Water in Johannesburg (and South Africa): Day zero?

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Introduction

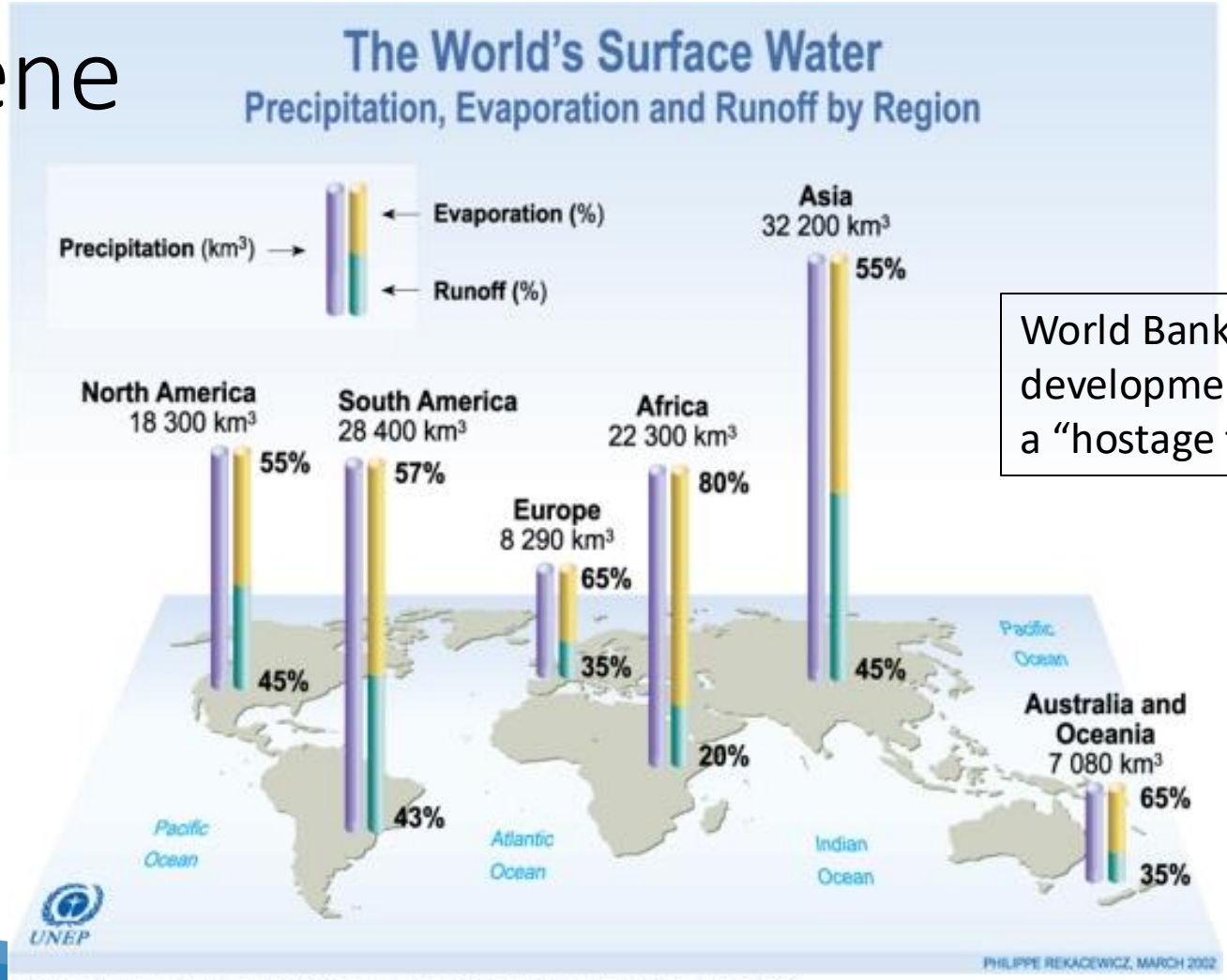
- Setting the scene… Joburg in it's geographical context
- What is water scarcity?
- What is water security?
- What do I mean by sovereignty?
- Challenges to water quality.
- How can we make the supply of water sustainable?







