Climate resilient approach to sanitation service delivery: A case study of the eThekwini Municipality, Durban, South Africa

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eThekwini Municipality Overview

- Area = 2555km²
- Boundary – 100km N to S, 70km E to W
- 55% urban, 45% rural
- Economic hub of KwaZulu-Natal province
- Population > 4.2 million people

32 % unemployment

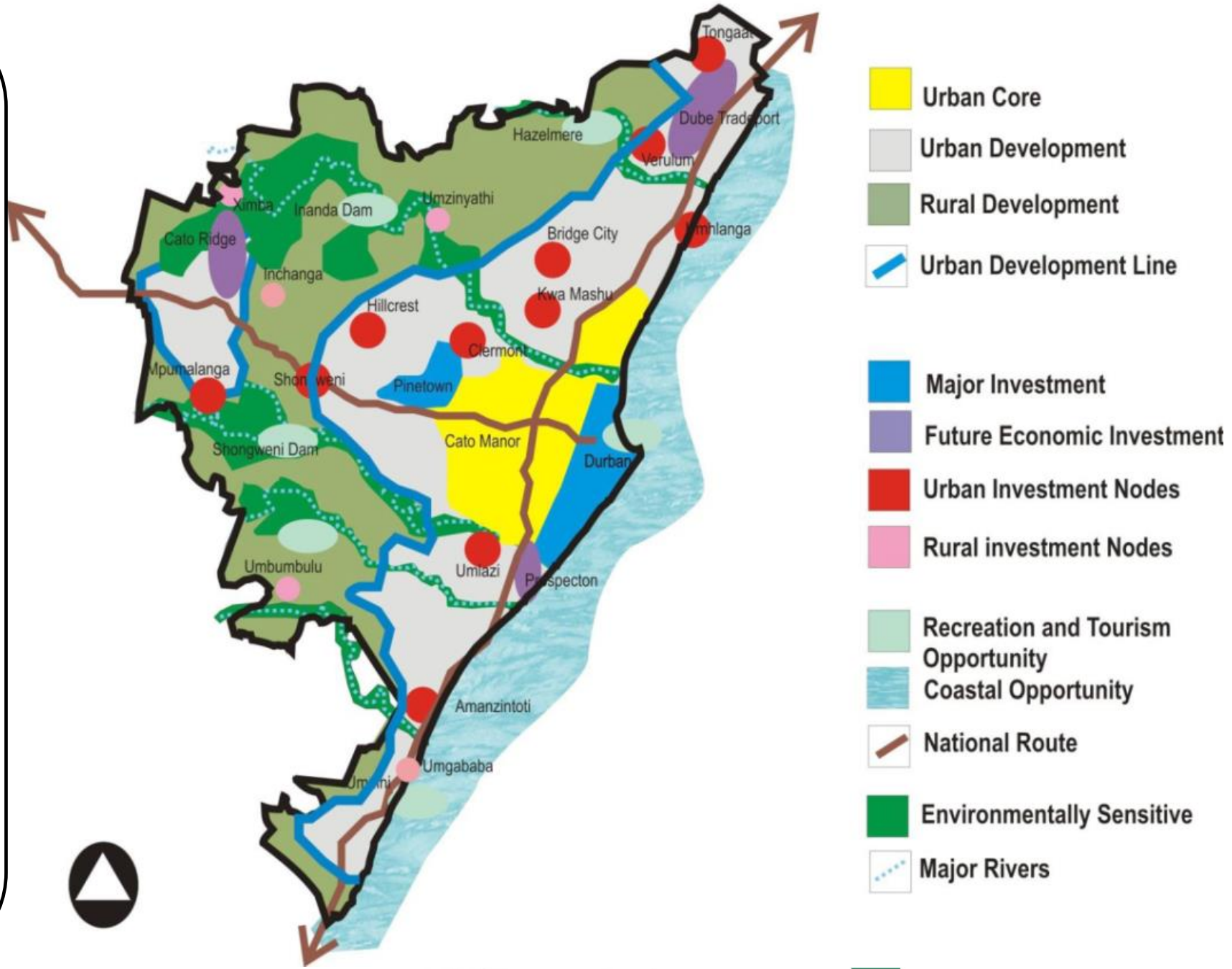
26% of residents live in informal settlements (567 informal settlements in Durban)

