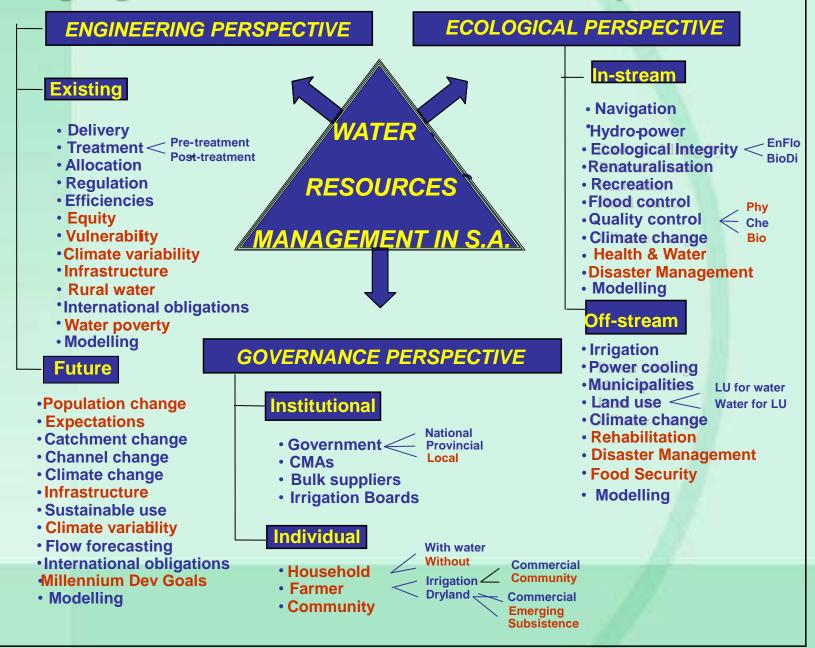
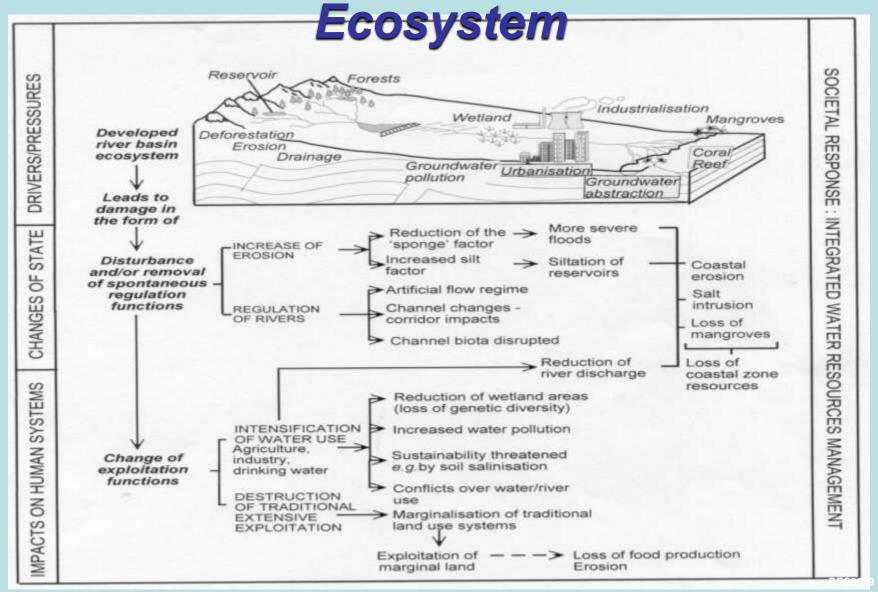


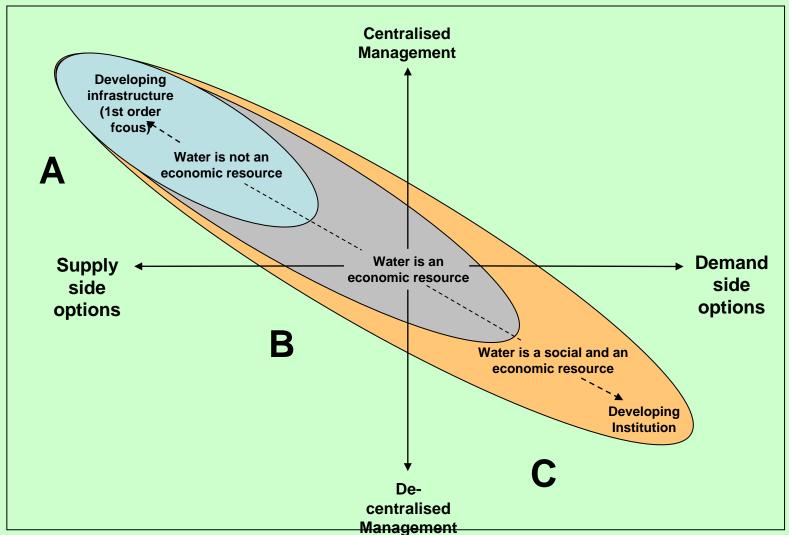
The Challenges Facing Water Security in Southern Africa are Already Significant

1. Managing Water Resources is a Complex Business



2. We have to Manage Towards Water Security within an Already Damaged

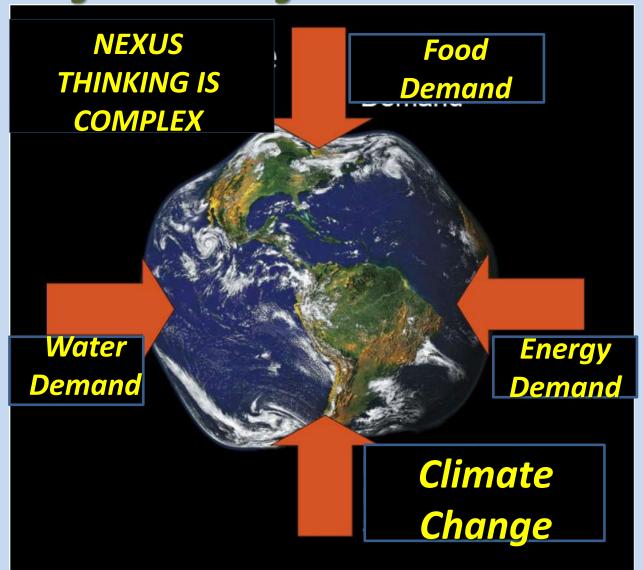




3. We Juggle Between Supply vs Demand Side and Centralised vs Decentralised Management

(Source: Africa Water and Sanitation, 2008)

