



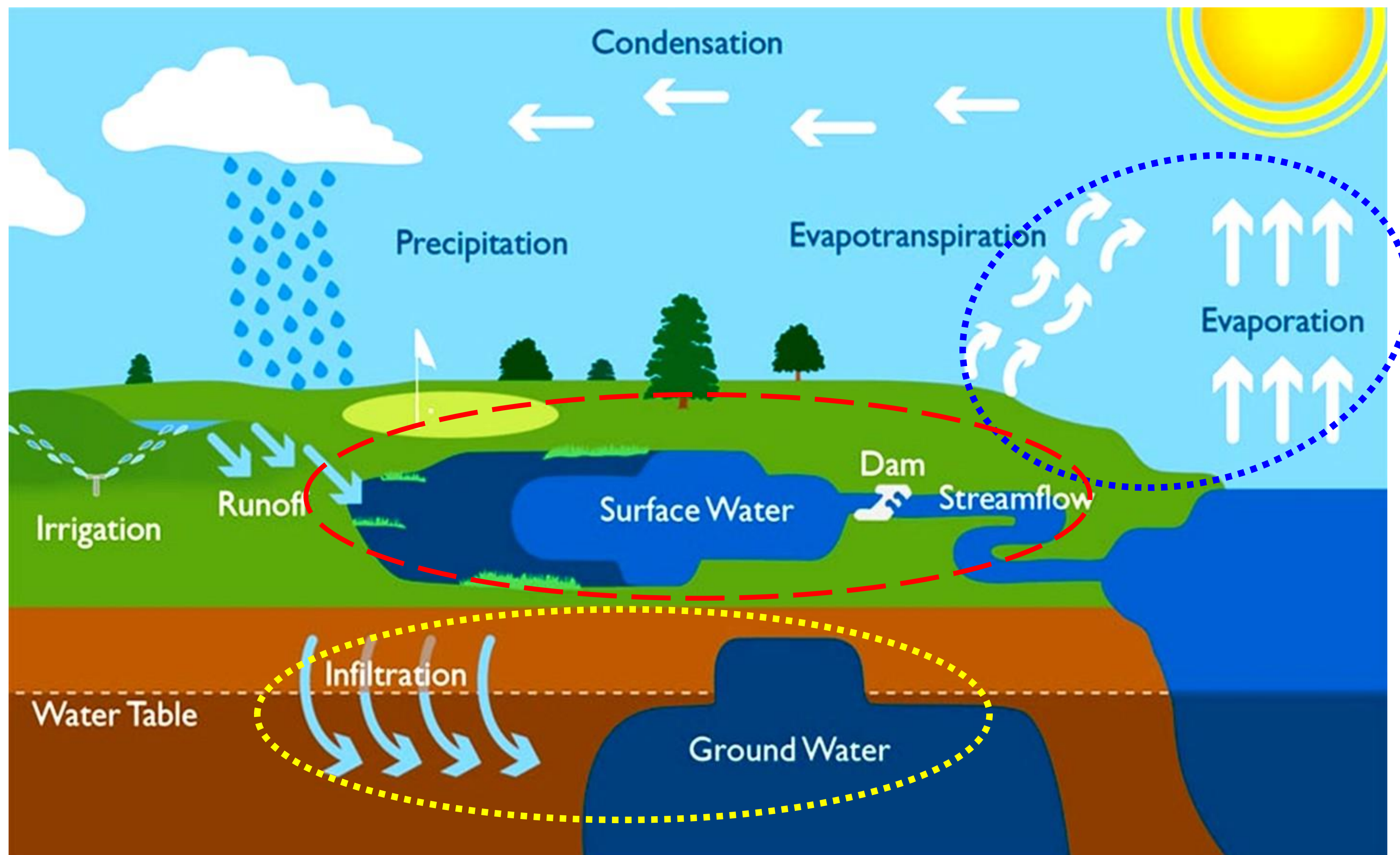
Urban Groundwater Quality and Quantity in Sub-Saharan Africa: A Case for Lusaka, Zambia

International Conference on Geology, Mining, Mineral and Groundwater Resources of the
Sub-Saharan Africa: Opportunities and Challenges Ahead, Livingstone, Zambia, 11 - 13
July 2017

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1. Introduction

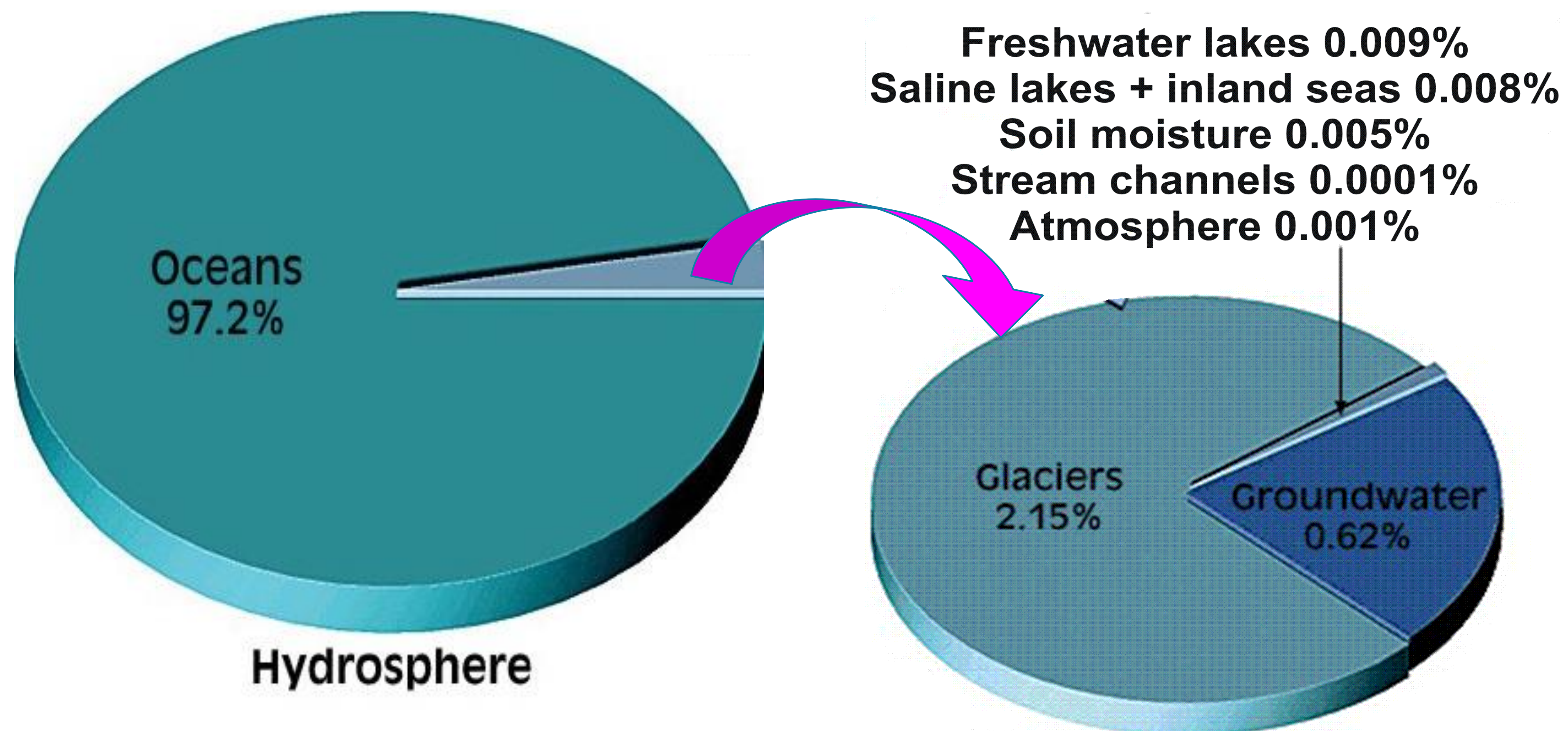
- All water – contained in **Hydrologic Cycle**, which:
- describes movement & interrelationships among **surface water**, **groundwater**, and **water in atmosphere**.





1. Introduction.....contd.

Water plays very essential role in every person's life. In terms of distribution,:

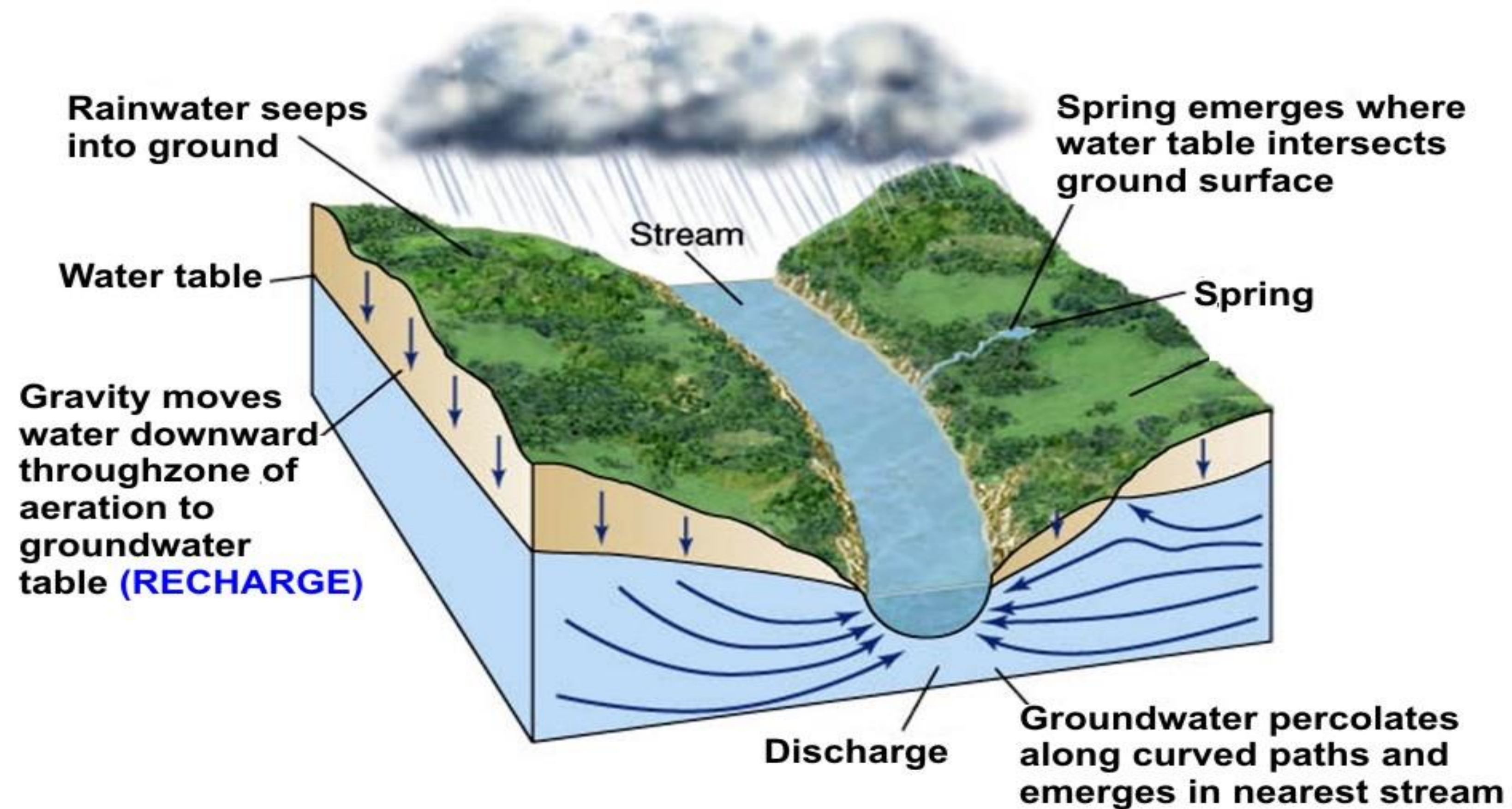


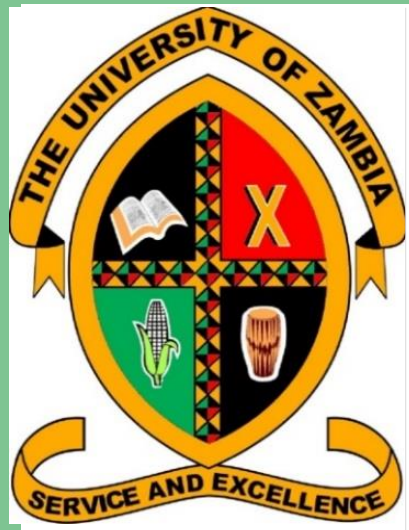
Accordingly, most of freshwater is stored underground.

1. Introduction.....contd.

Groundwater:

- **contributes significantly to stream-flow** in humid regions.





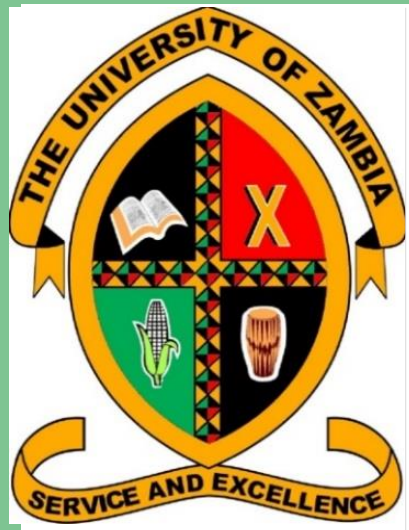
1. Introduction....contd.

Surface water – easier to deal with.....



But Groundwater is a unique resource.....