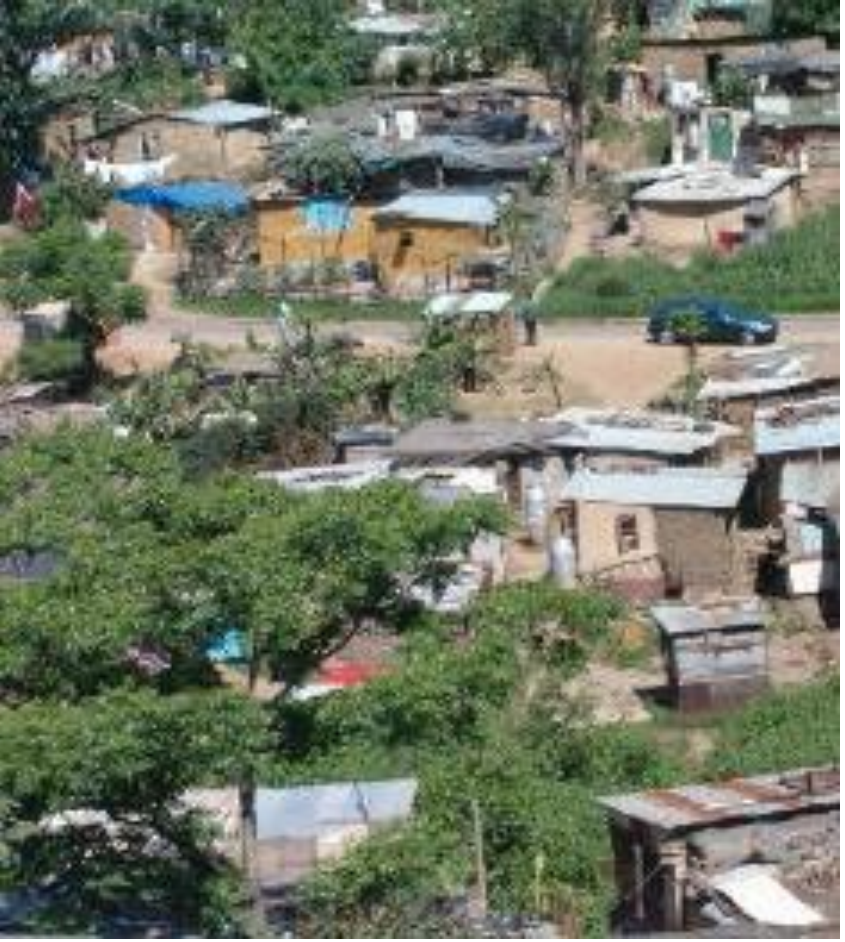
43% of municipal area under dual governance: traditional authority and municipal administration (peri-urban areas: city building from below)

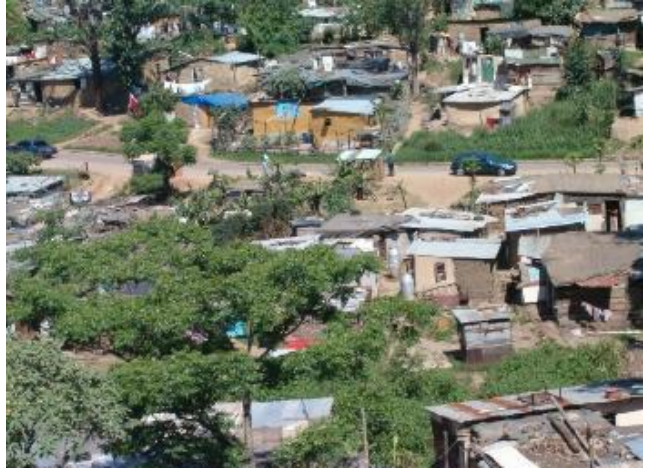
Water and sanitation and housing backlogs

