Phil Mashoko (Pr Eng)
Director: W & S
City of Cape Town
South Africa
SECURITY OF WATER SUPPLY

It is the ability to continuously produce and supply safe drinking water to the end-user

ASSURANCE RISK LEVEL : 98%
SECURITY OF WATER SUPPLY DETERMINANTS

a) Demand
b) Availability of Water Resources;
c) Infrastructure Integrity and Capacity;
d) Operation and Maintenance Systems
DEMAND FACTORS

• Population Growth;
• Economic Growth – Industry Portfolio Mix;
• Water Value Chain System Efficiency;
• Conservation culture;
• New environmental/Ecological provisions
• Urbanisation dynamics;
• Pricing Strategy;
AVAILABILITY OF WATER RESOURCES

- Hydrology and hydrogeology of the catchment;
- Topography and geology- economic dam sites
- Weather Patterns & climate change;
- Land Use/cover activities;
- Alien Vegetation;
- Catchments yield optimisation;
- Quality of Water Resources and monitoring;
- Integrated Catchment Management;
INFRASTRUCTURE INTEGRITY AND CAPACITY - FACTORS

- Design assumptions;
- Asset Material and Technology used;
- Workmanship and operations;
- Configuration of Network – integrated?;
- Level of system redundancies
- Forward Planning;
- Asset Management/age of assets;
- Hydrogeology of the area;
MANAGEMENT AND OPERATIONAL SYSTEMS

- Water Resources Optimisation
- Water Assets Security and location;
- Investment Decision Making
- Risk Management;
- Operational Policies and procedures;
- Response systems;
- Resources(human, financial, IT etc)
- Compliance with Standards and legislation;
- Water Quality monitoring systems;
City of Cape Town Information

- Population: ±3.7 million;
- Water connections: 790,000
- Metered water connections: 614,000
- Bulk Customers: Stellenbosch, Drakenstein
- Number Dams: 13 (3 DWA; 10 COCT)
- WCWSS comprised of 6 major dams
- WCWSS Dams Capacity: 889 mil m³
- WCWSS Dam yield (2% risk): 559 mil m³/yr
- Small Dams Capacity: 3.9 mil m³
- COCT’s Allocated yield: 399 mil m³/yr
COCT WATER SUPPLY SYSTEM

- Treatment Works : 12(1,610ML/day);
- Bulk Reservoirs : 25(2,845ML/day);
- Bulk Conveyance Pipes: 605km
- Distribution Reservoirs : 148
- Reticulation network : 10 500km
- Waste Water Treatment Works: 24(3 outfalls)
- WWTW Capacity : 758 ML/day
- Effluent Re-use Capacity : 562 ML/day
- Average effluent Re-used : 45 ML/day
COCT WATER VALUE CHAIN

Atlantis Boreholes → 14 WTWS

14 WTWS → 25 BULK RESERVOIRS

25 BULK RESERVOIRS → 148 DISTRIBUTION RESERVOIRS

148 DISTRIBUTION RESERVOIRS → CONSUMERS 3.7m

CONSUMERS 3.7m → 21 WWTW

21 WWTW → OCEAN

OCEAN → 3 SEA OUTFALLS – 4.7%

6.4% Treated Effluent

2.7%

86.2%
COCT WATER DEMAND

- Water Supply demand;
- Agriculture Demand
- Ecological demand
WCWSS STATUS QUO SUPPLY VS DEMAND

WCWSS: RECONCILIATION OF SUPPLY AND REQUIREMENT

- Actual
- No WDM
- 100% High WDM
- Berg Dam

Annual Requirements (M m³/a)

Year (Ending 31 October)
COCT WATER SUPPLY DEMAND

Potable Unconstrained Water Demand

Allocated System Yield (399mil m³)

UWD
Actual demand
Yield

14 - 17 MARCH 2011 | CAPE TOWN, SOUTH AFRICA
COCT SECTORIAL DEMAND

Water Demand Profile (June 2010)
Total Demand: 907 Ml/d

- Residential: 47.2%
- Bulk Losses: 8.0%
- Reticulation Losses: 20.7%
- Business: 10%
- Industrial: 4.1%
- Municipal: 3.8%
- Other: 4.4%
ECOLOGICAL RESERVE DEMAND

