The Quality of Ground and Surface Water in a Groundwater-Dependant Peri-Urban Setting

STINKWATER (ADJACENT TO HAMMANSKRAAL)

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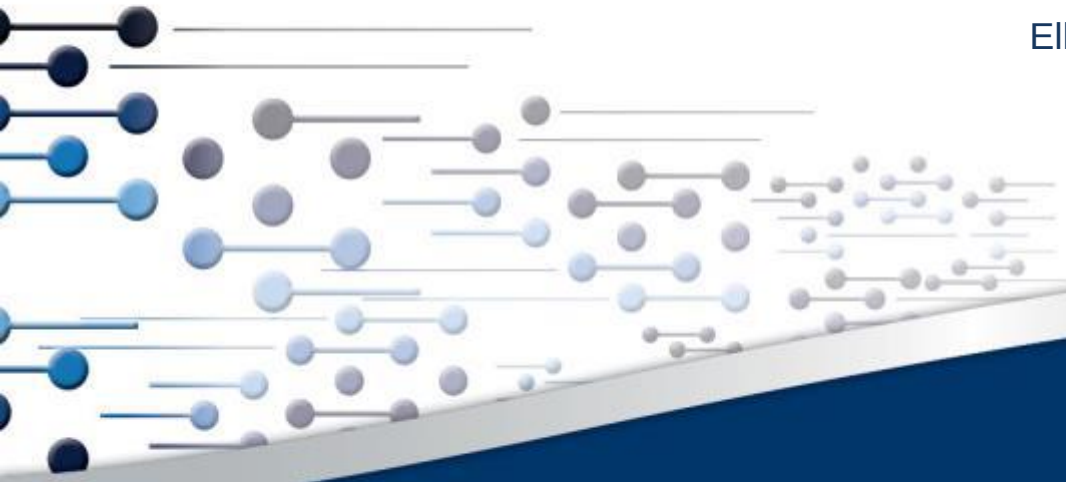

