Techno Park, Jamestown & De Zalze suburbs and the Brandwacht reservoir & PRV water distribution zones.

The additional water resources required for the Stellenbosch system for a drought scenario to replace the supply from the Paradyskloof WTP for these areas is calculated at 1 106 Ml/a (AADD of 3,03 Ml/d).

The potential future resources required for the Stellenbosch town system is calculated at 15 706 Ml/a in the latest Water Master Plan. This results in 5 482 Ml/a of additional water resources that is required in order to supply the potential future water demand for the Stellenbosch system.

For the Stellenbosch town system the following projects were identified to augment the existing available water resources in order to supply the future demand:

- Short term borehole projects (see paragraph 5.2.5 further on in the report).
- Longer term borehole projects (see paragraph 5.2.5 further on in the report).
- Transfer of irrigation water allocations (SM is currently in negotiation with the Winelands WUA).
- CCT Blackheath allocation (see Water Master Plan).
- Wastewater reclamation (a more detailed study will be required to determine feasibility and capacity of this augmentation scheme).
- Increase Paradyskloof allocation from DWS (this will be dependent on the capacity of a potential wastewater reclamation plant).
- Jonkershoek augmentation (detailed study will be required to investigate the potential to increase the capacity of the existing Idas Valley storage dams).

These proposed projects are discussed in more detail in chapter 5, (i.e. “Bulk Water Augmentation Projects”) further on in the report.

2.5.4 Dwars River system

The Dwars River system is currently supplied with purified water from the CCT Wemmershoek scheme. SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

The Dwars River system also has a water license from the DWS to abstract water from the Pniel spring, stream and boreholes with a volume of 156 946 Ml/a.

Water from the CCT Wemmershoek source is however dependent on surface water. For the drought scenario the following assumptions were made regarding the available water resources and potential demand for the Dwars River system:

- No water available from the CCT Wemmershoek line (for a scenario where the Wemmershoek dam is empty)
- Existing ground water sources cannot currently be incorporated in the existing potable water system.
- Water from the existing Pniel spring and stream cannot currently be incorporated in the existing potable water system.
- Water demand during drought conditions for the Dwars River system can be reduced by 45% on the 2014/15 baseline demand to a water demand of 469 Ml/a (AADD of 1 285 kl/d).

Based on the assumptions above the existing Dwars River system has no reliable water resources for a drought scenario and additional water resources of 469 Ml/a (AADD of 1,29 Ml/d) is required for the area for a drought scenario.

The potential future resources required for the Dwars River system is calculated at 2 140 Ml/a in the latest Water Master Plan. The potential future Dwars River system will mainly be supplied with purified water from the CCT, and the existing CCT water allocation to SM should therefore be increased in order to supply the potential future water demand for the Dwars River system.

For the Dwars River system the following additional projects were identified to augment the existing water resources:

- Short term borehole projects (see paragraph 5.2.6 further on in the report)
- Longer term borehole projects (see paragraph 5.2.6 further on in the report)
- Development of Pniel water registrations (incorporate available water from the Pniel spring and Pniel stream into the existing water system).
- Banhoek horizontal drilling source (option to supply water from the Banhoek horizontal drilling site during the winter months to the Kylemore Upper reservoir should be investigated).
- Wastewater reclamation (a more detailed study will be required to determine feasibility and capacity of this augmentation scheme)
- Water allocation from the WCWSS (option to supply water from the Theewaterskloof tunnel to the Kylemore Upper reservoir should be investigated)

These proposed projects are discussed in more detail in chapter 5, (i.e. "Bulk Water Augmentation Projects") further on in the report.

2.5.5 Franschhoek system

The eastern part of Franschhoek is supplied with water from its own source in the adjacent mountains and the western part of Franschhoek, La Motte and Wemmershoek are supplied with purified water from the CCT Wemmershoek scheme. SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

The SM has water licences from DWS to abstract raw water from its own source in the adjacent mountains, the so-called "Perdekloof source" of 901 Ml/a (2,47 Ml/d).

Water from both sources is however dependent on surface water. For the drought scenario the following assumptions were made regarding the available water resources and potential demand for the Franschhoek system:

- No water available from the CCT Wemmershoek line (for a scenario where the Wemmershoek dam is empty)
- Limited water will be available from the Perdekloof source (water supply from this source has not run dry during the current drought, but the SM has no storage capacity available to store excess water during winter months). For a drought scenario it was assumed that all the urban areas in the eastern part of the Franschhoek system to the east of Akademie Street can be supplied with water from the Perdekloof source.
- The water resources required to supply these areas is calculated at 155 Ml/a, or 17,5 % of the yield of the Perdekloof source.
- Water demand during drought conditions for the Franschhoek system can be reduced by 45% on the 2014/15 baseline demand to a water demand of 820 Ml/a (AADD of 2 247 kl/d).

Based on the assumptions above the existing Franschhoek system has very little reliable water resources for a drought scenario and additional water resources of 665 Ml/a (AADD of 1 822 kl/d) is required for the Franschhoek system for a drought scenario.

The potential future resources required for the Franschhoek system is calculated at 2 983 Ml/a in the latest Water Master Plan. The potential future Franschhoek system will mainly be supplied with purified water from the CCT and from groundwater resources next to Wemmershoek.

For the Franschhoek system the following projects were identified to augment the existing available water resources in order to supply the future demand:

- Short term borehole projects (see paragraph 5.2.7 further on in the report)
- Franschhoek Pass horizontal drilling (option to supply water through horizontal drilling from the Franschhoek Pass to the Fransche Hoek Estate Lower reservoir should be investigated).
- Franschhoek reservoir incline drilling (option to supply water through incline drilling at the existing Franschhoek reservoir site to the Franschhoek reservoir should be investigated).
- Development of Groendal water registrations (option to incorporate available water from the existing Groendal water source in the existing water system should be investigated).
- Longer term borehole projects (see paragraph 5.2.7 further on in the report)
- Wastewater reclamation (a more detailed study will be required to determine the feasibility and capacity of this augmentation scheme)
- Increase CCT allocation (dependent on the capacity of a potential wastewater reclamation plant and the capacity of the future groundwater resources).

These proposed projects are discussed in more detail in chapter 5, (i.e. "Bulk Water Augmentation Projects") further on in the report.

2.5.6 Klapmuts

The Klapmuts system is supplied with purified water from the CCT Wemmershoek scheme. SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

Water from the CCT Wemmershoek pipeline is however dependent on surface water. For the drought scenario the following assumptions were made regarding the available water resources and potential demand for the Klapmuts system:

- No water available from the CCT Wemmershoek line (for a scenario where the Wemmershoek dam is empty)
- Water demand during drought conditions for the Klapmuts system can be reduced by 45% on the 2014/15 baseline demand to a water demand of 305 Ml/a (AADD of 0,84 Ml/d).

Based on the assumptions above the existing Klapmuts system has no reliable water resources for a drought scenario and additional water resources of 305 Ml/a (AADD of 0,84 Ml/d) is required for the Klapmuts system for a drought scenario.

The potential future resources required for the Klapmuts system is calculated at 2 830 Ml/a in the latest Water Master Plan. The potential future Klapmuts system will mainly be supplied with purified water from the CCT, and the existing CCT water allocation to SM should therefore be increased in order to supply the potential future water demand for the Klapmuts system.

For the Klapmuts system the following additional projects were identified to augment the existing water resources:

- Short term borehole projects (see paragraph 5.2.8 further on in the report)
- Longer term borehole projects (see paragraph 5.2.8 further on in the report)
- Wastewater reclamation (a more detailed study will be required to determine the feasibility and capacity of this augmentation scheme)

These proposed projects are discussed in more detail in chapter 5, (i.e. "Bulk Water Augmentation Projects") further on in the report.

2.5.7 Rural supply systems

The following rural supply systems are operated in SM to supply purified water to rural consumers within the boundary of SM:

- Faure system
- Raithby system
- Polkadraai system
- Koelenhof system
- Muldersvlei system
- Meerlust, Croydon & Helderberg systems

SM has a current allocation from CCT to abstract water of 6 848 Ml/a. Water abstracted from CCT is used to supply water to the Dwars River system, a large portion of the Franschhoek system, the Klapmuts system and the rural supply systems.

The Faure and Raithby systems are supplied with purified water from the Faure WTP, the Polkadraai system is supplied with purified water from the Blackheath WTP and the Koelenhof and Muldersvlei rural water systems are supplied with purified water from the Wemmershoek scheme.

The Meerlust, Helderberg and Croydon systems supplies water to the urban users in these areas and purchases water in bulk from the CCT. The Meerlust area is supplied with bulk water from the Wemmershoek scheme and the Helderberg and Croydon areas with bulk water from the Steenbras dam through the CCT's reticulation network.

All these areas are however dependent on surface water. For the drought scenario the following assumptions were made regarding the available water resources and potential demand for the various supply systems:

- No water available from the CCT Wemmershoek line (for a scenario where the Wemmershoek dam is empty)
- The Muldersvlei system will be supplied from the CCT Bloekombos reservoir during a drought scenario.
- The Faure and Raithby systems will be supplied from the CCT Faure reservoir during a drought scenario.
- The Polkadraai system will be supplied from the CCT Blackheath reservoir during a drought scenario.
- Water demand during drought conditions for the rural systems can be reduced to 1 139 Ml/a (AADD of 3,12 Ml/d), with a water demand for each sub-system as follows:

o	Faure/Raithby	:	396 Ml/a (AADD = 1,09 Ml/d)
o	Polkadraai	:	229 Ml/a (AADD = 0,63 Ml/d)
o	Koelenhof	:	413 Ml/a (AADD = 1,13 Ml/d)
o	Muldersvlei	:	82 Ml/a (AADD = 0,23 Ml/d)
o	Meerlust	:	9 Ml/a (AADD = 0,03 Ml/d)
o	Croydon & Helderberg	:	8 Ml/a (AADD = 0,02 Ml/d)
		:	1 139 Ml/a (AADD = 3,12 Ml/d)

Based on the assumptions above provision should be made for additional water resources during a drought scenario of 9 Ml/a (AADD of 0,03 Ml/d) for the Meerlust system and 413 Ml/a (AADD of 1,13 Ml/d) for the Koelenhof system.

The water demand of the other systems (Raithby, Faure, Polkadraai, Muldersvlei, Croydon and Helderberg can be reduced to 717 Ml/a (AADD of 1,96 Ml/d) and can be supplied from the CCT.

The potential future resources required for the rural systems is calculated at 3 795 Ml/a in the latest Water Master Plan. These rural supply systems will mainly be supplied with purified water from the CCT, and the existing CCT water allocation to SM should therefore be increased in order to supply the potential future water demand for the rural supply systems.

The potential water demand for each sub-system is as follows:

- o Faure system : 988 Ml/a (AADD of 2,71 Ml/d)
- o Raithby system : 162 Ml/a (AADD of 0,44 Ml/d)
- o Polkadraai system : 930 Ml/a (AADD of 2,55 Ml/d)
- o Koelenhof system : 1 603 Ml/a (AADD of 4,39 Ml/d)
- o Muldersvlei system : 92 Ml/a (AADD of 0,25 Ml/d)
- o Meerlust system : 9 Ml/a (AADD of 0,02 Ml/d)
- o Croydon & Helderberg : 11 Ml/a (AADD of 0,03 Ml/d)

For the rural systems the following additional projects were identified to augment the existing water resources:

- Meerlust borehole project
- Koelenhof reservoir borehole project
- Mariendahl borehole project

These proposed projects are discussed in more detail in paragraph 5.2.9 further on in the report.

2.5.8 Summary of water resources required for a drought scenario

For a severe drought condition the only reliable surface water will be from SM's own sources in the Jonkershoek Valley for Stellenbosch and from the Perdekloof source for Franschhoek. It was assumed that no water will be available from CCT from the Wemmershoek pipeline to supply water to the Franschhoek, Dwars River, Meerlust, Klapmuts and Koelenhof systems. It was further assumed that sufficient water will however be available from CCT to supply the Muldersvlei, Polkadraai, Faure, Raithby, Helderberg and Croydon rural systems.

The available water resources during a severe drought for SM can be summarised as follows:

- Stellenbosch town system : 6 600 Ml/a
- Dwars River system : None
- Franschhoek system : 155 Ml/a
- Klapmuts system : None
- Koelenhof system : None
- Meerlust system : None
- Other rural systems : Supplied with water from CCT

The total additional resources required for SM from groundwater sources (or the reclamation of wastewater) in order to supply basic water during drought conditions to the existing SM consumers can be summarised as follows:

- Stellenbosch town system : 1 106 Ml/a (required to replace a portion of the supply from the Paradyskloof WTP)
- Dwars River system : 469 Ml/a
- Franschhoek system : 665 Ml/a
- Klapmuts system : 305 Ml/a
- Koelenhof system : 413 Ml/a
- Meerlust system : 9 Ml/a

Figure SW2.7 gives a summary of the current water demand for SM, the safe yield of the existing water resources available during severe drought conditions, and the additional resources required to supply basic water during a severe drought scenario.

2.5.9 Summary of water resources required for future demand

The total additional resources required for SM in order to supply the potential future water demand as calculated in the latest Water Master Plan can be summarised as follows:

Stellenbosch system:

	Future resources required	=	15 706 Ml/a
-	Existing resources	=	- <u>10 224 Ml/a</u>
=	Required resources	=	5 482 Ml/a

Other systems:

	Total of future resources required	=	11 747 Ml/a
-	Franschhoek own resources	=	- 901 Ml/a
-	Existing CCT allocation	=	- <u>6 848 Ml/a</u>
=	Required resources	=	3 998 Ml/a

The proposed projects in order to augment the existing SM water resources in order to supply the potential future water demand for the SM systems are discussed in more detail in chapter 5, (i.e. “Bulk Water Augmentation Projects”) further on in the report.

Figure SW5.4 gives a summary of the future water demand for SM, the safe yield of the existing water resources available, and the additional resources required to supply the future water demand for SM.

Table SW2.1: Stellenbosch Municipality existing water resources1

Table SW2.2: Stellenbosch Municipality bulk water savings2

Table SW2.3: Present and future water demand summary 3

Figure SW2.1: Existing bulk water resources2

Figure SW2.2: Water demand per source for 2016/17 financial year 3

Figure SW2.3: Annual water demand per source4

Figure SW2.4: Monthly bulk water consumption and savings5

Figure SW2.5: Idas Valley and Paradyskloof water production6

Figure SW2.6: Stellenbosch Municipality required bulk water resources[7]

Figure SW2.7: Bulk water resources required for a severe drought scenario8

3. BULK WATER MONITORING

3.1 BULK WATER METERS

3.1.1 Background

Bulk water meters are a crucial part of the bulk water system to accurately determine water demand and losses in the system. For SM bulk water meters should be maintained (and implemented where required) to accurately calculate the following:

- Raw water supply and losses
- Water treatment losses and efficiency
- System input volume (to perform accurate water balances)
- Losses in potable bulk water supply system
- Metering of sub-zones downstream of the supply reservoirs

Table SW3.1 below shows the different levels of bulk meters that is used in SM to perform the larger water balance of the bulk water system:

Table SW3.1: Bulk water meter definitions for SM

Bulk meter level	Description
Level 1	Demand from raw water sources
Level 2	Inlet at water treatment plants
Level 3	Outlet at water treatment plants
Level 4	Supply to network from other sources
Level 5	Meters on the bulk supply system between the reservoirs and the water source
Level 6	Outlet from reservoirs
Level 7	Sub-zonal meters
Level 8	Consumer meters

These bulk meters are used to calculate the following water losses and efficiencies in the existing water system:

- Raw water supply losses : Level 1 meters – level 2 meters
- Water treatment losses & efficiency : Level 2 meters – level 3 meters
- System input volume : Level 3 meters + level 4 meters
- Losses in the bulk supply system : (Level 3 & 4 meters) – level 6 meters; (or level 5 meters)
- Water losses in reticulation network : (Level 6 & 7 meters) – volume sold to consumers within reservoir or sub-zones (level 8 meters)

In SM bulk water meter projects were identified to improve the integrity of the existing water balances, as follows:

- **Phase 1**: System input volume (project to measure the system input volume of each system within SM. This includes the metering of all water downstream of the existing water treatment plants (level 3 meters) and treated water purchased from external sources (level 4 meters)).
- **Phase 2**: Water treatment losses and efficiency (project to measure the losses and efficiency of the existing WTPs in SM. This includes the metering of all water downstream of the existing water treatment plants (level 3 meters, implemented in phase 1) and the metering of all water at the inlet of the existing water treatment plants (level 2 meters)).

- **Phase 3**: Losses in bulk water supply system (project to measure the losses in the bulk water system between the treatment plant or connection point to external sources of treated water (level 3 & 4 meters, implemented in phase 1) and the water supplied from the outlet of the reservoirs (level 6 meters). Level 5 meters can also be used to determine water losses on certain sections of the larger bulk water supply network.
- **Phase 4**: Losses in raw water system (project to measure the water losses in the raw water system downstream of the raw water source (level 1 meters) and the inlet to the water treatment plants (level 2 meters, implemented under phase 2)).
- **Phase 5**: Water reticulation losses in reservoir and sub-zones (project to measure the water losses in the reticulation systems downstream of the reservoirs (level 6 meters, implemented under phase 3) and within sub-zones (level 7 meters, i.e. booster zones, pressure-reducing zones or any other sub-zones)).

Figure SM3.1 shows the positions of the existing and proposed level 2, 3 & 4 meters in SM, required to measure system input volume and the efficiency of the existing water treatment works. The proposed positions of the level 1 meters to measure the volume of water extracted from the raw water sources is also shown on Figure SM3.1.

3.1.2 Raw water supply losses

In SM raw water supply losses are not currently metered and form part of phase 4 of the larger “SM bulk water meter project”. In SM raw water losses can be determined in the Stellenbosch and Franschhoek systems on the following raw water lines:

1) Jonkershoek raw water pipelines between the Eerste River weir and the Idas Valley WTP and dams.
2) Paradyskloof raw water pipeline between the outlet of the Theewaterskloof Tunnel and the Paradyskloof WTP.
3) Perdekloof raw water pipeline between the Perdekloof water sources and the filters (located at the Franschhe Hoek Estate lower reservoir) and the Franschhoek raw water dam (between Reservoir East and Van Riebeeck Streets).

The positions of the existing and proposed level 1 and 2 meters to calculate raw water losses for the Stellenbosch and Franschhoek systems are shown on Figures SW3.2a - c and SW3.3a - d.

Table SW3.3 shows the relevant inflow and outflow meters in order to calculate the raw water losses for each raw water metering pipe system.

3.1.3 Water treatment losses and efficiency

In SM water losses and efficiency of the water treatment plants can be determined through the implementation of level 2 and 3 meters. These meters are implemented under phases 1 and 2 of the larger “SM bulk water meter project”. In the Stellenbosch and Franschhoek systems water losses and efficiency can be determined at the following water treatment plants:

1) Idas Valley WTP
2) Paradyskloof WTP
3) Jonkershoek WTP (potential future package plant)
4) Franschhoek filters

The positions of the level 2 and 3 meters to calculate water losses and efficiency of the existing (and potential future) water treatment plants are shown on Figures SW3.3a, SW3.3b, SW3.3c & SW3.3d.