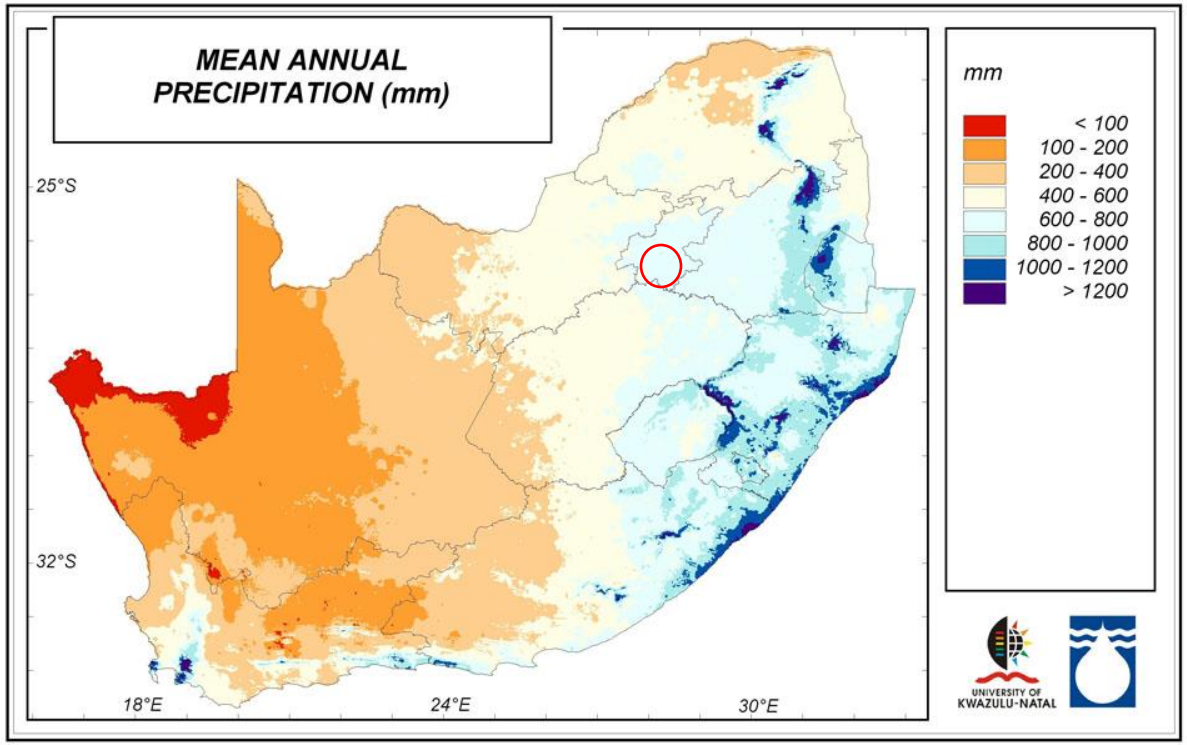

Setting the scene



Source: Peter H. Gleick, *Water in Crisis*, New York Oxford University Press, 1993.

World Bank: development in Africa is a "hostage to hydrology"

Source: UNEP (http://www.grida.no/graphicslib/)