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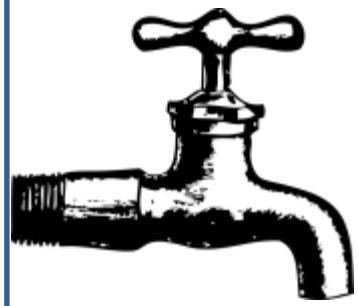
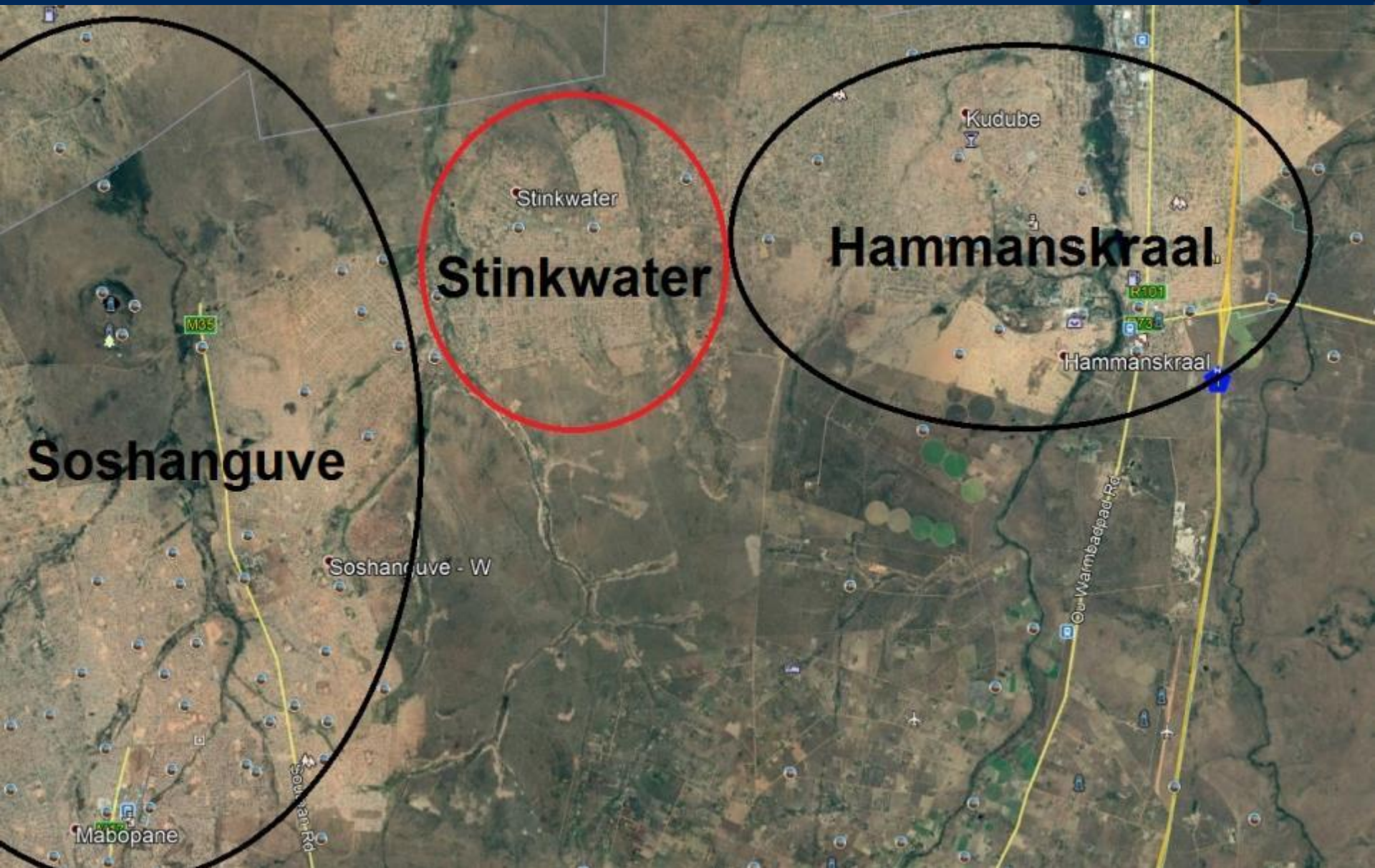
INTRODUCTION