Value of ecological infrastructure

Major disruptions: COVID, social unrest (2021), Floods (2019, 2022)







Informal settlements in eThekwini Municipality

- Over 590 urban informal settlements **(312, 741 households)**
- **~ 25% of the Municipality population**
- Continued urbanization and scarcity of well-located land
- Over 80 years forecasted to overcome the backlog by means of conventional housing delivery
- Challenging topography, high densities and many settlements **within environmentally sensitive areas**
- Many are very dense (200+ du per hectare)
- Less than 3% of households earmarked for relocation (due mainly to sites being unsafe for habitation)
- 41% of land is privately owned (only 18% city-owned)

Response: large scale, top down and universal

199 000 free low-cost houses delivered since 1994

1200 CABs installed, 566 informal settlements in the municipality

88 000 UDDTs installed, TA areas 43% of municipal area

Peri-Urban Areas with Differentiated Services: Urine Diversion Toilets

Large scale systems ….
Small scale innovation …
for transformed large scale systems …

- Post-apartheid transformation (1994 – 2016)
  - Expansion of municipal boundaries
  - Cholera outbreak
  - universal basic services: ‘some for all’ versus spatially incremental service provision
  - Circular economy and resource recovery
  - University-state research partnership (UKZN, EWS and WRC) with some community engagement

UDDTs, Free Basic Water and CABs

- Sustainable sanitation: Responding to social, economic and environmental challenges (2015 +)
  - Innovation: socio-technical, environmental, circular economy, resource recovery
  - Decentralised systems to supplement centralized systems or in the absence of them
  - Transdisciplinary: Engineering Field Testing Platform
  - Bill and Melinda Gates Foundation Field Testing of innovative water and sanitation systems
  - University-state-community research partnership (UKZN, EWS, WRC, communities)

(Odili and Sutherland, 2021)

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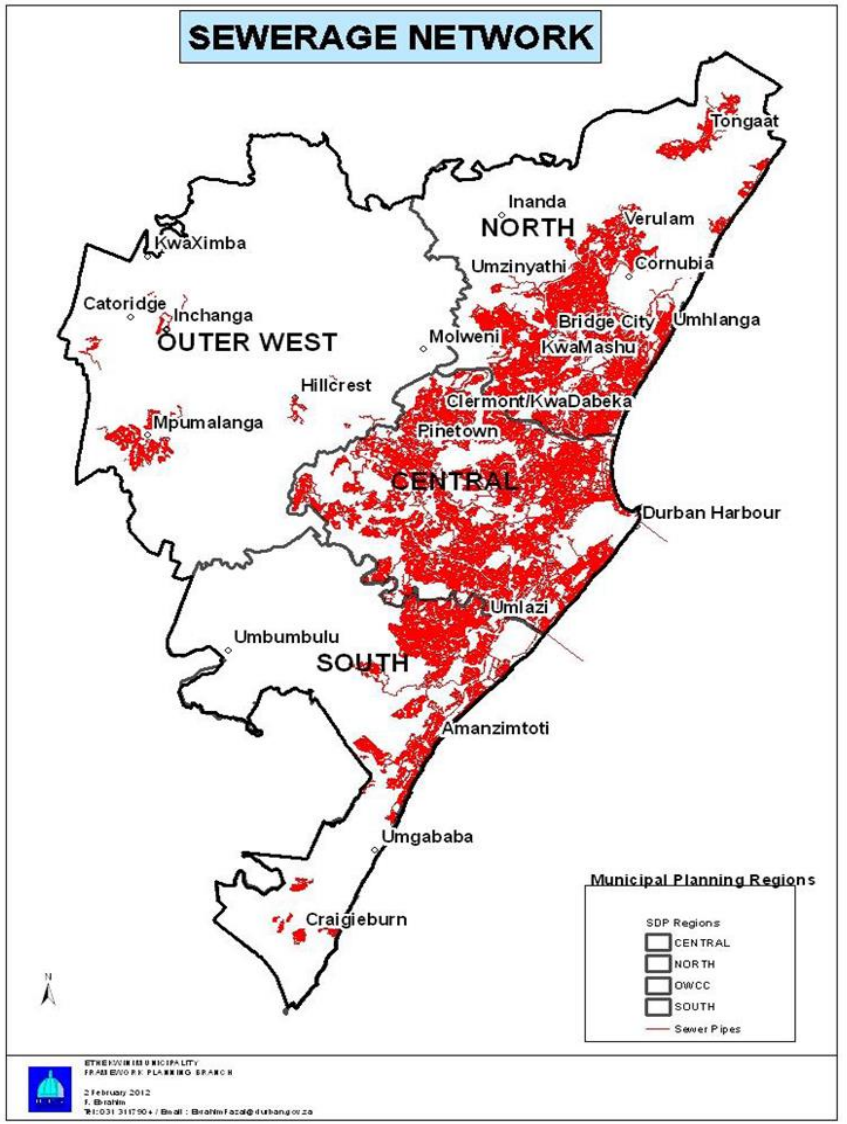
The need for climate resilient, non-sewered sanitation