MEAN ANNUAL
PRECIPITATION (mm)
mm
< 100
100 - 200
200 - 400
400 - 600
600 - 800
800 - 1000
1000 - 1200
> 1200
25°S
32°S
18°E
24°E
30°E
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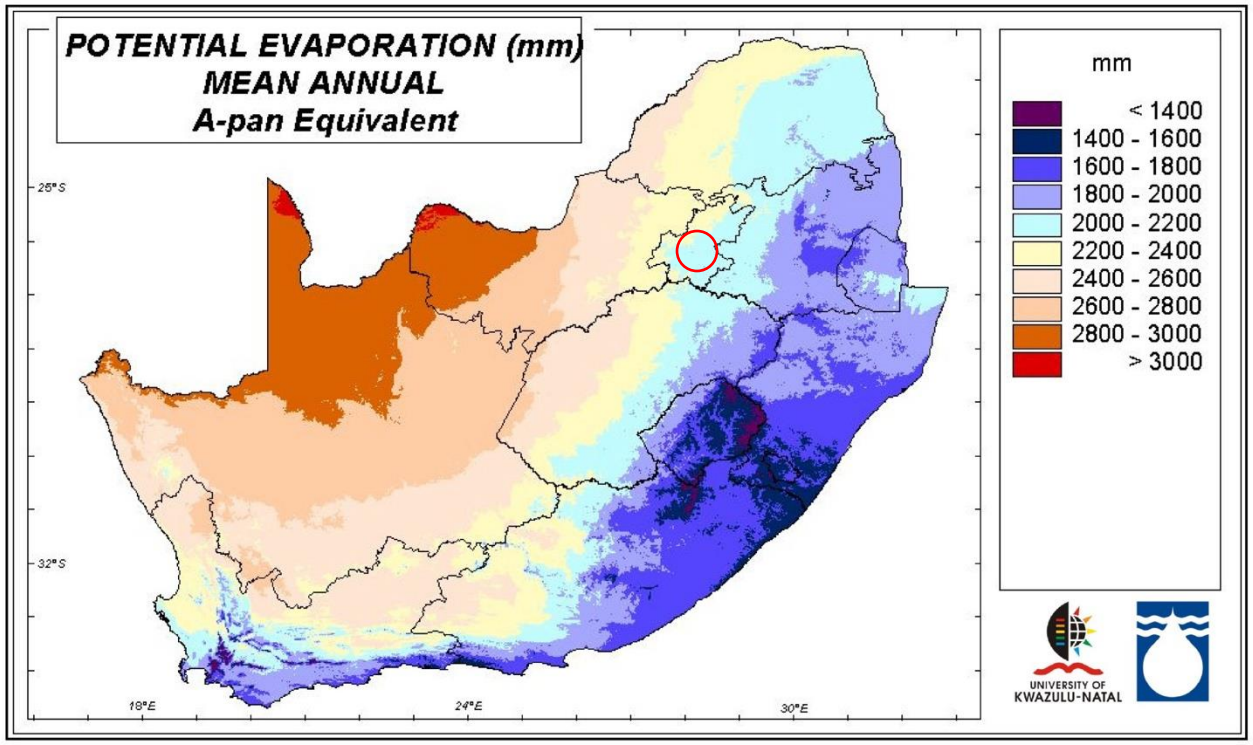
POTENTIAL EVAPORATION (mm)
MEAN ANNUAL
A-pan Equivalent
mm
< 1400
1400 - 1600
1600 - 1800