PEOPLE NEED CLEAN WATER TO SURVIVE

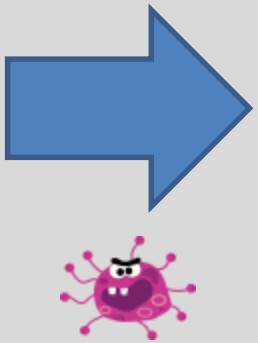
SOURCES OF WATER



INTRODUCTION *the study area*



INTRODUCTION

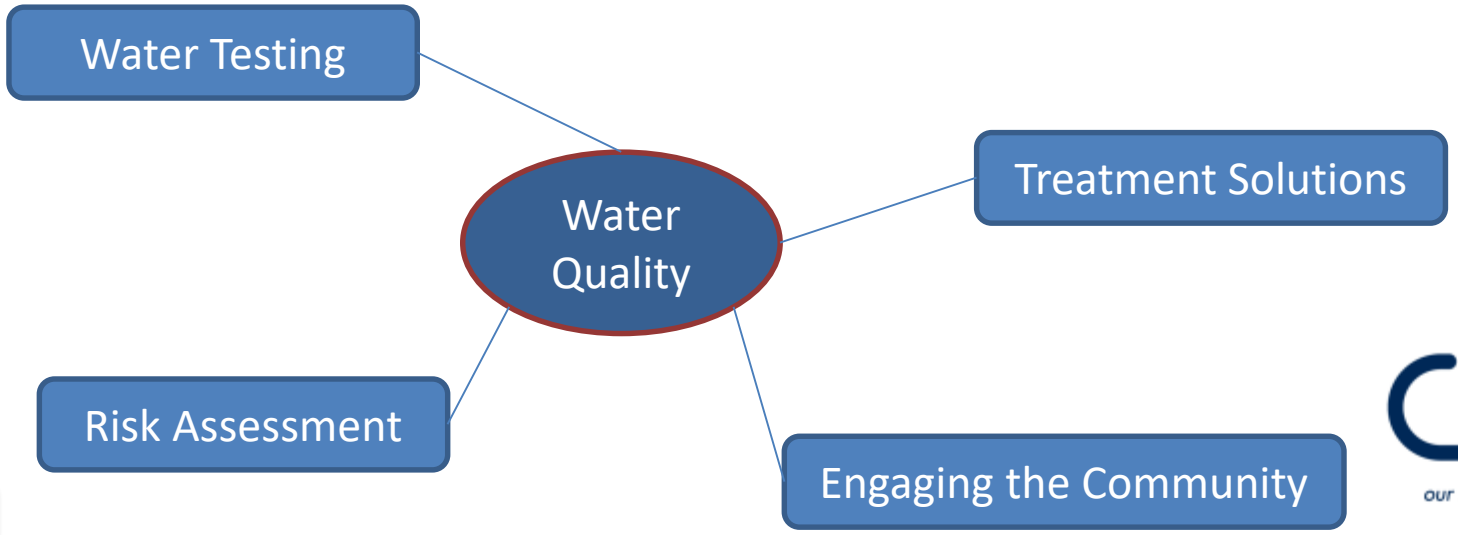


THE PROJECT

- *The **aim** of the research was to:*

  Investigate the health risks that untreated groundwater pose to the user community and to explore potential interventions.

- **Three (3) year project** followed up by another three (3) year project



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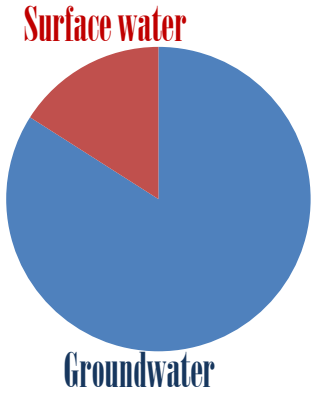
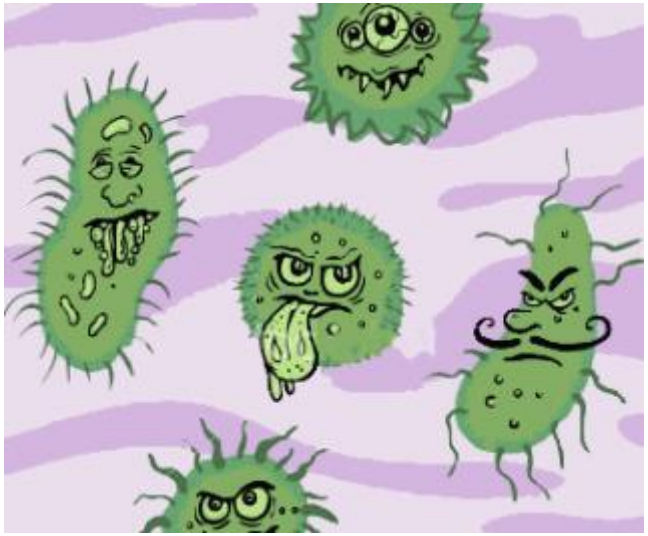
WATER TESTING

- 144 Water samples collected over a 2-year period (wet & dry seasons)
- The majority of samples were taken from hand-dug wells





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RESULTS

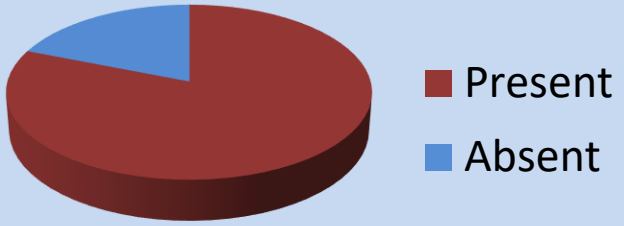
You can call me ***E. coli,*** that is my short name