- Rapid densification of the urban periphery
- Proliferation of informal settlements
- Currently 59% of the population is connected to waterborne sanitation
- Flush toilet accepted as “golden standard”
- Waterborne sanitation is too expensive to implement throughout the Municipal Area
- Wastewater infrastructure working at capacity
- Conventional centralized sanitation technologies have not solved the challenges in the sanitation sector
- Non-sewered, off-grid sanitation systems, are viewed as potentially better solutions
- Requirement for sanitation solutions that can be delivered quickly
- Effects of climate change are affecting sanitation
    - Water shortages
    - Drought
    - Floods



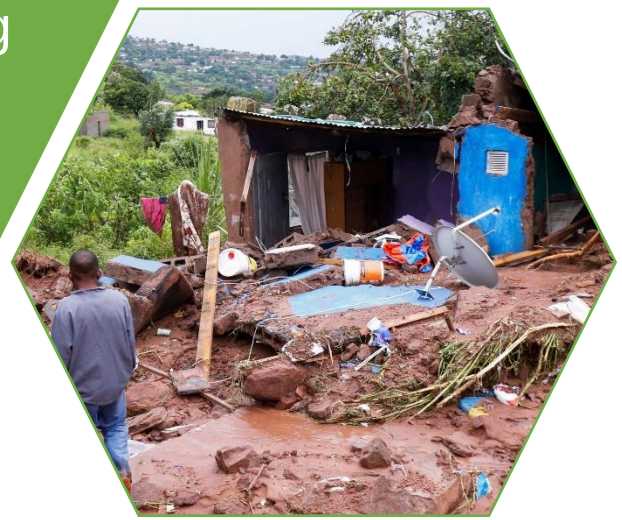
Durban Floods (April 2022): Teachable moment for climate adaptation and risks

Over 12,000 homes completely destroyed

461 people died

Sanitation services restoration lag behind

Millions worth of water & sanitation infrastructure damaged



ENGINEERING FIELD TESTING PLATFORM

- Since 2016
- Adoption of experimental governance and learning-by- doing approaches to support social learning and innovation through the EFTP process
- Real world testing; household and community level
- Evaluates performance over an extended period
- Feedback from community on suitability and impact
- Uses the information and data generated to improve sanitation for all

OUTCOMES & LESSONS: TECHNICAL

- Over 15 sanitation systems tested (2016-2022)
- Some Testing parameters:
  - Total Suspended Solids
  - Chemical Oxygen Demand
  - Nitrate NO3-
  - Ammonia NH4
  - Ortho Phosphates
  - Free Chlorine
  - pH
  - Electrical Conductivity
  - Faecal coliforms
  - Total coliforms
  - Turbidity
  - Electricity usage
- Some systems have performed well, others did not
- Appropriateness for context is key

