

Title: Monitoring and Communicating Risk of Emerging Contaminant in Mangaung Water Sources

Submitting University: Central University of Technology, Free State

Name, Position and Email of Contact Person: Prof SA Oke, Director- Centre for Sustainable Smart City (CSSC), FEBIT. soke@cut.ac.za

SUMMARY OF THE IMPACT

- Monitoring of emerging contaminants in water sources is crucial given their incessant introduction into the aqueous environment and the impact on aquatic life and human health, particularly in water-stressed countries such as South Africa. The project was the first in the Modder River catchment in the Free State province aimed at quantifying the level and risks of emerging contaminants in rivers, dams, wastewater treatment works and treated drinking water around the Mangaung Metropolitan Municipality.
- The major impact is the training of mid-level municipal managers in charge of water and wastewater treatment on the risk and treatment of emerging contaminants present in their water treatment plant, wastewater plant and treated drinking water. Around 30 water managers (Mangaung Water Services, VC Waters formerly Bloemwater and Water Catchment Managers) received training certificates. These managers were never aware of these contaminants' presence in their water sources as it's not a requirement for SANS 241 and other national standards.
- Other important benefits are that the project extensively point out the state of water quality regarding emerging contaminants in the drinking water of the city of Bloemfontein. The outcome of the research and resolution from the training and workshop led to speedy approval by the municipality for the urgent refurbishment of the city water works.
- This is a first for the city and the Modder River catchment. This ends the dearth of data on emerging contaminant pollution in the Free State province. Nationally, the Free State is the only province this investigation has been lacking. In addition, the project sensitized the city to prioritization on the refurbishment of its drinking water plant which commenced thereafter.
- The project addressed serious matter relating to water pollution and health in the country, in particular the region of Free State where water quality supply is a challenge as municipal services deteriorate. The outcomes of the project are deemed to be very crucial in inhibiting water pollution from emerging contaminants for the protection and sustainability of the Modder River catchment in the Free State province of South Africa. Academically, five (5) research articles were published from the project. Therefore, the significance of this project cannot be ignored as it has demonstrated all aspects of scholarly and community engagement. Capacitating CUT students on solving challenges present in its immediate environment. The positive impact and contribution of CUT to the Central Region of South Africa water and environmental health sustainability.

UNDERPINNING ACADEMIC WORK

The investigation and monitoring of emerging contaminants from point sources on the Modder River catchment system in the Free State, South Africa which was the first in the region was specifically designed to (i) detect the types of emerging contaminants prevalent in the surface water bodies of the Modder River catchment of South Africa, particularly those close to the city of Bloemfontein (ii) to detect the concentration levels of emerging contaminants that may be of health risk and (iii) To train the mid-level municipal staff and officers in charge of water treatment on the presence, danger and removal of these contaminants.

Emerging contaminants are contaminants without regulations but equally dangerous for the environment. Because they have no standards, they are not monitored or removed by the water treatment plant and water managers are unaware of them. To achieve the aim of the project various risk assessment methods including field sampling and tracing, laboratory testing and multivariate statistical techniques were adopted and applied as the lens through which the possible sources of emerging contaminants in water sources and their likely environmental and human health risks were examined. These were done with the Mangaung and VC Water Managers over a period of 4 seasons. The project trained mid-level Mangaung Municipal and Vaal Central Water staff through the quarterly field work and in a joint workshop at CUT campus on the danger of pollution by emerging contaminants as a result of anthropogenic activities and their level of occurrence which are likely to seriously impair the ecosystem and torment aquatic species as well as putting the health of the public at risks.

The outcomes of the project were deemed relevant for the prioritization of hazardous substances to be removed and development of necessary countermeasures for environmental protection and sustainability of water resources through escalation to higher authorities. The workshop outcome was that some pressure must be exerted on the political leaders who are responsible for funding the management of the water sources and that strategic communication be made to the city residence through different mass media (Whatapp, Netwerk24, CUT News etc) for risk communication purposes. The Mangaung Metropolitan Municipality indirectly yielded to these tactics as it approved the refurbishment of its major drinking water plant at Masselspot, Bloemfontein, which the project leader frequently visits for monitoring. The refurbishment is still ongoing.