1800 - 2000
2000 - 2200
2200 - 2400
2400 - 2600
2600 - 2800
2800 - 3000
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25°S
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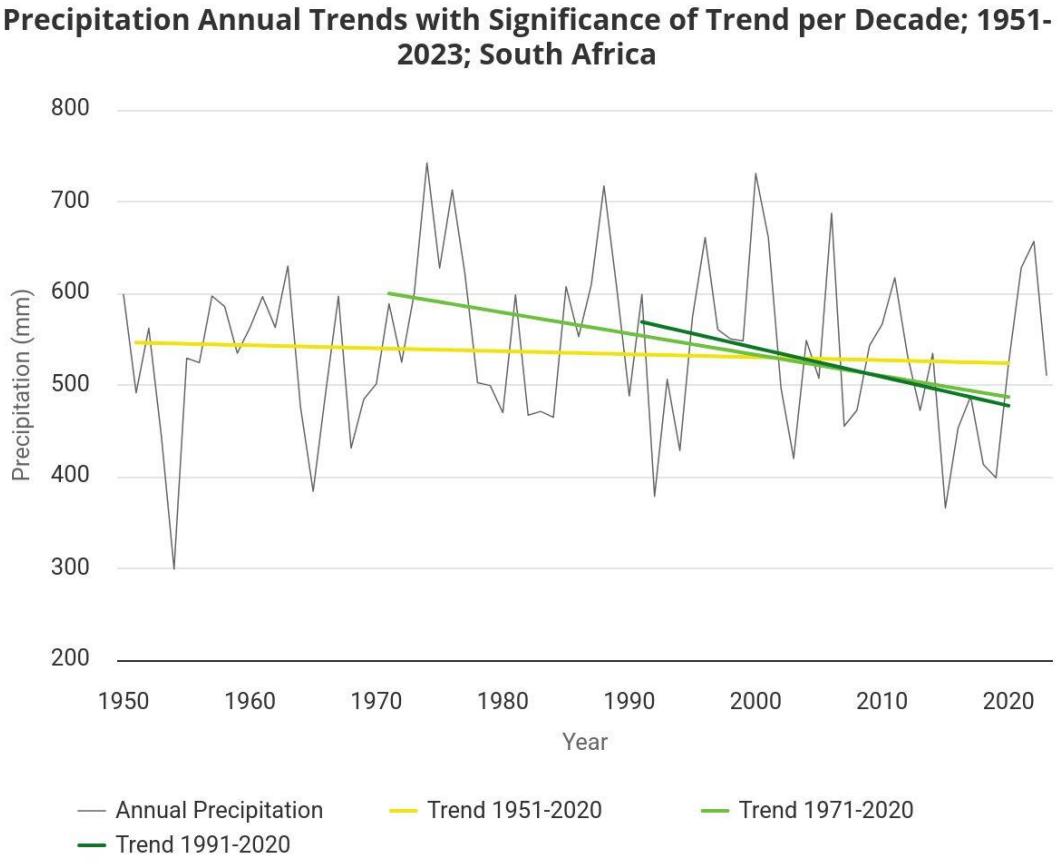
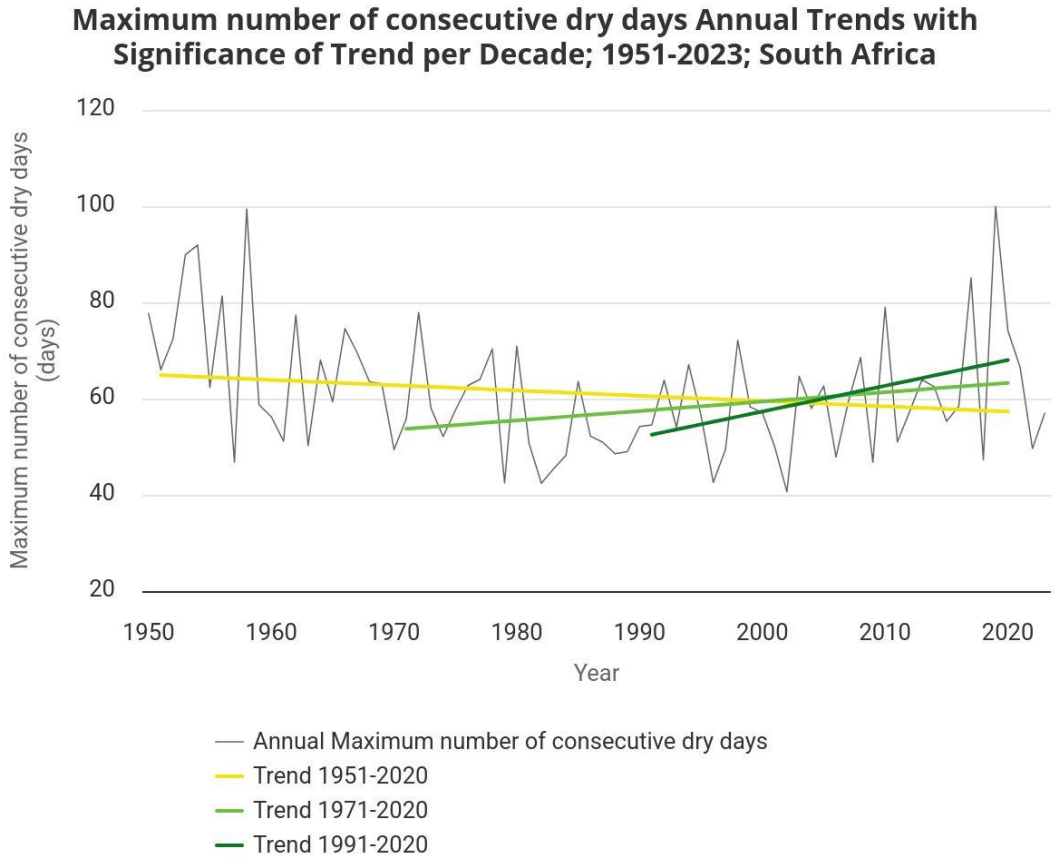
Climate *variability* (world bank data)