Table SW3.3 shows the relevant inflow and outflow meters for each water treatment plant in order to calculate water losses and efficiency.

3.1.4 System input volume

The system input volume is the total volume of potable water supplied by the municipality. For SM this is the total of water after the treatment works plus treated water purchased from the CCT and are determined through the level 3 & 4 meters. These meters are implemented and maintained under phase 1 of the larger "SM bulk water meter project".

For SM system input volume is measured for the following systems:

1)	Stellenbosch system	:	Meters S3.1 - S3.5, S4.1 - S4.3 & F5.3
2)	Dwars River system	:	Meter D4.1
3)	Franschhoek system	:	Meters FH2.1 & FH4.1
4)	Klapmuts system	:	Meter K4.1
5)	Rural supply systems		
5.1)	Koelenhof system	:	Meter KH4.1
5.2)	Muldersvlei system	:	Meter MV4.1
5.3)	Polkadraai system	:	Meters P4.1, F5.1 & F5.2
5.4)	Faure system	:	(Meter F4.1) - (meters F5.1, F5.2 & F5.3)
5.5)	Raithby system	:	Meters R4.1 & R4.2
5.6)	Meerlust system	:	Meter M4.1 & M4.2
5.7)	Helderberg & Croydon	:	Meters H4.1 & C4.1

The existing positions of the level 3 and 4 meters to calculate system input volume of the existing water supply systems in SM are shown on Figure SW3.1.

3.1.5 Losses in bulk supply system

In SM losses in the bulk supply systems downstream of the treatment plants or connection points to the CCT supply are not currently metered and form part of phase 3 of the larger "SM bulk water meter project". Losses in the bulk supply system include any water losses on the infrastructure between the level 3 & 4 meters (system input volume) and the water meters downstream of the reservoirs (supply into the reticulation network). This include water losses in reservoirs.

In the SM systems losses can be determined on the following bulk supply infrastructure:

1) Bulk supply infrastructure from the Idas Valley and Paradyskloof water treatment plants, supplying bulk water to all the reservoirs in the Stellenbosch town system.
2) Bulk supply infrastructure in the Dwars River system after the bulk connection point to the CCT Wemmershoek pipeline, supplying bulk water to the reservoirs in the Dwars River system.
3) Bulk supply infrastructure in the Franschhoek system after the bulk connection point to the CCT Wemmershoek pipeline, supplying bulk water to the Groendal, Langrug and Franschhoek reservoirs in the Franschhoek system.
4) Bulk supply infrastructure in Klapmuts after the bulk connection point to the CCT Wemmershoek pipeline, supplying bulk water to the 7.0 Ml reservoir in the Klapmuts system.
5) Bulk supply infrastructure in the Polkadraai system, after the bulk connection point to the CCT Blackheath pipeline, supplying bulk water to the SM Blackheath reservoirs.

The proposed positions of the level 3, 4, 5 and 6 meters to calculate water losses in the bulk supply infrastructure for the SM systems are shown on the following figures:

- Stellenbosch system : Figures SW3.3a - d & SW3.4a - m
- Dwars River system : Figures to be prepared
- Franschhoek system : Figures to be prepared
- Klapmuts system : Figures to be prepared
- Polkadraai system : Figures to be prepared
- Koelenhof system : Figures to be prepared

Table SW3.3 shows the relevant inflow and outflow meters in order to calculate the water losses for each main and secondary bulk supply systems.

In the combined SM water network there is currently 74 existing water distribution zones (reservoir, booster or PRV zones), as shown on Table SW3.4.

3.1.6 Reticulation and sub-zonal meters

In SM limited bulk water meters are available to determine water losses in the reticulation system of the reservoir supply areas or any smaller sub-zones, i.e. booster zones, pressure-reducing zones or any other sub-zones. It is proposed that these level 6 and 7 meters are implemented under phases 3 & 5 of the larger "SM bulk water meter project".

The positions of the level 6 and 7 meters to calculate water losses in the existing reticulation systems downstream of the reservoirs are shown on Figures SW3.1 to SW3.3.

The relevant inflow and outflow meters for each reservoir supply zone or any smaller sub-zone in order to calculate water losses in the SM reticulation network are shown on Table SW3.3.

3.2 LIVE TELEMETRY DATA

3.2.1 Background

As part of phases 1 and 2 of the "SM bulk water meter project" all level 2, 3 & 4 water meters in SM were equipped with monitoring devices in order to access data remotely. All information from these bulk meters are currently available in real time and can be access on the MyCity website.

In a separate project, live data from other existing service providers such as Zednet (flow and pressure data of existing PRV's and critical pressure points in the SM network) and SSE (reservoir and dam level data) were accessed and linked to the existing Infrastructure Management Query Station (IMQS) system for SM.

This gives the municipality the ability to access all relevant telemetry and SCADA data in real time on one platform.

As part of the current drought project new boreholes and bulk meters are currently being installed for SM and it is proposed that monitoring and flow data from the boreholes are in future included in the existing live telemetry system of SM.

3.2.2 Water dashboard

Live data from the level 3 & 4 bulk water meters (system input volume) and live data of the SM dam levels are used on a weekly basis to report on water demand, water storage capacity and water savings in SM.

Data presented in the weekly water dashboard for SM such as weekly water demand per system, current status of water savings, dam levels and water production per treatment plant are shown on Figures SW3.1a, SW3.1b and SW3.1c below.

Figure SW3.5a: SM Water dashboard - Demand, savings and dam levels

SM AADD	% Savings	Dam storage	Water dam level change (%)
(weekly average)	(on 2014/15 baseline demand)	(Stellenbosch town)	
19.95 ML/d	**51.6%**	**94.4%**	**0.0%**
(Target = 22.43 ML/d)	(Target = 45,0 %)	(166 days x current AADD)	Increase since last week

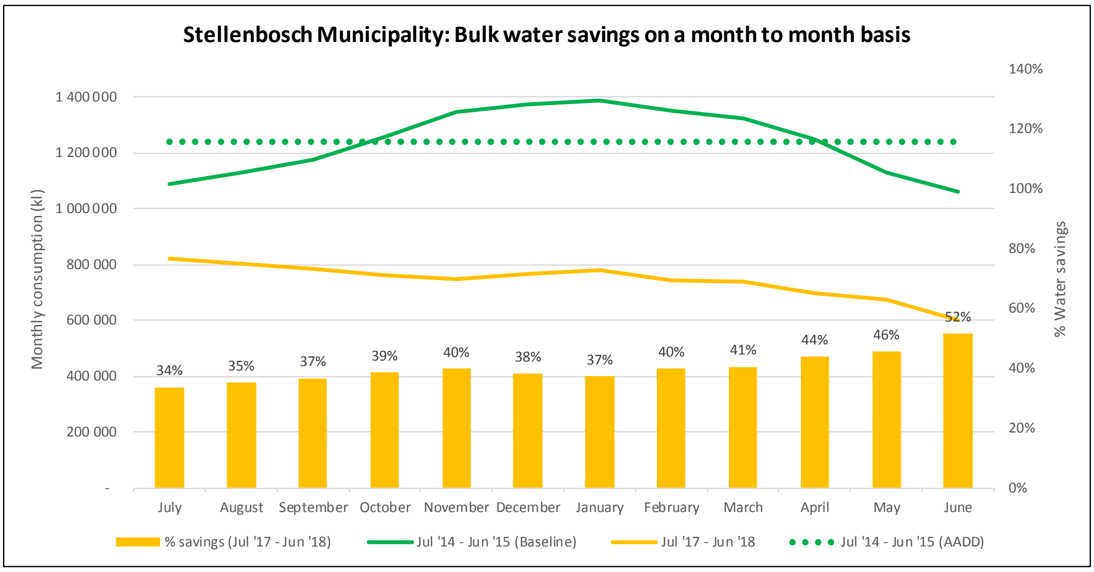


Figure SW3.5b: SM Water dashboard - Water production per plant

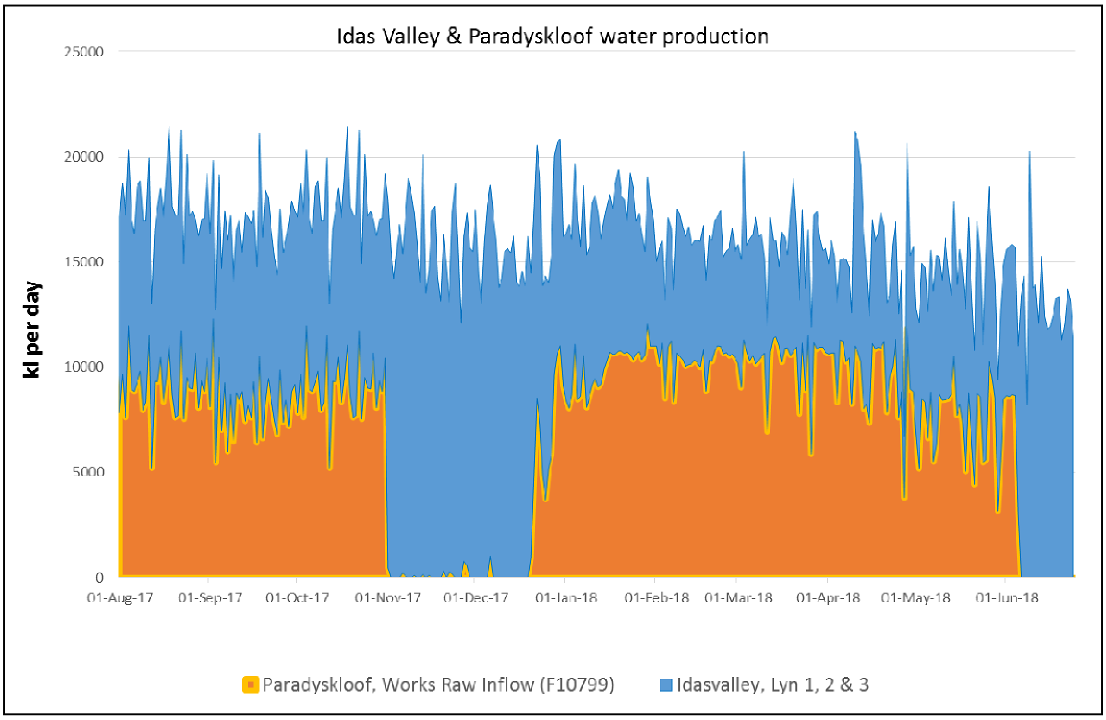
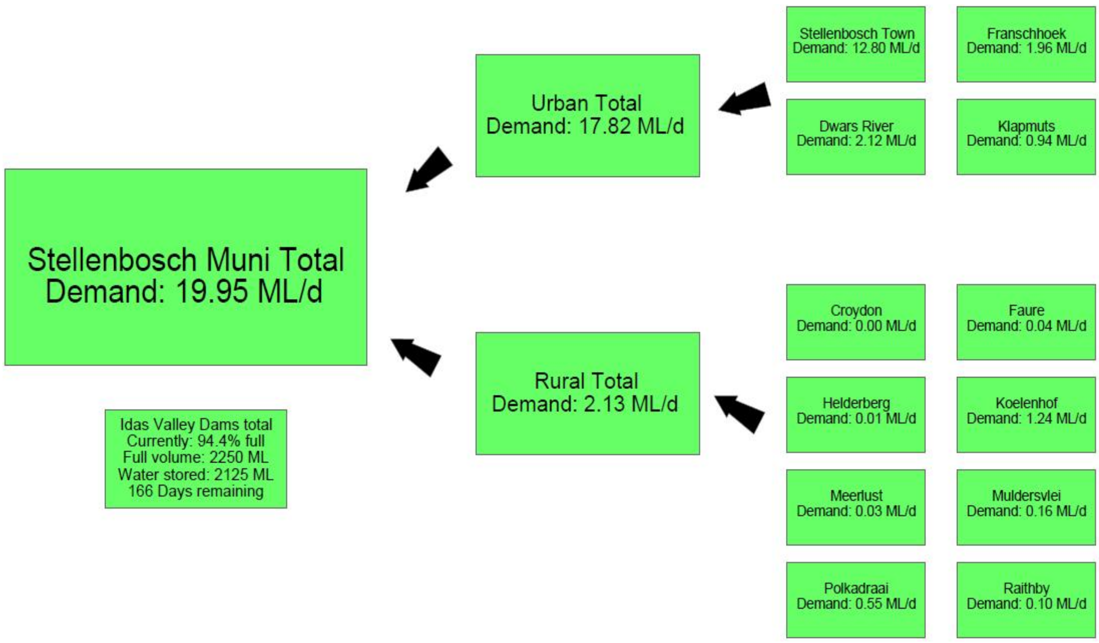


Figure SW3.5c: SM Water dashboard - Water demand per system



3.2.3 IMQS

Live telemetry data of MyCity, Zednet and SSE is currently available on IMQS. The following information can be accessed in real time on IMQS:

- MyCity data:
  - bulk water meter readings for all level 2, 3 & 4 water meters
  - water levels for the Idas Valley 1 and 2 dams
- Zednet data:
  - bulk water meter readings at PRV's
  - pressure readings before and after PRV's
  - water pressure readings at critical points in the network
- SSE data:
  - water levels of the existing reservoirs in SM
  - water levels for the Idas Valley 1 and 2 dams

It is proposed that the ground water resources that is currently being developed for SM is monitored through the GEOTELL system and that data from the system is added in future to the live telemetry system on IMQS.

3.2.4 Schematic layouts

Live data from the telemetry system is also used to populate the existing schematic layouts of the SM water systems. The following schematic system layouts are available for SM:

- Stellenbosch system : See Figure SW3.6a
- Dwars River system : See Figure SW3.6b
- Franschhoek system : See Figure SW3.6c
- Klapmuts system : See Figure SW3.6d

The different main and sub water distribution zones in the SM water network are included in Table SW3.4.

Table SW3.1: Bulk water meter definitions for SM4

Table SW3.2: List of bulk water meters for SM5

Table SW3.3: Water metering zones and calculation of water losses for SM6

Table SW3.4: Existing water distribution zones7

Figure SW3.1: Bulk water zones & meters : Stellenbosch Municipality9

Figure SW3.2a: Bulk water meters : Kleinplasie dam10

Figure SW3.2b: Bulk water meters : Theewaterskloof tunnel outlet11

Figure SW3.2c: Bulk water meters : Perdekloof source12

Figure SW3.3a: Bulk water meters : Idas Valley WTP13

Figure SW3.3b: **Bulk water meters : Paradyskloof WTP14**

Figure SW3.3c: **Bulk water meters : Jonkershoek reservoir15**

Figure SW3.3d: **Bulk water meters : Franschhoek Filters16**

Figure SW3.4a: Bulk water meters : Rozendal reservoir17

Figure SW3.4b: Bulk water meters : Arbeidslus reservoir18

Figure SW3.4c: Bulk water meters : Uniepark reservoirs19

Figure SW3.4d: Bulk water meters : Idas Valley 1 reservoir20

Figure SW3.4e: Bulk water meters : Papegaaiberg reservoir21

Figure SW3.4g: **Bulk water meters : Cloetesville reservoir22**

Figure SW3.4h: Bulk water meters : Kleinvallei reservoir23

Figure SW3.4i: **Bulk water meters : Kayamandi reservoir24**

Figure SW3.4j: Bulk water meters : Brandwacht reservoir25

Figure SW3.4k: Bulk water meters : Welgelegen reservoir26

Figure SW3.4l: Bulk water meters : Paradyskloof 1 reservoir27

Figure SW3.4m: Bulk water meters : Jamestown reservoir28

Figure SW3.5: Water dashboard29

Figure SW3.6a: Schematic layout : Stellenbosch town current system30

Figure SW3.6b: Schematic layout : Dwars River current system 31

Figure SW3.6c: Schematic layout : Franschhoek current system 32

Figure SW3.6d: **Schematic layout : Klapmuts current system 33**

4. PRESSURE MANAGEMENT PROJECTS

4.1 EXISTING PRESSURE REDUCING ZONES

4.1.1 Introduction

As part of the Water Demand Management strategy of SM existing pressure reducing zones should be optimised in order to reduce water pressure, with the aim of reducing water demand and water losses in the reticulation network.

Each of the existing pressure reducing valve (PRV) zones in SM should be optimised and monitored through the following actions:

- Verify that each pressure zone is discreet.
- Ensure that a bulk water meter is installed at the PRV installation (if relevant).
- Set PRV and monitor PRV (and if relevant critical point in network).

In the SM water systems there are currently 22 existing PRV zones, supplied with water from 24 PRVs. In the SM system there are also 5 PRVs that are currently not in operation (and can be decommissioned), 6 PRVs that are only used under emergency conditions, 4 PRVs that augment water supply to existing reservoir zones and 1 PRV on the existing Perdekloof raw water system in Franschhoek.

Table SW4.1 shows a list of the existing PRVs (total of 40), the status and setting for each PRV and if the PRV is equipped with a water meter as part of the installation.

4.1.2 Stellenbosch town system

In the Stellenbosch town system there are currently 14 existing PRV zones, i.e:

- Arbeidslus PRV
- Brandwacht PRV
- De Zalze PRV
- Jamestown PRV
- Kayamandi PRV 1
- Kayamandi PRV 2
- Kayamandi PRV 3
- Kayamandi PRV 4 (supplied from Kayamandi PRVs 4.1 & 4.2)
- Kayamandi PRV 5
- Kleinvallei PRV 1
- Kleinvallei PRV 2
- Paradyskloof 2 PRV 1
- Paradyskloof 2 PRV 2
- Welgelegen PRV

The Arbeidslus 2, Old Kayamandi 1, Kayamandi 4.3 and La Coline PRVs are currently not operational and can be decommissioned.

The Cloetesville PRV supplies water from the 400 mm diameter bulk pipeline between the Uniepark reservoirs and the Cloetesville reservoir into the Cloetesville reservoir zone.

The Papegaaiberg PRVs 1 & 2 supplies water from the 450 mm diameter bulk pipeline between the Paradyskloof 1 reservoir and the Papegaaiberg reservoir into the Papegaaiberg reservoir zone.

Under emergency conditions the Idas Valley PRV can supply water to the Idas Valley 1 reservoir zone from the Central distribution zone, and water can be supplied to the

Welgelegen reservoir directly from the Paradyskloof 2 reservoir through a PRV situated at the Paradyskloof 1 reservoir site.

The existing PRV zones in Stellenbosch are shown on Figure SW4.1a.

4.1.3 Dwars River system

In the Dwars River system there is currently only 1 PRV zone, i.e the Lanquedoc zone. The existing Lanquedoc PRV zone in the Dwars River system is shown on Figure SW4.1b.

4.1.4 Franschhoek system

In the Franschhoek system there are currently 3 existing PRV zones, i.e:

- Fransche Hoek Estate Lower PRV
- Lermitage PRV
- Onder-Dorp zone (supplied from Onder-Dorp PRVs 1 & 2)

In the private water network of the Fransche Hoek Estate water can be augmented from the Fransche Hoek Estate Upper reservoir zone through the Country Estate PRV 2 to the Fransche Hoek Estate Lower reservoir zone.

On the Perdekloof raw water pipeline a PRV is located after the take-off to the Franschhoek filters.

In the Franschhoek system water is supplied from the Fransche Hoek Estate Lower reservoir zone to the Bo-Dorp zone through the Bo-Dorp PRV.