The emerging contaminant project was funded by the Water Research Commission of South Africa (Project No. 2022/2023-00791). The extensive results from the project forms part of the country's repository on the type, quantity, sources and risk of emerging contamination present in one of South Africa major metros water and the capital of one of its provinces. These repository by the Water Research Commission has been built for the development of a South Africa National Standard for emerging contaminant in the nearest future.

The project impact is both socio-economic and environmental development. Postgraduate and undergraduate students were involved. Skills transfer impact includes completion of a doctoral and master's student studies who can replicate the project elsewhere. Student of the BSc Hydrology and Water Resources Management at CUT were engaged for Work Integrated Learning. 5 DHET accredited research publications were accomplished. International conference on emerging contaminant was attended to compare case studies globally. The improvement in the capacitation of local laboratories used for the project. Through the WRC, other Catchment Water

Management Authorities served as reviewers panel. The community of Bloemfontein were informed of their water quality. The project won CUT Vice Chancellors Award for Community Engagement.

EVIDENCE AND SOURCE TO CORROBORATE THE IMPACT:



Figure1. CUT researchers with community members during technical workshop held at Prosperitas Auditorium CUT Bloemfontein campus. The community members include process controllers from wastewater treatment plant from Mangaung Municipality, drinking water process controllers from 5 regions of Vaal Central (formerly Bloemwater), Environmental Officers from DWS, Bulk water officers from Mangaung Municipality.



Fig. 2. Mid-level water managers in Mangaung Metro and VC Water participating in a workshop at CUT Bloemfontein campus. Right is the Water Research Commission Managers (WRC) Mrs Eunice Ubomba Jaswa engaging with the municipal water managers at CUT campus in Bloemfontein.

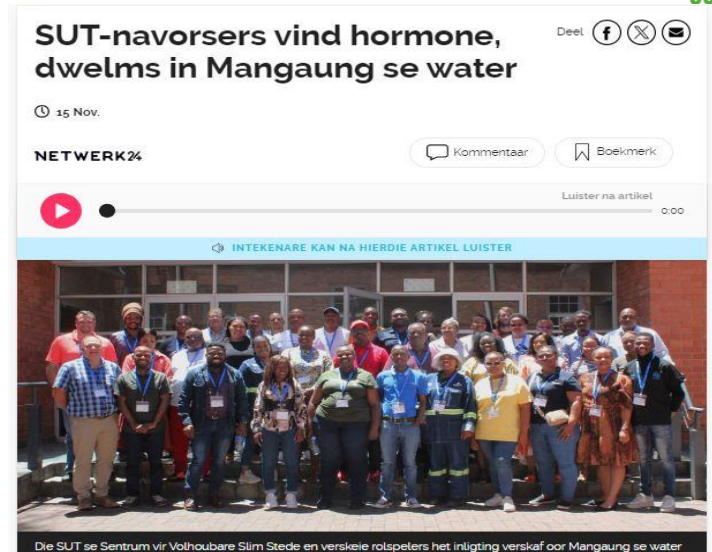


Fig 3. (Published article in national newspaper as part of raising awareness on emerging contaminants to the local communities. See below link to news in Network 24 news.