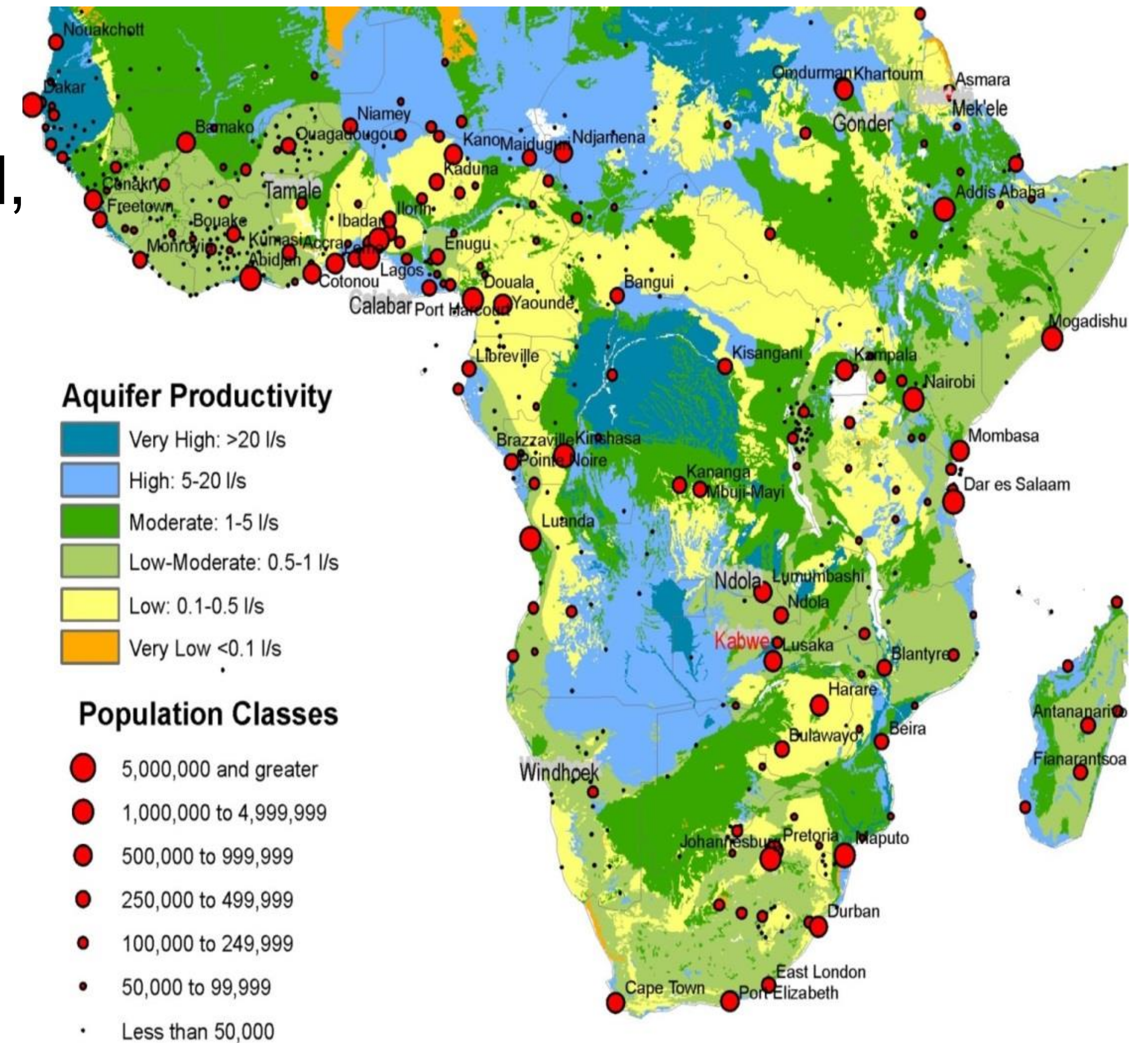
.....it is a **HIDDEN** resource



2. State of Continent's Water Resources

Africa has huge potential for groundwater, but which is threatened, among others, by:

- Over abstraction, and
- Quality impairment

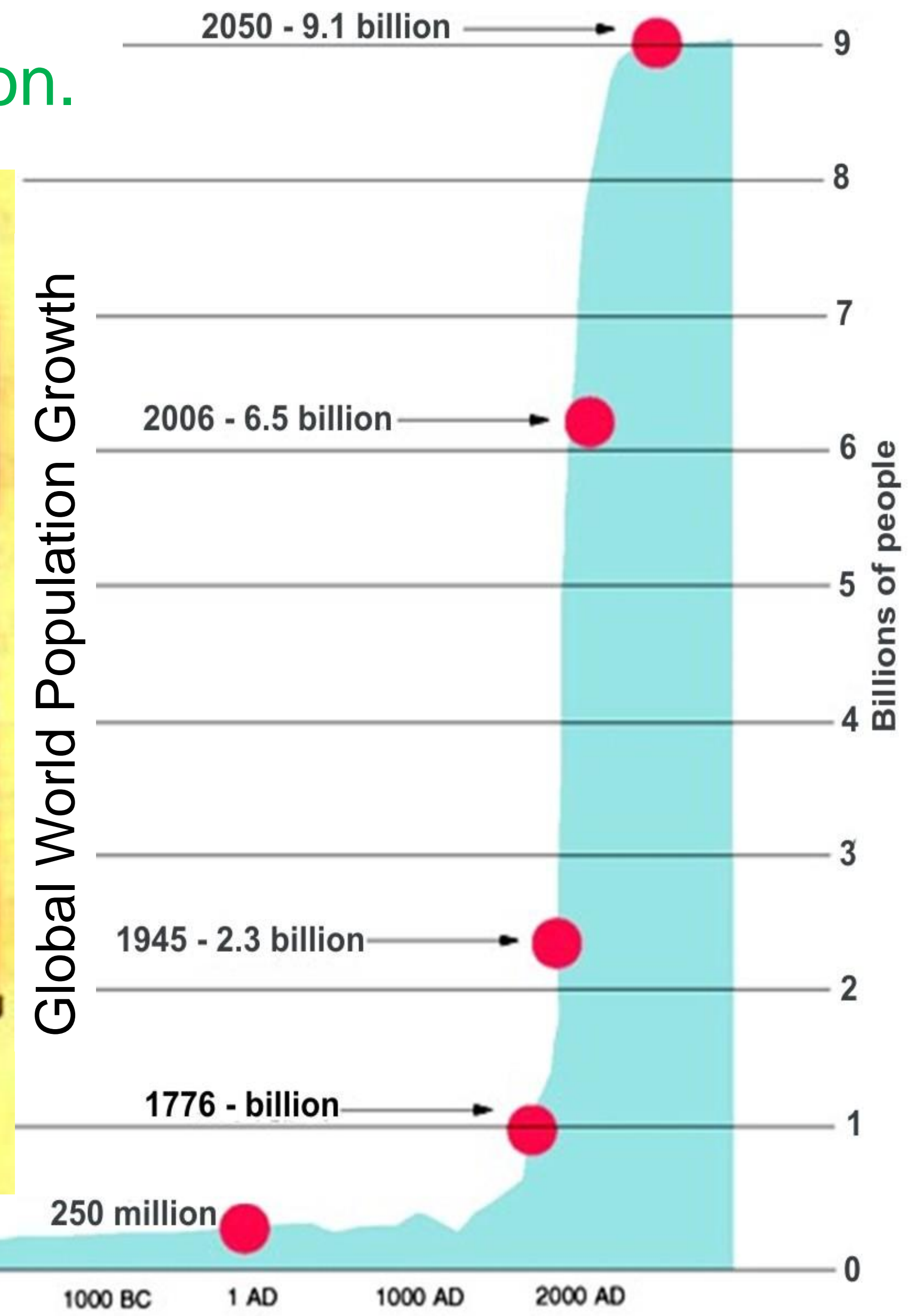
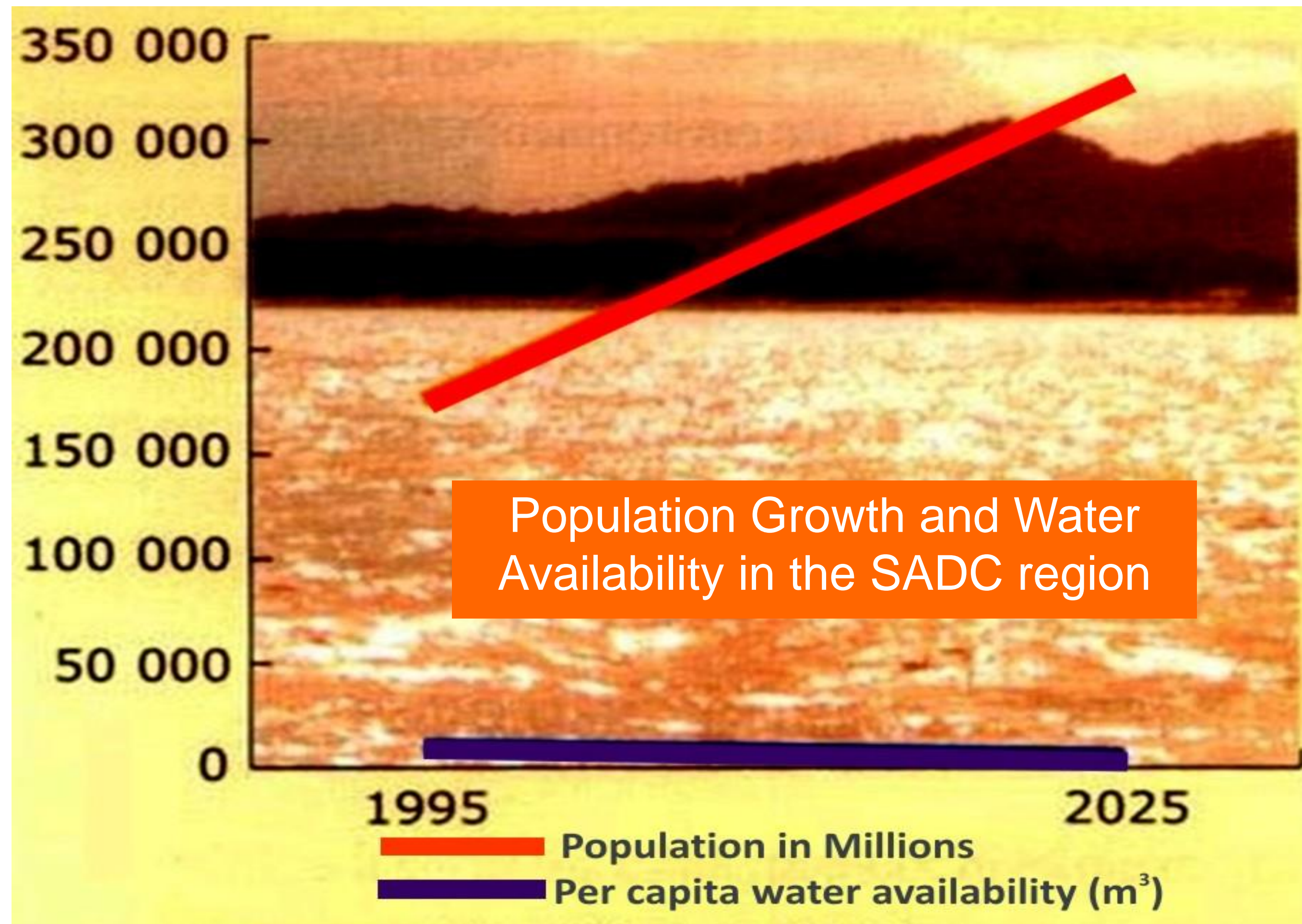


Source: Lapworth (2014)



2. State of Continent's Water Resources.....contd.

Among factors that have affected state of water resources include a **Rapidly Growing Population.**



source: Parida & Kenabatho (2012)



2. State of Continent's Water Resources.....contd.

Consequence(s) of rapid growth in population:

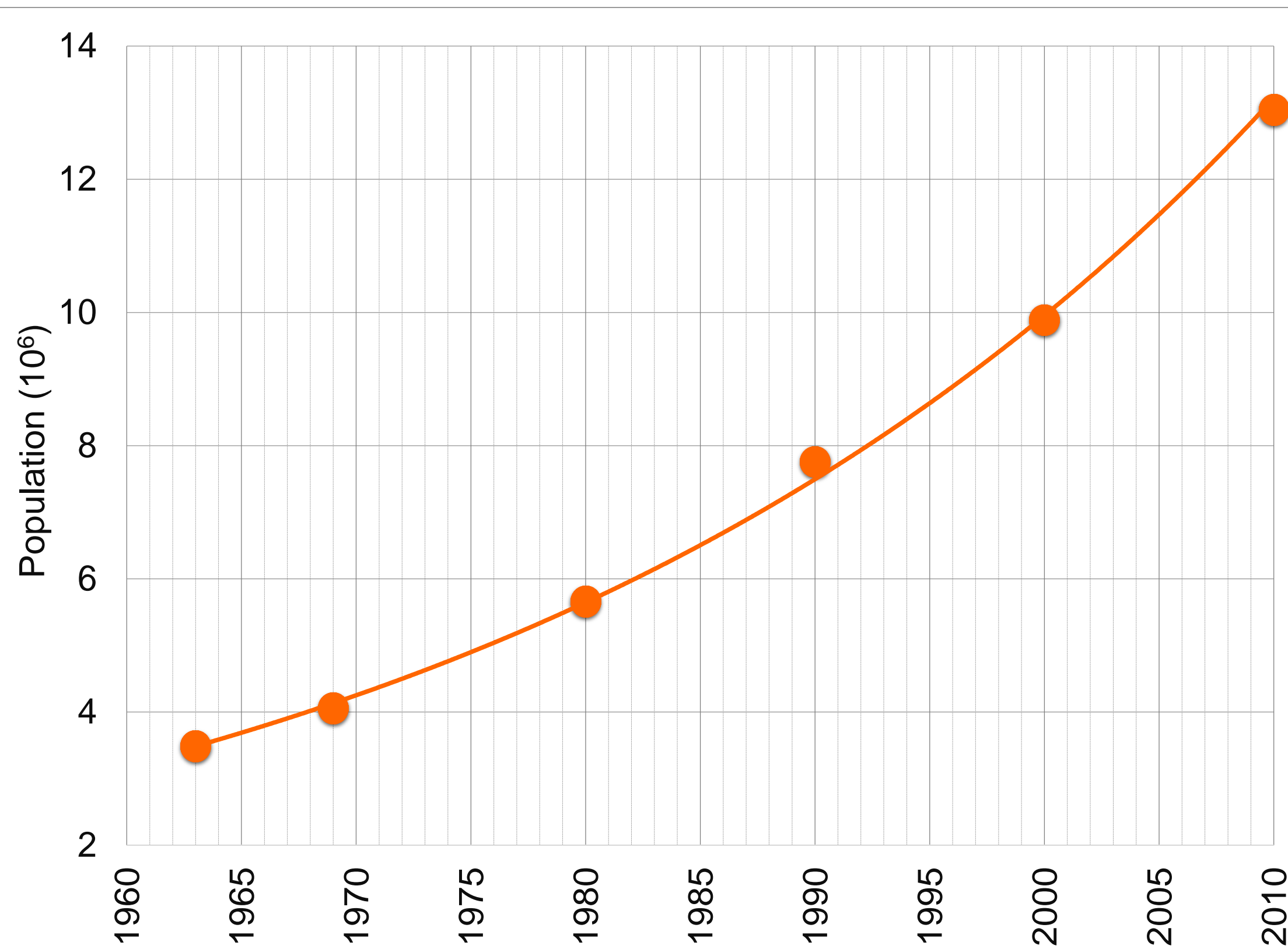
- expansions in economies, resulting in;
 - Increased demand for water, while
 - **availability** might remain **constant or even dwindle**, ⇒ causing **demand to outstrip Supply.**
 - Degradation in Water **quality and, quantity** thereby
 - Inciting water-use conflicts.