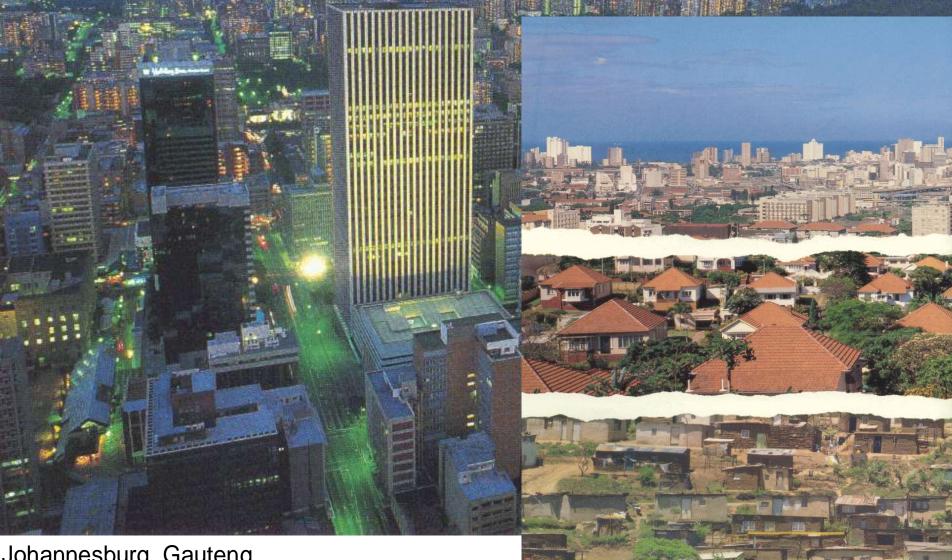
4. Water Security Lies at the Heart of the WATER – FOOD – ENERGY NEXUS Reconciling Global – Regional – Local Human Security



The Cost of In-Action > Cost of Pro-Action

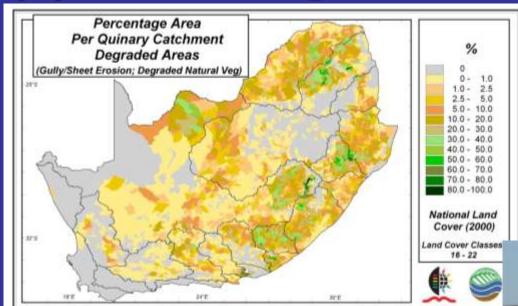
5. Water Security Encompasses the Landscape & the Channel Components of the Hydrological System NO ←Net Radiation →Runoff →Water Quality -CO₂ S OF LAND USE AND CLIMATE CHANGE RESPONSES AND WATER RESOURCES Land Cover/Use Responses **Drivers** Soils **Topography ∆** Baseline **Key CC HYDROLOGICAL** Landscape **∆ Land Use** Issues **∆ Moisture Budget PROCESSES** Component **∆** Runoff Generation **Natural Systems ∆ Water Quality** Anthropogenically Impacted Wetlands Riparian Zones **HYDROLOGICAL Key CC** Δ Ecological Integrity **Transitional ∆ Ecosystems Goods/ MODEL** Issues Component Services REQUIREMENTS **Estuaries Anthropogenic Needs** Water Engineered Systems **Key CC** WATER RESOURCES Channel ∆ Demand/Supply **MODELLING IMPACTS** △ System Failure Issues HYDROLOGICAL **MANAGEMENT** Component ΔIFRs Biotic/Abiotic A Storages Releases Routing Supply Demand Human ←Surface Water ←Ecological ←Groundwater ←Urban/Industrial ←Dams ←Irrigation ←Return Flows ←Power ←IB Transfers Allocation; IWRM

Influences of the Landscape Component: (i) Urbanisation in its Many Facets



Johannesburg, Gauteng

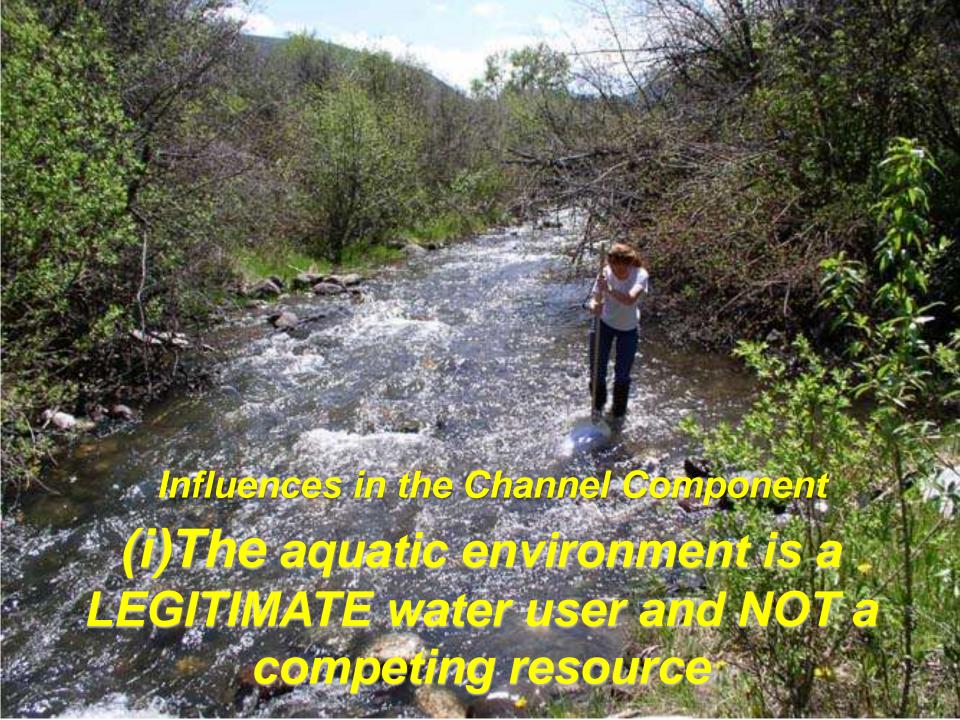
Influences of the Landscape Component: (ii) Land Degradation



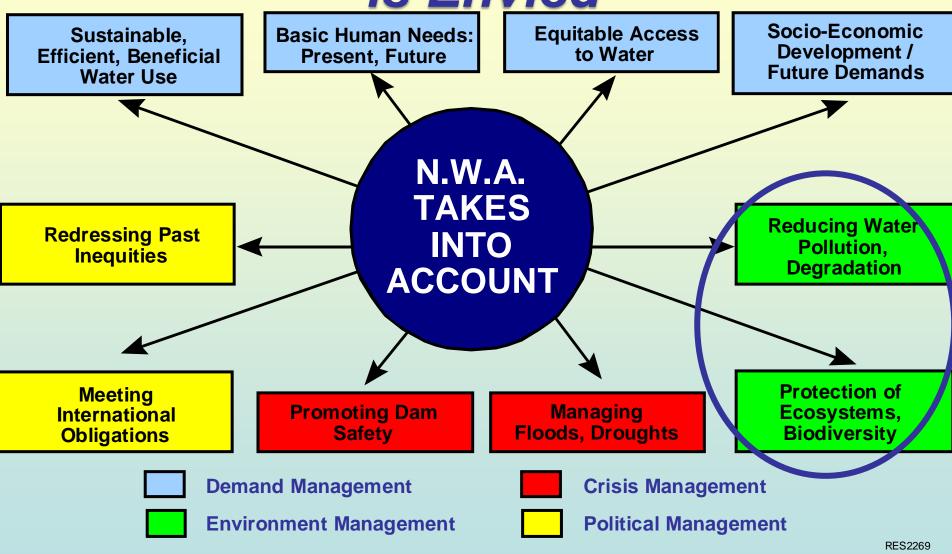
and Associated
Loss of Net
Primary
Productivity







