AUGMENTING CAPE TOWN’S WATER SUPPLY

An Alternative Solution

By Willem Botes (Pr. Tech Eng.) and Dr. Johann van Wyk
Decreasing water availability due to climate change and increasing population resulted in an urgent need for augmenting Cape Town’s water supply.

All possible alternatives/proposed solutions need to be considered in terms of benefits and risks:

- Environmental
- Financial
- Social (including legal and political)
- Practical

These factors ultimately influence the feasibility and sustainability of the chosen solution(s)
Cape Town = Winter Rainfall Area

A better solution than trying to source water from within the region could be to source from another climatic region (summer rainfall area).

Given its size and current use, as well as potential positive impact on the water security of a much larger area, the Vanderkloof Dam seems to be the best option.
The seven largest dams in South Africa

<table>
<thead>
<tr>
<th>Dam</th>
<th>Completed</th>
<th>River</th>
<th>Capacity (mil. m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gariep</td>
<td>1971</td>
<td>Orange</td>
<td>5,343</td>
</tr>
<tr>
<td>Vanderkloof</td>
<td>1977</td>
<td>Orange</td>
<td>3,188</td>
</tr>
<tr>
<td>Sterkfontein</td>
<td>1980</td>
<td>Nuwejaarspruit</td>
<td>2,616</td>
</tr>
<tr>
<td>Vaal</td>
<td>1938</td>
<td>Vaal</td>
<td>2,536</td>
</tr>
<tr>
<td>Pongolapoort</td>
<td>1973</td>
<td>Pongola</td>
<td>2,446</td>
</tr>
<tr>
<td>Bloemhof</td>
<td>1970</td>
<td>Vaal</td>
<td>1,269</td>
</tr>
<tr>
<td>Theewaterskloof</td>
<td>1980</td>
<td>Riviersonderend</td>
<td>480</td>
</tr>
</tbody>
</table>

Are there more alternatives?
The Vanderkloof Dam (Orange River) is the second largest dam in South Africa. Capacity: 3187.5 million m³.

50% of capacity can supply 29 million people for one year at a consumption of 150 liter/person/day.

The Vanderkloof Dam is augmented by the Gariep Dam, 50 km upstream, the largest dam in South Africa. Capacity: 5343 million m³.

These dams are in the summer rainfall area. During winter (low rainfall) the effect of additional abstraction will be limited.
Vandekloof Dam Specifications

Capacity of Vandekloof compared to:

- Theewaterskloof Dam: **6.6 x larger**
- Voëlvlei Dam: **19 x larger**
- Bergrivier Dam: **25 x larger**
- Wemmershoek Dam: **55 x larger**
Vanderkloof Dam Specifications

Difference in elevation between Theewaterskloof Dam:

> 1000 m

Distance between Voelvlei Dam and Vanderkloof as the crow flies:

700 km
Compare the Orange River catchment to the Berg River catchment.

Of the 6 main metropolitan areas in South Africa only 2 are supplied by a portion of the Orange River Basin.
The annual runoff from the catchment feeding the Vanderkloof Dam (Senque, Caledon, Upper Orange) is 6,673 million m$^3$. If 400 000 m$^3$ per day is transferred for 3 months (summer), it amounts to 0.5% of the annual runoff.

Department of Water Affairs, South Africa, 2012. DEVELOPMENT OF RECONCILIATION STRATEGIES FOR LARGE BULK WATER SUPPLY SYSTEMS ORANGE RIVER: SURFACE WATER HYDROLOGY AND SYSTEM ANALYSIS REPORT: Report No. P RSA D000/00/18312/7
Pipeline(s) to the Western Cape

Preliminary optimized route between Vanderkloof and Voëlvlei is 824 km
Length of pumping lines: 120 km. This is a conservative estimate as detailed surveys will result in a more optimized route.

Length of gravity lines: 704 km

Three pump stations

Headloss due to friction: 412 m (> 1000 m available)
Pipeline(s) to the Western Cape: Some technical aspects

Requirements to convey 400 million liters of water (1/2 the daily consumption of Cape Town and adjacent towns in the Cape Winelands and Berg River municipalities):

- Flow of 2.1 m³/s in 2 x 1.7 m diameter pipelines.
- Flow of 1.5 m³/s in 3 x 1.4 m diameter pipelines.

Why 2 or 3 pipelines?

- More sustainable option with regard to maintenance and shut downs.
- More pump alternatives (smaller pumps)
- Route preparation the same.
- Project can be phased over time as the demand increase.
Pipeline(s) to the Western Cape: Some technical aspects

Abstraction of 400 000 m³/day for one month is < 0.4% of the total capacity of the Vanderkloof Dam.

Environmental impact: Limited to construction (temporary) as for most of the line existing servitudes for roads, rails or power lines can be followed. Insignificant when compared to alternative new resources (groundwater extraction, new dams or brine discharges to the surf zone).

No new treatment plants (or additional process plant) are required.

Immediate and long term solutions to frequently drought stricken Karoo towns (e.g. Victoria West, Beaufort West, Laingsburg, etc.) saving millions of Rands.
Pipeline(s) to the Western Cape: Some technical aspects

Present inflow to Vanderkloof (13/10/2017) is > 60 cumec (or 6.9 million m$^3$/day) which is > 10 times the present daily target of Cape Town (500 000 m$^3$).
**Cost:** Preliminary estimates:

< 50% of estimated cost for desalination plant

**Employment:** Preliminary estimates include:

> 200,000 man days

**Local/national work force:** All expertise and facilities are locally available – South African companies.

**Available gravity head:** Possible generation of electricity – turbines in pipelines.
Is this a far fetched idea (Pipe dream)?

Water conveyance systems in the USA – Coastal Cities

**Pipe Dreams: Water Supply Pipeline Projects in the West**

Authors
Denise Fort, University of New Mexico Law School
Barry Nelson, Natural Resources Defense Council

California State Water Project:
> 1100 km

Los Angeles Aquaduct:
> 350 km

Transbasin diversions: **Source from other climate region**
Is this a far fetched idea (Pipe dream)?

Australia – Coastal Cities

Moving water long distances:
Is this a far fetched idea (Pipe dream)?

Due to rapid urbanization and industrial developments there was in 1959 already 353,000 miles of WATER, gas and oil pipelines in the USA and pipelines worth > $ 2 milliard were added in 3 years time.

These were trans-state and trans-basin lines to provide for water scarce urban developments.
How can WAMTech Contribute?

Experience.....

First feasibility study for gas pipeline from Saldanha Bay via Mossgas to Coega in the Eastern Cape.

Two routes:
- Via Cape Town
- Via Breede Valley

> 900 km

TOTAL LENGTH: 912.64 km
Experience.....

Assessment of existing 900 km pipeline – Overberg Water

Same tools and technology applied as for Protokon / PetroSA pipeline.
Experience.....
Assessment of existing 900 km pipeline – Overberg Water

- Pipe details
- Air valves
- Flush valves
- Valve chambers
- Road/Rail crossings
- River crossings
- Take-off points
Experience.....
Assessment of existing 900 km pipeline – Overberg Water

How can WAMTech Contribute?

- Pipeline Friction
- Headloss
- Velocities
- Flow rates
Thank You