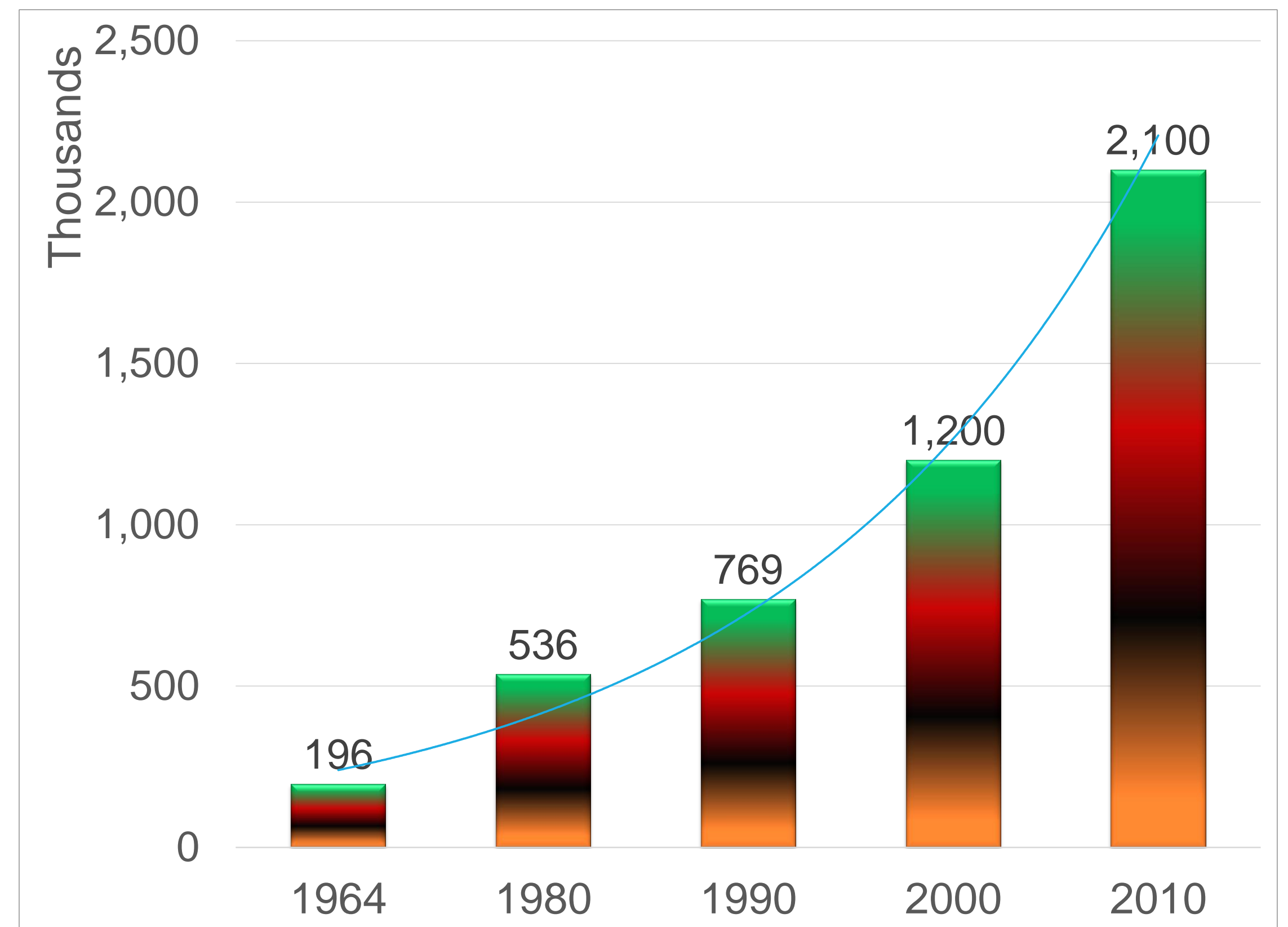
3. Factors affecting state of (Ground)Water Resources in Zambia

Major one has mainly been a *rapidly growing population*.

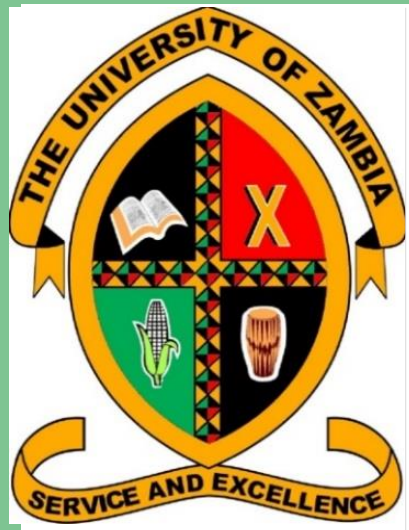
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Growth of Population in Zambia(1963 – 2010)

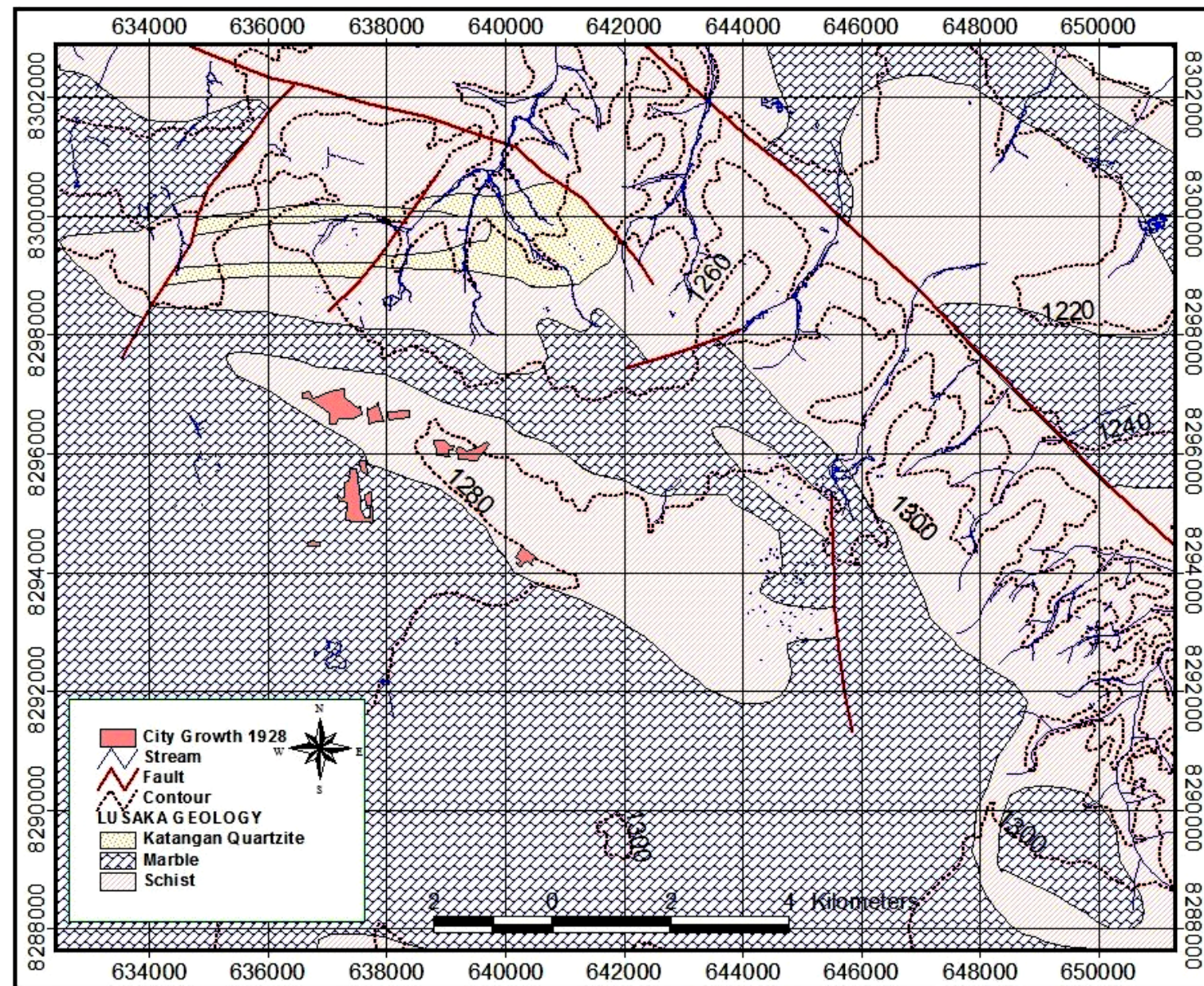


Growth of Population in Lusaka(1964 – 2010)