**WCWSS: RECONCILIATION OF SUPPLY AND REQUIREMENT**

<table>
<thead>
<tr>
<th>INTERVENTION SELECTION</th>
<th>YEAR</th>
<th>YIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michell's Pass Diversion (4m³/s)</td>
<td>2019</td>
<td>36</td>
</tr>
<tr>
<td>Lourens</td>
<td>2020</td>
<td>19</td>
</tr>
<tr>
<td>Upper Wit River Diversion</td>
<td>2021</td>
<td>10</td>
</tr>
<tr>
<td>Cape Flats Aquifer</td>
<td>2022</td>
<td>18</td>
</tr>
<tr>
<td>DWAF:ASR: West Coast</td>
<td>2022</td>
<td>14</td>
</tr>
<tr>
<td>TMG Scheme 1</td>
<td>2022</td>
<td>20</td>
</tr>
<tr>
<td>Raise Lower Steenbras</td>
<td>2023</td>
<td>25</td>
</tr>
<tr>
<td>Eerste</td>
<td>2024</td>
<td>8.3</td>
</tr>
<tr>
<td>Upper Molenaars (To Berg River Dam)</td>
<td>2024</td>
<td>27</td>
</tr>
<tr>
<td>Re-use Generic 1</td>
<td>2026</td>
<td>40</td>
</tr>
<tr>
<td>Re-use Generic 2</td>
<td>2027</td>
<td>40</td>
</tr>
<tr>
<td>Desalination 1 Generic</td>
<td>2029</td>
<td>22</td>
</tr>
</tbody>
</table>

**Annual Requirements (Mm³/a)**

**Year (Ending 31 October)**

**Existing System Yield**
# COCT Water Balance 2009/10

|                                           | Authorised Consumption 717.25 Ml/d | Billed Authorised Consumption 676.92 Ml/d | Billed Metered 676.92 Ml/d | Billed Unmetered 0 Ml/d | Unbilled Authorised Consumption 40.33 Ml/d | Unbilled metered 7.98 Ml/d | Unbilled unmetered 32.44 Ml/d | Free Basic Water | Recovered Revenue | Non-Payment | Non-Revenue Water 230.1 Ml/d (25.3%) |
|------------------------------------------|-----------------------------------|------------------------------------------|----------------------------|------------------------|-------------------------------------------|---------------------------|---------------------------|-------------------|-------------------|-------------|----------------|------------------|
| System Volume Input 907.02 Ml/d          |                                   |                                          |                            |                        |                                           |                           |                           |                   |                   |             |              |                   |
| Water Losses 189.78 Ml/d (20.9%)         |                                   | Apparent Losses 83.84 Ml/d              |                            |                        |                                           |                           |                           |                   |                   |             |              |                   |
|                                           |                                   | Real Losses 105.94 Ml/d                 |                            |                        |                                           |                           |                           |                   |                   |             |              |                   |

- **Leakage on mains**
- **Leakage on storage tanks**
- **Leakage on service conn.**
UNACCOUNTED FOR WATER

% NON-REVENUE WATER

- Total NRW
- Bulk Loss
- Distribution Losses
- Target

Percentage (%) NRW

2007/8 to 2015/16
COCT WDM INITIATIVES

- 10 year Water Demand Strategy;
- Reduce demand by 90million m³/yr- 15/16
- Reduce non–revenue water to <15%;
- Achieve a 20% saving of unconstrained demand (Berg River Dam with DWA requirement)
- Reduce wastage to <2%;
- Reduce projected potable water demand to 1% vs growth demand of ±3%;
- Introduce more equitable tariffs and informative billing;
COCT WC/WDM STRATEGY

- **Pressure Management** to reduce pipe bursts and leakage;
- **Pipe Replacement program** to reduce bursts and leakage;
- **Leak detection and pipe replacement**;
- **Fix Leaks Repair Project** for poor households;
- **Integrated Leaks Repair Projects** to reduce leakage;
- **Treated Effluent Re-use and recycling**;
- **Metering, meter audits & replacement** to improve water accounting through metering and billing inefficiencies;
- **Installation of WDM Devices** - reduce wastage & leaks
- **Consumer educational campaigns** to reduce wastage
- **Creation of District Management Areas**
- **Improved Network Information Management System** to improve response times to reported pipe bursts and leaks
EXPECTED SAVINGS VS ACTUAL

Million m³

Planned Savings
Actual Savings

COCT WATER RESOURCES

a) Surface Water Sources (93.4%)
   - Integrated WC Dam system 889mil m³/yr
   - 3 Western Cape DWA Dams: 73%
   - 10 COCT Dams (27%)

b) Borehole Water (2%)

c) 4.7% Effluent Re-use for irrigation
COCT Water Resource Allocation

CCT Total Allocation: 399 million m³/annum

DWA Sources: 73%
CCT Sources: 27%

Outside CCT Area: 13%
Inside CCT Area: 87%

Surface water: 93%
Groundwater: 2%
Effluent Re-use: 4.7%
COCT WATER SOURCES MIX

Current Available Water Resource Mix (in Million m³)