<https://www.network24.com/nuus/wetenskap/sut-navorsers-vind-hormone-dwelms-in-mangaung-se-water-20231115>

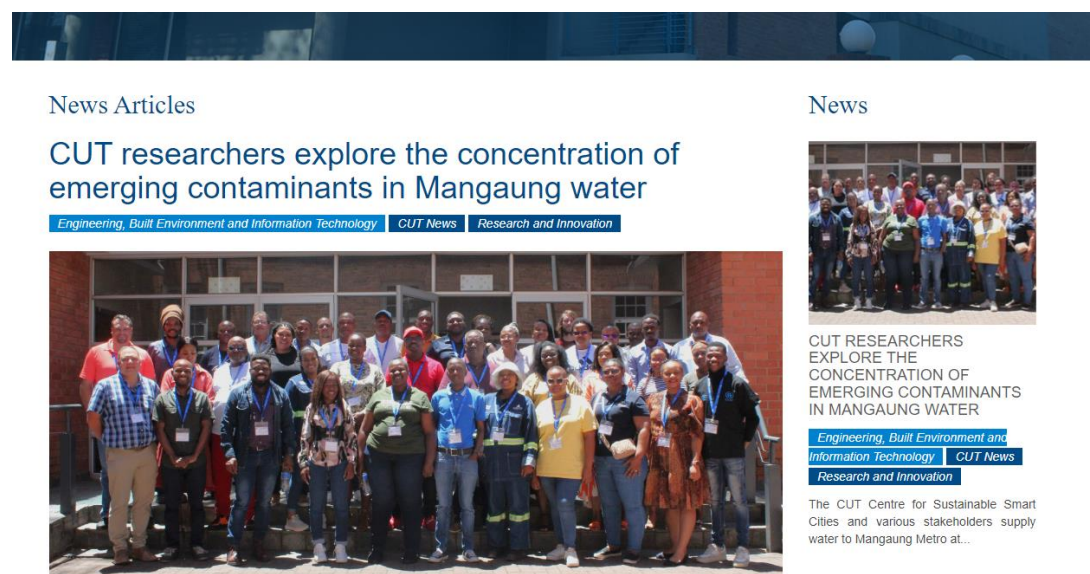


Fig 4. CUT news bulletin report on the training and capacity building of Municipal water staff in charge of water services on CUT Bloemfontein Campus. See link below for the news.

<https://www.cut.ac.za/news/cut-researchers-explore-concentration-emerging-contaminants-mangaung-water>

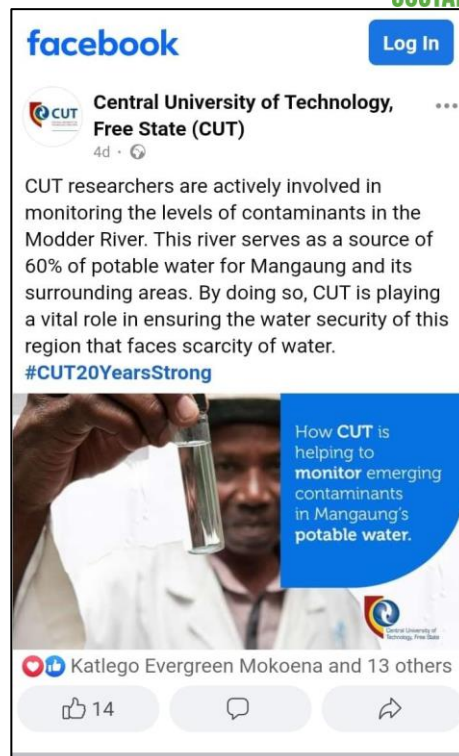
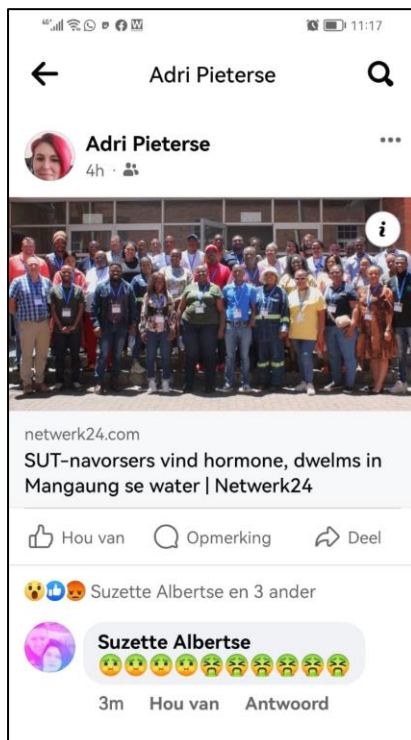


Fig 5. Community response to the emerging contaminant found in Mangaung Modder River area. (Right) CUT Facebook page news on the emerging contaminant project.