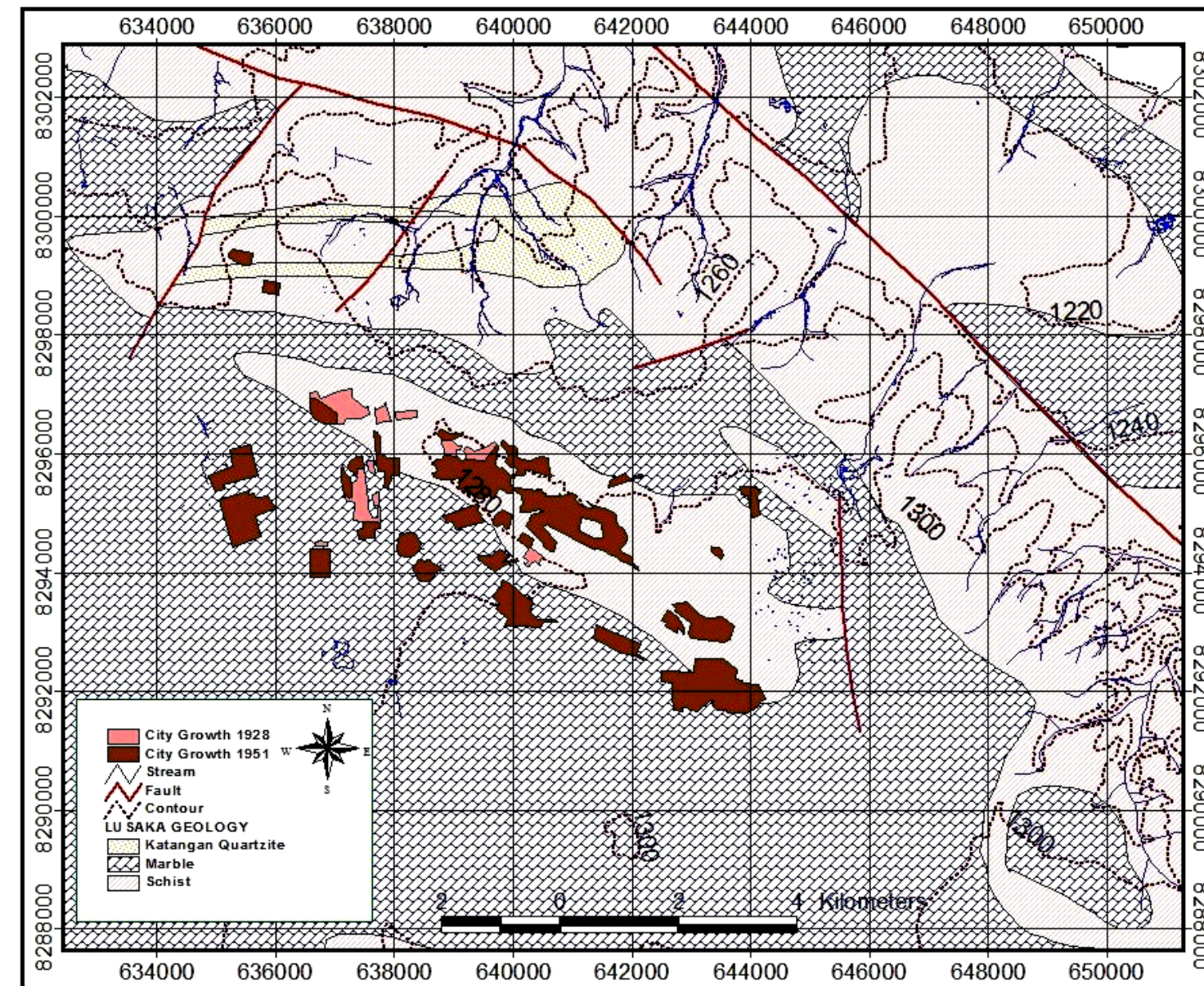


3. Factors affecting state of (Ground)Water Resources in Zambia....(2)

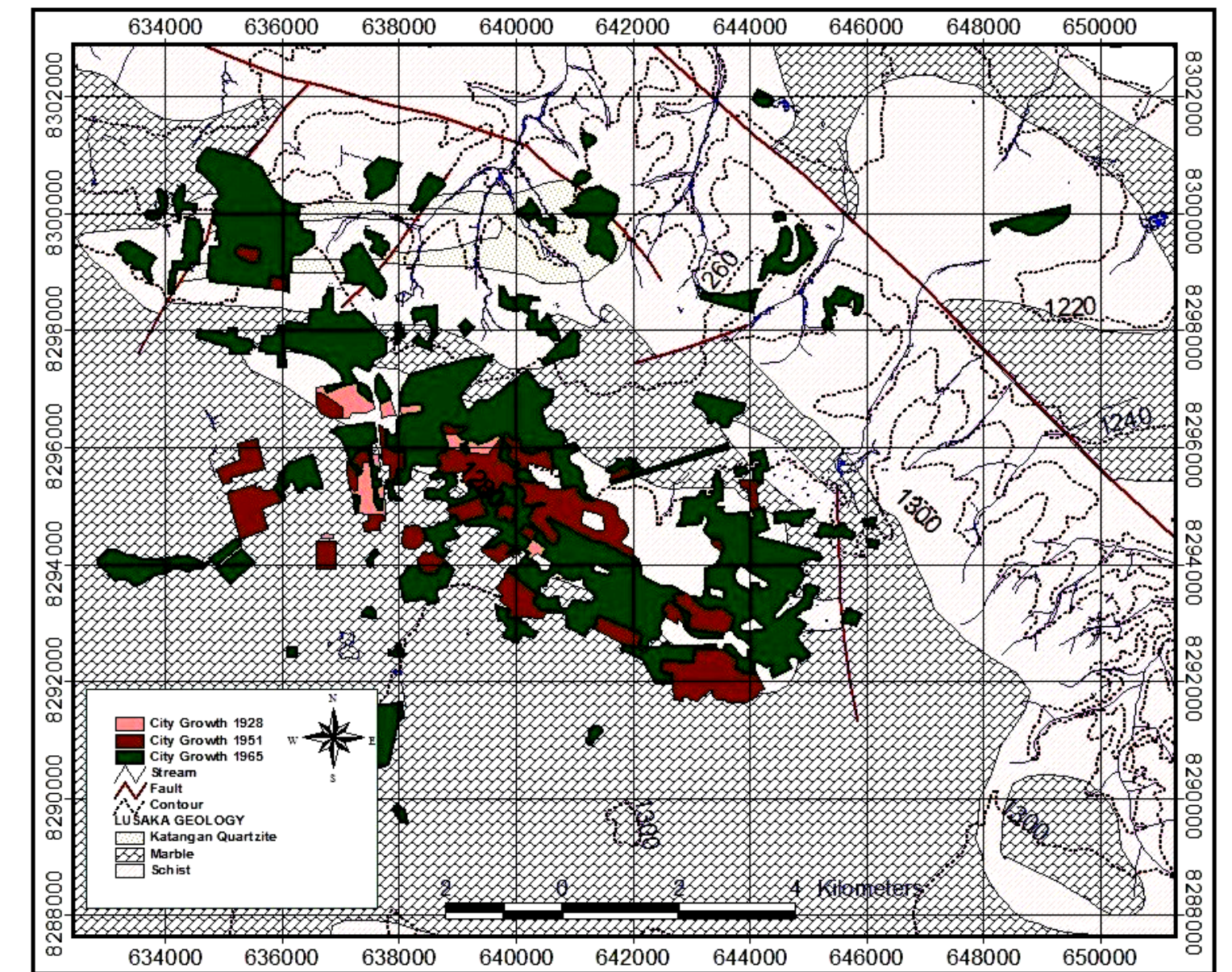
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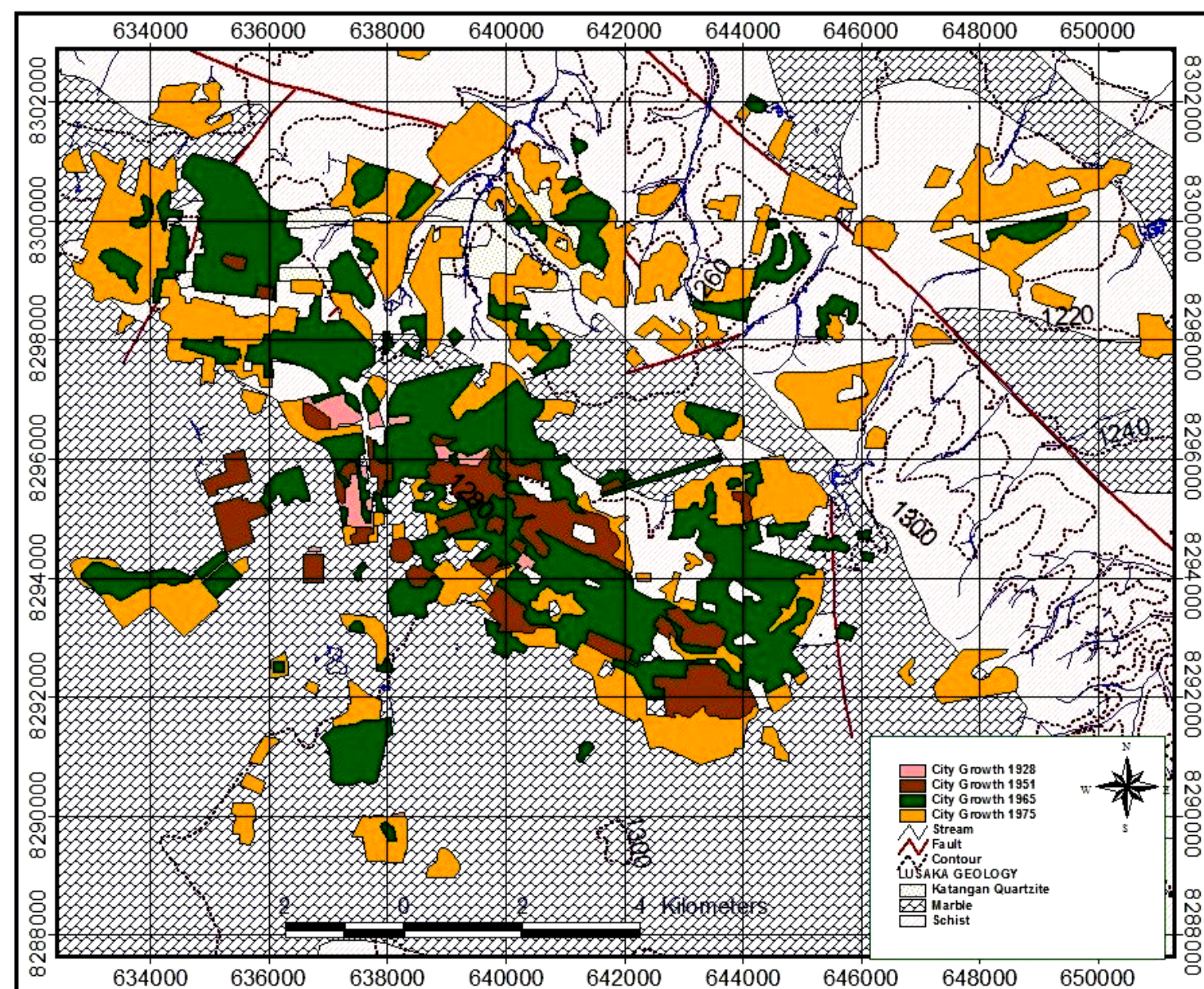
1928



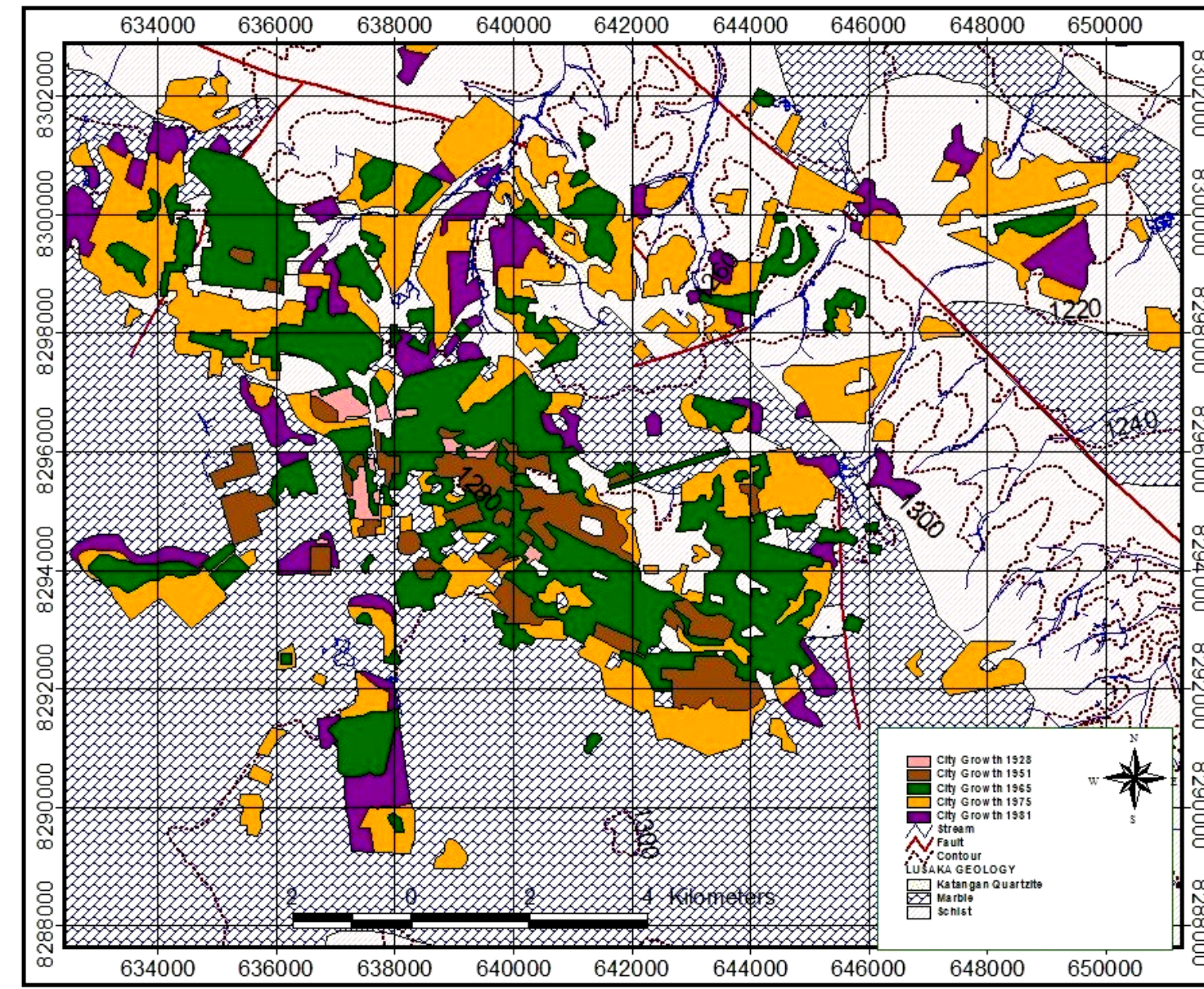
1951



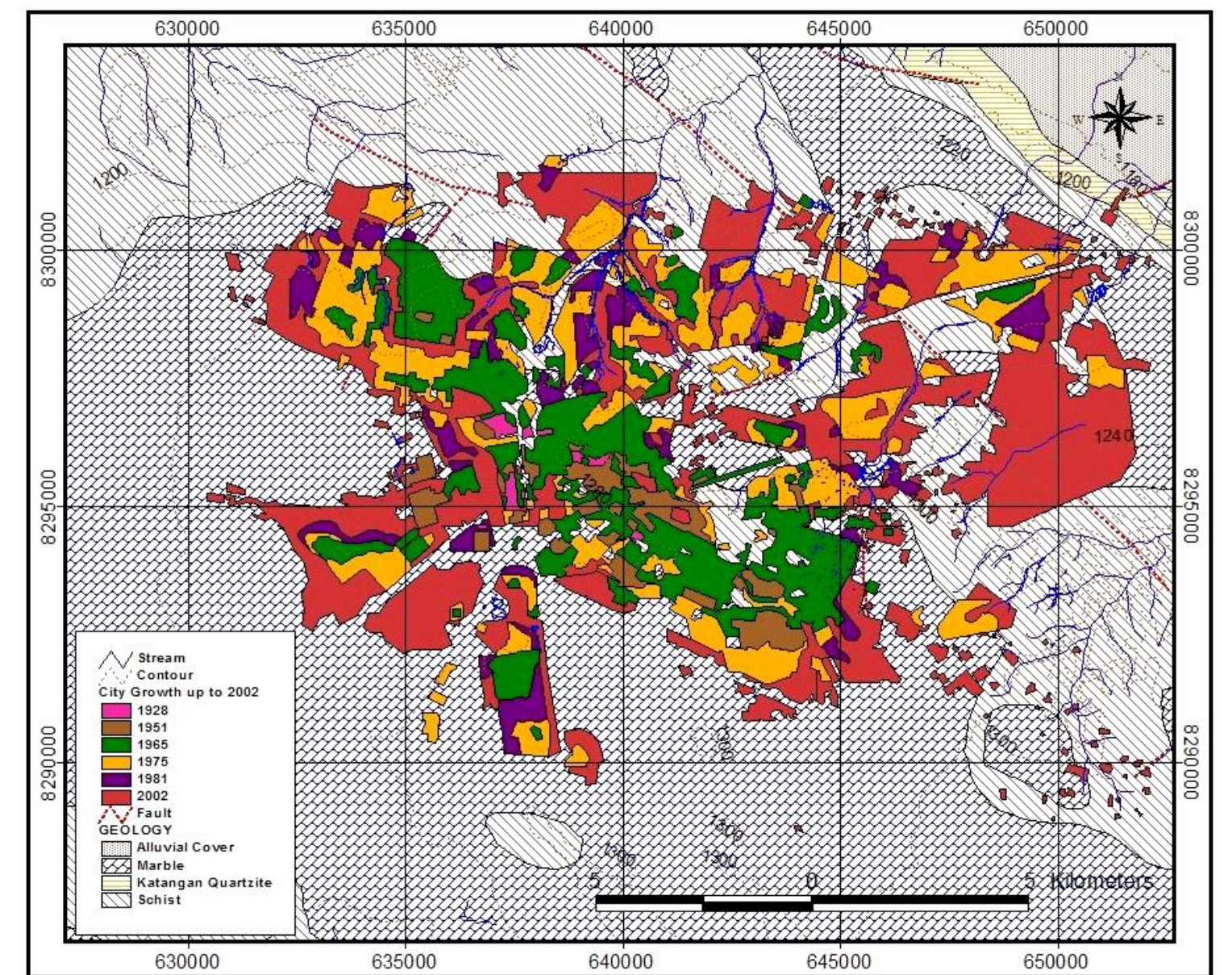
1965



1975



1981



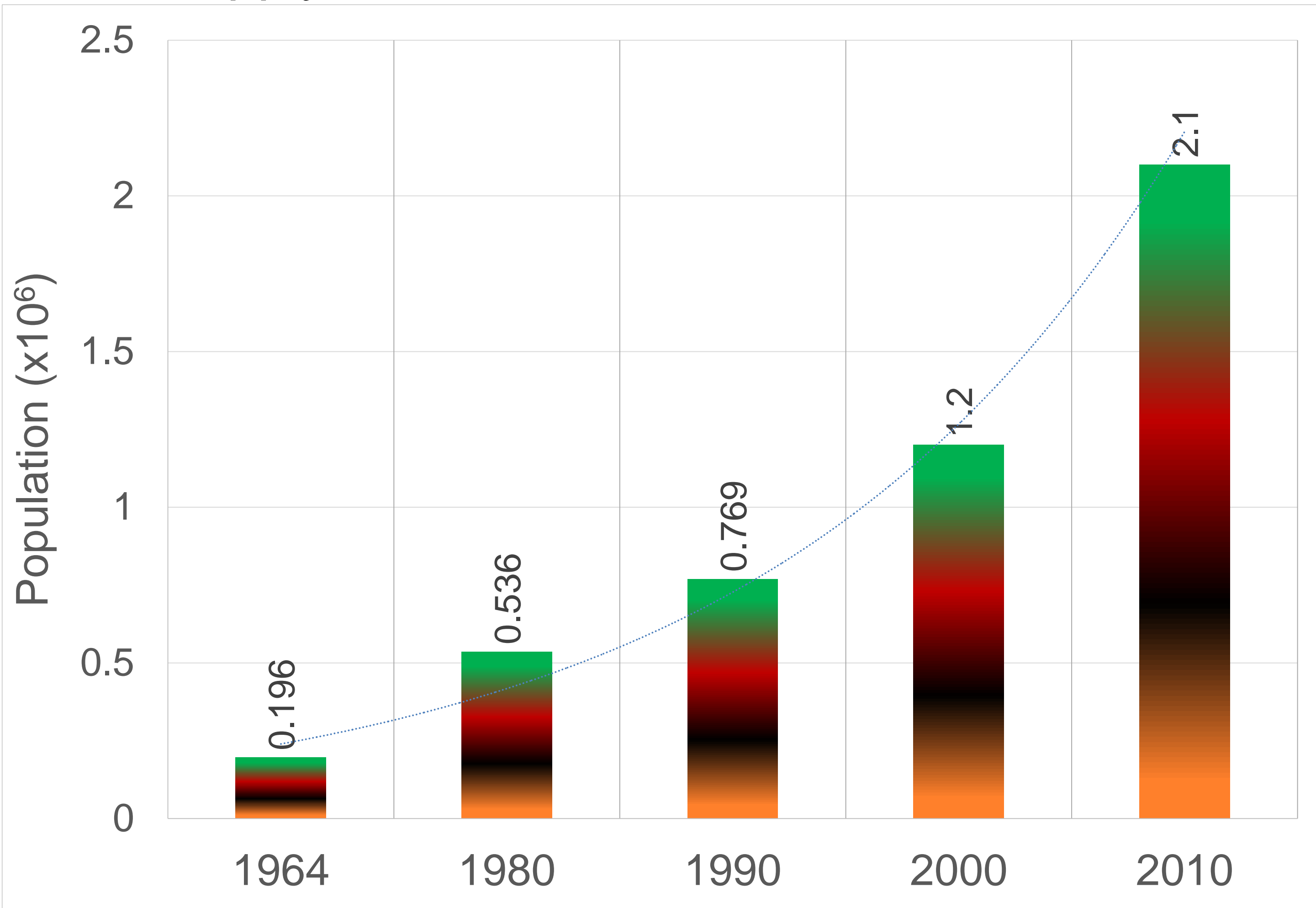
2002



3.1 Groundwater Over-abstraction

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Water supply scenario in Lusaka as at 2010:



With population = 2.1 million, &

Assuming **200 litres** per capita per day....