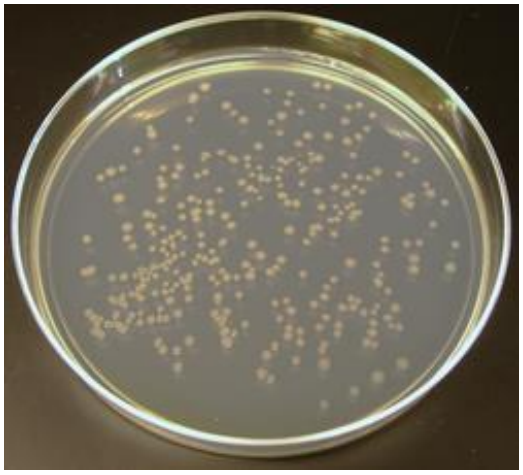
Escherichia coli

Indicator of faecal contamination

- Present in **81%** of the samples
- Average count of **173.9** **/ 100 mL**
- Median count of **13.4** **/ 100 mL**

E. coli was present in most samples





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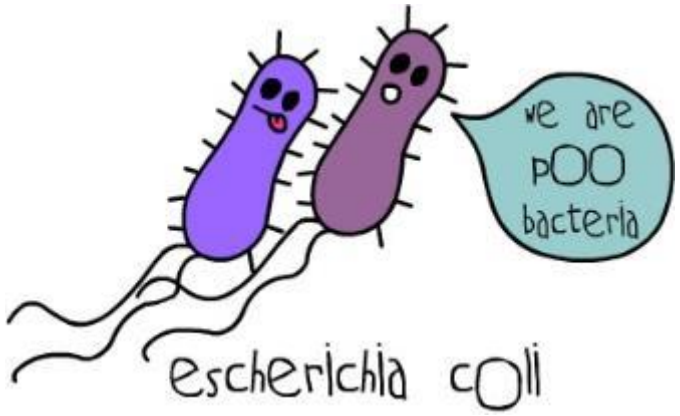
E. coli *an indicator of water quality*

- *E. coli* is a species of bacteria
- The is the most studied of all bacteria
- They live inside the lower intestines of warm-blooded animals
- They are excreted in faeces, and are present in high numbers in sewage
- They generally do not grow (multiply) outside of their hosts
- Make very good INDICATOR ORGANISMS (indicative of sewage pollution in water)
- Mostly symbiotic, but some types can cause disease (ETEC, EHEC etc.)

Drinking water should not contain any *E. coli*

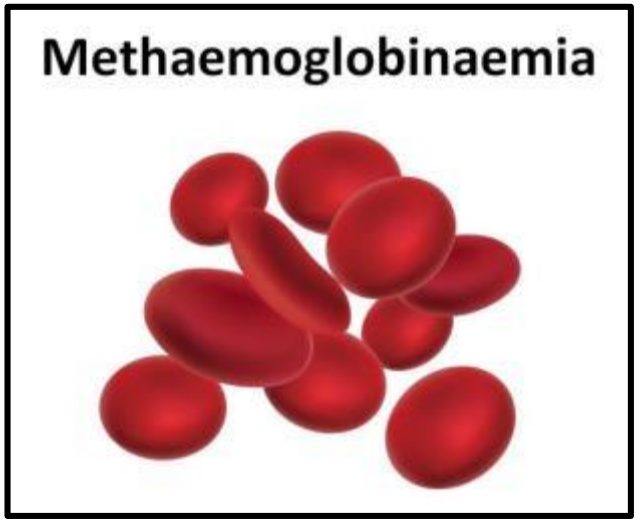
SANS 241:2015 (SA Drinking Water Standard)



RESULTS

Fluoride exceeded the drinking water standard in **9%** of samples [max 3.6 mg/L]

Nitrate exceeded the drinking water standard in **87%** of samples [Avg 23.1 mg/L]



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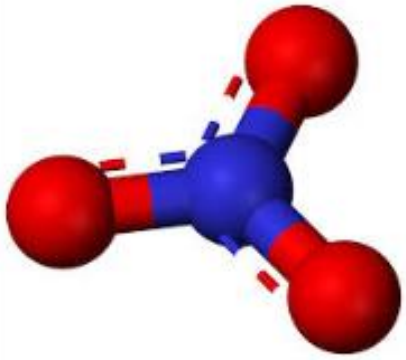
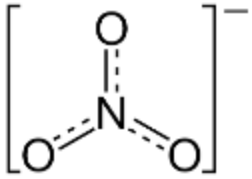
NITRATE what is the fuss about?