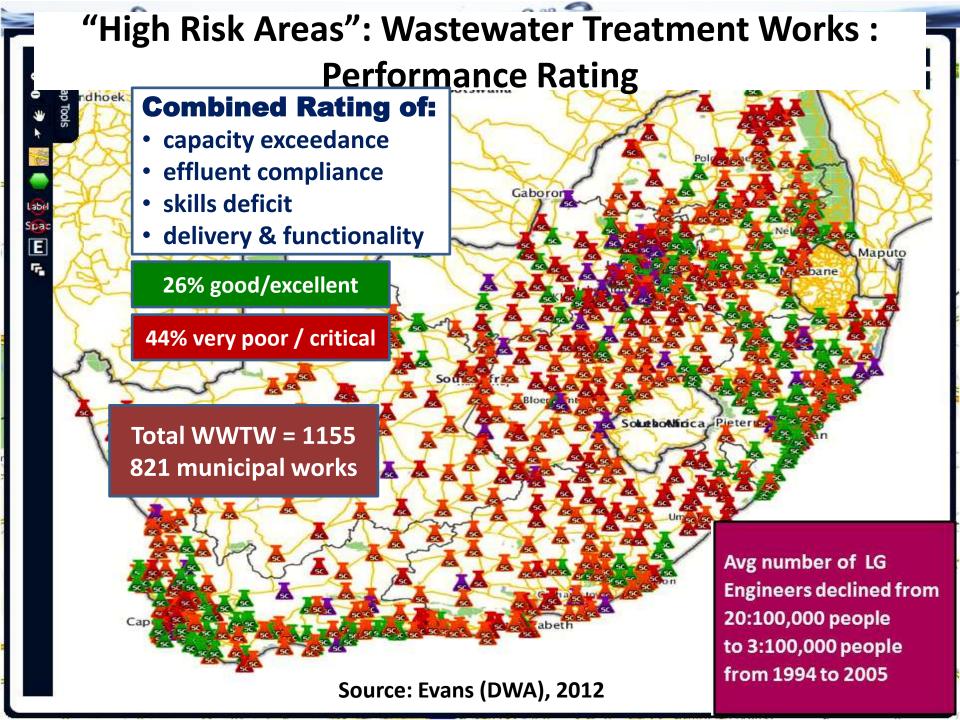
Supported Through a Water Act that is Envied











The Infrastructure Functionality Gap

Infrastructure %
Served

Functionality
%

Eastern Cape = 72%

EC = 62%

KwaZulu-Natal= 86%

KZN = 71%

Limpopo =82%

LP = 42%

North-West = 92%

NW = 68%

Mpumalanga = 91%

MP = 38%

Free State = 96%

FS = 82%

Northern Cape= 96%

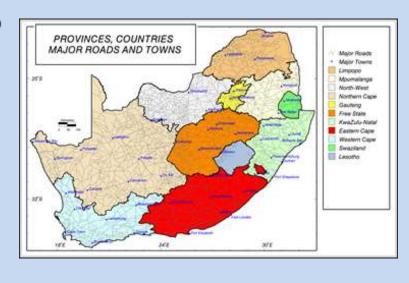
NC = 71%

Gauteng = 90%

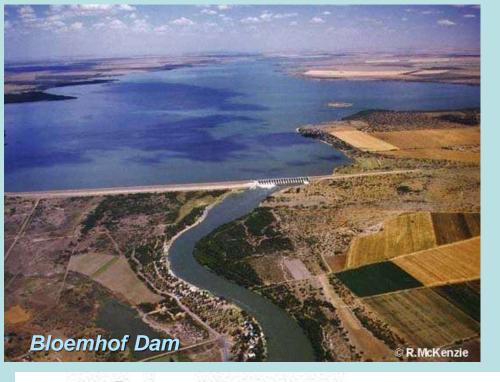
GT = 99%

Western Cape = 99%

WC = 98%

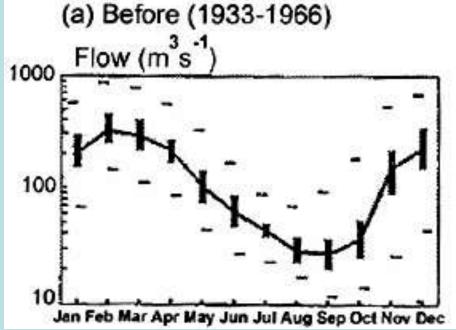


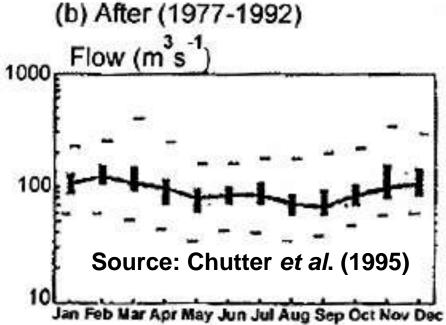
Source: Evans (DWA), 2012



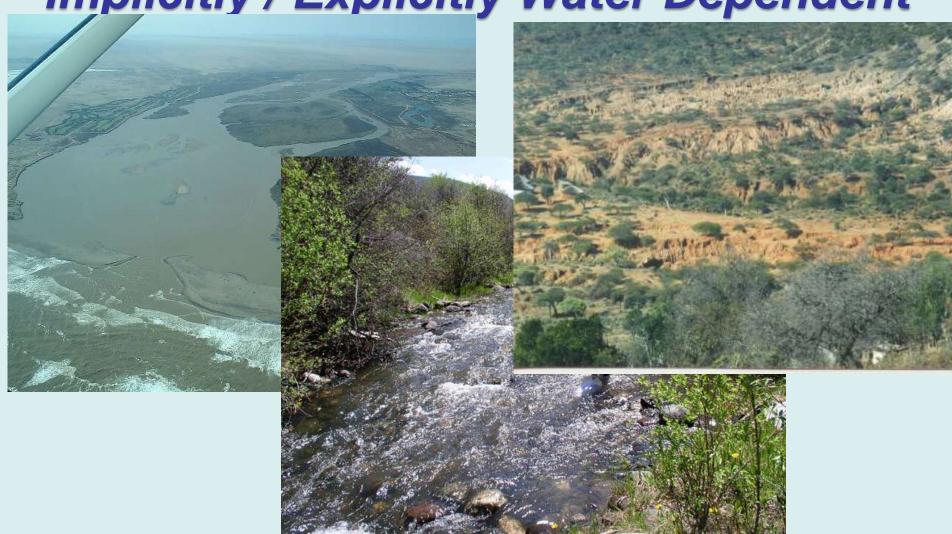
Influences in the Channel Component: (vi) Large Dams