420,000 m³ d⁻¹

Official supply ca. **240,000 m³ d⁻¹**

Deficit

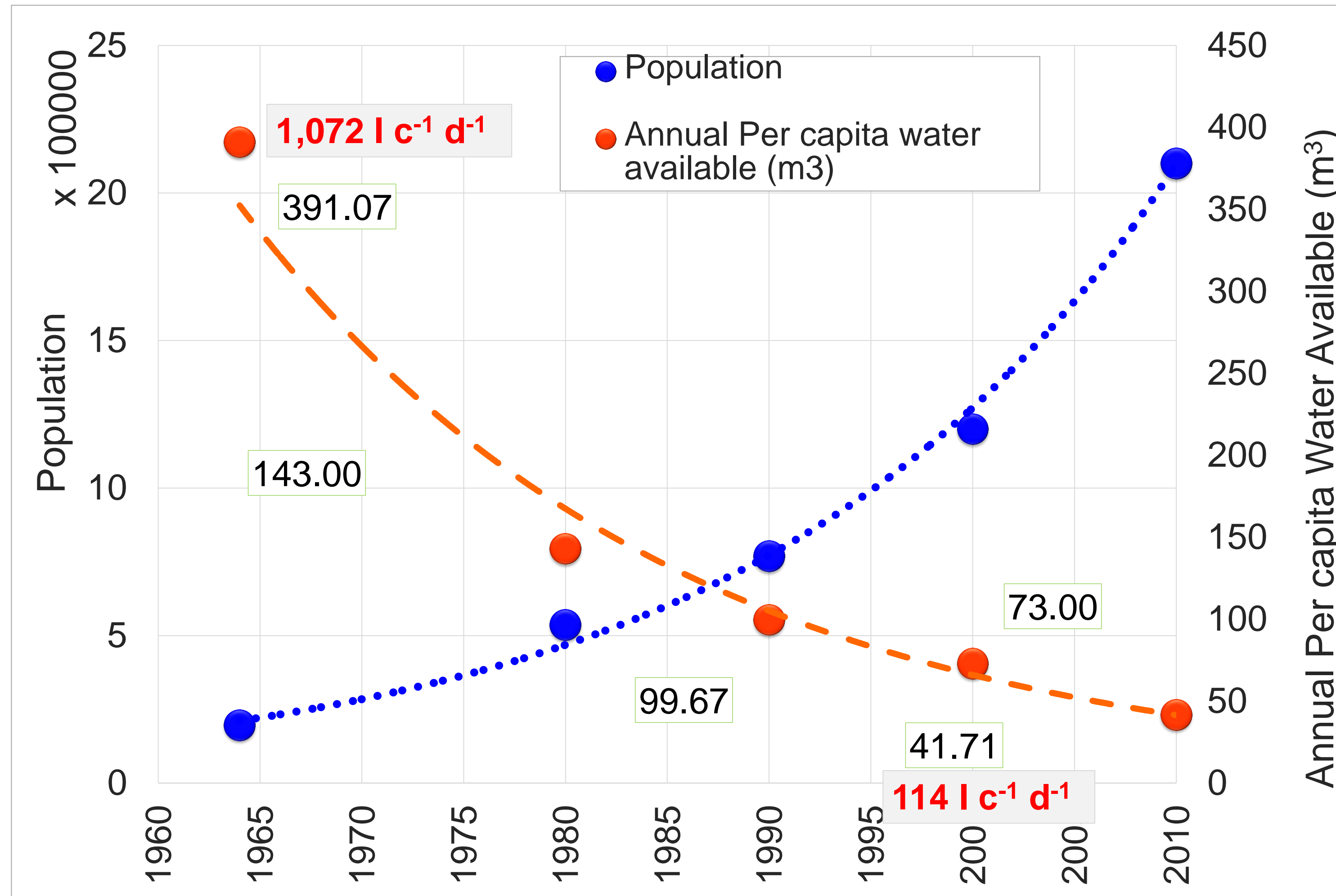
ca. 180,000 m³ d⁻¹

Data Source: Lusaka Water & Sewerage company (LWSC) and Central Statistical Office (CSO)



3.1 Groundwater Over-abstraction.....(2)

Population Growth vs. Per capita annual available water



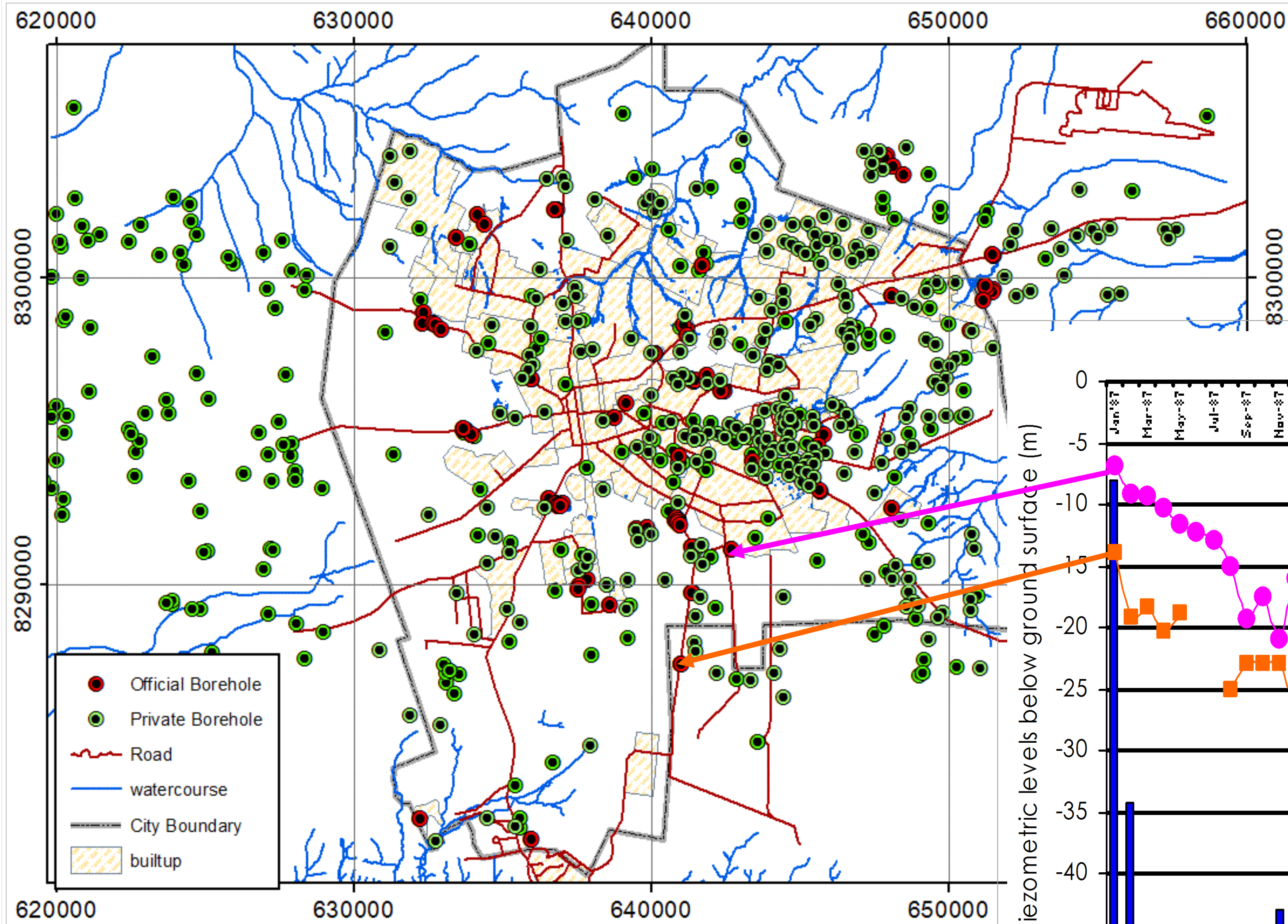
This per capita consumption is exacerbated by leaks in conveyance system of about 45%.

Data Source: Lusaka Water & Sewerage company (LWSC) and Central Statistical Office (CSO)

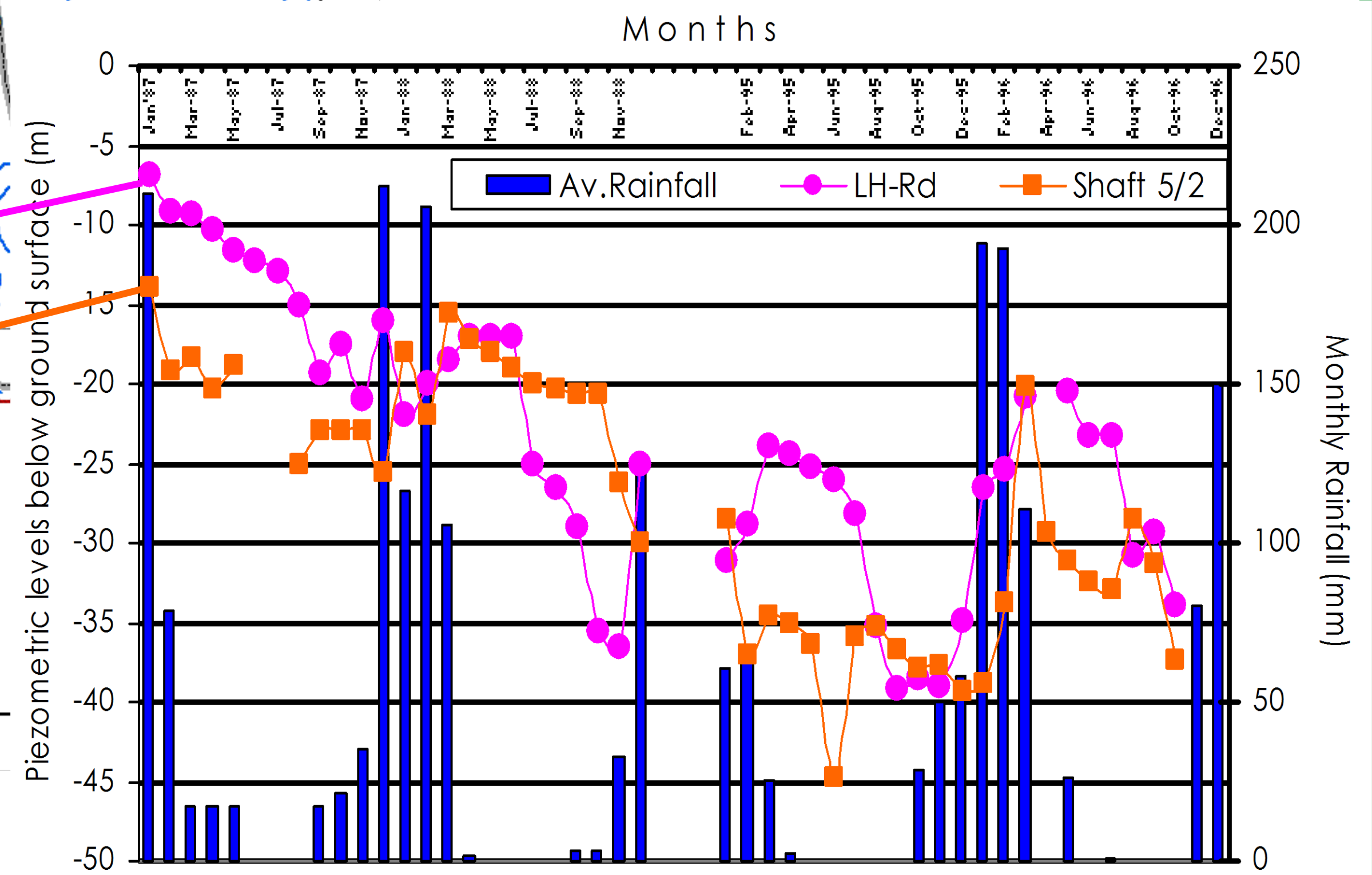


3.1 Groundwater Over-abstraction.....(3)

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Partial spread of private and public boreholes in Lusaka