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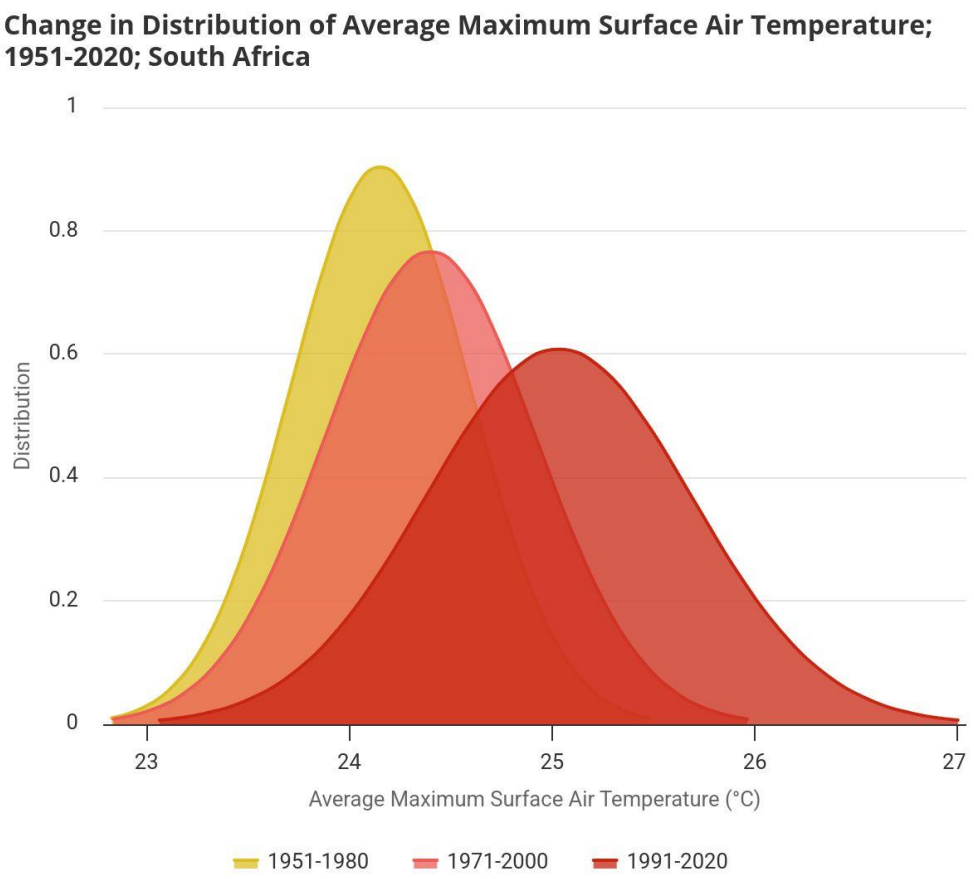
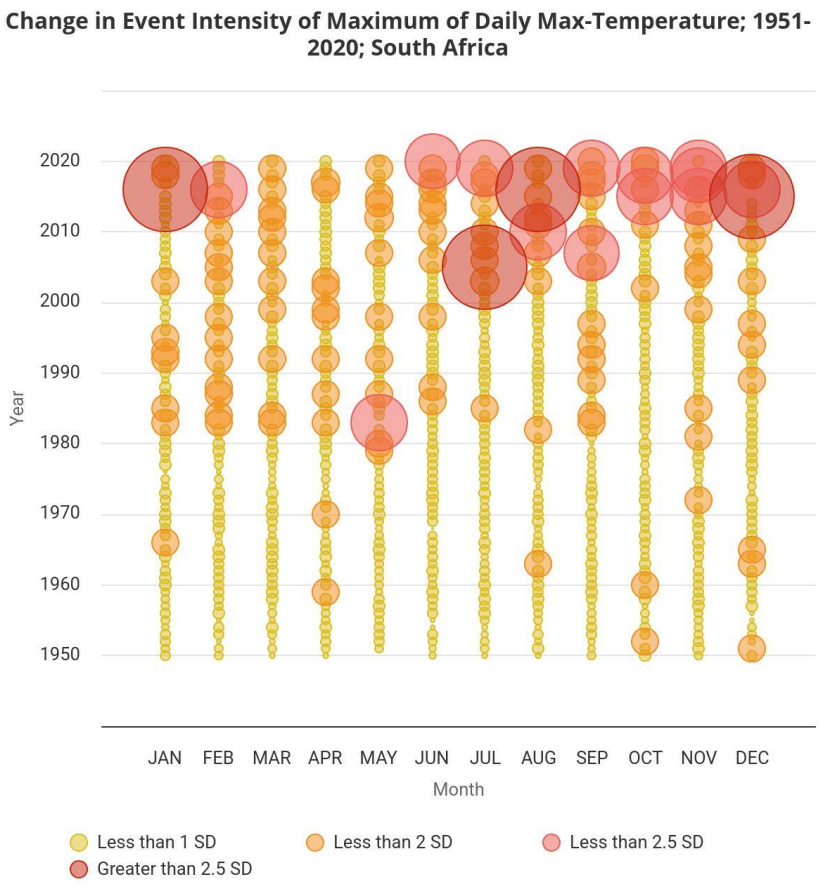