- Strong potential supporting climate resilient WASH, within a broader mix of sanitation options
- The most promising technologies were further developed, licenced to SA tech providers and commercialised

OUTCOMES & LESSONS: SOCIAL

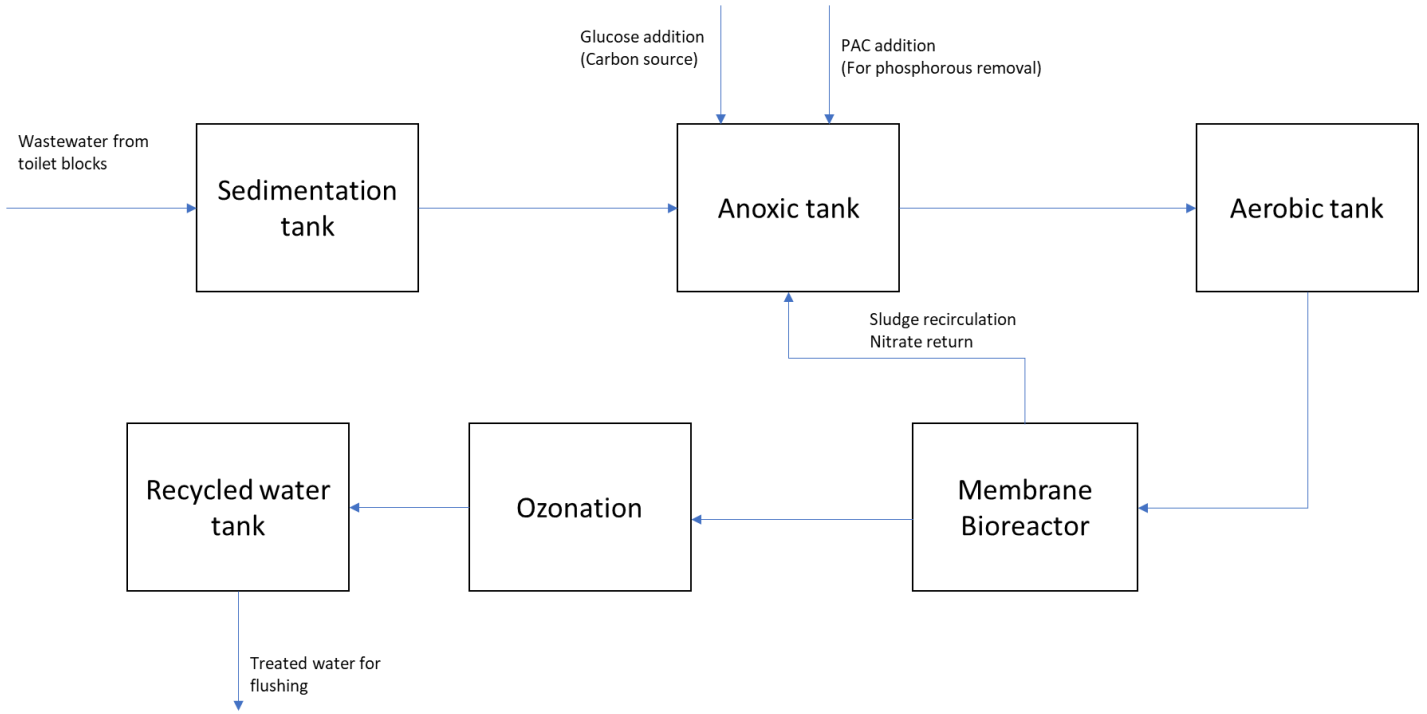
- High citizen awareness of increasing water scarcity and extreme weather events
- Balancing level of user involvement along the sanitation service chain is key – agency and convenience

- Sanitation and the senses – sight, smell, hearing, touch influence acceptance
- Citizens' lack of trust in government quality control oversight and automated quality control systems
- Affordability
- Greater acceptance of reuse systems for flushing toilets or non-food agriculture
- Concerns over operation and maintenance of innovative systems
- Satisfaction is relative – alignment of value propositions to existing sanitation challenges and aspirations of users is essential
- The need for synergy in messaging – balancing hygiene (public health protection) and reuse messaging