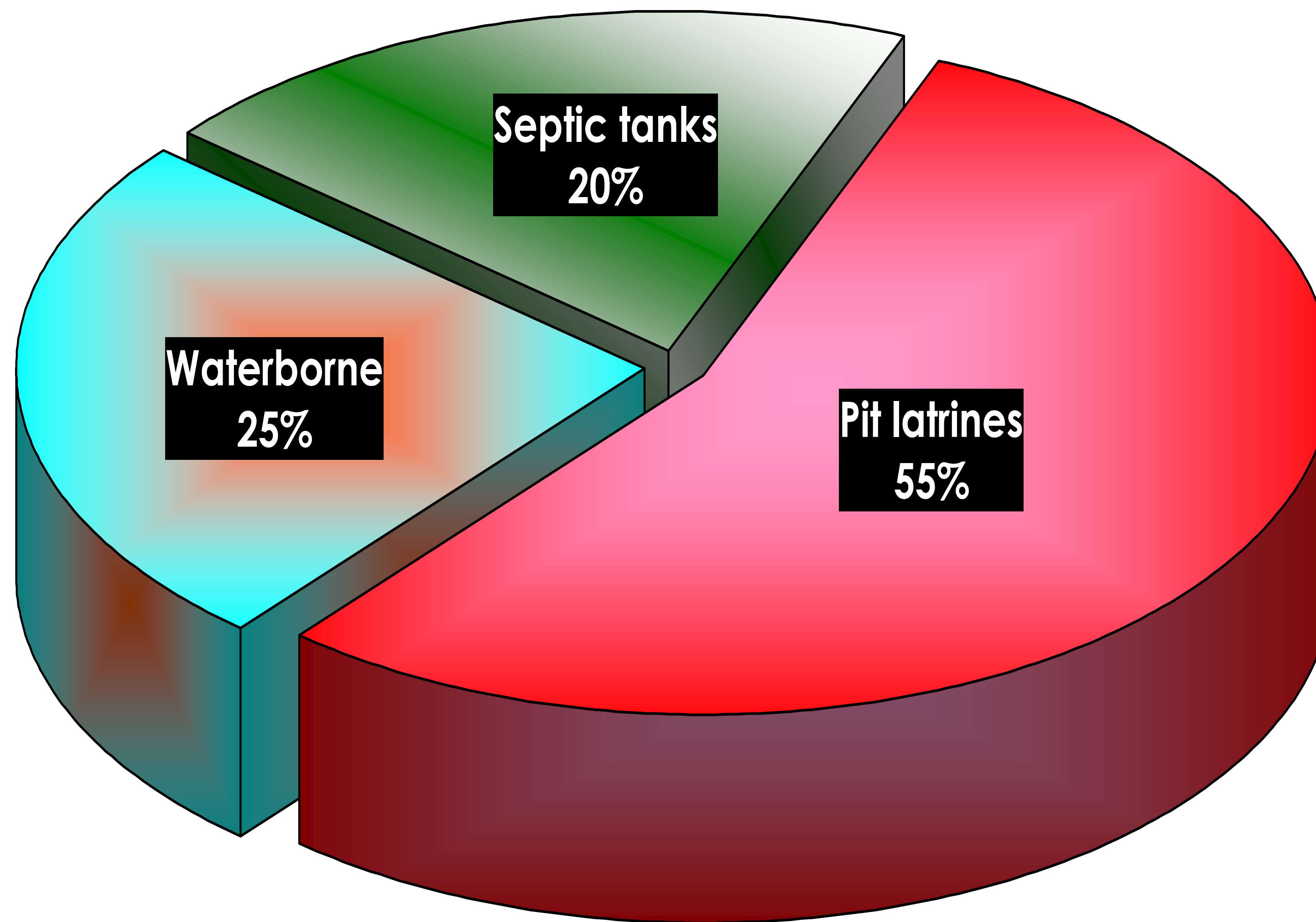


Fluctuation of groundwater table in some LWSC bhs (87 – 96)

Data Source: Lusaka Water & Sewerage company (LWSC) and Department of Water Affairs



3.3 Wastewater / Excreta Disposal Systems.....contd.

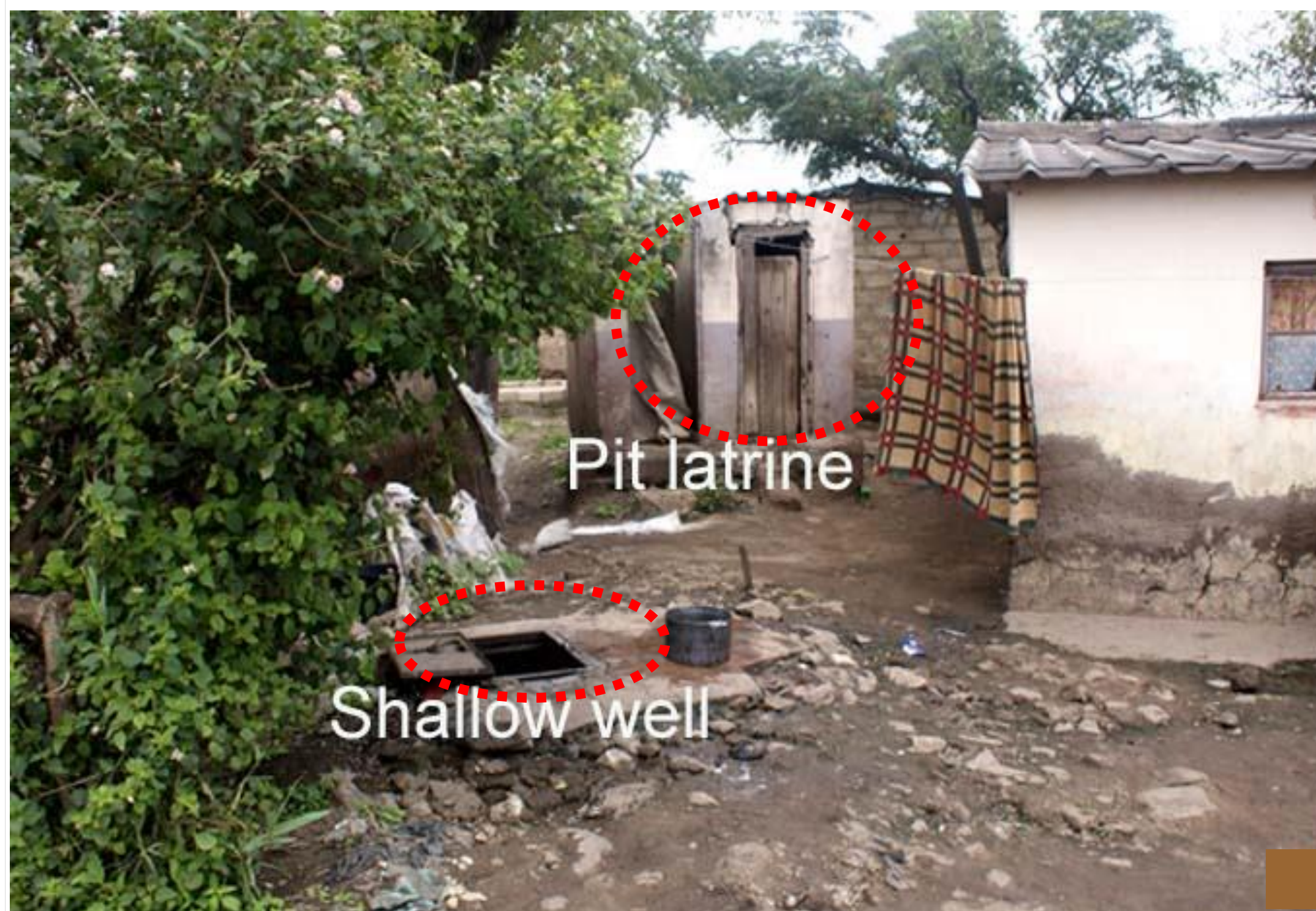


Distribution of excreta / wastewater disposal systems in Lusaka

3.3 Wastewater / Excreta Disposal Systems.....contd.

i) In High-density settlements

Proximity of pit latrines to water points....



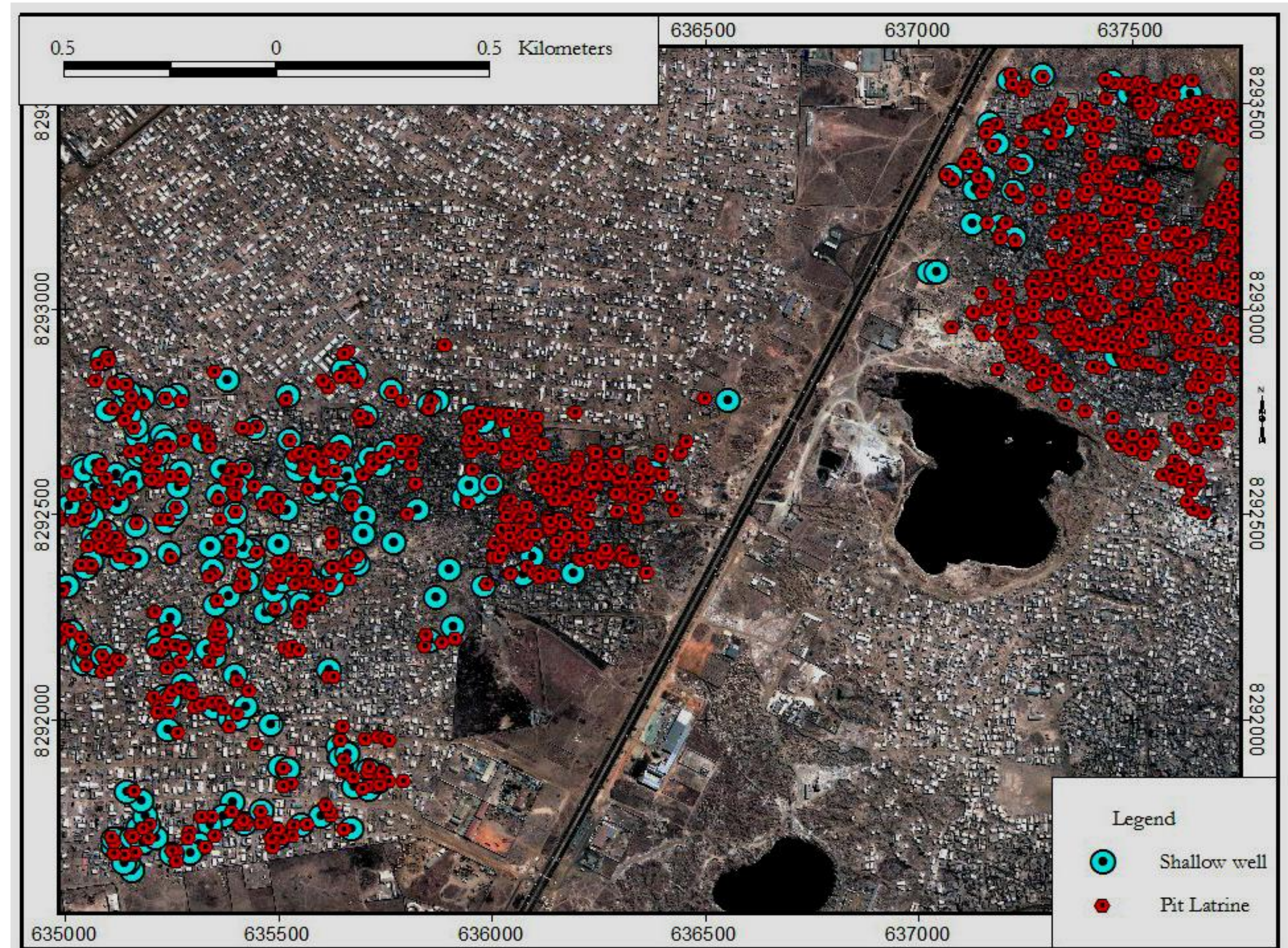
...and implications of flooding on groundwater quality.



3.3 Wastewater / Excreta Disposal Systems.....contd.

i) High-density settlements

Water points and On-site sanitation systems in a high-density settlement with pit latrines (**RED**) and shallow wells (**BLUE**)