To finish setting the scene

- We have hydrological challenges
- These hydrological challenges are increasing due to the climate crisis

So what is Water Scarcity?

- “an excess of water demand over available supply” (FAO, 2012)
- “An imbalance between supply and demand of freshwater in a specified domain … under prevailing institutional arrangements (including price) and infrastructural conditions.” (FAO, 2015)
- Can distinguish natural vs **human-induced** scarcity
- May be **physical** or **economic**
- **Whatever definition you use, I would consider Johannesburg Water Scarce, regardless of quantity of rainfall.**

So what is Water Security?

- The capacity of a population to safeguard **sustainable access** to **adequate** quantities of **acceptable quality water** for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability

UN Water

"When an individual does not have access to safe and affordable water to satisfy her or his needs for drinking, washing or their livelihoods we call that person water insecure. When a large number of people in an area are water insecure for a significant period of time, then we can call that area water scarce." (Rijsberman, 2006)

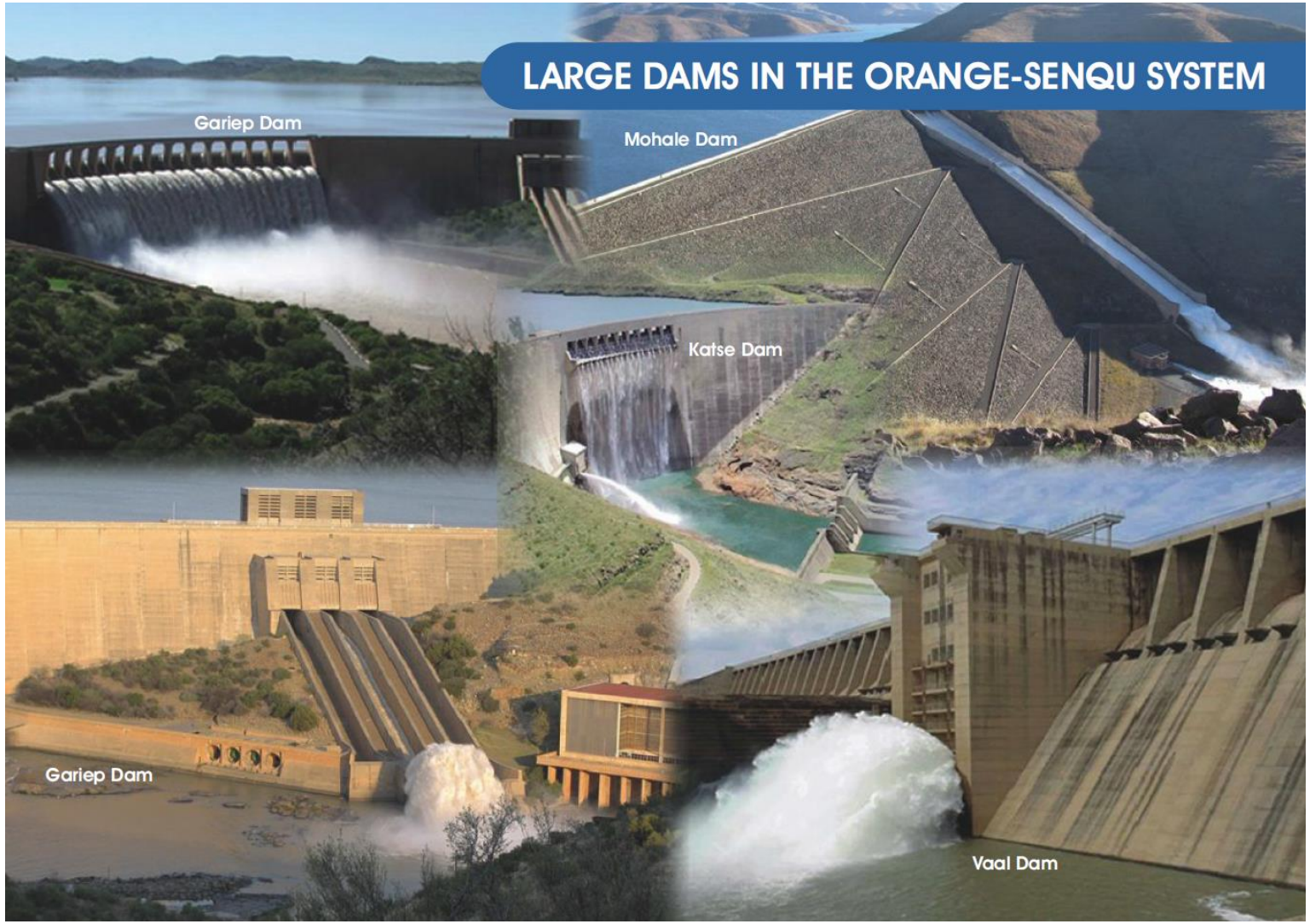
- Johannesburg is not only water insecure, but because of our institutional challenges we are also scarce.

Water (in)security in JHB?

- Water is ***allocated*** by DWS based on population and availability of water in the Integrated Vaal River System (levels in the Vaal Dam are a red herring…but make for sensational photos!)
- The ***allocation*** is sold by DWS to Rand Water (Bulk Water Utility/Water Board) who treat the water to potable (safe drinkable water) quality
- Rand Water sells the water to COJ (Joburg Water). They provide the reservoirs and piping networks to sell the water to residents (also known as consumers)
- There is a mismatch between what DWS allows and what is needed, because the DWS is responsible for supplying the water over long time periods

Why can’t we get more water from the dams?

- The dams supply not only current, but also future needs.
- New dam in Lesotho is being built but will only come online in 2028 (8 year delay) but…
- This delay coincides exactly with period Gauteng grew from 12 million to 15.1 million people.
- This means that in 2023 the province had the same water storage for a population which had grown by 25%.
- We have partially lost our water sovereignty…



Water sovereignty

- 2 of our top 8 largest dams are in Lesotho
- Lesotho has the keys to our water security