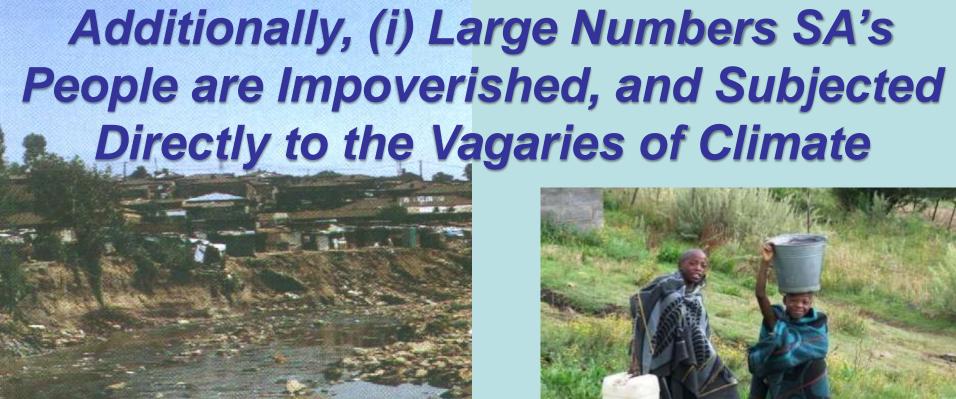






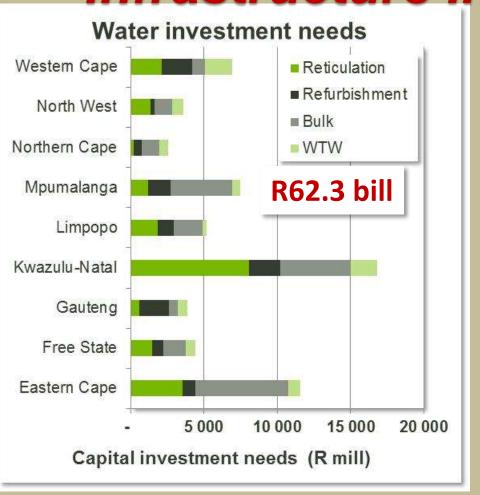
(vii) Many Fragile Ecosystems, Both Aquatic and Terrestrial, are Implicitly / Explicitly Water Dependent

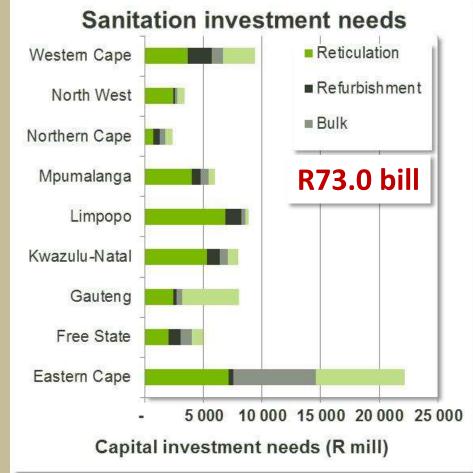






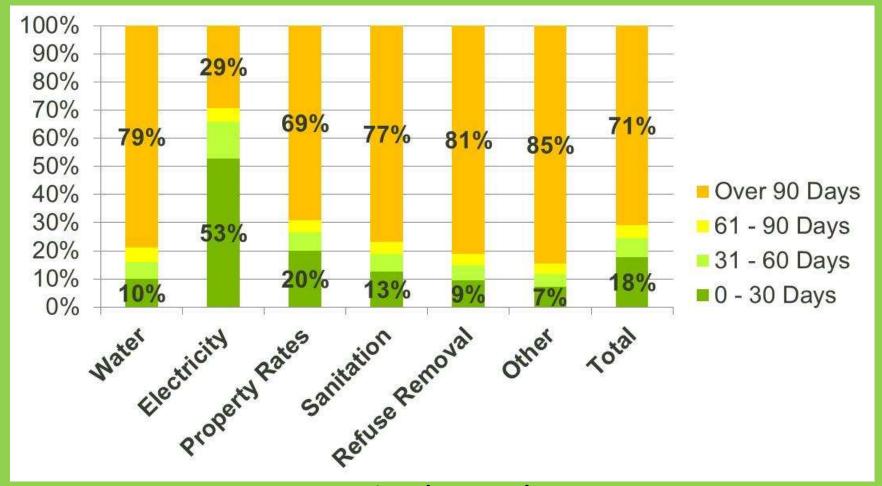
Additionally, (ii) There is a Need for Significant Municipal Water Infrastructure Investment in SA





Source: Wium (Aurecon) 2012

Additionally, (iii) There is the Inability by Municipalities to Collect Outstanding Debt



Source: Wium (Aurecon), 2012

Now, Superimposing the Climate Change Stressor

1. Does Government in SA View Climate Change as a Water Security Threat?

How is Climate Change Viewed Officially in South Africa's Water Sector? From the NWRS2 (2012) ... (a)

- * CC has 69 [vs 15] entries on 25 [vs 8] different pages
 * Key Contexts in which Climate Change is mentioned
 - Another dimension of stress/complexity/uncertainty
 - An exacerbator of other impacts, e.g. WQ, over-abstraction
 - Added variability
 - More severe extremes
 - An added imperative on effective WRM
 - A key pressure on freshwater ecosystems
 - DWA's committed response to position itself purposely re CC
 - DWA's need for pro-active response & for adaptation re.

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research planning implementation
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How is Climate Change Viewed Officially in South Africa's Water Sector? From the NWRS2 (2012) ... (b)

- * Key Contexts in which Climate Change is mentioned (cont)
- DWA's responsibilities as signatory to #National Initiatives, e.g.

NCCRS [Weak section]; Presidential Outcomes; National Strategy for Sustainable Development Action Plan for 2011-2014 #International Conventions, e.g.

UNFCCC [Relatively strong section on water in SNC 2011]

- DWA's need to complete the SA water sector's Climate Change Response Strategy
- Need for CC inclusion in short / medium / long term planning
- A DWA undertaking on focussed monitoring & research
- Vulnerability of people, ecosystems & economy to CC
- Government/Business partnerships are needed to solve CC issues

How is Climate Change Viewed Officially in South Africa's Water Sector? From the NWRS2 (2012) ... (c)

* Key Contexts in which Climate Change is mentioned (cont)

- An entire section on CC, viz. Section 2.3 Technical Strategy 2

Introduction

Situation analysis

DWA's vision and objectives

Strategic actions

- Links regarding CC and neighbouring countries

Issues

Data sharing

Transboundary waters

The need for a balanced approach to Climate Change re.
 preparedness vs over-reaction

2. Why Should Climate Change be Taken Seriously in South Africa?

Why is CC and Water so Important re. Continued Sustainable Development?