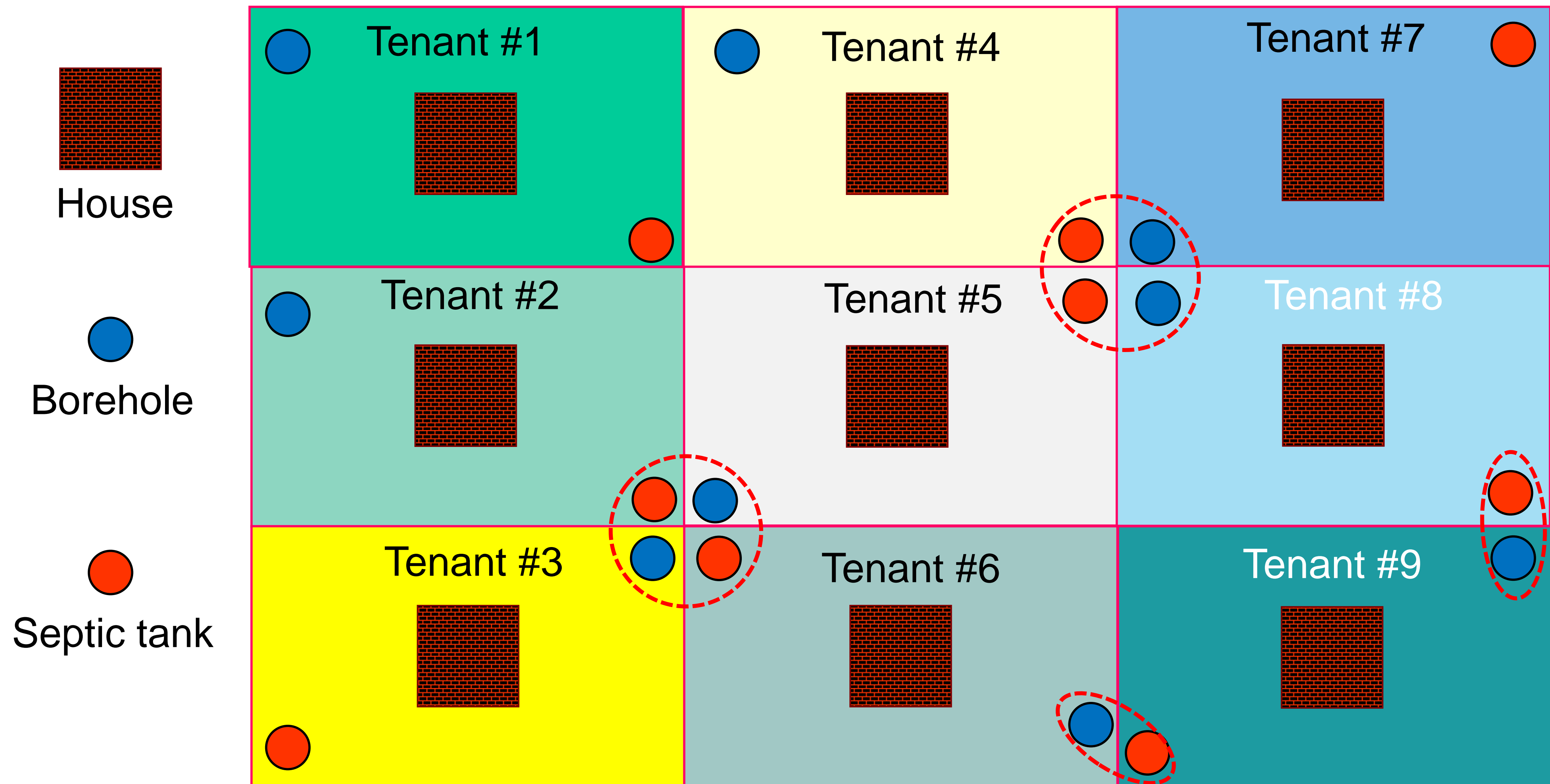




3.3 Wastewater / Excreta Disposal Systems.....contd.

ii) Low Density Settlements

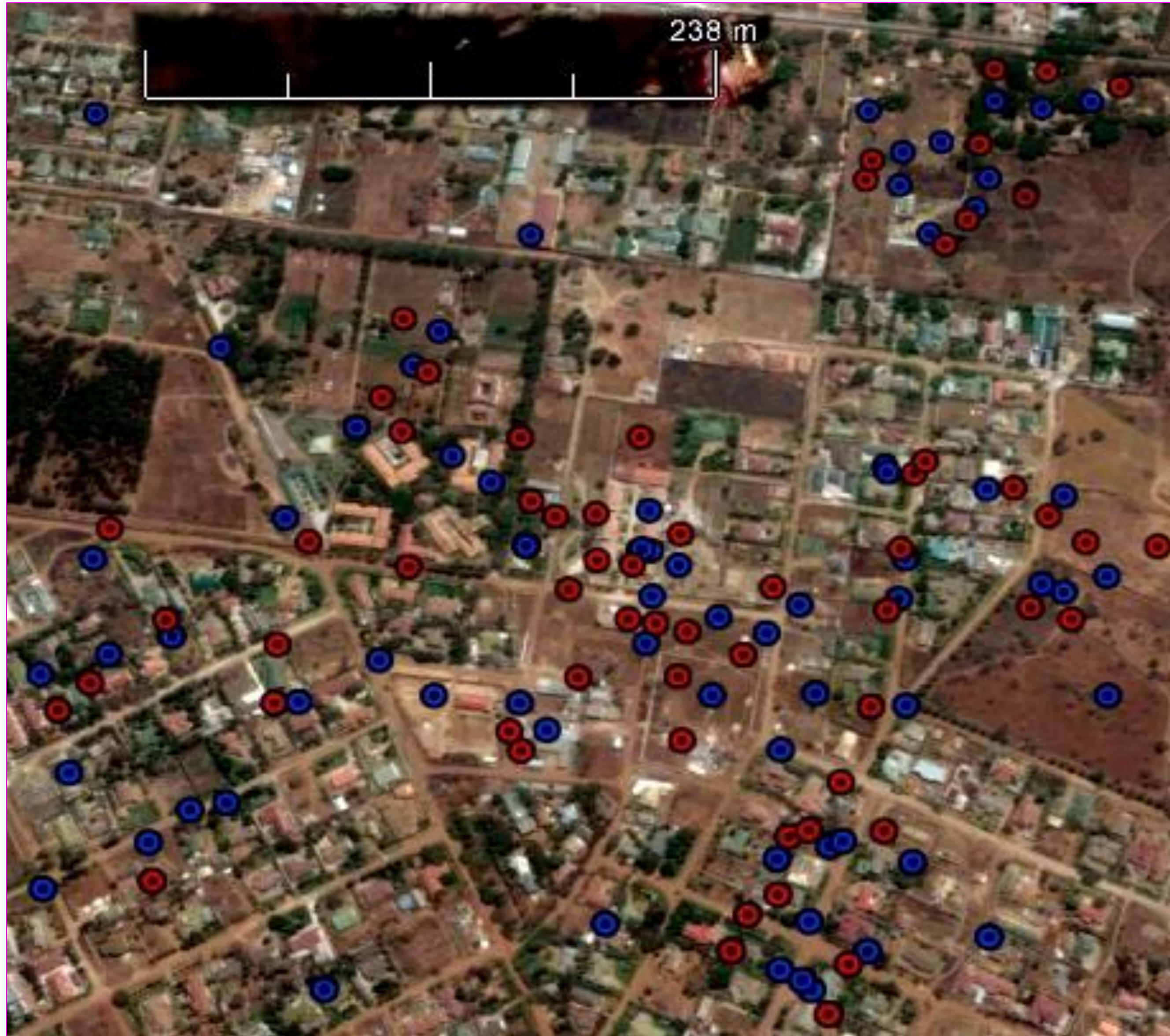
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3.3 Wastewater / Excreta Disposal Systems.....contd.

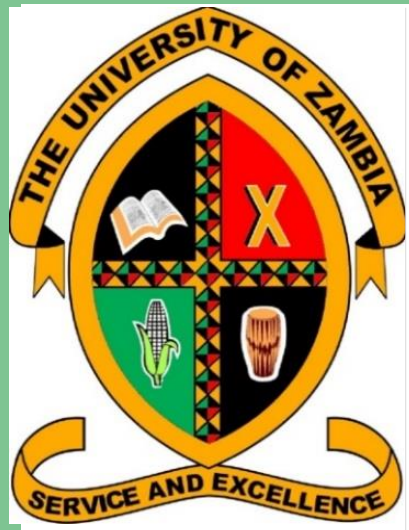
ii) Low-density settlements



Water points and On-site sanitation systems in a low-density settlement
septic tanks (RED) & boreholes (BLUE)

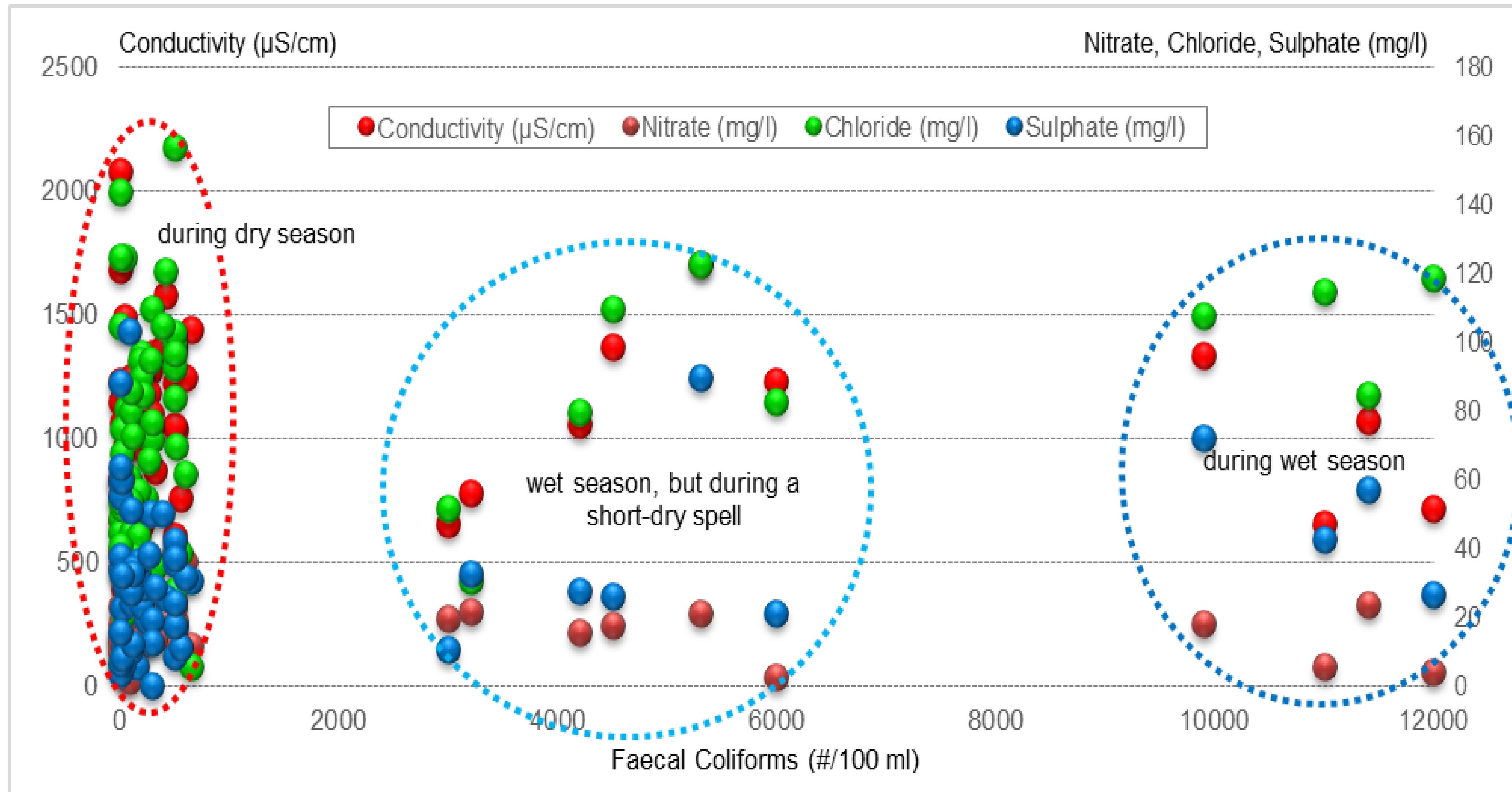
Built on a karstified terrain:





3.3 Quality of Groundwater

a) Shallow Wells (High Density Settlements)

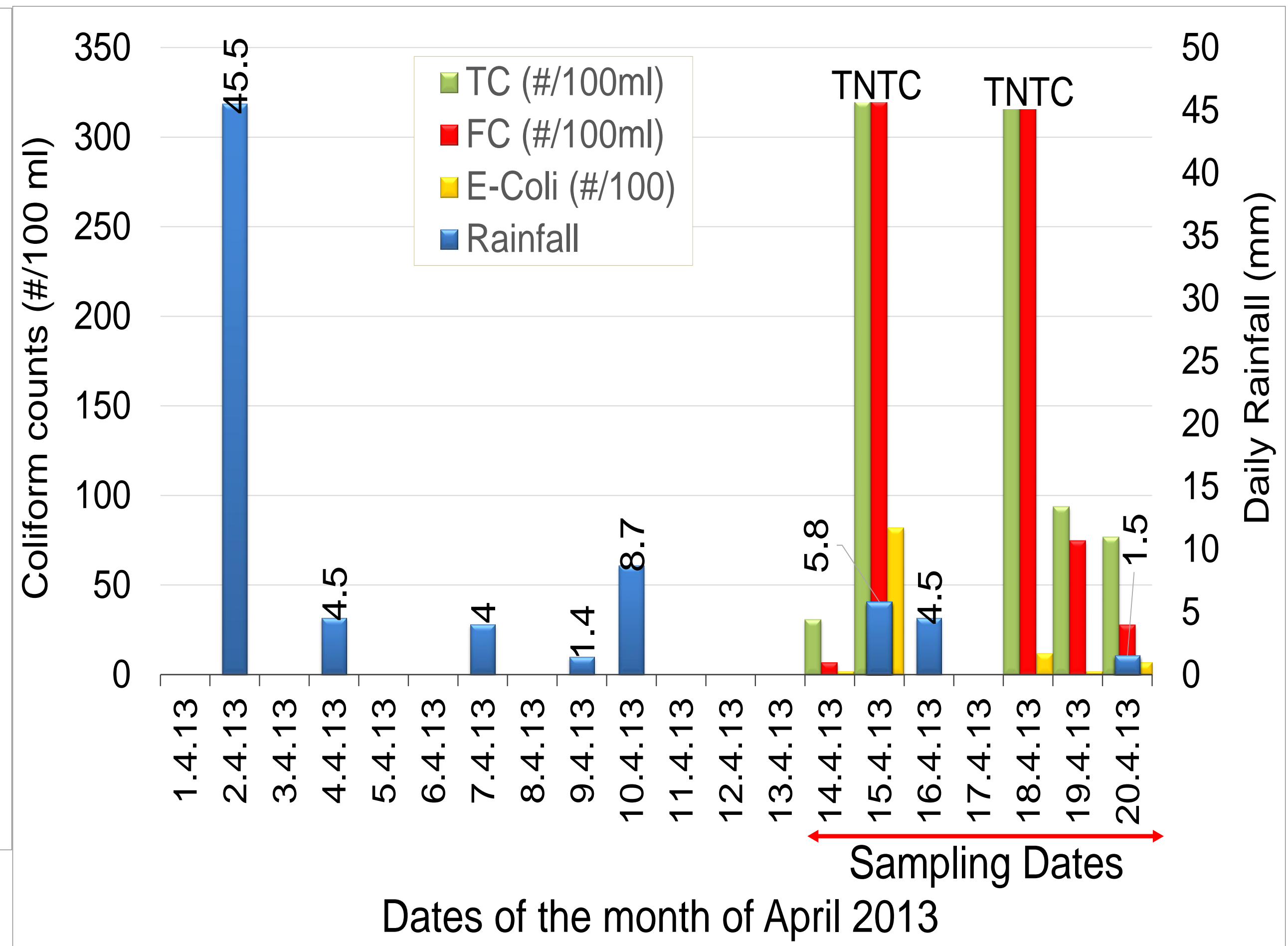
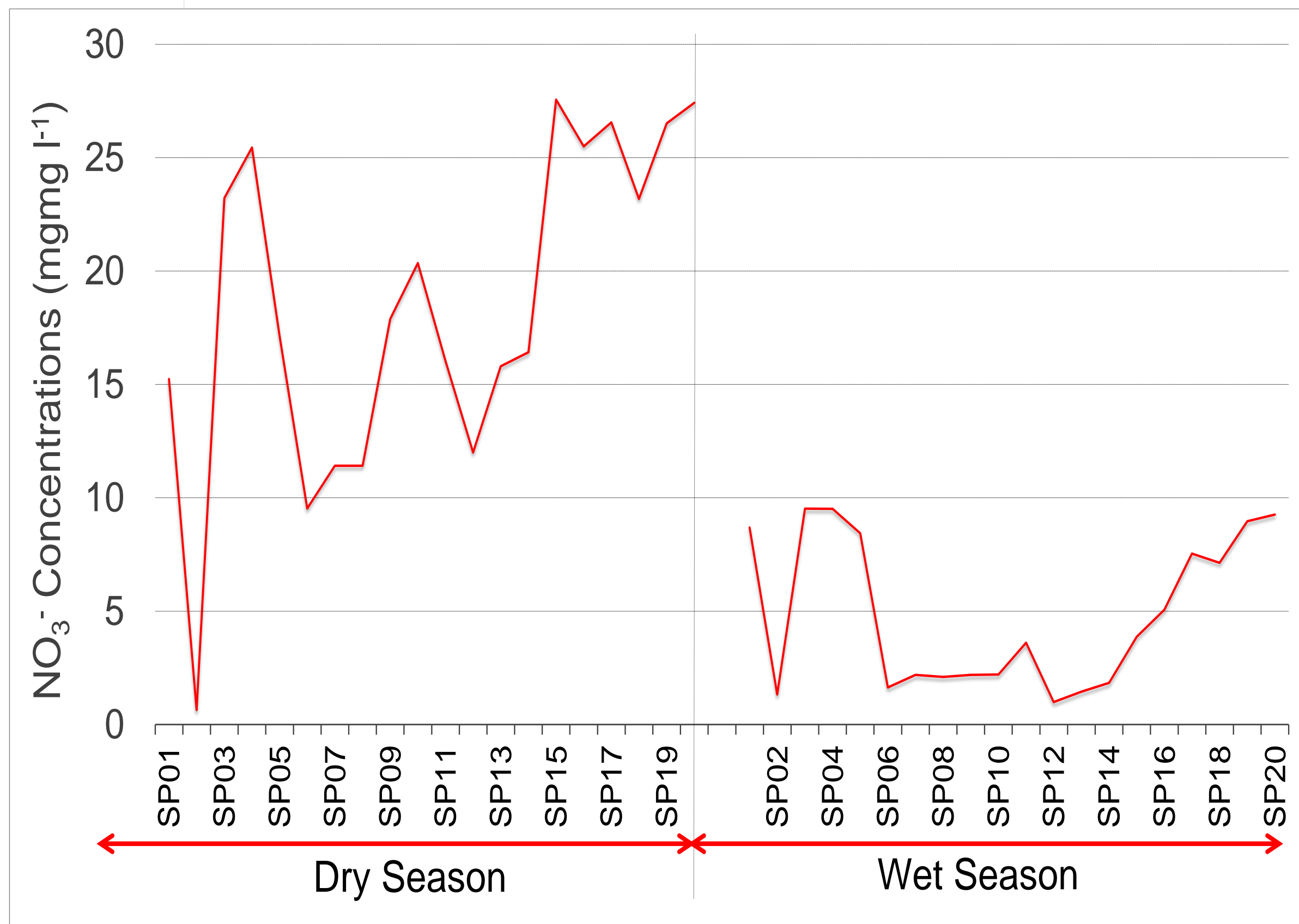