- Surface Sources: 392
- Borehole: 7
- Effluent Reuse gardening only: 205
- Spring Water gardening only: 45

Future (2036) Water Resource Mix (Million m³)

- Surface Water: 452
- Groundwater: 125
- Effluent re-use Gardening: 66
- Spring and harvesting water: 80
- Desalination: 2

Legend:
- Blue: Surface Sources
- Red: Borehole
- Green: Effluent Reuse gardening only
- Purple: Spring Water gardening only
- Other: Various water resource categories
# PLANNED WATER SOURCES

<table>
<thead>
<tr>
<th>No</th>
<th>Intervention</th>
<th>Estimated Yield (million m³/a)</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Voëlvlei Phase</td>
<td>35</td>
<td>DWA</td>
</tr>
<tr>
<td>2</td>
<td>Mitchell’s Plain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Water Re-use Scheme</td>
<td>80</td>
<td>COCT</td>
</tr>
<tr>
<td>3</td>
<td>Lourens River development</td>
<td>19</td>
<td>COCT</td>
</tr>
<tr>
<td>4</td>
<td>TMG Scheme</td>
<td>20</td>
<td>COCT</td>
</tr>
<tr>
<td>5</td>
<td>Raise Lower Steenbras Dam</td>
<td>25</td>
<td>DWA</td>
</tr>
<tr>
<td>6</td>
<td>Cape Flats Aquifer</td>
<td>18</td>
<td>COCT</td>
</tr>
<tr>
<td>7</td>
<td>Seawater Desalination Scheme</td>
<td>66</td>
<td>COCT</td>
</tr>
<tr>
<td>8</td>
<td>Rainwater Harvesting</td>
<td></td>
<td>COCT</td>
</tr>
<tr>
<td>9</td>
<td>Spring water</td>
<td></td>
<td>COCT</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RESOURCE DEVELOPMENT PRIORITISATION

- Success of the Water Demand Management Initiatives;
- Resource Yield Capacity;
- Cost Implications (capital and operating);
- Environmental Impact;
- Ability to be integrated into the network;
- Technical Considerations;
- Readiness and Lead times
WATER QUALITY

- River, dam and borehole catchment Pollution;
- Air pollution

IMPACT

- Reduces water availability without further huge investment (including groundwater);
- Increased treatment costs;
- Decrease in agriculture yields;
Introduction

Drainage Network

- 180 000 Gullies / Intakes
- 7500km pipes and culverts
- Extensive surface channel systems
- 800 detention ponds
- 1 200km rivers and streams
- Vleis, estuaries & wetlands
Inland Water Quality Trends

![Image of water quality data]

Graph showing trends in % Compliance - Bacteriological Guidelines and Average Total Phosphorous.

- **Total Phosphorous (mg/l)**
  - 2006: 0.15
  - 2007: 0.20
  - 2008: 0.25
  - 2009: 0.30
  - 2010: 0.35

- **Year**
  - 2006
  - 2007
  - 2008
  - 2009
  - 2010

- **Bacteriological Compliance**

---

14 - 17 MARCH 2011 | CAPE TOWN, SOUTH AFRICA

www.african-utility-week.com
Protection of Receiving Waters

Strategic Response

- Enforcement
- Water Sensitive Urban Design
- Management of Gross Pollution Sources
- Communication
CLIMATE CHANGE

Climate Change Experts converging views:

• Increase in Rainfall Intensity/floods;
• Temperature Increase – reduced yields and increased water demand & productivity;
• Rise in sea level-affecting coastal facilities and water quality;
• Increase in extreme events (droughts/storms)
• Cape Town we rely on down scaling techniques by CSAG(UCT) & Prof Roland Schulze at UKZN
## Future Climate in Cape Town (Temperature)