STRENGTHENING DISASTER PREPAREDNESS AND RESILIENCE USING NSS

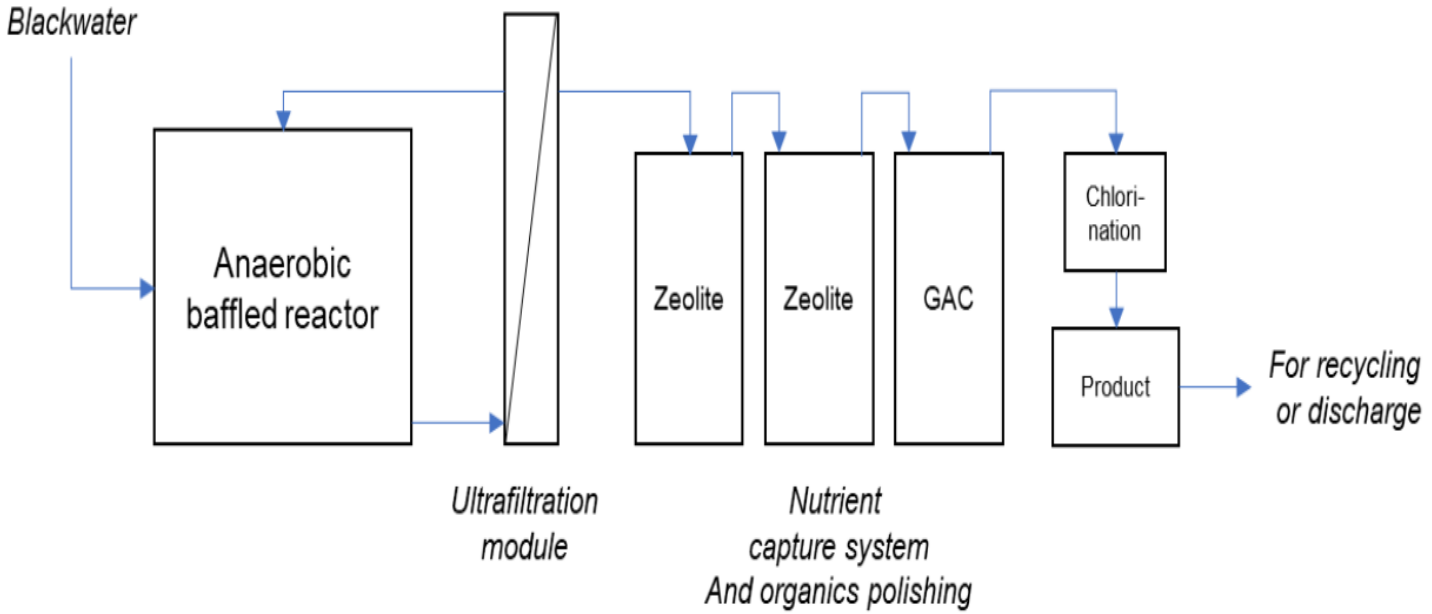
- Project Funded by the Bill & Melinda Gates Foundation
- Objective → to build disaster preparedness and responsiveness, and strengthen community resilience, through developing technical capabilities for emergency responses within eThekwini Municipality. This will be done through the introduction and adoption of innovative non-sewered sanitation technologies as climate resilient sanitation solutions.
- Monitoring and evaluation of these NSS demonstration systems will focus on the technical performance and resilience to adverse weather effects, operation and maintenance requirements, quality of recycled water for flushing toilets, and social and political acceptance by the communities in which they are based.
- Status → site selection and engagement with political leadership and local ward committees has been completed, contracting with technology developers is underway

