TOOLS TO INVESTIGATE reuse potential of INDUSTRIAL EFFLUENT

Industrial water reuse in South Africa is lagging. Currently, very little to no data exists regarding wastewater reuse options, treatment options and capabilities, or costs – which can be used for decision-making. In response to this, a national Atlas and Decision-based Support System has been developed.

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Further research and information is needed to identify wastewater and industrial effluent volume availability, quality and fitness for use in South Africa. A country-level assessment of the industrial effluent reuse potential can assist in identifying opportunities to unlock 'new water'.

National Atlas

The national Atlas has been developed for the potential bulk-scale reuse of industrial effluent in South Africa. The Atlas is essentially a compilation of geographic information system (GIS) maps that have been created by digitising large-volume (bulk) water users/consumers of water in South Africa, as well as the respective industry sectors producing and discharging bulk volumes of wastewater in South Africa.

In that context, the Atlas:

- defines water reuse and discusses the drivers of industrial reuse in South Africa
- summarises the legislation underpinning industrial water reuse in the country
- provides examples of a few existing industrial reuse projects/activities currently taking place in South Africa
- describes 'fitness for use' and the typical wastewater effluent quality for different industries
- identifies some of the current barriers to industrial effluent reuse
- geographically maps the largest consumers of water and effluent producers in South Africa, both at a national and provincial level.

Information in the Atlas was developed using open-source data obtained from:

- Department of Water and Sanitation (DWS).
- Water Use Authorisation and Registration Management System (WARMS) – the official national register of water use in South Africa. The DWS WARMS database contains detailed information and reports on South African water users who use this resource (surface water and groundwater) for irrigation and industrial use, including mining, power generation, recreational purposes and watering livestock in the country.
- QA Data Reports for water consumption and effluents produced.

The Atlas presents maps at both national and provincial context, and provides a visual account of both the volumes of water used and effluent produced per industry sector.

Findings

- From a national perspective, water-use-intensive industries were largely represented by the agriculture sector, mostly through irrigation. Second to agriculture was water supply services, urban industry, mining and non-urban industry.
- Water use for mining was the highest in Mpumalanga, followed by Gauteng, the North West, Northern Cape and Limpopo.
- Mpumalanga had the highest water withdrawals, followed by the Free State, Eastern Cape and Gauteng provinces.
- In all provinces, the largest water use was for agricultural irrigation, except in Gauteng, where industrial water use was the highest.
- The second highest industrial water use was the Western Cape. In the Western Cape, the highest water withdrawals per sector were for agricultural irrigation, followed by urban industry and water supply services.
- A large portion of non-urban industrial water use was identified in KwaZulu-Natal and Mpumalanga.
- The Northern Cape province had the lowest registered water withdrawal of all provinces.
- From a national perspective, the highest effluent produced was registered by urban/domestic (sewage treatment works), followed by mining. Mining effluent was recorded in all provinces except the Western Cape.
- Gauteng was the highest ranked province in terms of wastewater discharge, followed by Mpumalanga and the Eastern Cape provinces, respectively.
- Discharging wastewater effluent was associated with urban areas and industry. Large-scale irrigation with wastewater is largely limited to the Breede-Gouritz catchment in the Western Cape.
- The provinces that registered the lowest effluent volumes were Limpopo and the Northern Cape.

Wastewater generation per industrial sector

The water consumption rates of industrial users are significantly higher than those of individual households.

Provincial average values for individual water consumption range from:

- 182 litres per capita per day (ℓ/c/d) for Limpopo
- to 305 ℓ/c/d for Gauteng.

This suggests that the average consumption rates for a household of four persons is in the order of one kilolitre per day, or 0.001 megalitres per day (Mℓ/d).

By contrast, manufacturing plant/factory water consumption rates are three orders of magnitude higher in some industries:

- Paper and pulp uses between 0.1 Mℓ/d to 150 Mℓ/d.
- Wet-cooled power stations (Matla and Lethabo) require in the order of up to 100 Mℓ/d.
- Dry-cooled power stations (Kendal and Matimba) use in the order of 10 Mℓ/d.
- Sugar mills consume between 0.6 Mℓ/d to 6.8 Mℓ/d.
- Oil refineries consume between 5 Mℓ/d and 10.5 Mℓ/d of water.

Industrial water users return significant fractions of their water consumption to the municipal wastewater system or the environment as effluent, except for wet-cooled power stations where water use is nearly entirely consumptive.

Decision-based Support System (DSS)

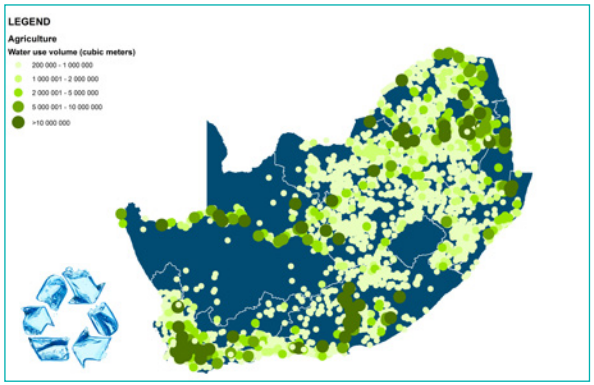
The authors realised that this Atlas provided only a one-dimensional and geographical overview of industrial reuse effluent volumes (based on water-use licence registrations). As a result, an Excel-based DSS for the bulk-scale reuse of industrial effluent was developed (a web-based and mobile application is in the process of being developed).

This assists municipal and industry partners, and water quality managers to make informed decisions for possible reuse options. The tool aims to directly assist by linking industrial effluent volumes and quality to fitness for use, and linking it with specific industries in the geographical vicinity based on industry-specific water quality and quantity requirements.

The DSS can be particularly useful in wastewater reuse, as it can aid in the evaluation and selection of alternatives for a given reuse application. In addition, the tool will enable engineers and industry partners to collaborate to identify and employ treatment technologies and capabilities to link industrial effluent quality and volumes available to those of potential user requirements in a geographical area.

Effluent reuse (treating the final effluent to potable standards for on-site reuse, typically for non-product contact purposes), with or without energy recovery (biogas), represents the largest opportunity for water savings in the sector.

For more information regarding the Atlas and DSS, please contact msteyn@csir.co.za or cwalters@csir.co.za. 3S



DEFINITIONS

Reuse: The beneficial use of reclaimed or treated wastewater
Reclamation: The treatment of wastewater for reuse, either directly or indirectly as potable or non-potable water
Recycling: The reuse of wastewater, with or without treatment

Drivers of industrial water reuse (adopted from Steyn et al., 2021)