(Schulze, 2009)

- 1. SA already subjected to a high risk climate
- 2. Many ecosystems (terrestrial & aquatic) are fragile and implicitly/explicitly water dependent
- 3. Water is the primary medium through which CC impacts will be felt by people, ecosystems (aquatic, terrestrial) and economies
- 4. Agriculture is SA's major water user there are important land use : CC dynamics & feedbacks
- 5. A large proportion of SA's population is impoverished and subjected directly to the vagaries of climate hence they are vulnerable

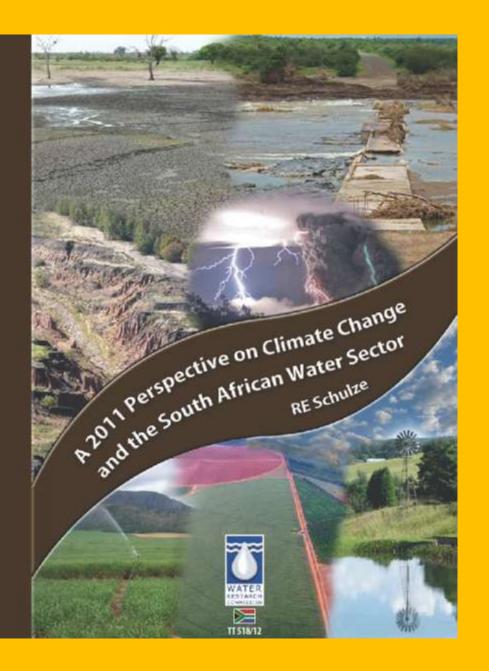
Furthermore ... (Schulze, 2009)

- 1. Water related infrastructure has a typical design life of 50 100 years...well into the era of CC
- 2. Any changes in rainfall are amplified by hydrological responses
- 3. There will be regional / sectoral "winners" and "losers" re. CC
- 4. CC does not happen over a clean, virgin catchment...it is superimposed onto existing, already stressed catchments
- 5. Need science informed CC strategies and plans of action

What Are the Take-Home Messages from Recent SA Climate Change Research?

Nationally?
More Locally?
And, So What?

Available
July/August
2012
pp366



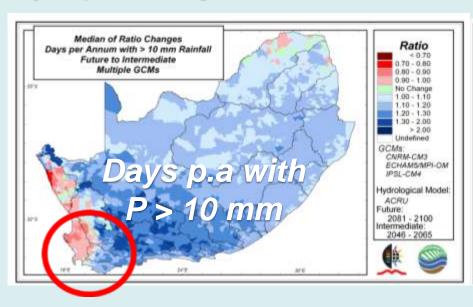


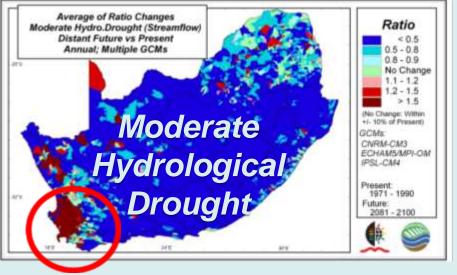
Take-Home Message 1

Some Areas will be 'Winners'

(with new opportunities)

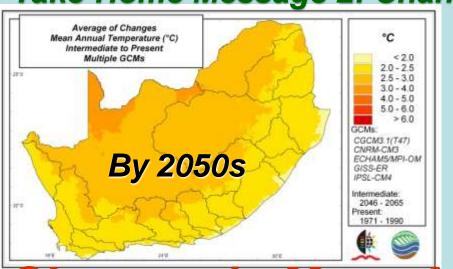
Others will be 'Hot-Spots of Concern' (especially in distant future, with added stresses)

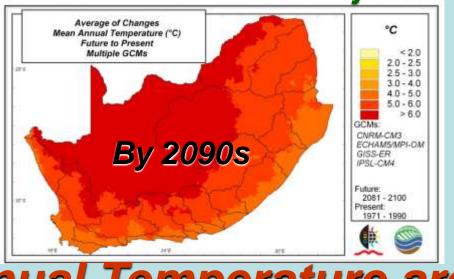




Hence, a Need to Prioritise re. CC & Water Security

Take-Home Message 2: Changes in Critical Drivers Projected

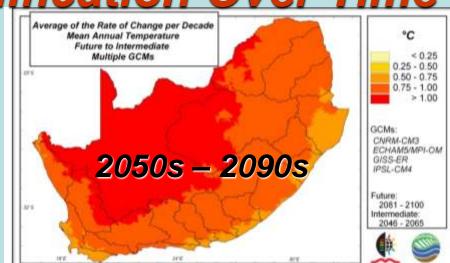




Changes in Mean Annual Temperature are Projected to be Significant

With Significant Amplification Over Time

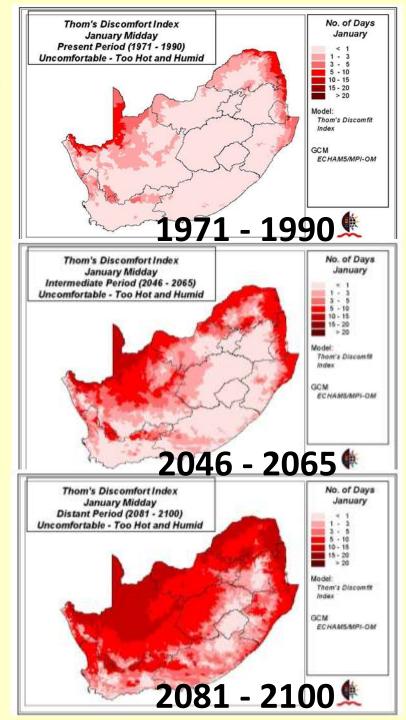




Translating CC to a Human Discomfort Index (Thom's HDI; f{T, RH})

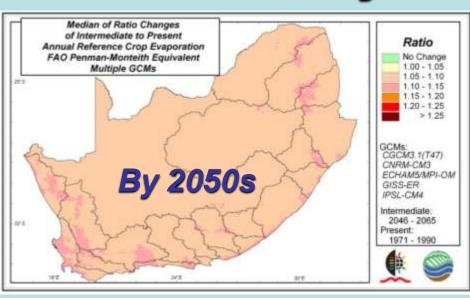
Projected Increases into the Future in Days in January (mid-summer) which are too Hot / Humid for Human Comfort