Under emergency conditions water can be supplied from the Langrug reservoir zone to the Groendal reservoir zone through the Langrug PRV.

The existing PRV zones in the Franschhoek system are shown on Figure SW4.1c.

4.1.5 Klapmuts system

There is currently no PRV zones in the Klapmuts system. The old Klapmuts PRV (located at the old Klapmuts reservoir site) is not operational and can be decommissioned. The layout of the existing Klapmuts system is shown on Figure SW4.1d.

4.1.6 Rural systems

There is 1 PRV zone in the Koelenhof system and 3 PRV zones in the Polkadraai system. There are no PRV zones in the Muldersvlei, Meerlust, Helderberg, Croydon and Raithby systems. The PRV zones in the rural systems are:

- Sonop PRV zone (in the Koelenhof system)
- Skoonheid PRV 1 zone (supplied from the Polkadraai PRV 1)
- Skoonheid PRV 2 zone (supplied from the Polkadraai PRVs 2 & 3)
- Skoonheid PRV 3 zone (supplied from the Polkadraai PRV 4)

During emergency conditions water can be supplied from the Jamestown reservoir (in the Stellenbosch system) through an existing PRV situated at the De Zalze PS to the Faure network.

The existing PRV zones in the Polkadraai and Koelenhof systems are shown on Figures SW4.1f & SW4.1g.

The layout of the Raithby, Faure, Muldersvlei, Meerlust, Helderberg and Croydon systems are shown on Figures SW4.1b, SW4.1e & SW4.1g.

4.2 POTENTIAL PRESSURE MANAGEMENT PROJECTS

4.2.1 Introduction

As part of the Water Master Plan and the Drought Intervention Planning for SM projects to optimise existing PRV zones and projects to implement additional PRV zones in SM are identified.

Through the implementation of these projects SM will be able to further reduce water pressure in their networks in order to reduce water demand and water losses in the reticulation network.

4.2.2 Stellenbosch town system

In the Stellenbosch town system the following pressure management projects are proposed:

1) Kayamandi PRV project: Phase 1
   - Ensure discreteness of existing PRV zones in Kayamandi
   - (project completed, see Figure SW4.2a)

2) Kayamandi PRV project: Phase 2
   - Optimise operation of existing PRVs in Kayamandi
   - Include data on live telemetry system
   - (project in progress)

3) Stellenbosch PRV refurbish project
   - Refurbish controllers and critical point loggers at the Kleinvallei PRVs, Welgelegen PRV, Paradyskloof PRV and Brandwacht PRV
   - Include data on live telemetry system
   - (project in progress)

4) Arbeidslus PRV investigation project
   - Log pressure and flow, determine operation of PRV and discreteness of zone
   - Prepare short report on findings
   - (project in progress)

5) Uniepark PRV project
   - Implement new PRV zone
   - Include data on live telemetry system
   - (future project, see Figure SW4.2b)

6) Brandwacht PRV 2 project
   - Implement new PRV zone
   - Include data on live telemetry system
   - (future project, see Figure SW4.2c)

7) Techno Park PRV project
   - Implement new PRV zone
   - Include data on live telemetry system
   - (future project, see Figure SW4.2d)

4.2.3 Dwars River system

In the Dwars River system the following pressure management project is proposed:

8) Pniel PRV project
   - Implement new PRV zone
   - Include data on live telemetry system
   - (future project, see Figure SW4.2e)

4.2.4 Franschhoek system

In the Franschhoek system the following pressure management projects are proposed:

9) Franschhoek PRV investigation project
   - Log pressure and flows of Lientjiesdorp and Franschhoek PRVs, determine operation of PRVs and discreteness of zones
   - Prepare short report on findings
   - (project in progress)

10) Franschhoek new PRV 1 project
   - Implement new PRV zone
   - Include data on live telemetry system
   - (future project, see Figure SW4.2f)

11) Franschhoek new PRV 2 project
   - Implement new PRV zone
   - Include data on live telemetry system
   - (future project, see Figure SW4.2g)

4.2.5 Klapmuts system

In the Klapmuts system the following pressure management project is proposed:

12) Klapmuts PRV project
   - Implement new PRV zone
   - Include data on live telemetry system
   - (future project, see Figure SW4.2h)

4.2.6 Rural systems

In the rural systems the following pressure management projects are proposed:

13) Koelenhof PRV project
   - Verify settings and operation of existing PRVs
   - Install bulk water meters and critical point loggers where required
   - Include data on live telemetry system
   - (future project)

14) Polkadraai PRV project
   - Verify settings and operation of existing PRVs
   - Install bulk water meters and critical point loggers where required
   - Include data on live telemetry system
   - (future project)

Table SW4.1: Existing pressure reducing valves8

Figure SW4.1a: Existing PRV zones : Stellenbosch town system34

Figure SW4.1b: Existing PRV zones : Dwars River system35

Figure SW4.1c: **Existing PRV zones : Franschhoek system36**

Figure SW4.1d: Existing PRV zones : Klapmuts system37

Figure SW4.1e: Existing PRV zones : Faure, Raithby, Helderberg and Croydon systems38

Figure SW4.1f: Existing PRV zones : Polkadraai system39

Figure SW4.1g: Existing PRV zones : Koelenhof and Muldersvlei systems40

Figure SW4.2a: Pressure management projects: Kayamandi PRV zones41

Figure SW4.2b: Pressure management projects: Proposed Uniepark PRV zone42

Figure SW4.2c: Pressure management projects: Proposed Brandwacht PRV 2 zone43

Figure SW4.2d: Pressure management projects: Proposed Techno Park PRV zone44

Figure SW4.2e: Pressure management projects: Proposed Pniel PRV zone45

Figure SW4.2f: Pressure management projects: Proposed Franschhoek Bo-Dorp PRV 1 zone46

Figure SW4.2g: Pressure management projects: Proposed Franschhoek Bo-Dorp PRV 2 zone47

Figure SW4.2h: Pressure management projects: Proposed Klapmuts PRV zone48

5. BULK WATER AUGMENTATION PROJECTS

5.1 INTRODUCTION

5.1.1 Short term requirements

Currently SM is dependent on surface water to supply the existing SM water demand. Although SM has boreholes as part of their existing available water resources, these boreholes are used mainly for irrigation purposes and cannot currently contribute to the potable water supply systems of the municipality.

The SM's own sources from the Eerste River in Stellenbosch and the Perdekloof source in Franchhoek currently supply only 35% of the total water demand of the municipality. The balance of the municipality's water demand is dependent on water supplied from external sources (e.g. DWS and CCT) and during drought conditions SM has no control over these external sources. This poses a big risk for the municipality to continue to supply a reliable bulk water service to its consumers.

In order to mitigate the current risk of being mostly dependent on surface water and having no control over water supplied from external sources, it is proposed that bulk water resources for SM should be augmented to include more supply from groundwater or the reclamation of water from the existing wastewater treatment plants.

The total additional resources required for SM in order to supply basic water during drought conditions is calculated at 2 967 Ml/a (AADD of 8,13 Ml/d). The required additional resources per supply area is calculated as follows:

- Stellenbosch town system : 1 106 Ml/a (AADD of 3 030 kl/d)
- Dwars River system : 469 Ml/a (AADD of 1 285 kl/d)
- Franschhoek system : 665 Ml/a (AADD of 1 822 kl/d)
- Klapmuts system : 305 Ml/a (AADD = 840 kl/d)
- Rural supply systems : 422 Ml/a (AADD = 1 156 kl/d)

It is proposed that the augmentation of ground water resources should be implemented as the first priority in SM in order to supply water to the existing urban areas for a scenario where reliable water supply is not available from the current surface water resources.

5.1.2 Long term planning

In order to meet the future water demand for SM (as calculated in the Water Master Plan), the existing SM water resources should be augmented. This can be from the following resources (after groundwater and reclamation projects are implemented).

- Increase existing allocations from CCT (this can only be done after CCT has increased the reliability of their existing water resources).
- Increase existing allocation from DWS (from the Theewaterskloof tunnel).
- Rainwater harvesting.

The total resources required for SM in order to supply the potential future water demand (based on the latest Water Master Plan) is calculated at 27 453 Ml/a (AADD of 75,21 Ml/d). The required resources per supply area is as follows:

- Stellenbosch town system : 15 706 Ml/a (AADD = 43,03 Ml/d)
- Dwars River system : 2 140 Ml/a (AADD = 5,86 Ml/d)
- Franschhoek system : 2 983 Ml/a (AADD = 8,17 Ml/d)
- Klapmuts system : 2 830 Ml/a (AADD = 7,75 Ml/d
- Rural supply systems : 3 795 Ml/a (AADD = 10,40 Ml/d)

5.2 DROUGHT MITIGATION PROJECTS

5.2.1 Introduction

In order to mitigate the current risk of being mostly dependent on surface water and having no control over water supplied from external sources the SM has initiate projects to augment bulk water supply from groundwater resources.

The first project was a comprehensive groundwater resource study. GEOSS, specialists in geohydrology and with local knowledge of the groundwater resources in SM, was appointed as sub-consultants to perform a comprehensive groundwater resource study for SM.

5.2.2 Groundwater resource study

As part of the groundwater resource study all existing municipal boreholes were identified and investigated. Boreholes with the highest yield and potential to be included in the existing water systems were identified and water quality and safe yield test were performed. These existing boreholes were included in the data basis of existing water resources.

Through the groundwater resource study areas were identified within the boundary of SM with a high probability to contain groundwater with good quality water and a high yield.

These potential new borehole sites were then filtered based on land ownership and the proximity of the existing water infrastructure. From this exercise 31 potential areas within SM were identified where the potential borehole sites were close to the existing water infrastructure and exploration drilling could commence. In the areas where the potential boreholes were not on municipal land, but still close to the existing water infrastructure, the SM has negotiated with the land owners in order to commence with the exploration drilling.

5.2.3 Yield and quality testing

Where successful exploration boreholes were drilled, yield and quality testing were performed to determine the water quality and the safe yield of the exploration boreholes.

These information were used to determine if each exploration borehole could be used as a production borehole, or if a new production borehole should be drilled (with a higher yield), what the safe yield should be for the borehole, at what depth the borehole pump should be installed and if it is required to treat the water before it can be used as part of the reticulation network.

From these information a borehole scheme could be designed for each area.

5.2.4 Borehole scheme design

For each production borehole a scheme was designed of how the borehole will connect to the existing water system. The following information were provided per borehole scheme:

- Proposed duty points of production boreholes
- Safe yield per borehole
- Proposed pipework to connect borehole to the network or to a mobile water treatment plant (if required)
- Position of mobile water treatment plant (if borehole water requires treatment)
- Proposed duty points of booster PS from mobile water treatment plant to the network (if required)
- Connection point to the water network

From the borehole design scheme information the required electricity demand for the borehole pumps, mobile treatment units and booster pumps were calculated and provided to the SM Electricity Department to perform detail designs.

The required yield from the groundwater resources, existing boreholes and results of yield and quality testing, potential borehole areas, results of the borehole drilling, results of the yield and quality testing and proposed borehole design schemes for each supply system are discussed in the following paragraphs:

5.2.5 Stellenbosch system

Required bulk water resources

The total bulk water resources required for drought conditions is calculated at 5 449 Ml/a (AADD = 14,93 Ml/d). Currently the SM has reliable surface water resources available from the Jonkershoek scheme with a 1:100 safe yield of 14 000 Ml/a. The 1:100 safe yield from the source is however restricted due to the capacity of the raw water pipelines to 6 600 Ml/a, which is more than the calculated volume of 5 449 Ml/a for a severe drought condition.

As part of the drought planning for Stellenbosch town it was decided to develop ground water resources in Stellenbosch to replace the areas that is currently supplied with water directly from the Paradyskloof WTP, i.e. Paradyskloof, Techno Park, Jamestown & De Zalze suburbs and the Brandwacht reservoir & PRV water distribution zones.

The additional water resources required for the Stellenbosch system for a drought scenario to replace the supply from the Paradyskloof WTP for these areas is calculated at 1 106 Ml/a (AADD of 3,03 Ml/d).

Existing boreholes

In the Stellenbosch system there are currently 9 existing boreholes, i.e. Cloetesville, Kayamandi, Van der Stel, Die Braak, Nursery, Jan Marais, Doornbosch, Jamestown 1 & Jamestown 2. Safe yield and quality testing were performed on 5 of these boreholes (Cloetesville, Kayamandi, Van der Stel, Die Braak & Doornbosch). Of these 5 boreholes 3 were identified to form part of the groundwater augmentation project. These boreholes are:

- Cloetesville : Safe yield = 134 Ml/a (367.2 kl/d; 8.5 l/s @ 12 h, 12 h rest)
- Van der Stel : Safe yield = 252 Ml/a (691.2 kl/d; 12 l/s @ 16 h, 8 h rest)
- Die Braak : Safe yield = 134 Ml/a (367.2 kl/d; 8.5 l/s @ 12 h, 12 h rest)

The Jamestown 1, Jamestown 2 & Doornbosch boreholes are currently not in use, whereas the Kayamandi, Nursery and Jan Marais boreholes are currently used for irrigation purposes.

The locations of the existing boreholes are shown on Figures SW2.1 & SW5.1.

Potential borehole areas

From the groundwater resource study the following 7 areas (23 potential sites) were identified for exploration drilling:

- Paradyskloof : 5 potential sites, 3 drilled
- Jonkershoek : 4 potential sites, 1 drilled
- Town centre : 8 potential sites, 5 drilled
- Cloetesville : 2 potential sites, 1 drilled
- Idas Valley dams : 1 potential site, not drilled
- Fire department : 1 potential site, drilled
- Jan Marais : 2 potential sites, 1 drilled

The positions of the proposed exploration sites are shown on Figures SW5.2a to SW5.2g. Of the 23 potential exploration borehole sites 12 new exploration boreholes were drilled. Due to low yields in the Paradyskloof area this area was not further developed. Development of the Idas Valley dams and Jonkershoek areas was postponed to focus on the Town Centre area where results of the first exploration boreholes showed that the area has potential to develop a sustainable high yielding wellfield.

Production, monitoring and abandoned boreholes

From the 12 new exploration boreholes that were drilled in the Stellenbosch system, 4 were developed into production boreholes, one is allocated for use by the Fire Department, but was dry and will be abandoned (or if possible be used as a monitoring borehole), one will be used for irrigation by the Jan Marais Park, one will be used for irrigation of the bowling green at the Bowl Club next to the Van der Stel Sports Ground, 3 will be used as monitoring boreholes, one collapsed and will be abandoned and one was dry and will be abandoned (or if possible be used as a monitoring borehole).

Where exploration boreholes were drilled and the yield tests showed potential for a larger yield than the capacity of the exploration borehole (due to the limited size of the exploration borehole), a new production borehole were constructed next to the exploration borehole. In the Stellenbosch system no additional production boreholes were drilled.

Results of yield and quality testing

For each production borehole a 72 hour yield test was performed to calculate the safe yield for the borehole. During this 72 hour test the impact of the borehole extraction on the surrounding boreholes were monitored in order to ensure that the proposed extraction rates of each borehole is sustainable. From the yield tests performed for the new production boreholes and the results of the yield tests for the existing boreholes, the following safe yields were determined for each borehole supply area:

- Paradyskloof : Not developed
- Jonkershoek : Not developed
- Idas Valley dams : Not developed
- Town centre : 1 464 Ml/a (4 010 kl/d)
- Cloetesville : 134 Ml/a (367 kl/d)

TOTAL : 1 598 Ml/a (4 378 kl/d)

The quality testing of the boreholes in Stellenbosch has shown that some of the groundwater contains high levels of magnesium and iron and should be treated before it can be connected to the existing water system. 3 New mobile water treatment units were proposed for the Stellenbosch system, i.e. the Cloetesville, Van der Stel and Die Braak mobile units.

- Cloetesville WTP : Capacity = 1 300 kl/d (15 l/s)
- Van der Stel WTP : Capacity = 1 300 kl/d (15 l/s)
- Die Braak WTP : Capacity = 1 300 kl/d (15 l/s)

TOTAL : 3 900 kl/d

It is proposed that boreholes in the Town Centre area that are not connected to the Braak or Van der Stel treatment units supply bulk water to the Papegaaiberg reservoir, where water can be treated with chlorine and be incorporated within the existing supply network.

Borehole schemes

Borehole schemes were design to incorporate each of the production boreholes within the existing water network. The following borehole schemes were designed to connect the production boreholes to the existing Stellenbosch network:

Van der Stel scheme	:	See Figure SW5.3a
	:	Boreholes: Van der Stel BH & STB_Centre_ExBH_1
	:	Safe yield of scheme: 568 Ml/a (1 555 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 1,3 Ml/d
	:	Status: Commissioned in April 2018

Die Braak scheme	:	See Figure SW5.3b
	:	Boreholes: Die Braak BH & STB_Centre_ExBH_3
	:	Safe yield of scheme: 370 Ml/a (1 015 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 1,3 Ml/d
	:	Status: Commissioned in May 2018

Cloetesville scheme	:	See Figure SW5.3c
	:	Borehole: Cloetesville BH
	:	Safe yield of scheme: 134 Ml/a (367 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 1,3 Ml/d
	:	Status: To be commissioned in September 2018

The Cloetesville borehole scheme can in future be extended to include the potential exploration borehole STB_Centre_ExBH_5.

Papegaaiberg scheme	:	See Figure SW5.3d
	:	Boreholes: STB_Centre_ExBH_2 & STB_Centre_ExBH_8 (with the capacity to in future include boreholes from the Van der Stel and Die Braak schemes)
	:	Safe yield of scheme = 526 Ml/a (1 440 kl/d)
	:	Treatment plant required: No, only chlorination at the Papegaaiberg reservoir
	:	Status: Not required now

(The capacity of the Papegaaiberg borehole scheme is designed to include the potential exploration boreholes STB_Centre_ExBH_4, 10 & 12 as well as the existing boreholes that are currently part of the Van der Stel and Die Braak schemes).

The existing Doornbosch and Kayamandi boreholes are currently only used for irrigation purposes, but can in future be incorporated within the existing Stellenbosch system:

Doornbosch scheme	:	See Figure SW5.3e
	:	Borehole: Doornbosch BH
	:	Safe yield of scheme: 134 Ml/a (367 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: None, future project
	:	Status: Not required now

Kayamandi scheme	:	See Figure SW5.3f
	:	Borehole: Kayamandi BH
	:	Safe yield of scheme: 158 Ml/a (432 kl/d)
	:	Treatment plant required: No, only chlorination at the Kayamandi reservoir
	:	Status: Not required now

Resource summary

The additional water resources required for the Stellenbosch system for a drought scenario to replace the areas that is currently supplied with water directly from the Paradyskloof WTP (i.e. Paradyskloof, Techno Park, Jamestown & De Zalze suburbs and the Brandwacht reservoir & PRV water distribution zones), is calculated at 1 106 Ml/a (AADD of 3,03 Ml/d).