Snapshot of the technologies: CLEAR by EnviroLoo



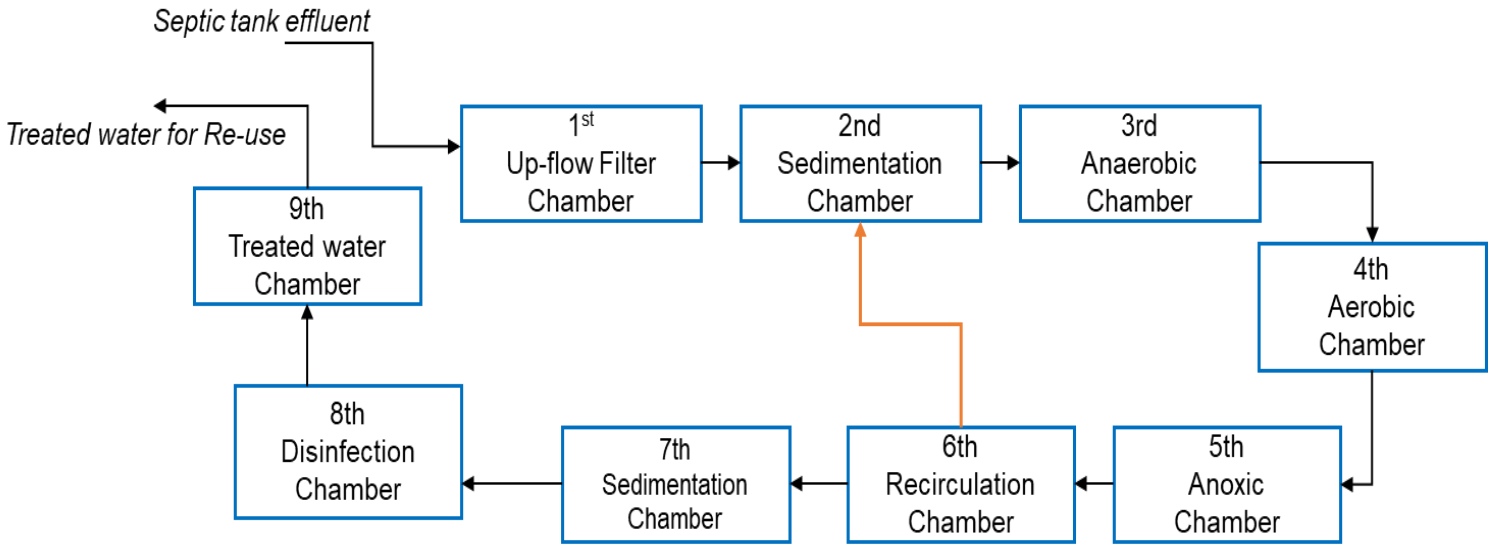
Process Flow diagram of the CLEAR system

Snapshot of the technologies: New Generator by WEC



Process flow diagram of the NEWgenerator system

Snapshot of the technologies: Aquonic by PRANA



Process flow diagram for the Aquonic system

Snapshot of the selected sites

Monitoring and Evaluation

- **Social evaluation**
  - Baseline survey, mid-term and final evaluation focusing on various dimensions of social acceptance (at user and community level)

- **Technical evaluation**
  - Technical performance of the RT technologies e.g. with respect to water and effluent quality - ISO30500, EFT recycling standards (proposed by WASH R&D centre for water recirculation toilets)

- **Economic evaluation**
  - CAPEX, OPEX, comparative life cycle costs

- **Scale-ability**
  - Prospects for potential replication and scale-ability, including specific preconditions or pre-requisites which might be relevant e.g. the types of sites, social preconditions, O&M models etc.

Conclusions

- Significant capital investment is required in the current water and sanitation grid in order to get it to optimum functioning. However, significant fiscal constraints continue to inhibit required upgrades and repairs.
- The need for strategic alignment with law and policy at the national and local levels to promote climate resilient WASH
- Climate resilient WASH goes beyond environment adaptation goals. It includes economics (lifecycle cost competitiveness), robust and flexible technical performance and social acceptance
- There is need to explore and expand other alternatives and innovations to expand the viable mix of sanitation services which are appropriate to context, which maximize the use of limited fiscal resources (from both a capital and O&M point of view) and which leverage spatial change and urban inclusion

Thank You

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