<table>
<thead>
<tr>
<th></th>
<th>Historic</th>
<th>Mid-century</th>
</tr>
</thead>
</table>
| **Mean annual temperature** | • 15-16°C in the Cape Point areas  
• 7-18°C in the inland areas | • 1.80-2.20°C increase across the city  
• 2.20 – 2.30°C increase in temperature in the north east of the city |
| **Max temp January**   | • 20-24°C in the Cape Point area  
• 25-29°C throughout the remainder of the city | • <2°C in the Cape Point area  
• 2.0 – 2.5°C throughout the remainder of the city |
| **Min temp. July**    | • 10-12°C in the Cape Point area and coastal parts of the city  
• 6-8°C throughout the remainder of the city | • 1.7-1.8°C in the Cape Point area  
• 1.8-1.9 in the remaining coastal areas of the city  
• 1.9-2.0°C in the remaining parts of the city |

(Source: Golder Associates)
**Future climate in Cape Town (Rainfall)**

<table>
<thead>
<tr>
<th></th>
<th>Historic</th>
<th>Mid-century</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean annual Rainfall</strong></td>
<td>• 350-540 mm up the West coast and in the northern areas of the city</td>
<td>• Ratio increase of 1.1 across the entire city</td>
</tr>
<tr>
<td></td>
<td>• 540-660 mm in the central and eastern areas (incl. Cape Point)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 815-2,400 in the city area</td>
<td></td>
</tr>
<tr>
<td><strong>Median rainfall January</strong></td>
<td>• 0-50 mm across the entire city</td>
<td>• Variable increase across the city ranging between 1.3 times to a reduction in the city bowl area</td>
</tr>
<tr>
<td><strong>Median rainfall July</strong></td>
<td>• 50-100 mm in the inland and Cape Point areas</td>
<td>• Variable increase across the city ranging between 1.4 times to a reduction in the city bowl area</td>
</tr>
<tr>
<td></td>
<td>• 100-150 mm along the Indian Ocean seaboard</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 150-200 mm in the city bowl area</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Golder Associates)
SCENARIO 2
High Water /100% WC/WDM WITH CLIMATE CHANGE

WCSWSS: RECONCILIATION OF SUPPLY AND REQUIREMENT

Annual Requirements (M m³/a)

Year (Ending 31 October)

Existing System Yield
STRATEGIC INTERVENTIONS

• Dam & River Catchment Initiatives and protection of resources;
• Enhanced river management initiatives;
• Upgrading WWTWs & sewerage replacement;
• Industrial Pollution monitoring & By-Law Enforcement;
• By-law reviewed and Penalties & Waste discharge fees increased;
• Established air pollution testing and monitoring unit within the Water Department;
• Engage all stakeholders & education awareness
STRATEGIC INTERVENTIONS

• Low Risk for Level of Supply Assurance – 2%;
• WCWSS Reconciliation Steering Committee reviews situation and recommend way forward;
• Enhance Resource Optimisation - integration;
• Demand Management;
• Conduct Feasibility Studies for all interventions;
• Grow demand for wastewater re-use(substitute;
• Prioritization of Resource development- Decision to fast track projects- 2012;
STRATEGIC INTERVENTIONS

• Regular yield analysis to check Climate Impact;
• Climate Change Adaptation Plan;
• Real-time water resource optimisation;
• Review of design return periods;
• Hydro-electricity generation;
• Adaptability and flexibility of technology;
INFRASTRUCTURE INTEGRITY

- Master Plan 99% complete
- Asset Management Plan;
- Replacing water pipes (≥40km per annum);
- Climate adaptation Plan (return periods);
- Identifying water assets vulnerable to increased High Flood levels;
- Embarked on a ±R1.6b Bulk Water Augmentation scheme;
PROPOSED BWAS

Figure 1
City of Cape Town: Review of Bulk Water Demands: Required works associated with Contract No WSC 1/2006

October 2007

14 - 17 MARCH 2011 | CAPE TOWN, SOUTH AFRICA

www.african-utility-week.com
MANAGEMENT & OPERATIONS

• Adopted a risk based approach to management and Investment decisions;
• Got Buy-In of the Council which is very supportive of all our initiatives;
• Working on a comprehensive practical Asset Management Plan;
• Standardisation of assets, procedures;
• Critical analysis of Material and Technology
• ISO 9000 and DIMS
• Technical Capacity Building initiatives;
CONCLUSION

• Consideration of the whole water value chain;
• Risk Approach-risks differ by region or country;
• Adaptation Plans & systems to Climate Change;
• Catchment/Environmental Management must be everyone’s business;
• Water Demand Management is the low hanging fruit for unlocking additional water resource;
• Water Sources Mix important to spread risk;
• Integrated catchment management;
• Water Pricing critical to Security of Water;
• Asset Management is key element for SOWS;
CONCLUSION

• Quick intervention Decisions;
• Soft and Hard Partnerships critical;
THANK YOU!