The total available ground water resources available to the Stellenbosch system after the Van der Stel, Die Braak and Cloetesville borehole schemes are implemented is as follows:

- Van der Stel BH scheme : 473 Ml/a (1 296 kl/d)
  (limited to the capacity of the plant)
- Die Braak BH scheme : 370 Ml/a (1 015 kl/d)
- Cloetesville BH scheme : 134 Ml/a (367 kl/d)

  TOTAL : 977 Ml/a (2 678 kl/d)

- The required yield for the Stellenbosch system for drought conditions is calculated at 5 449 Ml/a.
- The existing resources available for a drought scenario is calculated at 7 577 Ml/a after the Van der Stel, Die Braak and Cloetesville borehole schemes are implemented (this includes the 1:100 safe yield of 6 600 Ml/a from the Jonkershoek source).
- The Stellenbosch system will then have sufficient resources available to manage future drought conditions (available resources equates to 139% of targeted demand for drought conditions).
- The target yield from ground water resources for Stellenbosch is calculated at 1 106 Ml/a. After the Van der Stel, Die Braak and Cloetesville borehole schemes are implemented SM will be able to supply 88 % of this demand.
- SM can in future augment groundwater supply for the Stellenbosch system through:
  - the implementation of the Papegaaiberg scheme,
  - exploration drilling at sites STB_Centre_ExBH_4, 10 & 12 in the Town Centre area,
  - exploration drilling at site STB_Centre_ExBH_5 in the Cloetesville area,
  - the implementation of the Kayamandi and Doornbosch augmentation schemes, and
  - exploration drilling at the Idas Valley dams and Jonkershoek areas.

5.2.6 Dwars River system

Required bulk water resources

The total bulk water resources required for the Dwars River system for drought conditions is calculated at 469 Ml/a (AADD = 1,29 Ml/d). Currently the SM has no reliable water resources available for the Dwars River system during drought conditions and is 100% dependant on the CCT for bulk water supply.

It is proposed that groundwater resources are developed for the Dwars River area with a sustainable yield of at least 469 Ml/a in order to be able to supply the total system with water during drought conditions. This will also alleviate the risk of being dependant on an external service provider for bulk water supply.

Existing boreholes

In Pniel there are a stream and a spring (the so-called Pniel stream and Pniel spring), but they are currently not part of the reticulation network. In the larger Dwars River system there are currently 5 existing boreholes, i.e. Pniel borehole, Lanquedoc Sport borehole, Jackson Street borehole, Kylemore Sport borehole & Kylemore reservoir borehole. Safe yield and quality testing were performed on 3 of these boreholes. Two of these boreholes were identified to form part of the groundwater augmentation project. These boreholes are:

- Pniel borehole : Safe yield = 84.1 Ml/a (360.4 kl/d; 4 l/s & 16 h, 8 h rest)
- Jackson Street BH : Safe yield = 165.6 Ml/a (453.6 kl/d; 7 l/s & 18 h, 6 h rest)

The yield of the Kylemore reservoir borehole is very low and is currently not in use, the Kylemore Sport borehole has collapsed and is not in use and the Lanquedoc Sport borehole is currently used for irrigation purposes.

The locations of the existing boreholes are shown on Figures SW2.1 & SW5.1.

Potential borehole areas

From the groundwater resource study the following 6 areas (10 potential sites) were identified for exploration drilling:

- Banhoek : Horizontal : 1 site, 4 potential lines, 4 lines drilled
  : Vertical : 1 potential site, not drilled
- Kylemore Upper : 2 potential sites, 2 drilled
- Kylemore Sport : 1 potential site, drilled
- Jackson Street : 2 potential sites, 2 drilled
- Pniel Sport : 1 potential site, drilled
- Lanquedoc : 2 potential sites, 1 drilled

The position of the proposed exploration sites are shown on Figures SW5.2h to SW5.2l. Of the 10 potential exploration borehole sites 8 new exploration boreholes were drilled.

Due to lower than required yields achieved from the horizontal drilling at the Banhoek site it was decided not to commence with the vertical drilling, as the cost of the water infrastructure required to connect a possible borehole to the existing network will make the project unfeasible.

Production, monitoring and abandoned boreholes

From the 8 new exploration boreholes that were drilled in the Dwars River system, one was developed into a production borehole, one is in the process to be developed into a production borehole, one still has to be tested to determine the safe yield, 3 will be used as monitoring boreholes, one will be used for irrigation (Pniel sports ground) and the yield of one (horizontal drilling) was too low to be used as a production borehole and will be abandoned or used for monitoring purposes.

Where exploration boreholes were drilled and the yield tests showed potential for a larger yield than the capacity of the exploration borehole (due to the limited size of the exploration borehole), a new production borehole was constructed next to the original exploration borehole. In the Dwars River system no additional production boreholes were drilled. On one of the exploration sites (KLM_ExBH_1) the borehole has however collapsed and was re-drilled a few meters further.

Results of yield and quality testing

For each production borehole a 72 hour yield test was performed to calculate the safe yield. During this 72 hour test the impact of the borehole extraction on the surrounding boreholes were monitored in order to ensure that the proposed extraction rates of each borehole is sustainable. From the yield tests performed for the new production boreholes and the results of the yield tests for the existing boreholes, the following safe yields were determined for each borehole supply area:

- Banhoek : None
- Kylemore Sport : None
- Lanquedoc : To be developed
- Kylemore Upper : 52.6 Ml/a (144 kl/d)
- Jackson Street : 228.6 Ml/a (626 kl/d)
- Pniel Sport BH : 63.1 Ml/a (173 kl/d)
- Pniel borehole : 84.1 Ml/a (230 kl/d)

TOTAL : 428.4 Ml/a (1 173 kl/d)

The quality testing of the boreholes in Dwars River has shown that the groundwater in the Jackson Street area contains high levels of iron and magnesium and should be treated before it can be connected to the existing water system. A new mobile water treatment unit is proposed for the Dwars River system to treat water from the Jackson Street boreholes.

- Jackson Str WTP : Capacity = 1 300 kl/d (15 l/s)

Water from the Kylemore Upper, Pniel Sport and Pniel boreholes is of better quality and only has to be treated with chlorine before it is connected to the existing supply network.

Borehole schemes

Borehole schemes were design to incorporate each of the production boreholes within the existing water network. The following borehole schemes were designed to connect the production boreholes to the existing Dwars River network:

Jackson Street scheme : See Figure SW5.3g
: Boreholes: Jackson Street & KLM_ExBH_7
: Safe yield of scheme: 228.6 Ml/a (626 kl/d)
: Treatment plant required: Yes
: Capacity of plant: 1,3 Ml/d
: Status: To be commissioned in September 2018

Kylemore Upper : See Figure SW5.3h
: Borehole: KLM_ExBH_1_Redrill
: Safe yield of scheme: 52.6 Ml/a (144 kl/d)
: Treatment plant required: No, only chlorination
: Status: To be commissioned in October 2018

Pniel borehole scheme : See Figure SW5.3i
: Borehole: Pniel_BH
: Safe yield of scheme: 84.1 Ml/a (230 kl/d)
: Treatment plant required: No, only chlorination
: Status: To be commissioned in 2018/19 financial year

Pniel Sport scheme : See Figure SW5.3j
: Borehole: KLM_ExBH_5
: Safe yield of scheme: 63.1 Ml/a (173 kl/d)
: Treatment plant required: No, only chlorination
: Status: To be commissioned in 2018/19 financial year

Lanquedoc scheme : No detail available, drilling to be done at site LQD_ExBH_2.
: Boreholes: LQD_ExBH_1 & 2
: Safe yield of scheme: To be determined
: Treatment plant required: No, only chlorination
: Status: Future project

Resource summary

The total available bulk water resources available to the Dwars River system for a drought scenario after the Jackson Street, Kylemore Upper, Pniel Sport and Pniel borehole schemes are implemented is as follows:

• Surface water resources	:	None
• Lanquedoc scheme	:	To be determined
• Jackson Street scheme	:	228.6 Ml/a (626 kl/d)
• Kylemore Upper scheme	:	52.6 Ml/a (144 kl/d)
• Pniel Sport scheme	:	84.1 Ml/a (230 kl/d) - currently used for irrigation
• Pniel BH scheme	:	84.1 Ml/a (230 kl/d)
TOTAL	:	428.4 Ml/a (1 173 kl/d)

- The required yield for the Dwars River system for drought conditions is calculated at 469 Ml/a.
- The existing resources available for a drought scenario is calculated at 428 Ml/a after the Jackson Street, Kylemore Upper, Pniel Sport and Pniel borehole schemes are implemented.
- The Dwars River system will then require additional water resources of 34 Ml/a in order to successfully manage future drought conditions (available resources equates to only 91% of targeted demand for drought conditions).
- SM can in future augment groundwater supply for the Dwars River system through:
    - exploration drilling at the Lanquedoc target area (sites LQD_ExBH_1 & LQD_ExBH_2 (in process),
    - incorporate the yield from the horizontal drilling, and
    - incorporate yield from the Pniel spring and Pniel stream into the existing reticulation system.

5.2.7 Franschhoek system

Required bulk water resources

The total bulk water resources required for drought conditions is calculated at 820 Ml/a (AADD = 2 247 kl/d). Limited water will be available from the Perdekloof source (water supply from this source has not run dry during the current drought, but the SM has no storage capacity available to store excess water during winter months). For a drought scenario it was assumed that all the urban areas in the eastern part of the Franschhoek system to the east of Akademie Street can be supplied with water from the Perdekloof source. The water resources required to supply these areas is calculated at 155 Ml/a, or 17,5 % of the yield of the Perdekloof source.

The required yield from groundwater sources in order to supplement water supply to the Franschhoek system during drought conditions is calculated at 665 Ml/a (AADD of 1 822 kl/d).

Existing boreholes

In the Franschhoek system there are currently 2 existing boreholes, namely the La Motte borehole on the La Motte sport field and the Wemmershoek borehole on the Wemmershoek sport field. Safe yield and quality testing was performed on the Wemmershoek borehole. This information was however available for the La Motte borehole.

The borehole testing results from the Wemmershoek borehole showed that the yield in the area is very high and it was decided to drill a bigger diameter production borehole next to the existing borehole.

The existing Wemmershoek borehole is currently not in use and the La Motte borehole is currently used for irrigation purposes.

The locations of the existing boreholes are shown on Figures SW2.1 & SW5.1.

Potential borehole areas

From the groundwater resource study the following 7 areas (14 potential sites) were identified for exploration drilling:

- Wemmershoek sport ground : 3 potential sites, 2 drilled
- Wemmershoek wetlands : 5 potential sites, 5 drilled
- La Motte fire department : 1 potential site, drilled
- Franschhoek Groendal : 1 potential site, not drilled
- Franschhoek inclined : 1 potential site, not drilled
- Franschhoek horizontal : 1 potential site, not drilled
- Franschhoek South : 2 potential sites, not drilled

The position of the proposed exploration sites are shown on Figures SW5.2m to SW5.2p. Of the 14 potential exploration borehole sites 6 new exploration boreholes and 2 new production boreholes were drilled (yield testing at the Wemmershoek sport field showed that it is a high yielding area and production boreholes with a larger diameter were drilled).

Development of the potential ground water areas in Franschhoek town was postponed to focus on the Wemmershoek areas where results of the first exploration boreholes showed that the area has potential to develop a sustainable high yielding wellfield.

Production, monitoring and abandoned boreholes

From the 5 new exploration boreholes that were drilled in the Wemmershoek wetlands area, 2 were in a very high yielding area and it was decided to use them as monitoring boreholes and drill bigger diameter production boreholes next to them. The yield of the other 3 exploration boreholes were very low and the boreholes will be used as monitoring boreholes.

The exploration borehole in La Motte is allocated for use by the Fire Department in La Motte.

The 4 production boreholes that were drilled in the Wemmershoek area are:

- WH_P_BH1 next to the existing Wemmershoek sport ground BH.
- WH_P_BH2 next to exploration borehole WH_ExBH_3
- WH_P_BH3 on the Wemmershoek sport ground
- WH_P_BH4 next to exploration borehole WH_ExBH_1

Results of yield and quality testing

For each production borehole a 72 hour yield test was performed to calculate the safe yield. During this 72 hour test the impact of the borehole extraction on the surrounding boreholes were monitored in order to ensure that the proposed extraction rates of each borehole is sustainable. From the yield tests performed for the new production boreholes and the results of the yield tests for the existing boreholes, the following safe yields were determined for each borehole supply area:

- Franschhoek Groendal : Not developed
- Franschhoek inclined : Not developed
- Franschhoek horizontal : Not developed
- Franschhoek South : Not developed
- Wemmershoek sport ground : 263 Ml/a (720 kl/d)
- Wemmershoek wetlands : 591 Ml/a (2 167 kl/d)

TOTAL : 854 Ml/a (2 887 kl/d)

The quality testing of the boreholes in Wemmershoek has shown that some of the groundwater contains high levels of magnesium and iron as should be treated before it can be connected to the existing water system. A new mobile water treatment unit is proposed for the Franschhoek system next to the existing Wemmershoek bulk PS. The capacity of the proposed treatment plant is as follows:

- Wemmershoek WTP : Capacity = 3 900 kl/d (45 l/s)

Borehole schemes

A borehole scheme was design in order to incorporate each of the production boreholes in Wemmershoek within the existing water network of the Franschhoek system:

Wemmershoek scheme	:	See Figure SW5.3k
	:	Boreholes: WH_P_BH1, WH_P_BH2, WH_P_BH3 & WH_P_BH4
	:	Safe yield of scheme: 1 054 Ml/a (2 887 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 3,9 Ml/d
	:	Status: To be commissioned in September 2018

Resource summary

The total available bulk water resources available to the Franschhoek system for a drought scenario after the Wemmershoek borehole scheme is implemented is as follows:

• Surface water resources	:	155 Ml/a (425 kl/d)
• Wemmershoek scheme	:	854 Ml/a (2 887 kl/d)
TOTAL	:	1 009 Ml/a (3 312 kl/d)

- The required yield for the Franschhoek system for drought conditions is calculated at 820 Ml/a.
- The existing resources available for a drought scenario is calculated at 1 009 Ml/a after the Wemmershoek borehole scheme is implemented.
- The Franschhoek system will then have sufficient resources available to manage future drought conditions (available resources equates to 123% of targeted demand for drought conditions).
- SM can in future augment groundwater supply for the Franschhoek system through exploration drilling at sites FH_ExBH_1, FH_ExBH_2, FH_ExBH_3, FH_ExBH_Inclined & FH_ExBH_Horizontal in Franschhoek town.
- Water from the Groendal water source (which previously supplied water to Franschhoek) can in future be incorporated into the water reticulation network.

5.2.8 Klapmuts system

Required bulk water resources

The total bulk water resources required for the Klapmuts system for drought conditions is calculated at 305 Ml/a (AADD = 840 kl/d). Currently the SM has no alternative water resources available for the Klapmuts system and is 100% dependant on the CCT for bulk water supply.

It is proposed that groundwater resources are developed for the Klapmuts system with a sustainable yield of at least 305 Ml/a in order to be able to supply the total system with water during drought conditions. This will also alleviate the risk of being dependant on an external service provider for bulk water supply.

Existing boreholes

In Klapmuts there are currently 2 existing boreholes, i.e. the Klapmuts boreholes 1 & 2. Both these boreholes have collapsed and could not be tested for water quality. The Klapmuts BH 1 is in an area with potential for groundwater and it was decided that a new exploration borehole should be drilled at the existing site.

The locations of the existing boreholes are shown on Figures SW2.1 & SW5.1.

Potential borehole areas

From the groundwater resource study the following 7 areas (16 potential sites) were identified for exploration drilling:

- Klapmuts WWTW : 3 potential sites, 3 drilled
- Railway line : 5 potential sites, 4 drilled
- Sport field : 2 potential sites, 2 drilled
- Butterfly wold : 1 potential site, drilled
- Old reservoir : 1 potential site, drilled
- Lower reservoir : 3 potential sites, 3 drilled
- Upper reservoir : 1 potential site, drilled

The position of the proposed exploration sites are shown on Figure SW5.2q. Of the 16 potential exploration borehole sites 15 new exploration boreholes were drilled.

Production, monitoring and abandoned boreholes

From the 15 new exploration boreholes that were drilled in the Klapmuts system, 4 were developed into production boreholes, 3 have the potential to be developed in future to production boreholes, 2 were in a high yielding area and it was decided to use them as monitoring boreholes and drill bigger diameter production boreholes next to them, and the yield of the remaining 6 exploration boreholes were very low or dry and will be used as monitoring boreholes or be abandoned.

In Klapmuts 2 production boreholes (KM_PBH_1 & KM_PBH_2) were drilled next to exploration boreholes KM_ExBH_11 & KM_ExBH_12.

Results of yield and quality testing

For each production borehole a 72 hour yield test was performed to calculate the safe yield. During this 72 hour test the impact of the borehole extraction on the surrounding boreholes were monitored in order to ensure that the proposed extraction rates of each borehole is sustainable. From the yield tests performed for the new production boreholes, the following safe yields were determined for each borehole supply area:

- Upper reservoir : None
- Butterfly wold : None
- Klapmuts WWTW : 252.3 Ml/a (691 kl/d)
- Railway line : 84.1 Ml/a (230 kl/d)
- Sport field : 73.6 Ml/a (202 kl/d)
- Old reservoir * : 23.7 Ml/a (65 kl/d)
- Lower reservoir * : 39.4 Ml/a (108 kl/d)

TOTAL : 473.1 Ml/a (1 296 kl/d)

* Boreholes KM_ExBH_3, KM_ExBH_4 & KM_ExBH_5 are currently not equipped with borehole pumps or connected to the existing water network.

The water quality testing of the boreholes in Klapmuts has shown that the groundwater is of a good quality and only has to be treated with chlorine before it is connected to the existing water network.

Borehole schemes

Borehole schemes were design to incorporate each of the production boreholes within the existing water network. The option to supply excess water from the Klapmuts boreholes within the Klapmuts WWTW and Railway line wellfields to the Koelenhof rural water supply scheme was also investigated and included in the design of the larger Klapmuts borehole scheme.

The following borehole schemes were designed to connect the production boreholes to the existing Klapmuts and Koelenhof water networks:

Klapmuts WWTW and Railway line scheme	:	See Figure SW5.3l
	:	Boreholes: KM_ExBH_1, KM_ExBH_2, KM_PBH_1, KM_PBH_2 & Old_Klapmuts_borehole
	:	Safe yield of scheme: 336.4 Ml/a (922 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in October 2018
	:	Transfer capacity: Water can be transferred to the Koelenhof rural supply scheme
Sport field	:	See Figure SW5.3m
	:	Borehole: KM_ExBH_15
	:	Safe yield of scheme: 73.6 Ml/a (202 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in the 2018/19 financial year
Old & Lower reservoirs	:	See Figure SW5.3n
	:	Boreholes: KM_ExBH_3, KM_ExBH_4 & KM_ExBH_5
	:	Safe yield of scheme: 63.1 Ml/a (173 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: Future project

Resource summary

The total available bulk water resources available to the Klapmuts system for a drought scenario after the Klapmuts WWTW, Klapmuts railway line & Klapmuts sport field borehole schemes are implemented is as follows:

• Surface water resources	:	None
• Old & Lower reservoirs	:	Future project
• WWTW & railway scheme	:	336.4 Ml/a (921 kl/d)
• Sport field scheme	:	73.6 Ml/a (202 kl/d)
TOTAL	:	410.0 Ml/a (1 123 kl/d)

- The required yield for the Klapmuts system for drought conditions is calculated at 305 Ml/a.
- The existing resources available for a drought scenario is calculated at 410 Ml/a after the the Klapmuts WWTW, Klapmuts railway line & Klapmuts sport field borehole schemes are implemented.
- The Klapmuts system will then have sufficient resources available to manage future drought conditions (available resources equates to 134% of targeted demand for drought conditions).
- Excess water from the boreholes within the Klapmuts WWTW and Railway line wellfields can be supplied to the Koelenhof rural water supply scheme. Available excess water is calculated at 105 Ml/a (AADD of 288 kl/d) if Klapmuts can reduce its water consumption to 305 Ml/a.
- SM can in future augment groundwater supply for the Klapmuts system through the implementation of the Old reservoir and Lower reservoir schemes (potential safe yield of 63.1 Ml/a (173 kl/d).