Water quality from shallow wells in a high-density settlement of Lusaka (dry seasons 2003 & 2004; wet seasons 2004 & 2005)



3.3 Quality of Groundwater.....contd.

b) Boreholes (Low Density Settlement)



Nitrate and coliform loading Dry Season 2012 & Wet Season 2013

Coliform loading (Rainy Season 2013)

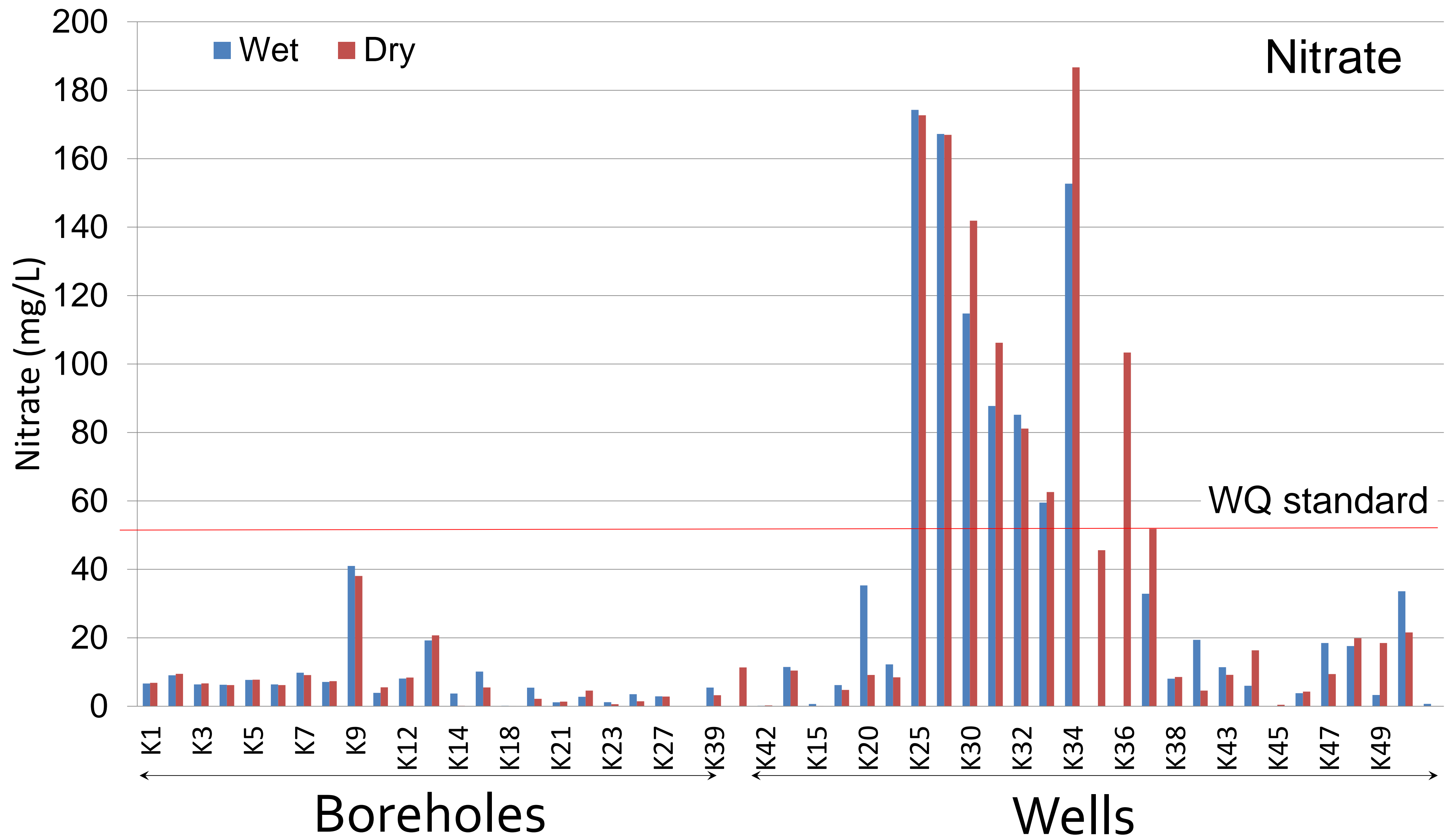
Borehole water quality from a low-density settlement of Lusaka

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3.3 Quality of Groundwater.....contd.

c) Boreholes & Shallow Wells (Low- & High-Density Settlements)



4. Impact of Groundwater Quality on Disease Burden

Consumption of poor quality water has usually resulted in:

- Outbreaks of waterborne diseases (*cholera, typhoid, etc.*).

Consequence;

- Expenditure of vast unbudgeted-for resources (*time, money, etc.*) on health care services, which resources could've been directed to other sectors of development.
- Loss of productive time due to illnesses that are otherwise avoidable.

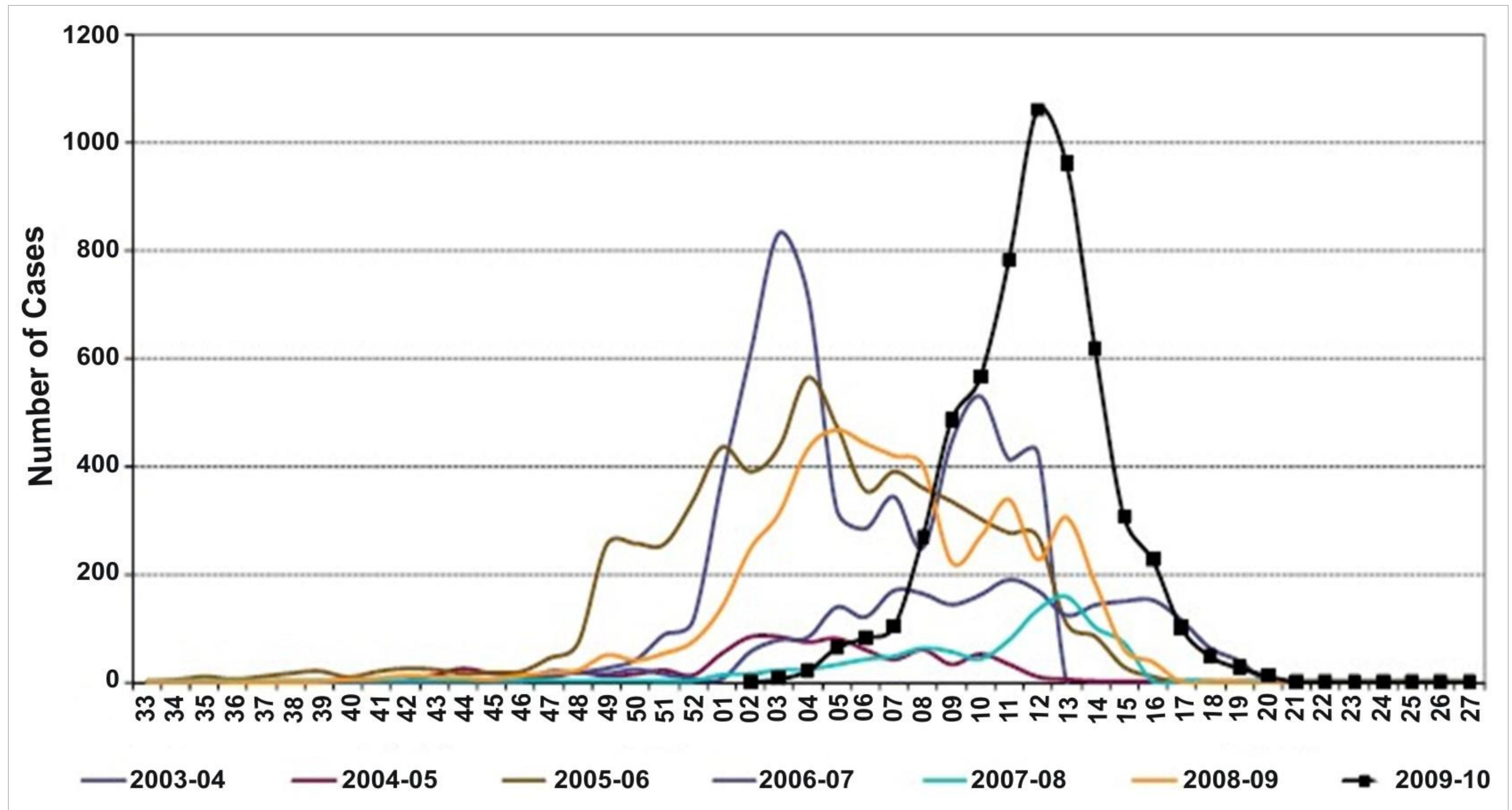


Cholera centre established during such outbreaks in Lusaka



4. Impact of Groundwater Quality on Disease Burden....contd.

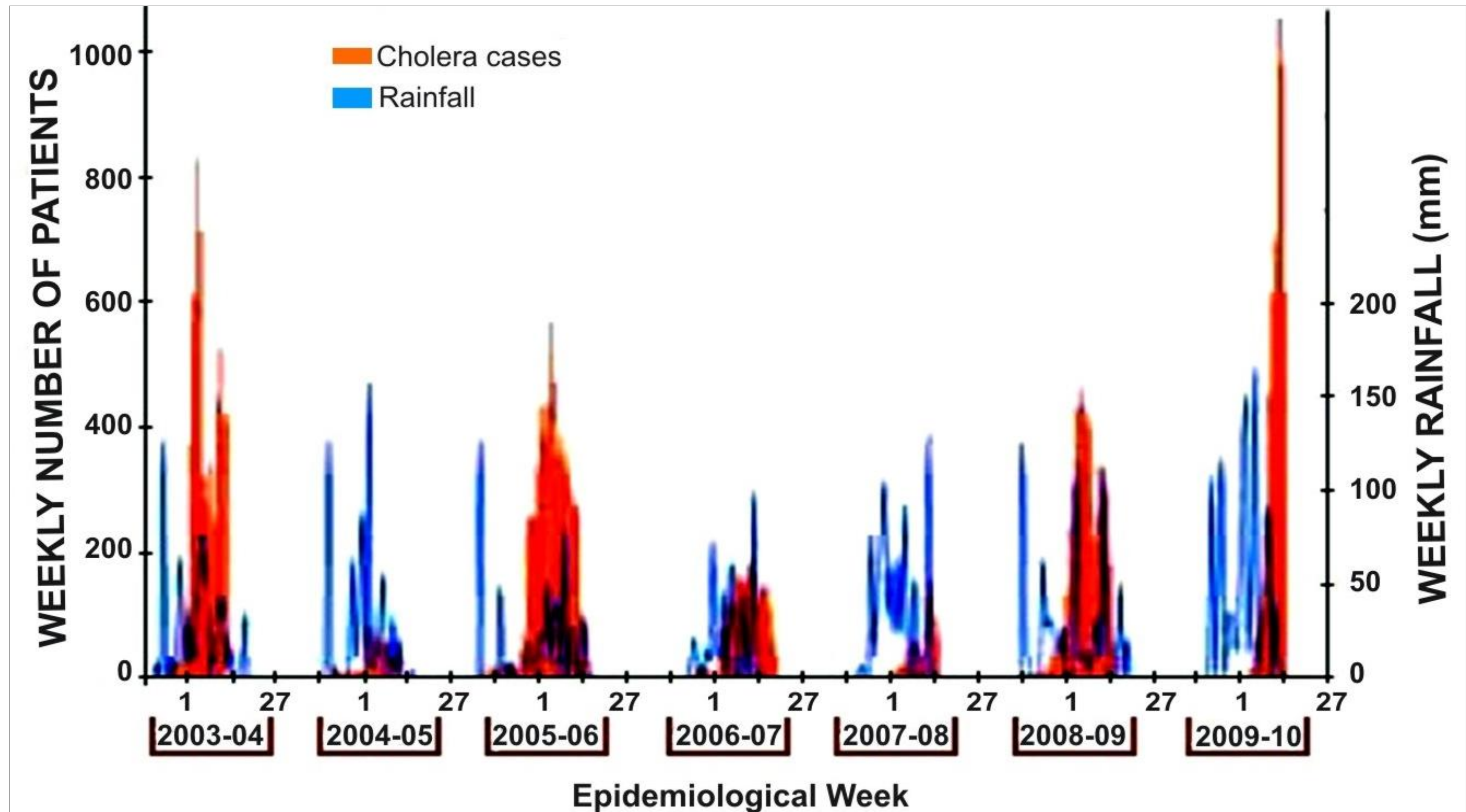
Weekly Historical trends of cholera cases in Lusaka (2003/04 – 2009/10)





4. Impact of Groundwater Quality on Disease Burden....contd.

Historical cholera and rainfall data for Lusaka (2003/04 – 2009/10)





5. Concluding Remarks.

The foregoing indicate the need to re-think city's development in order to:

- Reconcile any conflicting requirements for different land uses, that would ensure;
 - sustainable use of available groundwater resources
 - a safe, healthy, useable, serviceable & pleasant environment for all
 - a protected natural environment, in which people can live a healthy and productive life – now and in the future.



5. Recommendations

In this regard, country needs to:

- Adequately fund and coordinate research for early warning of impending outbreaks.
- Create platforms for sharing and disseminating research results.
- Develop a culture of using research results to inform decision-making processes in different sectors of development.
- Sync. between urban development & groundwater resources' development and management.
- Training for a cadre of adequately skilled water sector and development planning professionals at all levels.



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Thank YOU