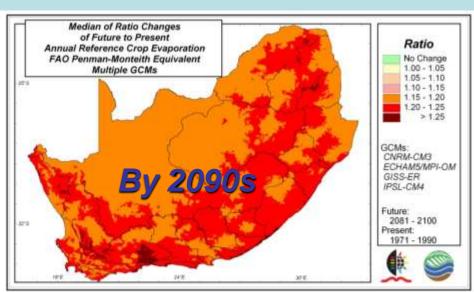
GCM: ECHAM5/MPI-OM



Take-Home Message 3: Changes to Critical Responses are Projected

Evaporation from Dams and the Soil is Projected to Increase





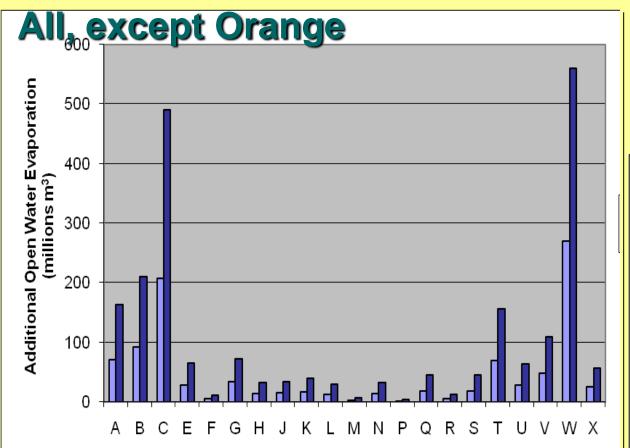
5 - 10 %

15 – 25 %

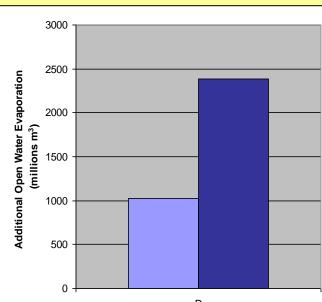
And... Is this a Water Security Threat?

Additional Evaporation per Primary Catchment from Open Water Bodies (dams, rivers, wetlands) by 2050s (light)

and 2090s (dark)



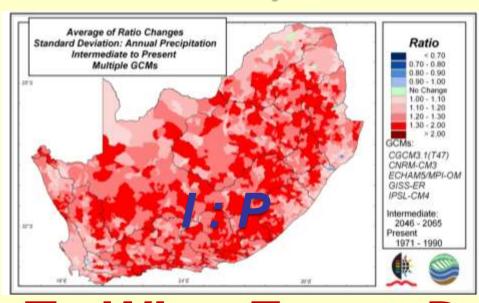
Orange

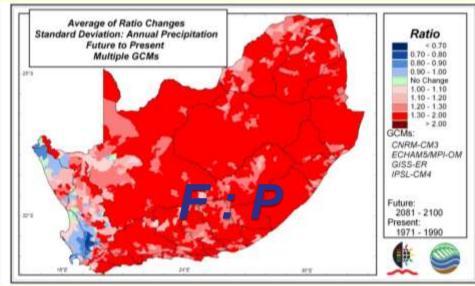


Take-Home Message 4

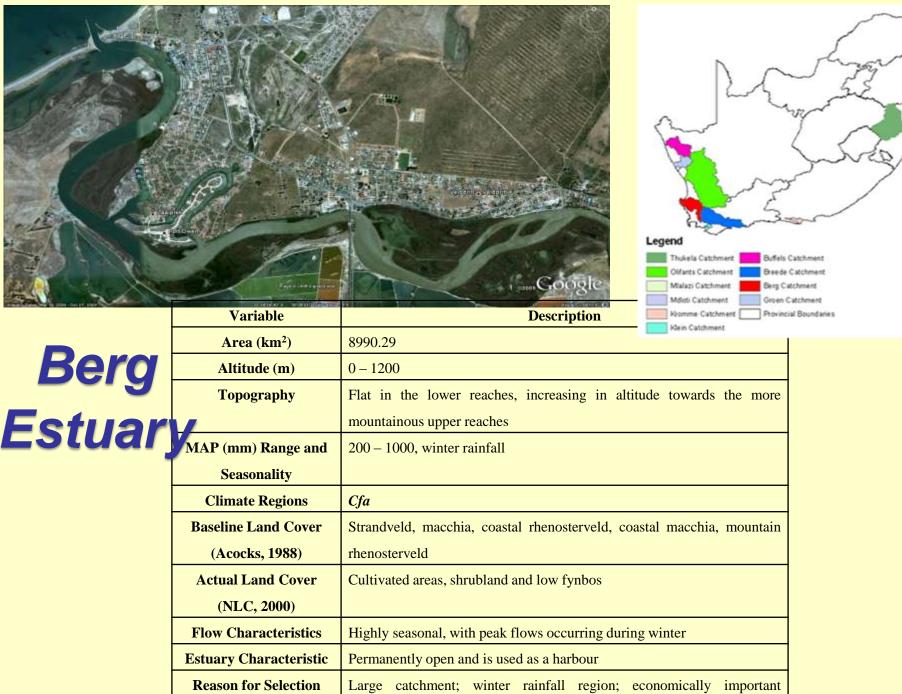
Variability is Projected to Increase ...More so Over Time

Projected Increases in Standard Deviation of Annual Precipitation from Multiple GCMs





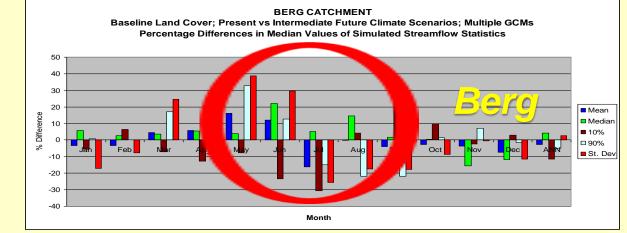
To What Extent Does This Become a Water Security Threat?

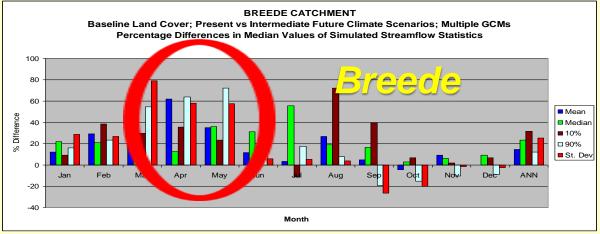


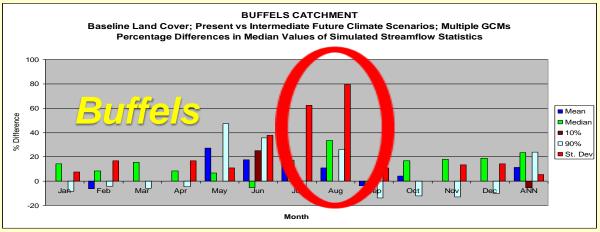
catchment for farming

Projected
Changes in
Variability (σ) of
Monthly
Freshwater
Inflows into
Estuaries
(Davis & Schulze, 2011)



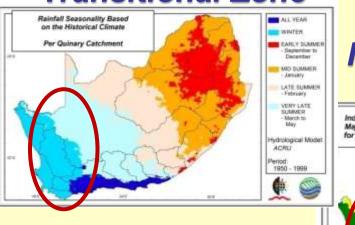




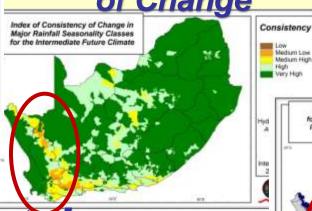


Take-Home Message 5

Some Regions are More Sensitive to Climate Change: The Transitional Zone Between the Summer and Winter Rainfall Transitional Zone