5.2.9 Rural supply systems

Required bulk water resources

SM supplies bulk water to the Faure, Raithby, Koelenhof, Muldersvlei, Meerlust, Croydon & Helderberg rural systems. The total bulk water resources required for these systems for drought conditions is calculated at 1 139 Ml/a (AADD of 3,12 Ml/d), and can be allocated to each sub-system as follows:

- o Faure/Raithby system : 396 Ml/a (AADD of 1,09 Ml/d)
- o Polkadraai system : 229 Ml/a (AADD of 0,63 Ml/d)
- o Koelenhof system : 413 Ml/a (AADD of 1,13 Ml/d)
- o Muldersvlei system : 82 Ml/a (AADD of 0,23 Ml/d)
- o Meerlust system : 9 Ml/a (AADD of 0,03 Ml/d)
- o Croydon & Helderberg : 8 Ml/a (AADD of 0,02 Ml/d)

The Faure and Raithby systems are supplied with purified water from the Faure WTP, the Polkadraai system is supplied with purified water from the Blackheath WTP, the Koelenhof, Muldersvlei and Meerlust systems are supplied with purified water from the Wemmershoek scheme and the Helderberg & Croydon areas are supplied with bulk water from the Steenbras dam through the CCT's reticulation network. Currently the SM has no alternative water resources available to supply these systems and is 100% dependant on the CCT for bulk water supply.

For planning of bulk water supply to these areas during severe drought conditions it was assumed that there will be water available at the CCT Faure WTP, Blackheath WTP and Steenbras WTP in order to supply basic water to the Faure, Raithby, Polkadraai, Croydon & Helderberg rural systems and that water will be available from the CCT Bloekombos reservoir to supply the Muldersvlei system. If no water is however available from the Wemmershoek scheme, the Koelenhof and Meerlust schemes should be supplied with water from SM from an alternative source of water.

It is proposed that groundwater resources are developed for the rural systems with a sustainable yield of 422 Ml/a in order to be able to supply the Koelenhof and Meerlust systems with water during drought conditions (413 Ml/a for the Koelenhof system and 9 Ml/a for the Meerlust system). This will also alleviate the risk of being 100% dependant on an external service provider for bulk water supply.

It is also proposed that the option to supply a portion of the Raithby town with groundwater is investigated.

Existing boreholes

In the rural supply areas there are currently 2 existing boreholes, namely the Raithby borehole in Raithby and the Meerlust borehole in Meerlust. Both boreholes have however collapsed and could not be tested for water quality.

The locations of the existing boreholes in Raithby and Meerlust are shown on Figures SW2.1 & SW5.1.

Potential borehole areas

In the groundwater resource study it was decided to only target the Koelenhof, Meerlust and Raithby systems for potential groundwater resources.

The following 4 areas (8 potential sites) were identified for exploration drilling:

- Raithby : 1 potential site (to be drilled)
- Meerlust : 2 potential sites, 1 drilled
- Koelenhof reservoir : 1 potential site, drilled

- Mariendahl * : 4 potential sites, 4 drilled (3 drilled by SU)

* The Mariendahl farm is the property of the Stellenbosch University (SU) and is currently supplied with potable water from the Koelenhof system through the internal water network of Elsenburg. The SU has drilled 3 exploration boreholes (MD_BH1, MD_BH3 & MD_BH4) on Mariendahl farm to supply drinking water to the animals on the farm (required demand of 100 kl/d). The SU and SM have however reached an agreement where SM can develop the potential wellfield at Mariendahl for municipal use in exchange that the SM will provide a potable water connection for the farm and supply a minimum of 100 kl/d of raw water to the animals.

The position of the proposed exploration sites are shown on Figures SW5.2r to SW5.2u. Of the 8 potential exploration borehole sites 6 new exploration boreholes were drilled.

Production, monitoring and abandoned boreholes

The potential exploration borehole in Raithby (next to the existing Raithby borehole) will be drilled in the 2018/19 financial year.

The exploration borehole in Meerlust was developed into a production borehole.

The yield test of the exploration borehole next to the Koelenhof reservoir could not be completed due to a lot of sand that were pumped as part of the testing. The borehole should be developed further by a borehole contractor before the test can be completed. Preliminary results of the yield testing did however indicated that this borehole has the potential to be developed into a high yielding production borehole.

From the 3 exploration boreholes that were drilled on the Mariendahl farm by SU, one was developed into a production borehole, one has collapsed before it could be developed to a production borehole (and will be used as monitoring borehole) and one has a very low yield and will be used as monitoring borehole. The exploration borehole drilled by SM was developed into a production borehole.

A new production borehole should be drilled by SM next to the collapsed exploration borehole MD_BH3.

Results of yield and quality testing

For each production borehole a 72 hour yield test was performed to calculate the safe yield. During this 72 hour test the impact of the borehole extraction on the surrounding boreholes were monitored in order to ensure that the proposed extraction rates of each borehole is sustainable. From the yield tests performed for the new production boreholes, the following safe yields were determined for each borehole supply area:

- Raithby : To be determined
- Koelenhof : To be determined
- Meerlust : 23.7 Ml/a (65 kl/d)
- Mariendahl : 151.5 Ml/a (415 kl/d)

The water quality testing of the boreholes at Meerlust and Koelenhof reservoir has shown that the groundwater is of a good quality and only has to be treated with chlorine before it is connected to the existing water networks.

Water quality tests should still be performed for the potential borehole in Raithby and the proposed third production borehole in Mariendahl.

Borehole schemes

Borehole schemes were design to incorporate the proposed production boreholes in Meerlust, Koelenhof reservoir and Mariendahl within the existing water networks of the Meerlust and Koelenhof systems. The following borehole schemes were designed:

Meerlust	:	See Figure SW5.3o
	:	Borehole: ML_ExBH_1
	:	Safe yield of scheme: 23.7 Ml/a (65 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in July 2018
Mariendahl	:	See Figure SW5.3p
	:	Boreholes: MD_BH1 & MD_BH5 (proposed production borehole MD_PBH_1 to be drilled)
	:	Safe yield of scheme: 151.5 Ml/a (415 kl/d) – excluding yield of proposed production borehole MD_PBH_1)
	:	Treatment plant required: To be determined, possibly only chlorination
	:	Status: To be commissioned in 2018/19 financial year

Resource summary

Raithby

The Raithby system is supplied with purified water from the Faure WTP. For planning of bulk water supply during severe drought conditions it was assumed that there will be water available at the CCT Faure WTP in order to supply basic water to the Raithby system. It is however proposed that groundwater resources should be developed for the Raithby system in order to reduce the dependency on bulk water supply from CCT.

Meerlust

The total available bulk water resources available to the Meerlust system for a drought scenario after the Meerlust borehole scheme is implemented is as follows:

• Surface water resources	:	None
• Meerlust scheme	:	23.7 Ml/a (65 kl/d)
TOTAL	:	23.7 Ml/a (65 kl/d)

- The required yield for the Meerlust system for drought conditions is calculated at 9 Ml/a.
- The existing resources available for a drought scenario is calculated at 23.7 Ml/a after the Meerlust borehole scheme is implemented.
- The Meerlust system will then have sufficient resources available to manage future drought conditions (available resources equates to 263% of targeted demand for drought conditions).

Koelenhof

The total available bulk water resources available to the Koelenhof system for a drought scenario after the Mariendahl and Koelenhof reservoir borehole schemes are implemented and excess water from the Klapmuts scheme is transferred to the Koelenhof system, is as follows:

• Surface water resources	:	None
• Excess water from Klapmuts	:	104.0 Ml/a (293 kl/d)
• Koelenhof reservoir scheme	:	To be determined
• Mariendahl scheme	:	151.5 Ml/a (415 kl/d)
• Raw water for Mariendahl	:	- 36.5 Ml/a (-100 kl/d)
TOTAL	:	324.0 Ml/a (896 kl/d)

- The required yield for the Koelenhof system for drought conditions is calculated at 413 Ml/a.
- The existing resources available for a drought scenario is calculated at 324 Ml/a after the Mariendahl borehole scheme is implemented and any excess water from the

boreholes within the Klapmuts WWTW and Railway line wellfields are supplied to the Koelenhof rural water supply scheme.

- The Koelenhof system will then have water resources available to supply 78% of the targeted demand for drought conditions.
- SM can in future augment groundwater supply for the Klapmuts system through the implementation of the Old reservoir and Lower reservoir schemes (potential safe yield of 63.1 Ml/a (173 kl/d). This volume of water can then potentially be transferred to the Koelenhof scheme from the Klapmuts WWTW and Railway line wellfields.
- An inter-connection can in future be made between the Koelenhof and Muldersvlei systems where water can be supplied from the Koelenhof system to the Muldersvlei system, or alternatively from the Muldersvlei system to the Koelenhof system.
- The capacity of the Mariendahl scheme will be improved after borehole MD_BH3 is redrilled.

5.3 FUTURE RESOURCE AUGMENTATION

5.3.1 Introduction

In the water master plan the potential future water demand for SM is calculated based on a scenario where all existing erven are occupied and all potential future development areas within the urban edge of the municipality is fully developed.

It was thus not only assumed that all existing but vacant stands in the treasury data would become “occupied”, i.e. start using water (as for the existing system), but also that potential future developments within the urban edge of SM would materialise and start using water.

The future AADD of SM is anticipated to be 75 214 kℓ/d. This AADD will be realised in the year ± 2046 if the demand increases at a compound growth rate of ± 2,0 % per year (low demand scenario) and ± 2035 if the demand increases at a compound growth rate of ± 3,0 % per year (medium demand scenario).

In order to meet the future water demand for SM (as calculated in the Water Master Plan), the existing SM water resources should be augmented. This can be from the following sources.

- Groundwater
- Wastewater reclamation
- Increase existing allocations from CCT (this can only be done after CCT has increased the reliability of their existing water resources)
- Increase existing allocation from DWS (from the Theewaterskloof tunnel)
- Rainwater harvesting

The total additional resources required for SM in order to supply the potential future water demand is calculated at 9 480 Ml/a (AADD of 25,97 Ml/d), and can be allocated to the main supply areas as follows:

- 15,02 Ml/d to the Stellenbosch town area (currently supplied with water from its own source in the Jonkershoek Valley and water from the WCWSS through the Paradyskloof tunnel), and
- 10,95 Ml/d to all the other urban and rural areas (the Dwars River system, Franschhoek system, Klapmuts system and rural supply areas, supplied with bulk water mainly from the CCT). .

5.3.2 Groundwater resources

The potential groundwater resources in SM is calculated at 10 042 kl/d, as shown on Table SW5.1. The contribution of each water system is as follows:

Stellenbosch system	=	4 378 kl/d
Dwars River system	=	1 001 kl/d
Franschhoek system	=	2 887 kl/d
Klapmuts system	=	1 296 kl/d
Meerlust system	=	65 kl/d
Koelenhof system	=	415 kl/d
TOTAL	=	10 042 kl/d

The total groundwater resources of 10.04 Ml/d can be allocated 4.38 Ml/d to the Stellenbosch town main supply area and 5.66 Ml/d to the other urban and rural areas.

5.3.3 Wastewater reclamation

In SM it is proposed that the feasibility of reclamation of wastewater as a future bulk water resource is investigated at the Klamputs, Dwars River, Wemmershoek and the Stellenbosch WWTPs.

At the Klamputs, Dwars River & Wemmershoek systems the SM is currently dependant on the CCT for bulk water supply to these areas. After the borehole projects are implemented the SM will be able to supply basic water to these areas during drought conditions. Under normal demand conditions water supply to these areas should however be augmented with potable water bought from CCT or from an additional resource such as treated effluent.

A more detailed study should be performed to determine the optimal capacity and feasibility of potential wastewater reclamation plants for each area.

Klapmuts

At the Klapmuts WWTP SM currently has a water use licence from DWS in place to release xxx Ml/a of treated effluent in the downstream Klapmuts River. The capacity of the Klapmuts WWTP is 2,4 Ml/d and it is proposed that SM in future first treat excess wastewater before they increase the water use license. Treated effluent from the WWTP can be used to supplement the groundwater supply to the Klapmuts and Koelenhof systems, resulting that these systems are less dependent on water supply from an external source such as CCT. Water reclaimed from the WWTP can also be used to recharge the groundwater aquifer in the area.

It is proposed that as a first phase a wastewater reclamation plant is implemented at Klapmuts with a capacity to treat 0.70 Ml of treated effluent to drinking water quality.

A 0.70 Ml reclamation plant at the Klapmuts WWTP will be able to supply 9% of the future water demand of Klapmuts.

Dwars River

In the Dwars River system the SM is in the process to secure groundwater with a safe yield of 1.00 Ml/d. This will enable the SM to supply 43% of the existing water demand (under normal demand conditions). It is proposed that SM investigate the feasibility to implement a water treatment plant at the Dwars River WWTP with the capacity to treat 1.00 Ml/d of treated effluent to drinking water quality. This will enable the SM to supply 86% of the existing water demand (under normal demand conditions) from their own water resources (groundwater and the reclamation of wastewater).

A 1.00 Ml reclamation plant at the Dwars River WWTP will be able to supply 17% of the future water demand of the Dwars River system.

Franschhoek

In the Franschhoek system the SM is in the process to secure groundwater with a safe yield of 2.89 Ml/d. This will enable the SM to supply 71% of the existing water demand (under normal demand conditions) from the groundwater resources or 131% of the existing water demand if the SM's own water from the Perdekloof resource is also taken into account.

It is proposed that SM investigate the feasibility to implement a water treatment plant at the Wemmershoek WWTP with the capacity to treat 2.00 Ml/d of treated effluent to drinking water quality. This will enable the SM to supply 49% of the existing water demand (under normal demand conditions) from the reclamation plant.

A 2.00 Ml reclamation plant at the Wemmershoek WWTP will be able to supply 24% of the future water demand of the Franschhoek system.

Stellenbosch

In the Stellenbosch system the SM is in the process to secure groundwater with a safe yield of 1 598 Ml/a. Together with the 7 224 Ml/a allocation from the Jonkershoek water source and the 3 000 Ml/a allocation from DWS through the Theewaterskloof tunnel, the Stellenbosch system will have sufficient water resources available to supply 119 % of the existing water demand (under normal demand conditions).

It is however proposed that the option is investigated to further augment bulk water resources to the Stellenbosch system through the reclamation of treated effluent from the Stellenbosch WWTP. At the Klapmuts, Dwars River and Wemmershoek WWTPs it is proposed that effluent from the WWTPs is treated to potable water standards and incorporated within the existing water systems.

In the case of Stellenbosch it is however proposed that water is as a first phase only treated to a standard in order to be used for irrigation purposes by farmers downstream of the treatment works. Currently the farmers downstream of the Stellenbosch WWTP receive irrigation water from the Wynland WUA through the Eersterivier system. The Eersterivier system is however augmented in summer months with water from the WCWSS through water released at the Kleinplasie dam. It is therefore proposed that water released by SM into the Eersterivier system is exchanged for an increased allocation from the WCWSS at the Paradyskloof tunnel outlet (volume of water released by SM into the Eersterivier system will result that less water should be released by the WCWSS at the Kleinplasie dam).

The water rights that could potentially be exchanged from the Wynland WUA through the reclamation of wastewater for irrigation purposes should be further investigated.

In future additional water rights could be transferred from the Wynland WUA through the implementation of an irrigation scheme that supplies irrigation water to Wynland WUA consumers upstream of the Stellenbosch WWTP (such as the De Zalze and Stellenbosch golf courses, supplied with water currently from the Helderberg system, and other consumers in the Eersterivier system adjacent to the Eersterivier).

In the longer term planning for Stellenbosch town it is proposed that the proposed reclamation plant is upgraded and extended in order to also treat 5.00 Ml/d of treated effluent to drinking water quality. A 5.00 Ml reclamation plant at the Stellenbosch WWTP will be able to supply 11% of the future water demand of the Stellenbosch system.

5.3.4 CCT allocation (short term)

The current allocation of bulk water to SM is 6 848 Ml/a. This allocation should be increased in future to supply the future water demand to SM as calculated in the water master plan (after the groundwater and wastewater reclamation projects for SM is implemented).

The required increase in the CCT allocation to SM is calculated for the two main supply systems as follows:

Stellenbosch main system

In the water master plan it is proposed that bulk water supply to Stellenbosch town is augmented in future through a new bulk supply system from the CCT Blackheath WTP to the existing Papegaaiberg reservoir in the Stellenbosch system. This will give Stellenbosch town more redundancy in their bulk supply system and the Stellenbosch system will be able to be supplied with bulk water from three separate sources, i.e. the Idas Valley WTP, the Paradyskloof WTP and the CCT Blackheath WTP. Furthermore this bulk system will reinforce the Polkadraai system and enable the SM to develop the Vlottenburg node.

It is proposed in the water master plan that this new bulk system should have the capacity to supply a peak demand of 5.0 Ml/d of water to the Stellenbosch system. The required annual allocation from CCT to the Stellenbosch system is calculated at 1 140 Ml/a.

Other urban and rural systems

The minimum required increase in allocation from the CCT to the other urban and rural systems (the Dwars River system, Franschhoek system, Klapmuts system and rural supply areas in SM) is calculated as follows:

Future demand	=	11 747 Ml/a	(from water master plan)
- Existing CCT allocations	=	6 848 Ml/a	
- Existing Perdekloof resource	=	901 Ml/a	
- Existing Pniel resources	=	78 Ml/a	(not included under groundwater resources)
- Groundwater resources	=	2 067 Ml/a	
- Wastewater reclamation	=	1 351 Ml/a	(to be refined)
	=	**502** Ml/a	

5.3.5 Paradyskloof tunnel allocation (short term)

The minimum required increase in allocation from DWS to the Stellenbosch system in order to supply the future water demand is calculated as follows:

Future demand	=	15 706 Ml/a	(from water master plan)
- Existing Jonkershoek source	=	7 224 Ml/a	
- Existing WCWSS allocation	=	3 000 Ml/a	
- Proposed CCT allocation	=	1 140 Ml/a	
- Groundwater resources	=	1 598 Ml/a	
- Groundwater augmentation	=	292 Ml/a	(Doornbosch & Kayamandi)
- Jonkershoek augmentation	=	0 Ml/a	(investigate option to increase yield through augmentation of Idas Valley dams storage)
- Wastewater reclamation	=	0 Ml/a	(exchange of allocations from Wynland WUA: to be determined)
- Wastewater reclamation	=	1 825 Ml/a	(to be refined)
	=	**627** Ml/a	

5.3.6 Proposed increase in allocation from CCT and WCWSS (long term)

Over the long term it could be more cost effective for SM to only utilize the ground water and the reclamation of wastewater resources during periods when surface water is under stress, and utilize the available surface water from the WCWSS on a more permanent basis (especially during times of high rainfall when there is excess water available from surface water resources).