- Nitrate is a compound that is formed naturally when nitrogen combines with oxygen or ozone.





- Nitrogen is essential for all living things, but high levels of nitrate in drinking water can be dangerous to health, especially for infants and pregnant women.
- Nitrates are also made in large amounts by plants and animals, and are released in smoke and industrial or automotive exhaust gasses.

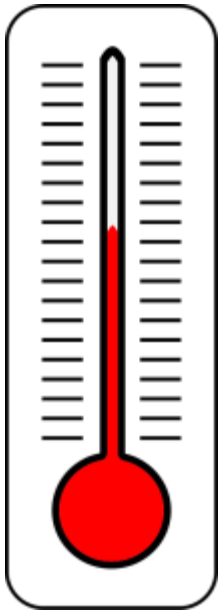
NITRATE what is the fuss about?

- Nitrate can occur naturally in surface and groundwater at a level that does not generally cause health problems.
- Groundwater can be contaminated with nitrate that comes from fertilizers, septic systems, animal feedlots, industrial waste, and food processing waste.
- High levels of nitrate can lead to adverse health effects
    - Methemoglobinemia (most important)
    - Adverse pregnancy outcomes, cancer, thyroid disease

At what nitrate level should we be worried?

- South African National Standard specifies that drinking water should not contain more than 11 mg/L nitrate (SANS 241:2015). Similar to WHO guideline (11.3 mg/L) and US EPA (10 mg/L).

NITRATE what is the fuss about?



- <10 mg/L nitrate (as N): no methemoglobinemia reported
- 10–20 mg/L: methemoglobinemia may be present, but sub-clinical
- >20 mg/L: methemoglobinemia cases sometimes reported
- In this study the average nitrate concentration was found to be 23.1 mg/L, how does this compare to water resources elsewhere?
  - In the USA 6-21% of wells exceed 10 mg/L nitrate (as N)
  - The average nitrate level in European groundwater was found to be 4 mg/L (1992 -2012)
  - In India (rural areas) the average nitrate levels exceed 10 mg/L in drinking water
  - In the Gaza strip 50% of public-supply wells had nitrate at levels above the 10mg/L safe level (some even exceeded 100 mg/L)

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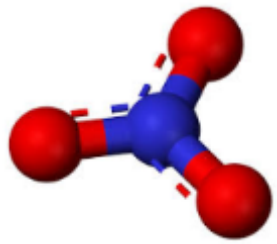
[1] Ward et al. 2018

NITRATE what is the fuss about?

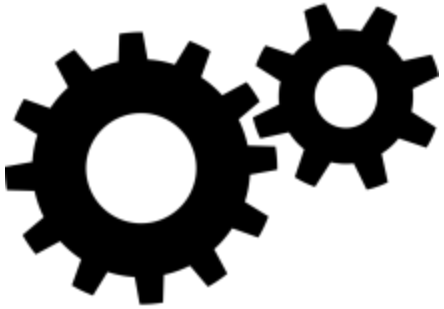
Interventions

Microbes

Nitrate



How do we address these water quality issues?