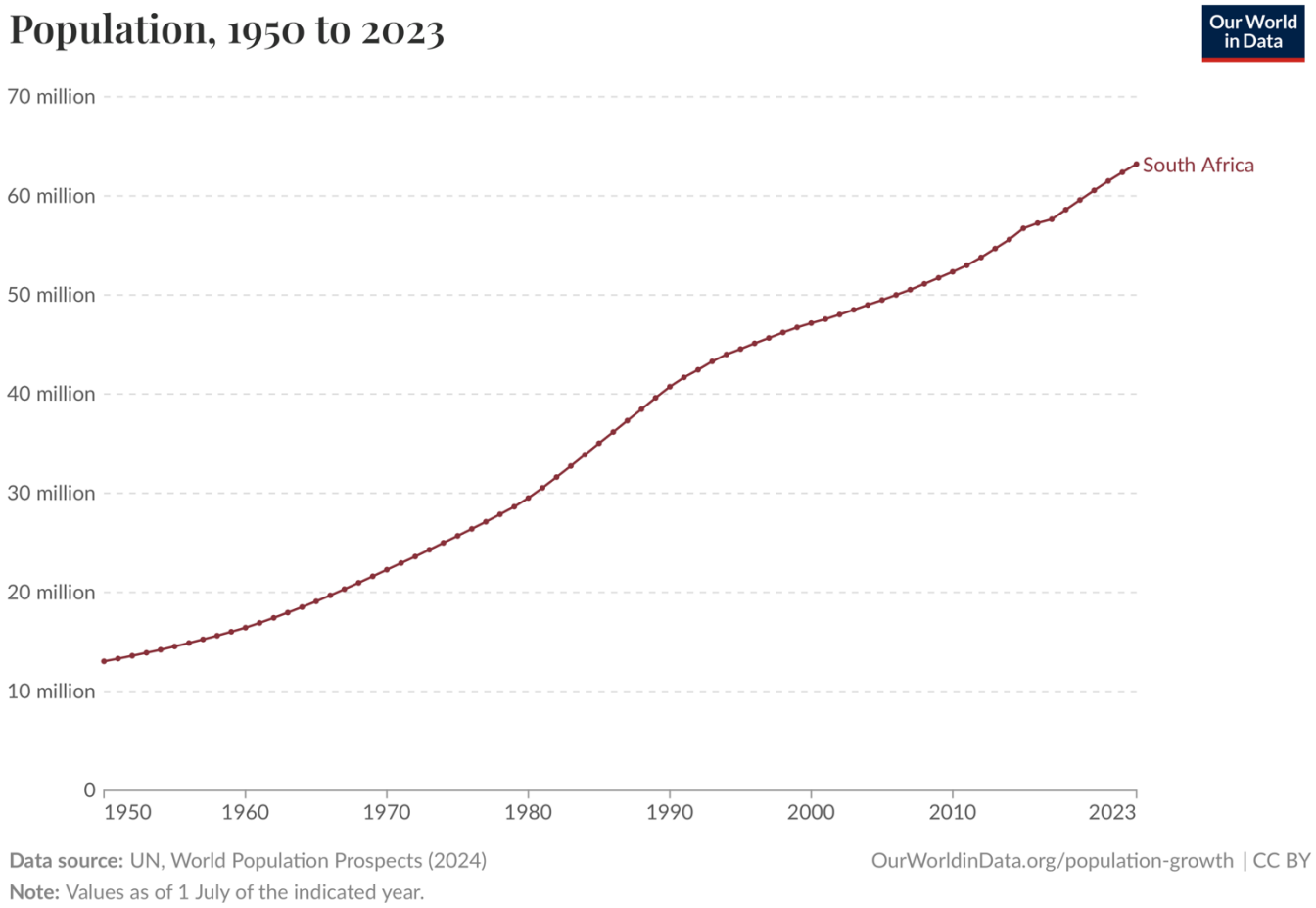
Why is the water not coming out the taps?

- COJ finances are poor. R2 billion(? or 3?) infrastructure bill but only R1 billion is allocated – maintenance needs spiralling out of control
- Almost 50% of the water provided is classed as non-revenue water (water lost to theft or leaks)
- This means that we have half our water allocation which needs to go 25% further due to population growth
- Water consumption is too high – ***average per capita usage*** is 279L per day
  - 60% greater than the global average
  - Highest of any province
  - 27% more than the country average
- The issue is complex – we don't have enough water for the population size, we use too much (when we have it), and our city is negligent and wastes massively.

So – what are the long-term prospects

- Issue is – there is no more space in SA for large dams (siltation issues with dams - up to 50% reduction in storage capacity)
- So after 2028? Then what? Especially important to consider demographic trends (see next slide)
- Not good unfortunately, if we proceed with current social/cultural/political/engineering practices
- Climate crisis is the elephant in the room. It makes everything worse. It drives up water demand because temperatures are higher, it increases evaporative losses, and flooding poses the very real risk of destroying infrastructure (dams, water works, wastewater treatment plants)

Demographics



- This is projected to grow to 80 million people by 2050
- In perspective, 2050 is 25 years away
- This means a 25% increase in population accessing a system with no further expansion capacity, already under severe strain due to mismanagement at municipal level

Food and Agriculture Organisation of the United Nations (FAO)(https://www.fao.org/aquastat/en/)

SDG 6.4.2. Water Stress	South Africa	2016	61.0 %
SDG 6.4.2. Water Stress	South Africa	2017	62.1 %
SDG 6.4.2. Water Stress	South Africa	2018	62.9 %
SDG 6.4.2. Water Stress	South Africa	2019	64.0 %
SDG 6.4.2. Water Stress	South Africa	2020	65.0 %

What is the revolution needed for sustainability

- Real shifts needed in economics. What is the true value of potable water? R17/1000L or R17/5L? This is dependent on trust in billing – would tariff increases be another tax or used to maintain and improve the water system.
- **The only way for us to use water sustainably is to start to reclaim water – i.e. we need to treat our sewage all the way back to potable and return to the reticulation systems directly – this has the potential to reduce need by 70%.**
- This needs research to understand 21st century compounds in the water system and how to remove them
- **This also needs a major refocusing by society on the value of water and also around the reuse of waste water – what is the value of our sewage?**

Long term sustainability

- Only achievable if we can safely reclaim water
- Only achievable if we revisit our value systems and rethink the value of water
- Only achievable if the state commits to supporting this vision

Water Quality Challenges (Especially for SA)

Types of pollution

1. Nutrients
2. Microbial contaminants
3. Chemical contaminants (existing and emerging)
4. Acid rock/mine drainage

Nutrients

- NO_2^-, NO_3^-, NH_4^+, PO_4^{3-}
  - basically nitrogen and phosphorous
- Called nutrients because they are nutrients for algae and micro-organisms!