It is therefore proposed that the allocations from the CCT and the WCWSS are increased to allow for a scenario where the available water from ground water and wastewater reclamation are only utilize during periods when the surface water is under stress (drought conditions).

The proposed increases in the allocations from the CCT and the WCWSS are calculated as follows:

CCT allocation:

Future demand	= 11 747 Ml/a	(excluding Stellenbosch town)
- Existing CCT allocations	= 6 848 Ml/a	
- Existing Perdekloof resource	= 901 Ml/a	
- Pniel surface water resources	= 78 Ml/a	(proposed future project)
+ Blackheath allocation	= 1 140 Ml/a	(required for Stellenbosch town)
	= **5 060** Ml/a	

WCWSS allocation:

Future demand	= 15 706 Ml/a	(for Stellenbosch town)
- Jonkershoek resource	= 7 224 Ml/a	
- Existing WCWSS allocation	= 3 000 Ml/a	
- Blackheath CCT allocation	= 1 140 Ml/a	(proposed at CCT Blackheath WTP)
	= **4 342** Ml/a	

It is proposed that the existing WCWSS allocation of 3 000 Ml/a is increased in two phases (first phase of 2 000 Ml/a and second phase of 2350 Ml/a) to a total allocation of 7 350 Ml/a.

5.3.7 Summary

Table SW5.2 gives a summary of the future water demand for SM, the safe yield of the existing water resources available, and the additional resources required to supply the future water demand for SM.

Figure SW5.4a below shows the phasing required of the water resource augmentation projects for Stellenbosch Municipality up to the year 2035:

Figure SW5.4a: Phasing of bulk augmentation projects for Stellenbosch Municipality

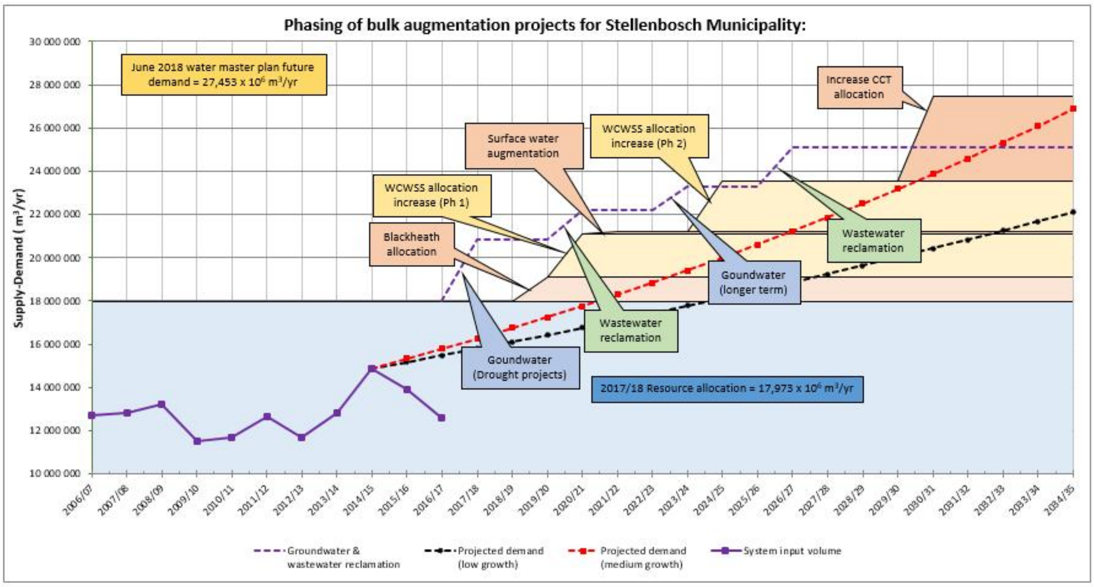
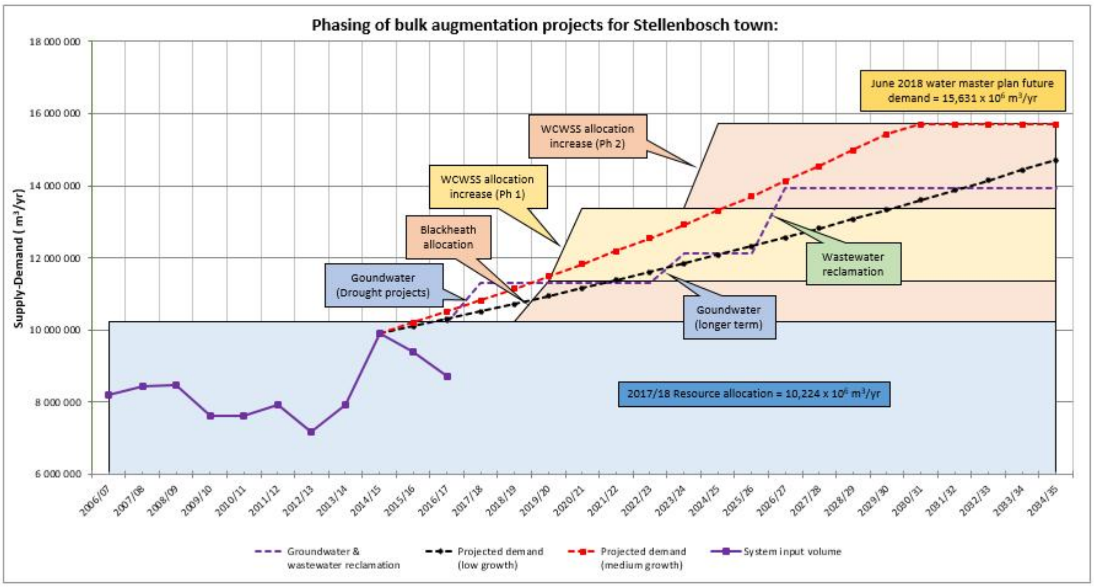


Figure SW5.4b below shows the phasing required of the water resource augmentation projects for the Stellenbosch town system up to the year 2035:

Figure SW5.4b: Phasing of bulk augmentation projects for Stellenbosch town



The phasing of the water resource augmentation projects for the other systems (other urban and rural areas in SM) is shown on Figure SW5.4c below:

Figure SW5.4c: Phasing of bulk augmentation projects for the other urban and rural areas in SM

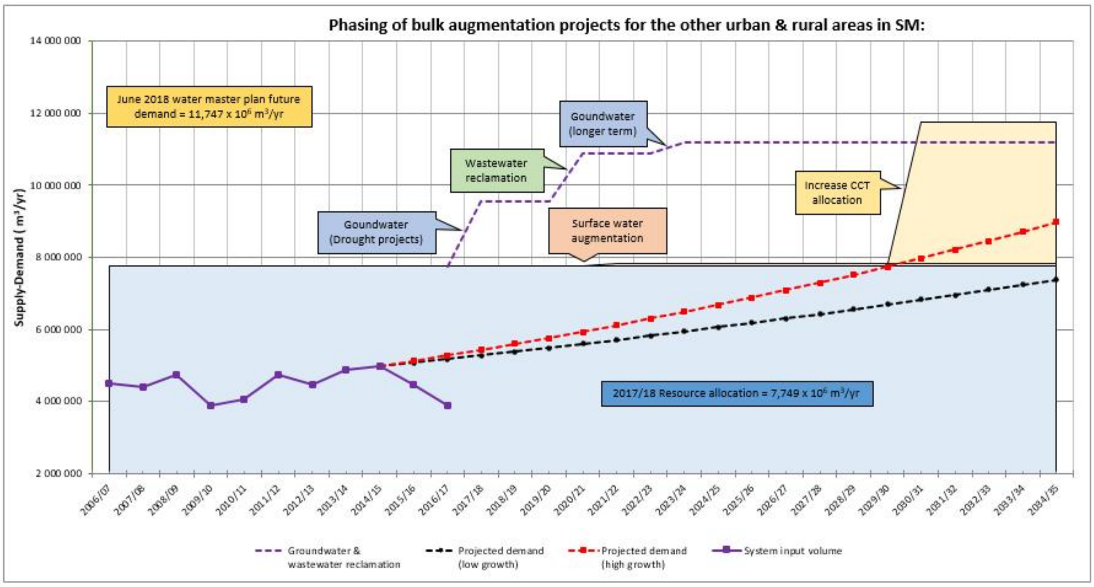


Table SW5.1: Results of SM borehole drilling programme9

Table SW5.2: Stellenbosch Municipality potential future water demand & required water resources (treated water)10

Figure SW5.1: Bulk water augmentation: SM borehole site location plan49

Figure SW5.2a: **Borehole site location plan: Paradyskloof50**

Figure SW5.2b: **Borehole site location plan: Jonkershoek51**

Figure SW5.2c: Borehole site location plan: Stellenbosch Central52

Figure SW5.2d: Borehole site location plan: Cloetesville53

Figure SW5.2e: Borehole site location plan: Idas Valley54

Figure SW5.2f: Borehole site location plan: Stellenbosch fire station55

Figure SW5.2g: **Borehole site location plan: Jan Marais Nature Park56**

Figure SW5.2h: Borehole site location plan: Banhoek57

Figure SW5.2i: **Borehole site location plan: Kylemore58**

Figure SW5.2j: Borehole site location plan: Jackson Street59

Figure SW5.2k: **Borehole site location plan: Pniel60**

Figure SW5.2l: Borehole site location plan: Lanquedoc61

Figure SW5.2m: Borehole site location plan: Wemmershoek62

Figure SW5.2n: Borehole site location plan: La Motte sport field and fire station63

Figure SW5.2o: **Borehole site location plan: Groendal and Franschhoek inclined64**

Figure SW5.2p: Borehole site location plan: Franschhoek horizontal and Circus ground65

Figure SW5.2q: Borehole site location plan: Klapmuts66

Figure SW5.2r: Borehole site location plan: Raithby67

Figure SW5.2s: **Borehole site location plan: Meerlust68**

Figure SW5.2t: Borehole site location plan: Koelenhof reservoir69

Figure SW5.2u: Borehole site location plan: Mariendahl70

Figure SW5.3a: Borehole augmentation scheme: Van Der Stel71

Figure SW5.3b: Borehole augmentation scheme: Die Braak72

Figure SW5.3c: Borehole augmentation scheme: Cloetesville73

Figure SW5.3d: **Borehole augmentation scheme: Papegaaiberg74**

Figure SW5.3e: Borehole augmentation scheme: Doornbosch75

Figure SW5.3f: Borehole augmentation scheme: Kayamandi76

Figure SW5.3g: Borehole augmentation scheme: Jackson Street77

Figure SW5.3h: **Borehole augmentation scheme: Kylemore Upper78**

Figure SW5.3i: Borehole augmentation scheme: Pniel borehole79

Figure SW5.3j: Borehole augmentation scheme: Pniel sport ground80

Figure SW5.3k: **Borehole augmentation scheme: Wemmershoek81**

Figure SW5.3l: Borehole augmentation scheme: Klapmuts WWTW and railway line82

Figure SW5.3m: Borehole augmentation scheme: Klapmuts sport ground83

Figure SW5.3n: Borehole augmentation scheme: Klapmuts reservoirs84

Figure SW5.3o: Borehole augmentation scheme: Meerlust85

Figure SW5.3p: Borehole augmentation scheme: Mariendahl86

Figure SW5.4: Phasing of bulk augmentation projects87

6. BULK WATER RESOURCE SUMMARY

This report describes the study undertaken with respect to drought intervention planning in order to assist the Stellenbosch Municipality (SM) to manage water demand and supply during the drought that is experienced in the Western Cape Province.

6.1 SCOPE OF DROUGHT INTERVENTION STUDY

The scope of this study was briefly defined as the following:

- Analysis of the existing available water resources.
- Analysis of the existing and future water demand.
- Monitoring of existing bulk water supply and demand.
- Planning of pressure management projects to reduce water demand and losses.
- Planning of bulk water augmentation projects to augment bulk water supply to the SM.
- Present all information electronically in geographic information system (GIS) format as well as a document including tables and plans.

6.2 STUDY AREA

The location of SM within the Western Cape is shown on Figure SW1.1. The water supply systems and towns within the boundary of the Stellenbosch Municipality are:

- Stellenbosch system (Stellenbosch town, including Jamestown and De Zalze)
- Dwars River system (Pniel, Kylemore, Johannesdal and Lanquedoc)
- Greater Franschhoek system (Franschhoek, La Motte and Wemmershoek)
- Klapmuts system (Klapmuts)
- Rural supply systems (Faure/Raithby system, Koelenhof system, Muldersvlei system & Meerlust, Croydon & Helderberg systems)

Figure SW2.1 shows the various supply systems with their respective supply areas. The total area of these supply systems indicates the study area of this investigation.

6.3 BULK WATER RESOURCES

6.3.1 Water sources

SM is supplied with water obtained from the municipality's own surface and groundwater sources within the Water Services Authority (WSA) area of jurisdiction, as well as water obtained from external sources (e.g. Department of Water and Sanitation (DWS) and the City of Cape Town (CCT)).

Water from the municipality's own sources are from the Eersterivier in Stellenbosch, the Perdekloof source in Franchhoek and boreholes in Stellenbosch and the Dwars River area. The balance of the water is supplied to SM from the Western Cape Water Supply System (WCWSS). Water from the WCWSS is supplied directly to SM through the Theewaterskloof tunnel, or indirectly through water bought from the CCT.

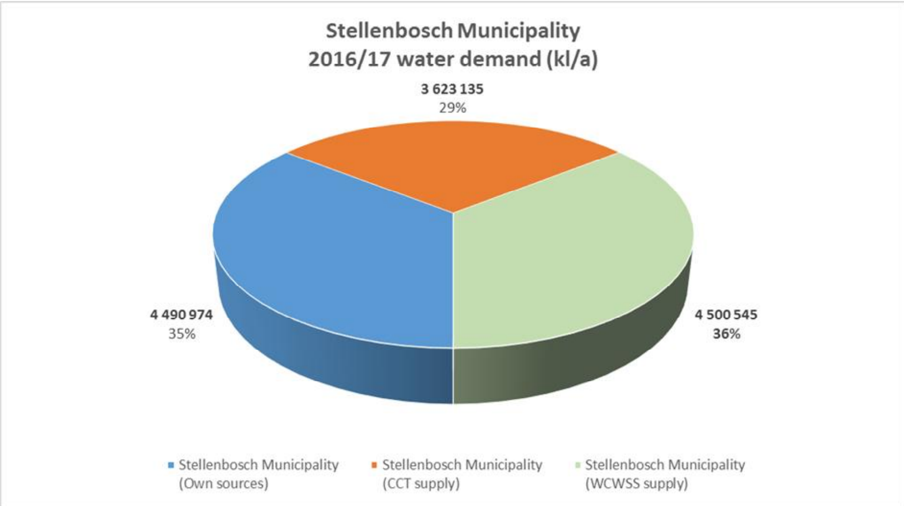
6.3.2 Existing demand

Reliable bulk water demand readings were available for SM from 2006 to 2017 and were used as base information for the analysis of the existing water demand for SM.

The water demand for SM for the 2016/17 financial year (July 2016 to June 2017) was 12 615 Ml/a (AADD of 34,6 Ml/d). The total demand for SM supplied from the relevant available water sources is as follows, and shown in FigureSW2.2a below:

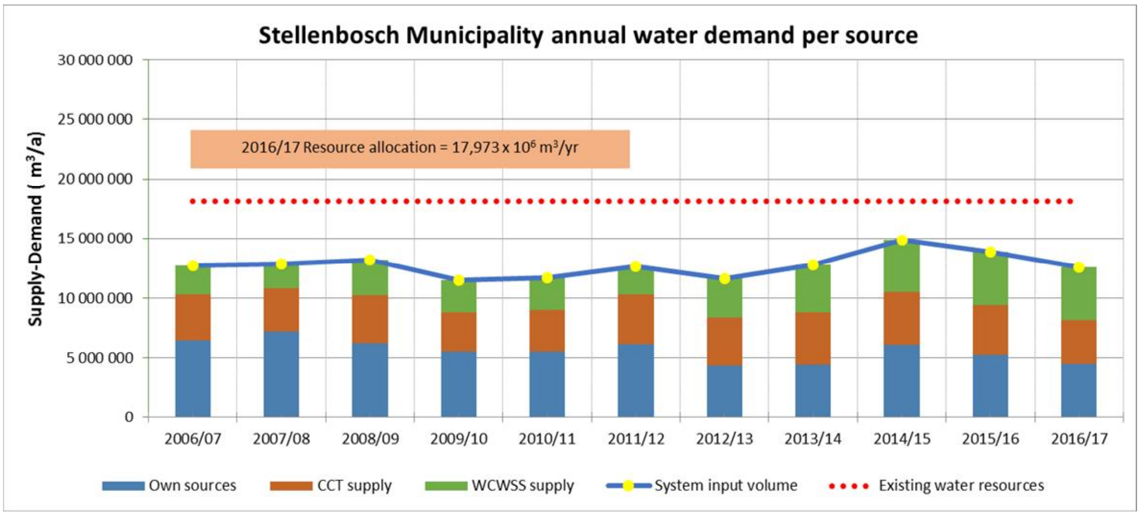
- SM own sources (4 491 Ml) - 35,6 %
- CCT supply (3 623 Ml) - 28,7 %
- WCWSS (4 500 Ml) - 35,7 %

Figure SW2.2a: Water demand per source for Stellenbosch Municipality



The water demand for SM from 2006 to 2017 are shown in Figure SW2.3a below:

Figure SW2.3a: Stellenbosch Municipality annual water demand per source



The historic water demand readings shows the following:

- The existing water resources available for SM from 2006 to 2017 is more than the water demand recorded for SM. The total annual demand of 12 615 Ml for the 2016/17 financial year is 70,2 % of the existing available water sources for SM.
- From 2014/15 to 2016/17 the water demand for SM decreases on an annual basis. This is due to water restrictions that were imposed on consumers and awareness of the current drought that is experienced in the Western Cape.
- Water demand for the 2014/15 financial year was the highest for the recorded period and is seen as the last year were normal consumption occur (no reduction in demand due to drought conditions). Demand from 2014/15 is also used in this document as the baseline demand for future water projections and to determine the target water demand for drought conditions.

6.3.3 Target water demand for a drought scenario

Under normal water demand conditions SM is supplied roughly with 30% if its water demand from the CCT, 30% from DWS through the Paradyskloof tunnel and 40% from its own sources. SM is therefore dependant on approximately 60% of its normal consumption from external water providers (CCT & WCWSS).