Index of Consistency of Change



Δ in 5 Year RP

Average of Ratio of Changes
for the 5 year RP Peach Discharge
Intermediate Future to Present
Multiple GCMs

A 330

0 80 - 0 90

10 - 1 10

10 - 1 30

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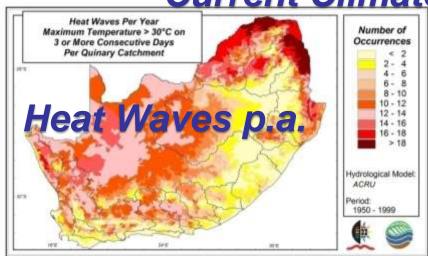
110 - 1 30

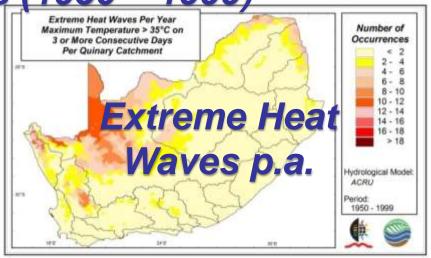
This has to be taken account of in Water Security planning

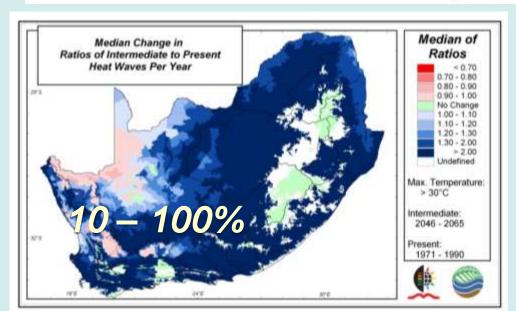
Take-Home Message 6: Extremes are Projected to Increase

Heat Waves

Current Climate (1950 - 1999)



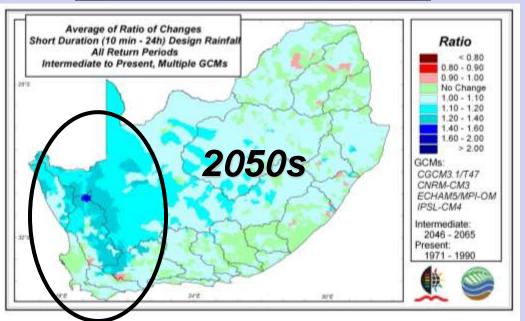


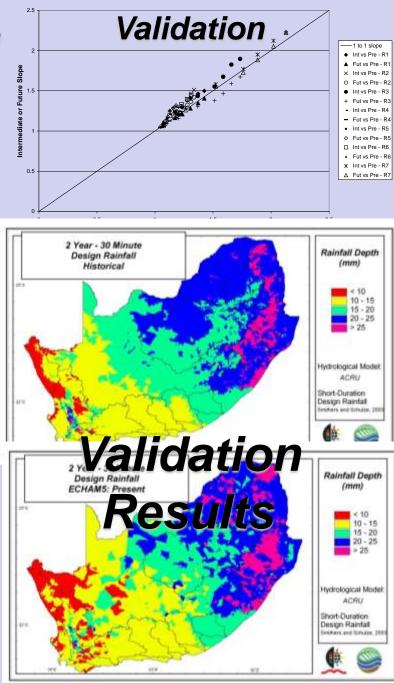


Projected
Changes over
the Next 40
Years

Impacts of CC on Short Duration (0.1–24h) Design Rainfall Using Regional Growth Curve Analysis



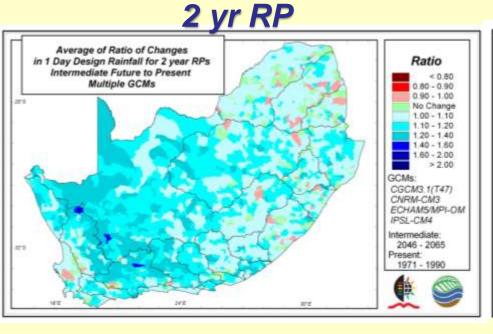


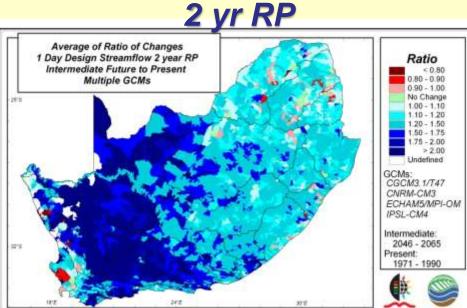


Take-Home Message 7

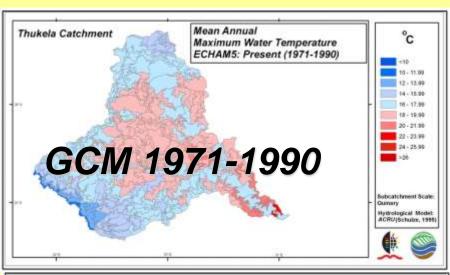
A Strong Amplification / Intensification is Projected when Changes in Rainfall Parameters are Compared with their Equivalent Runoff Responses

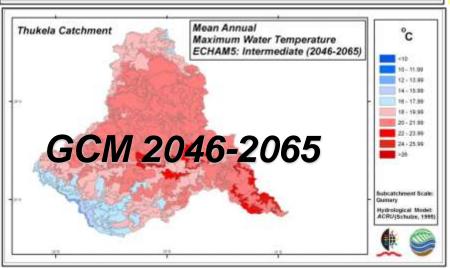
Δ in 1 Day Design Rainfall, Δ in 1 Day Design Runoff,

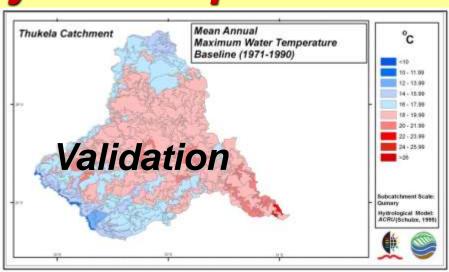


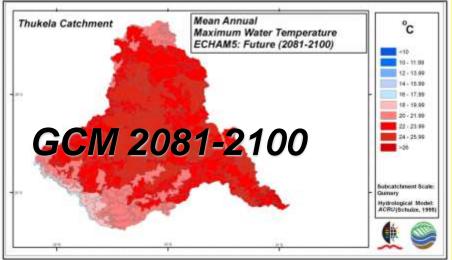


Take-Home Message 8: Changes in Hazards are Projected
Water Temperatures are Projected to
Increase Significantly into the Future
What Water Security Consequences?