Nutrient sources of pollution

- Agricultural run-off
- Sewage contamination of rivers
  - WWTP neglect
  - Sewer failure
  - Etc.

Hartbeespoort Dam (2022)

Microbial Contaminants: Water-borne diseases

Primarily through the faecal-oral route:

- Bacteria
  - Gastro, legionnaire's disease, salmonella, typhoid, shigellosis, ***cholera***, etc.
- Protozoa
  - Cryptosporidiosis, amoebic dysentery, giardiasis, etc.
- Helminths
  - Worms (tapeworms, roundworms, whipworms).
- Viruses
  - Hepatitis etc
- These can also be transmitted from rivers, or water to vegetables, and also through dermal contact.
- **E. Coli is an indicator organism – if you find it, there is faecal contamination – but not necessarily human.**
  - **E. Coli exist in the guts of all warm blooded animals. There are ducks and dogs in Emmarentia dam, therefore there will be E. Coli. Acceptable concentrations are less than 130 / 100mL for swimming; less than 1000/100mL for general recreation use. I have recorded up to 10 trillion /100mL in the Jukskei River.**

Water-borne diseases: impacts

- Typically rashes through to diarrheal disease
- Worst case: Death
  - Cholera outbreak 2023
  - NB: 90% of people are immune

Chemical contaminants

Historically relevant contaminants

- Heavy metals (lead, mercury, hexavalent chromium, etc) – Minamata disease
- Industrial and petrochemical contaminants (heavy metals, benzene, xylene, MTBE, dioxins, etc).
- Mining contaminants
  - Include almost anything depending on what is being mined and where.
  - In Gauteng (province within which Johannesburg is located) linked mainly to AMD – leads to acidity, iron high sulfate
  - Can also include cyanide (CN-), arsenic (As), mercury (Hg) – linked to artisanal mining

Emerging Contaminants

Suite of 21st century compounds with high degree of uncertainty of risk posed to human or environmental receptors. Classified in 4 different classes (some belong to more than 1 class)

- Personal Care Products (PCPs)
  - For example estrogenic compounds, antibiotics, triclosan (toothpaste), recreational drugs
- Pesticides
  - For example glyphosate (roundup) spraying on the Vaal Dam
- Microplastics
  - From the breakdown of plastics – micron sized plastics which get literally everywhere and are being researched for human health impacts
- Per- and polyfluoroalkyl substances (PFAS)
  - Scotch Guard, Teflon etc. These chemical do not break down. They are being shown to have human health impacts (mutagenic, teratogenic etc).

Pollution impacts

- Human and environmental health
- Aquatic, marine and land-based ecosystem degradation
- Agricultural
- Industry
- Loss of amenity value of water
- Rising treatment costs

Future Challenges

- Few WQ data but many water bodies show deteriorating WQ over last 20 years
- Climate change impacts on quantity and temperature of water – flooding, droughts, microbial processes
- Increased population, contamination and treatment costs
- Getting the wastewater treatment plants working properly again
- Ensuring freshwater treatment plants work properly and getting the water into homes safely
- Legacy problems like AMD
- Dealing with droughts and floods
- Embracing the circular economy – we might very well ultimately have to adjust to drinking reclaimed water

Linking back to sustainability

- We need to recognise that we are under water stress, water scarce and water insecure regardless of the amount of rain that falls. Demographics are no longer favourable. All water savings made make a difference (regardless of the mess our city council(s) make in terms of infrastructure).
- We must pressure our council to fix the leaks. It is very hard to promote saving water if it's gushing out the pipe into the street and down the stormwater drain
- We **have to** start to value our sewage as much as our drinking water: sewage is just water with substances in it, they can be removed.
    - An additional benefit of this is that is we valued sewage, it would not be in our rivers and they would be far cleaner.

What can we do?

- Most obviously, save water always.
- We need to proactively think about emerging contaminants – if we need to recycle, we will poison ourselves if we don't remove these.
- At individual level – make choices about water.
  - Choose not to use scotch guard
  - Return unused pharmaceuticals to the pharmacy for destruction
  - Choose organic clothing that don't shed microplastics into the environment.
  - Apply pressure on retailers for water impacts (see resources slide)
  - Eat food with a lower water footprint (see resources slide)
- Be activists – keep challenging our city officials to provide water for all

Hope for the future

Berlin – life on the canal

Thank you

Resources

- Water footprint calculators: https://www.waterfootprint.org/resources/interactive-tools/personal-water-footprint-calculator/
- Platform for a water secure Gauteng: https://www.dws.gov.za/gautengreports.aspx
- Upper Vaal Water Resource Information centre (lots of water quality data): https://reservoir.org.za
- Emerging contaminant database in SA: https://www.ceckh.agric.za
- Ensuring water is safe to drink: https://www.youtube.com/watch?v=hrOEVCLIe2Y&t=3s
- Water activities/research at Wits: www.wits.ac.za/ciward