Fig 6. Technical workshop program designed to engage Mid-level water managers in Mangaung. Right is certificate awarded to participant.



Fig 7. Monitoring of ongoing refurbishment works at the Masselspot drinking water treatment plant in Bloemfontein. The plant supply drinking water to Bloemfontein and was severely sampled, monitored for the emerging contamination project. The project facilitated the prioritisation of the ongoing refurbishment.

Published Report by Water Research Commission

1. WRC Report No. 3159/1/24. ISBN 978-0-6392-0641-7. Submitted to Water Research Commission Pretoria, South Africa, 228p <https://www.wrc.org.za/mdocs-posts/investigation-and-monitoring-of-emerging-contaminants-from-point-sources-on-the-modder-river-catchment-system-in-the-free-state-south-africa/>
<https://www.wrc.org.za/wp-content/uploads/mdocs/3159%20final.pdf>

Publications

- Oke SA, Mugudamani I, Kemp G (2024): Qualitative screening of emerging contaminants in urban and natural waters of Mangaung District of the Free State province of South Africa. Discover Environment 2, 144. <https://doi.org/10.1007/s44274-024-00178-3>

- Oke, S.A. Contaminant of Emerging Concerns in Modder River Catchment of Free State: Implication for Environmental Risk and Water Sources Protection. *Water* 2024, 16, 2494. <https://doi.org/10.3390/w16172494>
- Mugudamani, I., Oke, S.A., Gumede, T.P., Senbore, S. (2024). Risk Assessment of Emerging Contaminants in Urban and Natural Water Sources around Bloemfontein, South Africa: Implication for Environmental Sustainability, *Current Analytical Chemistry*, Vol. 20, 1-21. <https://www.eurekaselect.com/article/140792>
- Oke S.A., Mugudamani, I., Gumede, T.P., Senbore S (2023). Environmental Risk Assessment of Exposure to Selected Emerging Contaminants in Dams and Wastewater Effluent Around the City of Bloemfontein, South Africa. *Journal of Harbin Engineering University*, Vol 44 No. 12 page 1077 - 1082. <https://harbinengineeringjournal.com/index.php/journal/article/view/2407>
- Mugudamani, I., Oke, S.A., Gumede, T.P., Senbore S (2023). Herbicides in water sources: communicating potential risks to the population of Mangaung Metropolitan Municipality, South Africa. *Toxics* 2023, 11(6), 538; <https://doi.org/10.3390/toxics11060538>
- Mugudamani, I., Oke, S.A., Gumede, T.P., Senbore, S. (2024). Monitoring of Emerging Contaminants in Selected Wastewater Treatment Works Around Bloemfontein, South Africa: Initiative for Environmental Protection. In: Xu, H. (eds) *The 6th International Symposium on Water Resource and Environmental Management. WREM 2023. Environmental Science and Engineering*. Springer, Cham. https://doi.org/10.1007/978-3-031-55989-1_3



toxics



Article

Herbicides in Water Sources: Communicating Potential Risks to the Population of Mangaung Metropolitan Municipality, South Africa

Innocent Mugudamani ^{1,*}, Saheed A. Oke ², Thandi Patricia Gumede ¹ and Samson Senbore ²

International Conferences

- Persistent, Emerging, and Organic Pollution in Environment (PEOPLE) August 7-11, 2023. Concordia University Montreal, Canada. Presentation title: The Investigation and Monitoring of Emerging Contaminants from Points Sources on the Modder River Catchment System in Free State, South Africa



Fig 8. CUT students as project research assistants collecting water samples.



Fig 9. CUT Hydrology student undergoing work integrated learning at the water and wastewater treatment plant in Mangaung. Right is textbook from the project.