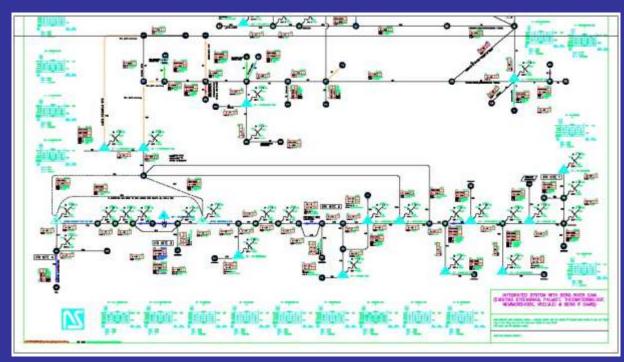




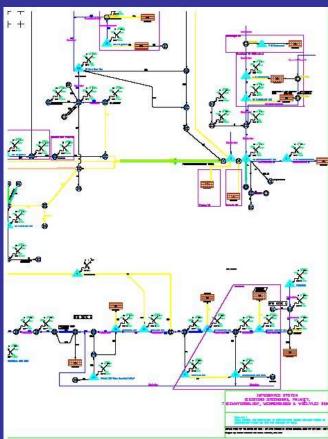


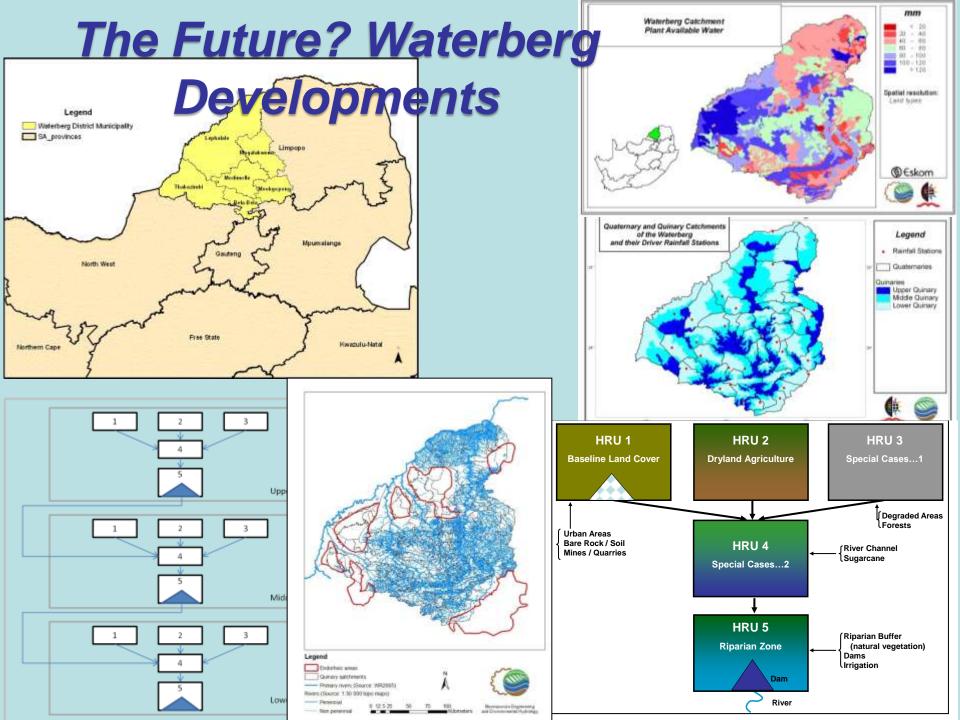
Are Water Engineered Systems the Solution to SA's Water Security Threats?

Part of the Western Cape Integrated System



We Have Already Re-Plumbed Entire Natural Flow Systems

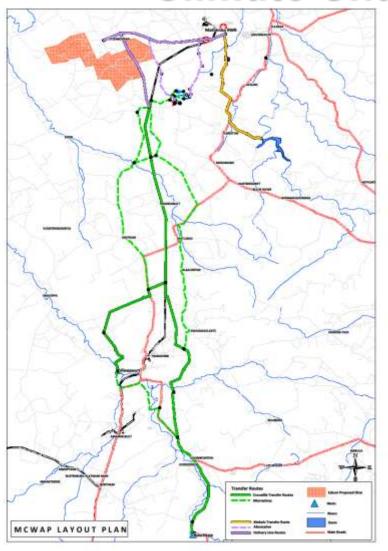


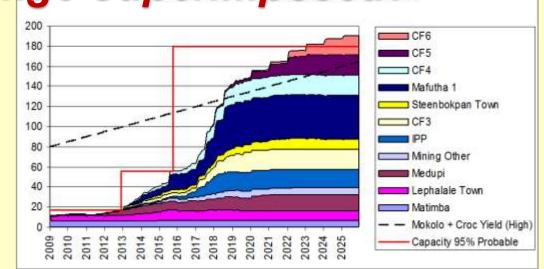


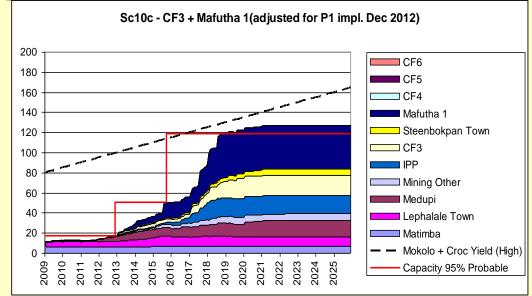




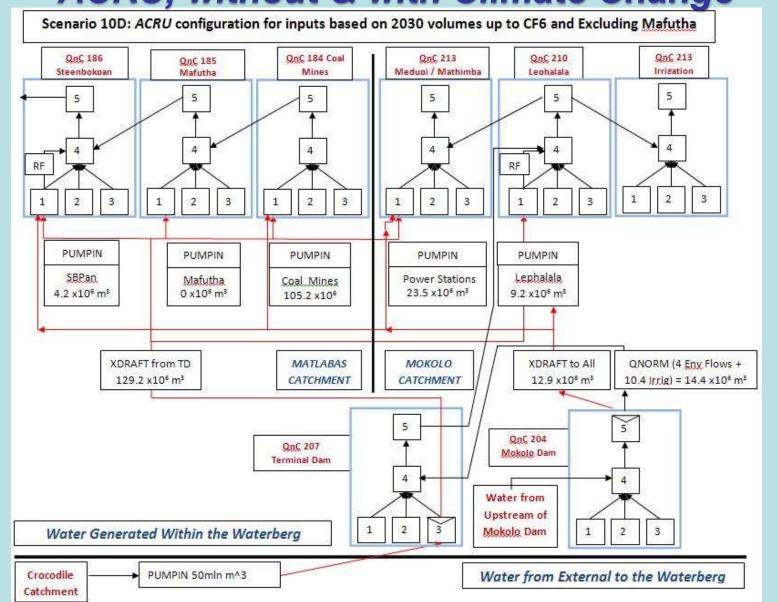
Different Development Scenarios and Their Water Security Ramifications .. What about Climate Change Superimposed?







Modelling In-Stream & Downstream Impacts of Water Engineered Scenarios in the Waterberg with ACRU, without & with Climate Change



Quo vadis?