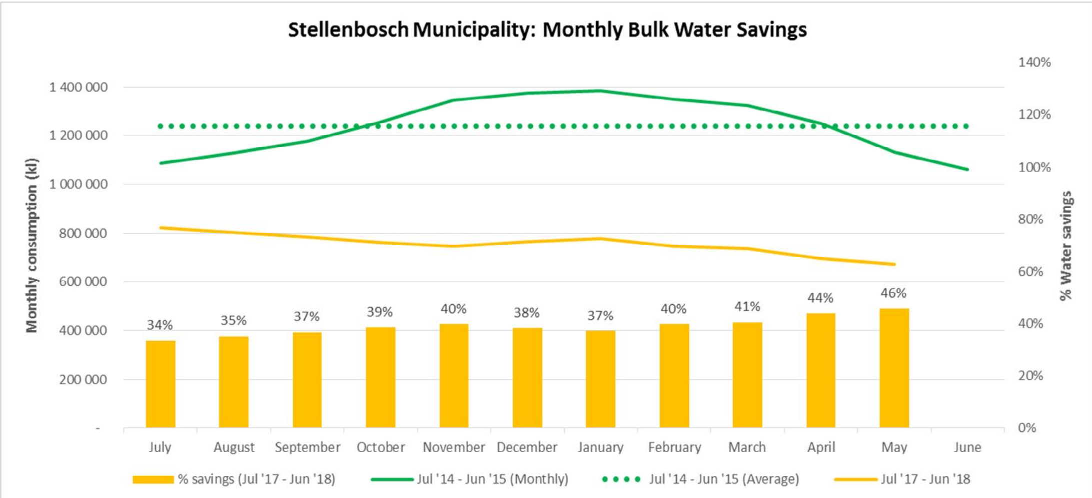
In order to manage the current drought that is experienced in the Western Cape SM has set a target to reduce their normal water consumption by 45%. The water demand for the 2014/15 financial year is used as base demand because it was the last financial year where no water restrictions were enforced on the SM water users (normal water consumption patterns were followed by the SM consumers).

The 2014/15 baseline water demand for SM was 14 876 Ml/a (AADD of 40,8 Ml/d). The target water demand for a drought scenario for SM is calculated at 8 182 Ml/a (AADD of 22,4 Ml/d). The target water demand for each supply system is as follows:

- Stellenbosch town system : 5 449 Ml/a (AADD = 14,93 Ml/d)
- Franschhoek system : 820 Ml/a (AADD = 2,25 Ml/d)
- Dwars River system : 469 Ml/a (AADD = 1,28 Ml/d)
- Klapmuts system : 305 Ml/a (AADD = 0,84 Ml/d)
- Rural supply systems : 1 138 Ml/a (AADD = 3,12 Ml/d)

Figure SW2.4a below shows the monthly water demand and percentage savings for SM against the target demand (based on the 2014/15 baseline demand):

Figure SW2.4a: Monthly water consumption and savings for Stellenbosch Municipality



From Figure SW2.4a above it can be seen that demand for SM has decreased during the 2017/18 financial year and the target demand of 22,4 Ml/d (monthly demand of 680 Ml) has been reached during May 2018.

On a system for system basis the Dwars River system is the only system that currently does not reach their target demand, as can be seen in Table SW2.2a below.

Table SW2.2a: Stellenbosch Municipality: Bulk water savings per supply area

Stellenbosch Municipality: Bulk water savings per supply area:			
Town/ supply area	**Baseline demand** (2014/15) ML/d	**Current demand** (May 2018 volumes) ML/d	**% Reduction** (Target = 45%)
Stellenbosch town	**27.2**	**14.7**	**46.0%**
Franschhoek area	**4.1**	**2.1**	**48.5%**
Dwars River area	**2.3**	**2.4**	**-1.1%**
Klapmuts	**1.5**	**0.9**	**42.2%**
Rural areas	**5.7**	**2.1**	**62.4%**
Total	**40.8**	**22.1**	**45.7%**

The Dwars River system is currently (May 2018 readings) using more water than what they did in 2014/15. This is also the reason that the target savings on the CCT source is currently only 42,9%, as can be seen in Table SW2.2b below:

Table SW2.2b: Stellenbosch Municipality: Bulk water savings per source

Stellenbosch Municipality: Bulk water savings per source:			
Water resources	**Baseline demand** (2014/15) ML/d	**Current demand** (May 2018 volumes) ML/d	**% Reduction** (Target = 45%)
CCT	**12.3**	**7.0**	**42.9%**
SM + WCWSS	**28.5**	**15.1**	**46.9%**
Total	**40.8**	**22.1**	**45.7%**

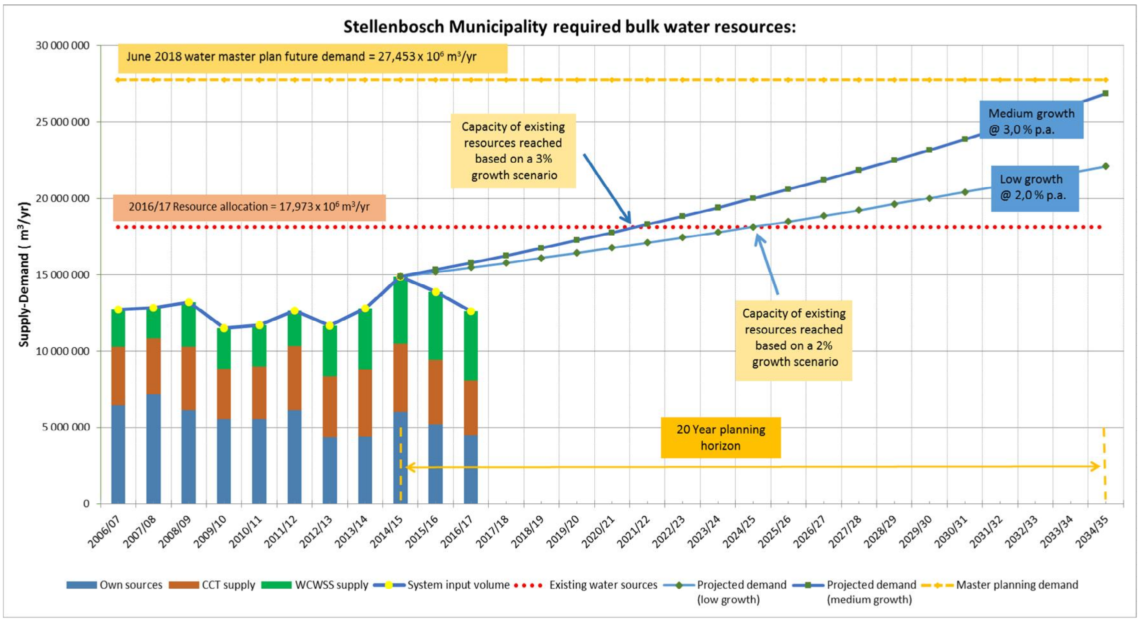
6.3.4 Future demand

In the June 2017 Water Master Plan for SM the potential future AADD for SM is calculated at 75,21 Ml/d. The future AADD of the SM system is summarised in Table SW2.3.

The future AADD (modelled as the future system) represents an increase of ± 86% over the baseline AADD of 40,8 Ml/d for the 2014/15 financial year. This AADD will be realised in the year ± 2036 if the demand increases at a compounded growth rate of ± 3,0% per year (a growth rate of 3,0 % was used as a medium growth rate for planning of the bulk water resources for SM). At a lower growth rate of 2,0% per year this AADD will be realised in the year ± 2046.

The current water resources available for SM is calculated at 17 973 Ml/a. The potential future resources required for SM is calculated at 27 453 Ml/a. Figure SW2.6a below shows the existing SM demand, projected demand based on a low and medium growth in water demand of 2,0% and 3,0% respectively (under normal demand conditions, no restrictions), the existing available resources, and the future required resources as calculated in the latest Water Master Plan.

Figure SW2.6a: Stellenbosch Municipality required bulk water resources



From Figure SW2.6a it can be seen that:

- The capacity of the existing SM water resources will be reached in 2021 if water demand in the municipality increases at a growth rate of 3,0% under normal demand conditions
- If a lower growth rate of 2,0% is realised, the existing water resources will be reached by 2025.
- Additional water resources of 9 480 Ml/a will be required to supply the future water demand of SM as calculated in the latest Water Master Plan.

6.3.5 Resource planning

In order to mitigate the current risk of being mostly dependent on surface water and having no control over water supplied from external sources, bulk water resources for SM should be augmented to include more supply from resources other than surface water. This can be water from the following resources:

- Extension of existing ground water sources.
- Transfer of irrigation water allocations (proposed increase in the allocation to the Paradyskloof WTP from DWS after existing water allocations from the Winelands Water Users Association (WUA) is transferred to SM in change for treated effluent from the Stellenbosch Wastewater Treatment Plant (WWTP)).
- Reclamation of water from the existing WWTPs.

In the Stellenbosch Municipality Resource Planning it is proposed that the extension of the existing ground water resources should first be implemented in order to supply water to the Municipality for a scenario where water is not available from the current surface water resources.

In order to meet the future water demand for SM (as calculated in the latest Water Master Plan), the existing surface and groundwater resources should be augmented. This can be from the following resources (after groundwater and reclamation projects are implemented).

- Increase existing allocations from CCT (this can only be done after CCT has increased the reliability of their existing water resources)
- Increase existing allocation from DWS (from the Theewaterskloof tunnel)

- Rainwater harvesting (this option was not investigated as part of this report)

For a severe drought condition the only reliable surface water will be from SM's own sources in the Jonkershoek Valley for Stellenbosch and from the Perdekloof source for Franschhoek. It was assumed that no water will be available from CCT from the Wemmershoek pipeline to supply water to the Franschhoek, Dwars River, Meerlust, Klapmuts and Koelenhof systems. It was further assumed that sufficient water will however be available from CCT to supply the Muldersvlei, Polkadraai, Faure, Raithby, Helderberg and Croydon rural systems.

The total additional water resources required for SM in order to supply basic water during drought conditions to the existing SM consumers can be summarised as follows:

- Stellenbosch town system : 1 106 Ml/a (required to replace a portion of the supply from the Paradyskloof WTP)
- Dwars River system : 469 Ml/a
- Franschhoek system : 665 Ml/a
- Klapmuts system : 305 Ml/a
- Koelenhof system : 413 Ml/a
- Meerlust system : 9 Ml/a

In order to supply the potential future water demand of 27.45 Ml/a (as calculated in the latest Water Master Plan) SM requires additional water resources of 9 480 Ml/a. The required resources of 9 480 Ml/a can be attributed 5 482 Ml/a to the Stellenbosch town system and 3 998 Ml/a to the other systems (Dwars River, Franschhoek, Klapmuts and rural systems).

6.4 BULK WATER MONITORING

Monitoring of existing water demand is crucial for any municipality to access the existing demand/supply situation, determine efficiency of the existing systems and to plan bulk water infrastructure to address existing efficiencies and provide for anticipated future growth. In SM projects were identified and implemented to measure bulk water demand and efficiency and to provide the required information to the managers of the systems in a user friendly and real time manner.

6.4.1 Bulk water meters

For SM bulk water meters should be maintained (and implemented where required) to accurately calculate the following:

- Raw water supply and losses
- Water treatment losses and efficiency
- System input volume (to perform accurate water balances)
- Losses in potable bulk water supply system
- Metering of sub-zones downstream of the supply reservoirs

Table SW3.1 below shows the different levels of bulk meters that is used in SM to perform the larger water balance of the bulk water system:

Table SW3.1: Bulk water meter definitions for SM

Bulk meter level	Description
Level 1	Demand from raw water sources
Level 2	Inlet at water treatment plants
Level 3	Outlet at water treatment plants
Level 4	Supply to network from other sources
Level 5	Meters on the bulk supply system between the reservoirs and the water source
Level 6	Outlet from reservoirs
Level 7	Sub-zonal meters
Level 8	Consumer meters

The positions of the existing and proposed meters to calculate raw water losses, water treatment losses and efficiency, system input volume, losses in the potable water system and metering of sub-zones downstream of the supply reservoirs are shown on Figures SW3.1 to SW3.4.

Table SW3.3 shows the relevant inflow and outflow meters in order to calculate the relative water losses for each system.

6.4.2 Raw water supply losses

In SM raw water supply losses are not currently metered, but can be determined in the Stellenbosch and Franschhoek systems on the Jonkershoek raw water pipelines between the Eerste River weir and the Idas Valley WTP and dams, the Paradyskloof raw water pipeline between the outlet of the Theewaterskloof Tunnel and the Paradyskloof WTP and on the Perdekloof raw water pipeline between the Perdekloof water sources and the filters (located at the Franschhe Hoek Estate lower reservoir) and the Franschhoek raw water dam (between Reservoir East and Van Riebeeck Streets).

The positions of the existing and proposed level 1 and 2 meters to calculate raw water losses for the Stellenbosch and Franschhoek systems are shown on Figures SW3.2a - c and SW3.3a – d.

6.4.3 Water treatment losses and efficiency

In SM bulk water meters are implemented to determine water losses and efficiency of the Idas Valley, Paradyskloof and Franschhoek filters water treatment plants.

The positions of the level 2 and 3 meters to calculate water losses and efficiency of the existing water treatment plants are shown on Figures SW3.3a, SW3.3b, SW3.3c & SW3.3d.

6.4.4 System input volume

The system input volume is the total volume of potable water supplied by the municipality. For SM this is the total of water after the treatment works plus treated water purchased from the CCT and are determined through the level 3 & 4 meters. These meters are implemented for SM and shown on Figure SW3.1.

6.4.5 Losses in bulk supply system

In SM losses in the bulk supply systems downstream of the treatment plants or connection points to the CCT supply are not currently metered and form part of a future project. Losses in the bulk supply system include any water losses on the infrastructure between the level 3 & 4 meters (system input volume) and the water meters downstream of the reservoirs (supply into the reticulation network). This include water losses in reservoirs.

In the SM systems losses can be determined on the following bulk supply infrastructure:

1) Bulk supply infrastructure from the Idas Valley and Paradyskloof water treatment plants, supplying bulk water to all the reservoirs in the Stellenbosch town system.
2) Bulk supply infrastructure in the Dwars River system after the bulk connection point to the CCT Wemmershoek pipeline, supplying bulk water to the reservoirs in the Dwars River system.
3) Bulk supply infrastructure in the Franschhoek system after the bulk connection point to the CCT Wemmershoek pipeline, supplying bulk water to the Groendal, Langrug and Franschhoek reservoirs in the Franschhoek system.
4) Bulk supply infrastructure in Klapmuts after the bulk connection point to the CCT Wemmershoek pipeline, supplying bulk water to the 7.0 Ml reservoir in the Klapmuts system.
5) Bulk supply infrastructure in the Polkadraai system, after the bulk connection point to the CCT Blackheath pipeline, supplying bulk water to the SM Blackheath reservoirs.

6.4.6 Reticulation and sub-zonal meters

In SM limited bulk water meters are available to determine water losses in the reticulation system of the reservoir supply areas or any smaller sub-zones, i.e. booster zones, pressure-reducing zones or any other sub-zones. It is proposed that these level 6 and 7 meters are implemented under future projects for SM.

The positions of the level 6 and 7 meters to calculate water losses in the existing reticulation systems downstream of the reservoirs are shown on Figures SW3.1 to SW3.3.

The relevant inflow and outflow meters for each reservoir supply zone or any smaller sub-zone in order to calculate water losses in the SM reticulation network are shown on Table SW3.3.

6.4.7 Live telemetry data

All water meters in SM required to determine system input volume are equipped with monitoring devices in order to access data remotely. All information from these bulk meters are currently available in real time and can be access over the internet.

Flow and pressure data of existing PRV’s, critical pressure points in the SM network and reservoir and dam level data are currently accessed in real time and linked to the existing Infrastructure Management Query Station (IMQS) system for SM.

This gives the municipality the ability to access all relevant telemetry and SCADA data in real time on one platform.

As part of the current drought project new boreholes and bulk meters are currently being installed for SM and it is proposed that monitoring and flow data from the boreholes are in future included in the existing live telemetry system of SM.

6.4.8 Water dashboard

Live system input volume and dam levels data are used on a weekly basis to report on water demand, water storage capacity and water savings in SM.

Data presented in the weekly water dashboard for SM such as weekly water demand per system, current status of water savings, dam levels and water production per treatment plant are shown on Figures SW3.5a, SW3.5b and SW3.5c below.

Figure SW3.5a: SM Water dashboard - Demand, savings and dam levels

SM AADD (weekly average) **19.95 ML/d** (Target = 22.43 ML/d)	**% Savings** (on 2014/15 baseline demand) **51.6%** (Target = 45,0 %)	**Dam storage** (Stellenbosch town) **94.4%** (166 days x current AADD)	**Water dam level change (%)** **0.0%** Increase since last week