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Interventions

International Journal of
Environmental Research and Public Health

MDPI

Article

Abundance of Pathogenic *Escherichia coli* Virulence-Associated Genes in Well and Borehole Water Used for Domestic Purposes in a Peri-Urban Community of South Africa

Akebe Luther King Abia [1], Lisa Schaefer [2], Eunice Ubomba-Jaswa [2] and Wouter Le Roux [2,*]

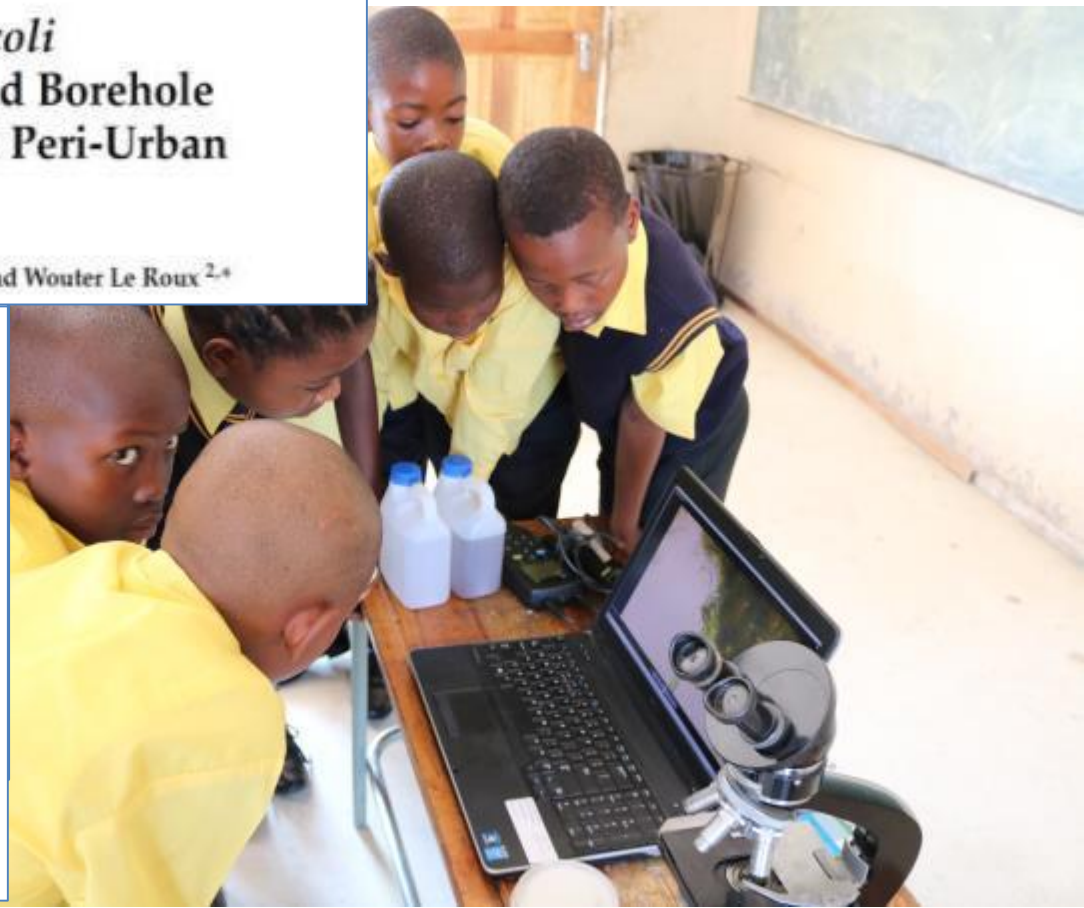
Policy implications for the use of poor quality groundwater in Stinkwater

Policy Brief

February 2017

CSIR

Council for Scientific and Industrial Research (CSIR)
Natural Resources and the Environment (NRE Business Unit)
Compiled by: Wouter le Roux, Lisa Schaefer and Elliot Moyo



Interventions

The people of Stinkwater

WATER QUALITY INTERVENTIONS

- **Microbes**: Kill or remove (chlorination, JIK, boiling, UV, filtration)

- **Nitrate**: Not so easy: ion exchange, distillation, and reverse osmosis

COMPLEX and COSTLY

Household level interventions for communities like Stinkwater:

- Easy to operate
- Low cost
- Uptake considerations

CSIR currently investigating two options:

- Using nano-engineered clays to remove nitrate
- Phytoremediation (small-scale, using plants to remove nitrate)

Thank you

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- Stinkwater Community
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