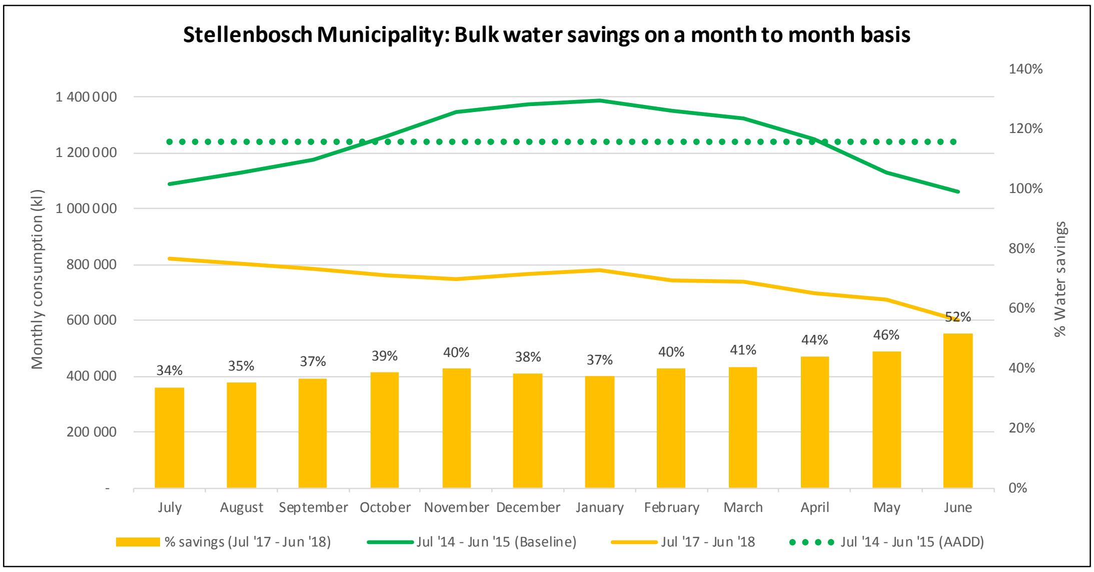


Figure SW3.5b: SM Water dashboard - Water production per plant

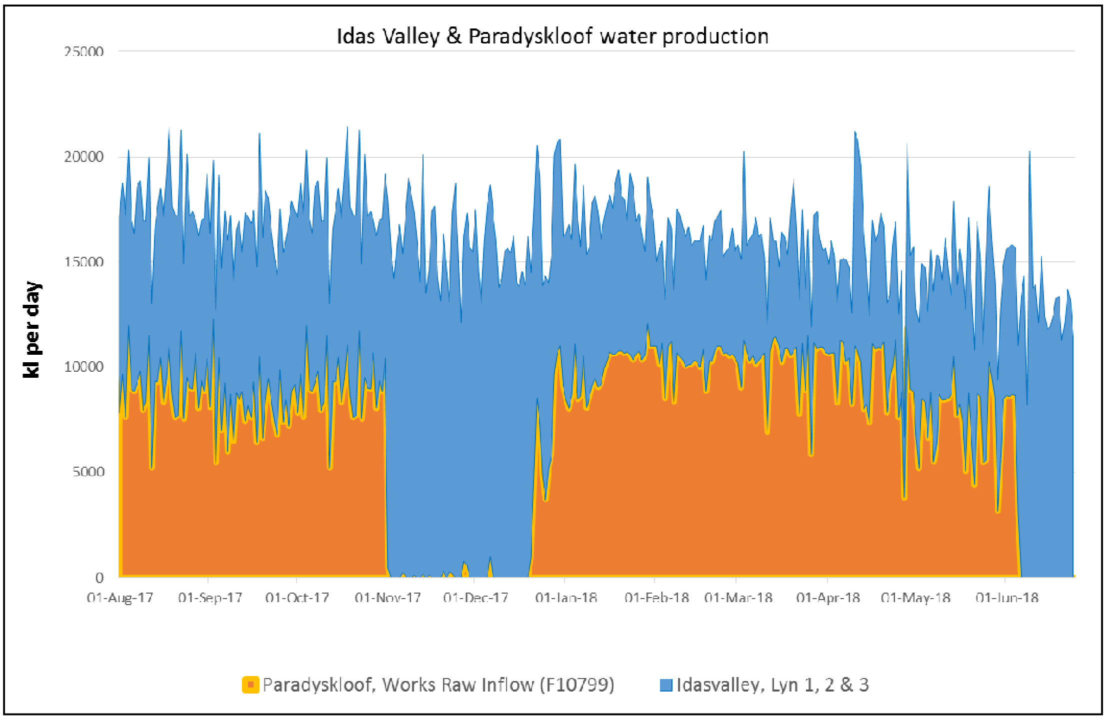
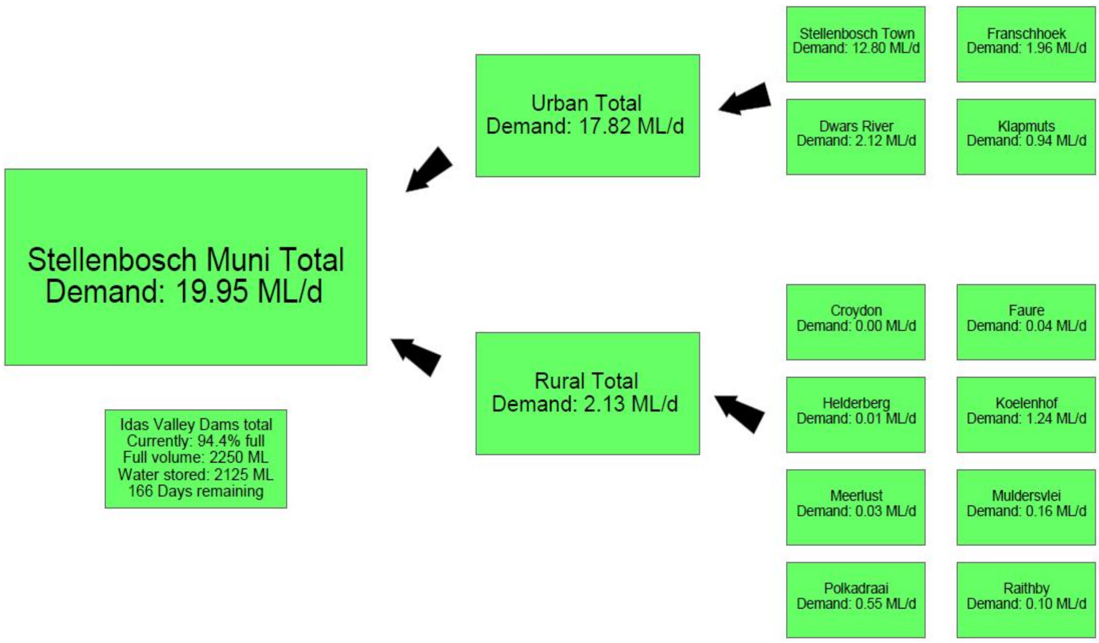


Figure SW3.5c: SM Water dashboard - Water demand per system



6.5 PRESSURE MANAGEMENT PROJECTS

6.5.1 Existing pressure reducing zones

As part of the Water Demand Management strategy of SM existing pressure reducing zones should be optimised in order to reduce water pressure in networks, with the aim of reducing water demand and water losses in the reticulation network.

Each of the existing pressure reducing valve (PRV) zones in SM should be optimised and monitored through the following actions:

- Verify that each pressure zone is discreet.
- Ensure that a bulk water meter is installed at the PRV installation (if relevant).
- Set PRV and monitor PRV (and if relevant critical point in network).

In the SM water systems there are currently 22 existing PRV zones, supplied with water from 24 PRVs. In the SM system there are also 5 PRVs that are currently not in operation (and can be decommissioned), 6 PRVs that are only used under emergency conditions, 4 PRVs that augment water supply to existing reservoir zones and 1 PRV on the existing Perdekloof raw water system in Franschhoek.

Table SW4.1 shows a list of the existing PRVs (total of 40), the status and setting for each PRV and if the PRV is equipped with a water meter as part of the installation.

6.5.2 Potential pressure management projects

As part of the Water Master Plan and the Drought Intervention Planning for SM projects to optimise existing PRV zones and projects to implement additional PRV zones in SM are identified.

Through the implementation of these projects SM will be able to further reduce water pressure in their networks in order to reduce water demand and water losses in the reticulation network. The following pressure management projects are proposed for SM:

- Kayamandi PRV project: Phase 1 (completed)
- Kayamandi PRV project: Phase 2 (in progress)

- Stellenbosch PRV refurbish project (in progress)
- Arbeidslus PRV investigation project (in progress)
- Uniepark PRV project.
- Brandwacht PRV 2 project.
- Techno Park PRV project.
- Pniel PRV project
- Franschhoek PRV investigation project (in progress)
- Franschhoek new PRV 1 project
- Franschhoek new PRV 2 project
- Klapmuts PRV project
- Koelenhof PRV project
- Polkadraai PRV project

Continuous attention and support to water demand management with the aim of permanent reduction in demand should be given, as it could substantially impact the capital expenditure required to meet the future demand.

6.6 BULK WATER AUGMENTATION

6.6.1 Drought mitigation projects

In order to mitigate the current risk of being mostly dependent on surface water and having no control over water supplied from external sources, SM has initiate projects to augment bulk water supply from groundwater resources.

The first project was a comprehensive groundwater resource study. GEOSS, specialists in geohydrology and with local knowledge of the groundwater resources in SM, was appointed as sub-consultants to perform a comprehensive groundwater resource study for SM.

Groundwater resource study

As part of the groundwater resource study all existing municipal boreholes were identified and investigated. Boreholes with the highest yield and potential to be included in the existing water systems were identified and water quality and safe yield test were performed. These existing boreholes were included in the data basis of existing water resources.

Through the groundwater resource study areas were identified within the boundary of SM with a high probability to contain groundwater with good quality water and a high yield.

These potential new borehole sites were then filtered based on land ownership and the proximity of the existing water infrastructure. From this exercise 31 potential areas within SM were identified where the potential borehole sites were close to the existing water infrastructure and exploration drilling could commence. In the areas where the potential boreholes were not on municipal land, but still close to the existing water infrastructure, the SM has negotiated with the land owners in order to commence with the exploration drilling.

Yield and quality testing

Where successful exploration boreholes were drilled, yield and quality testing were performed to determine the water quality and the safe yield of the exploration boreholes.

These information were used to determine if each exploration borehole could be used as a production borehole, or if a new production borehole should be drilled (with a higher yield), what the safe yield should be for the borehole, at what depth the borehole pump should be installed and if it is required to treat the water before it can be used as part of the reticulation network.

From these information a borehole scheme could be designed for each area.

Borehole scheme design

For each production borehole a scheme was designed of how the borehole will connect to the existing water system. The following information were provided per borehole scheme:

- Proposed duty points of production boreholes
- Safe yield per borehole
- Proposed pipework to connect borehole to the network or to a mobile water treatment plant (if required)
- Position of mobile water treatment plant (if borehole water requires treatment)
- Proposed duty points of booster PS from mobile water treatment plant to the network (if required)
- Connection point to the water network

From the borehole design scheme information the required electricity demand for the borehole pumps, mobile treatment units and booster pumps were calculated and provided to the SM Electricity Department to perform detail designs.

The required yield from the groundwater resources, existing boreholes and results of yield and quality testing, potential borehole areas, results of the borehole drilling, results of the yield and quality testing and proposed borehole design schemes for each supply system are discussed in detail in paragraphs 5.2.5 to 5.2.9.

6.6.2 Borehole schemes

The following borehole schemes were designed for SM:

Van der Stel scheme	:	Safe yield of scheme: 568 Ml/a (1 555 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 1,3 Ml/d
	:	Status: Commissioned in April 2018
Die Braak scheme	:	Safe yield of scheme: 370 Ml/a (1 015 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 1,3 Ml/d
	:	Status: Commissioned in May 2018
Cloetesville scheme	:	Safe yield of scheme: 134 Ml/a (367 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 1,3 Ml/d
	:	Status: To be commissioned in September 2018
Papegaaiberg scheme	:	Safe yield of scheme = 526 Ml/a (1 440 kl/d)
	:	Treatment plant required: No, only chlorination at the Papegaaiberg reservoir
	:	Status: Future project
Jackson Street scheme	:	Safe yield of scheme: 228.6 Ml/a (626 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 1,3 Ml/d
	:	Status: To be commissioned in September 2018
Kylemore Upper	:	See Figure SW5.3h
	:	Borehole: KLM_ExBH_1_Redrill
	:	Safe yield of scheme: 52.6 Ml/a (144 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in October 2018

Pniel borehole scheme	:	Safe yield of scheme: 84.1 Ml/a (230 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in 2018/19 financial year
Pniel Sport scheme	:	Safe yield of scheme: 63.1 Ml/a (173 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in 2018/19 financial year
Lanquedoc scheme	:	Drilling to be done at site LQD_ExBH_2.
	:	Safe yield of scheme: To be determined
	:	Treatment plant required: No, only chlorination
	:	Status: Future project
Wemmershoek scheme	:	Safe yield of scheme: 1 054 Ml/a (2 887 kl/d)
	:	Treatment plant required: Yes
	:	Capacity of plant: 3,9 Ml/d
	:	Status: To be commissioned in September 2018
Klapmuts WWTW and Railway line scheme	:	Safe yield of scheme: 336.4 Ml/a (922 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in October 2018
	:	Transfer capacity: Water can be transferred to the Koelenhof rural supply scheme
Sport field	:	Safe yield of scheme: 73.6 Ml/a (202 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in 2018/19 financial year
Old & Lower reservoirs	:	Safe yield of scheme: 63.1 Ml/a (173 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: Future project
Meerlust	:	Safe yield of scheme: 23.7 Ml/a (65 kl/d)
	:	Treatment plant required: No, only chlorination
	:	Status: To be commissioned in July 2018
Koelenhof reservoir	:	Safe yield of scheme: To be determined
	:	Treatment plant required: No, only chlorination
	:	Status: Future project
Mariendahl	:	Safe yield of scheme: 151.5 Ml/a (415 kl/d) – excluding yield of proposed production borehole MD_PBH_1)
	:	Treatment plant required: To be determined, possibly only chlorination
	:	Status: To be commissioned in 2018/19 financial year

The potential yield of the current borehole projects that are implemented (or in the process to be finalised) by SM is calculated at 2 867 075 Ml/a.

Potential future borehole projects with a safe yield of 1 101 205 Ml/a have also been identified by SM and can in future be implemented to augment bulk water supply to SM.

6.6.3 Future resources

In the water master plan the potential future water demand for SM is calculated based on a scenario where all existing erven are occupied and all potential future development areas within the urban edge of the municipality is fully developed.

The future AADD of SM is anticipated to be 75 214 kℓ/d. This AADD will be realised in the year ± 2046 if the demand increases at a compound growth rate of ± 2,0 % per year (low demand scenario) and ± 2035 if the demand increases at a compound growth rate of ± 3,0 % per year (medium demand scenario).

The total additional resources required for SM in order to supply the potential future water demand is calculated at 9 480 Ml/a (AADD of 25,97 Ml/d), and can be allocated to the main supply areas as follows:

- 15,02 Ml/d to the Stellenbosch town area (currently supplied with water from its own source in the Jonkershoek Valley and water from the WCWSS through the Paradyskloof tunnel), and
- 10,95 Ml/d to all the other urban and rural areas (the Dwars River system, Franschhoek system, Klapmuts system and rural supply areas, supplied with bulk water mainly from the CCT).

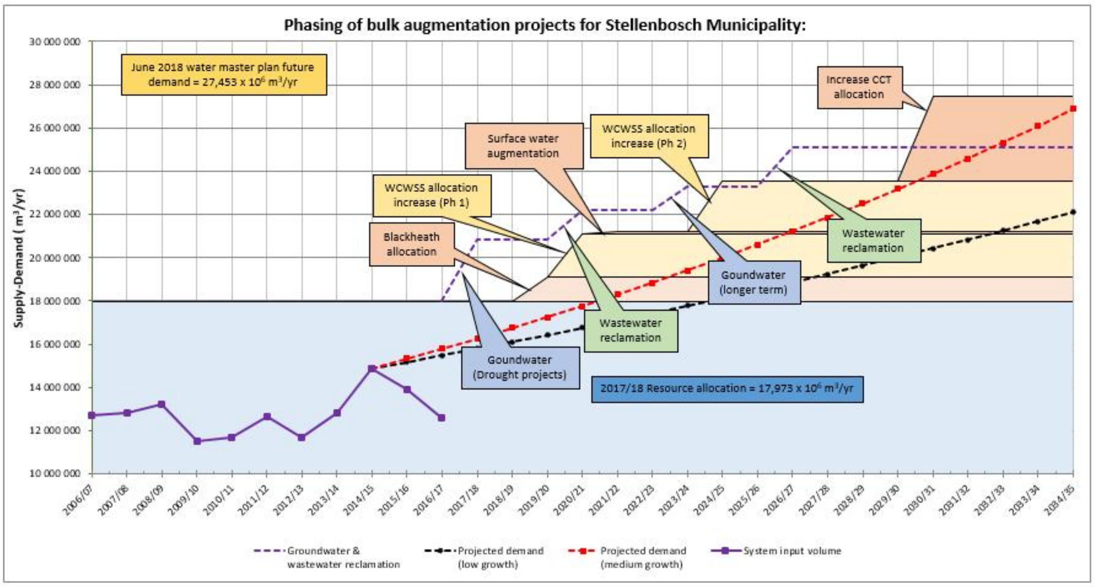
Table SW5.2 gives a summary of the future water demand for SM, the safe yield of the existing water resources available, and the additional resources required to supply the future water demand for SM

The phasing of the required future resources for SM can be summarised as follows:

1. Short term groundwater projects (2 867 Ml/a) - required for SM water systems to be more drought resilient.
2. Allocation to Stellenbosch town system from CCT Blackheath WTP (1 141 Ml/a) - required to develop Vlottenburg node and to improve redundancy of the Stellenbosch bulk supply system.
3. Wynland WUA allocation transfer (volume to be determined) – detail investigation required.
4. Increase allocation from WCWSS supplied to the Paradyskloof WTP (2 000 Ml/a as a first phase) - during normal demand conditions the current allocation is exceeded by SM.
5. Wastewater reclamation at the Dwars River, Wemmershoek and Klapmuts wastewater treatment works (1 350 Ml/a) - required for SM water systems to be more drought resilient, more detailed study required to determine volumes.
6. Surface water augmentation (78 Ml/a) – incorporate existing yield of the Pniel surface water resource. Option should also be investigated to include the yield of the Groendal water resource.
7. Longer term groundwater projects (1 101 Ml/a) - required for SM water systems to be more drought resilient and independent on supply from CCT.
8. Increase allocation from WCWSS supplied to the Paradyskloof WTP (2 350 Ml/a as a second phase).
9. Wastewater reclamation at the Stellenbosch wastewater treatment works (1 825 Ml/a) - required for SM water systems to be more drought resilient. A more detailed study is required to determine required volume.
10. Increase water allocation from CCT (490 Ml/a) - when demand of existing systems exceeds current allocation.

Figure SW5.4a below shows the phasing required of the water resource augmentation projects for Stellenbosch Municipality up to the year 2035:

Figure SW5.4a: Phasing of bulk augmentation projects for Stellenbosch Municipality



6.7 PRIORITY PROJECTS

It is proposed that projects are implemented by SM in order to improve the monitoring of bulk water supply, water losses and efficiency of the existing SM water systems, to improve existing and implement new pressure management zones within SM, and to extend the existing water resources of SM to be more drought resilient:

The proposed projects with the highest priorities are summarized below:

Water monitoring

- Stellenbosch bulk meters: Measurement and implementation of meters to determine bulk supply and reticulation water losses.
- Dwars River bulk meters: Measurement and implementation of meters to determine bulk supply and reticulation water losses.
- Franschhoek bulk meters: Measurement and implementation of meters to determine bulk supply and reticulation water losses.
- Klapmuts bulk meters: Measurement and implementation of meters to determine bulk supply and reticulation water losses.
- Update schematic layouts: Update existing schematic layouts of the SM water systems and update with live data.

Pressure management

- Kayamandi PRV project: Phase 1 (completed)
- Kayamandi PRV project: Phase 2 (in progress)
- Stellenbosch PRV refurbish project (in progress)
- Arbeidslus PRV investigation project (in progress)
- Uniepark PRV project.
- Brandwacht PRV 2 project.
- Techno Park PRV project.
- Pniel PRV project
- Franschhoek PRV investigation project (in progress)
- Franschhoek new PRV 1 project
- Franschhoek new PRV 2 project
- Klapmuts PRV project
- Koelenhof PRV project
- Polkadraai PRV project

<u>Ground water</u>

- Van der Stel borehole scheme (completed)
- Die Braak borehole scheme (completed)
- Cloetesville borehole scheme (to be commissioned in September 2018)
- Jackson Street borehole scheme (to be commissioned in September 2018)
- Kylemore Upper borehole (to be commissioned in September 2018)
- Pniel borehole scheme
- Pniel Sport borehole scheme
- Lanquedoc borehole scheme
- Wemmershoek scheme (to be commissioned in September 2018)
- Klapmuts WWTW and railway borehole scheme (to be commissioned in Sept 2018)
- Klapmuts sport field borehole scheme
- Meerlust borehole scheme (completed)
- Koelenhof reservoir borehole
- Mariendahl borehole scheme
- Water use license applications (WULA) for all boreholes at DWS

<u>Resource augmentation</u>

- Klapmuts wastewater reclamation: Detailed study required
- Dwars River wastewater reclamation: Detailed study required
- Wemmershoek wastewater reclamation: Detailed study required
- Winelands WUA allocation transfer: Detailed investigation required
- Pniel surface water augmentation
- Groendal surface water augmentation
- Increase WCWSS allocation to Paradyskloof WTP (phase 1)
- New CCT water allocation at Blackheath WTP to Stellenbosch town
- Jonkershoek augmentation (detail study required to investigate the possible increase in yield from the Jonkershoek water source through the enlargement of the storage capacity of the existing Idas Valley dams)

6.8 CONCLUSION

It is recommended that the projects as described in this report be implemented in order to allow the SM bulk water resources to keep in step with the anticipated growth in water demand and to be more resilient in future during periods of severe drought.