City of Johannesburg, South Africa

About the IWA Action Agenda for Basin-Connected Cities

The IWA *Action Agenda for Basin-Connected Cities* builds on the *Principles for Water Wise Cities*, with a focus on how cities can be active water stewards in their wider water basins. This includes the Drivers for Action such as extreme events, declining water quality, and water availability; followed by the Pathways to Action through assessment, planning and implementation; and the Foundations for Action from developing a vision to building capacity to improving governance. To learn more visit - http://www.iwa-network.org/press/the-action-agenda-forbasin-connected-cities/

About the Basin Stories

The basin stories are documenting some of the best practices and approaches that demonstrate how stakeholders, especially those in urban areas (e.g., city government, water and wastewater utilities, industries) are taking part or contributing to sustainable management of water resources. Greater basin-level collaboration from catchment to consumer is essential for sustainable water management in the face of growing demand on water resources and global change. The stories aim to inspire urban stakeholders to be aware and respond to what is happening in their watershed.

Addressing non-revenue water and unemployment in the City of Johannesburg

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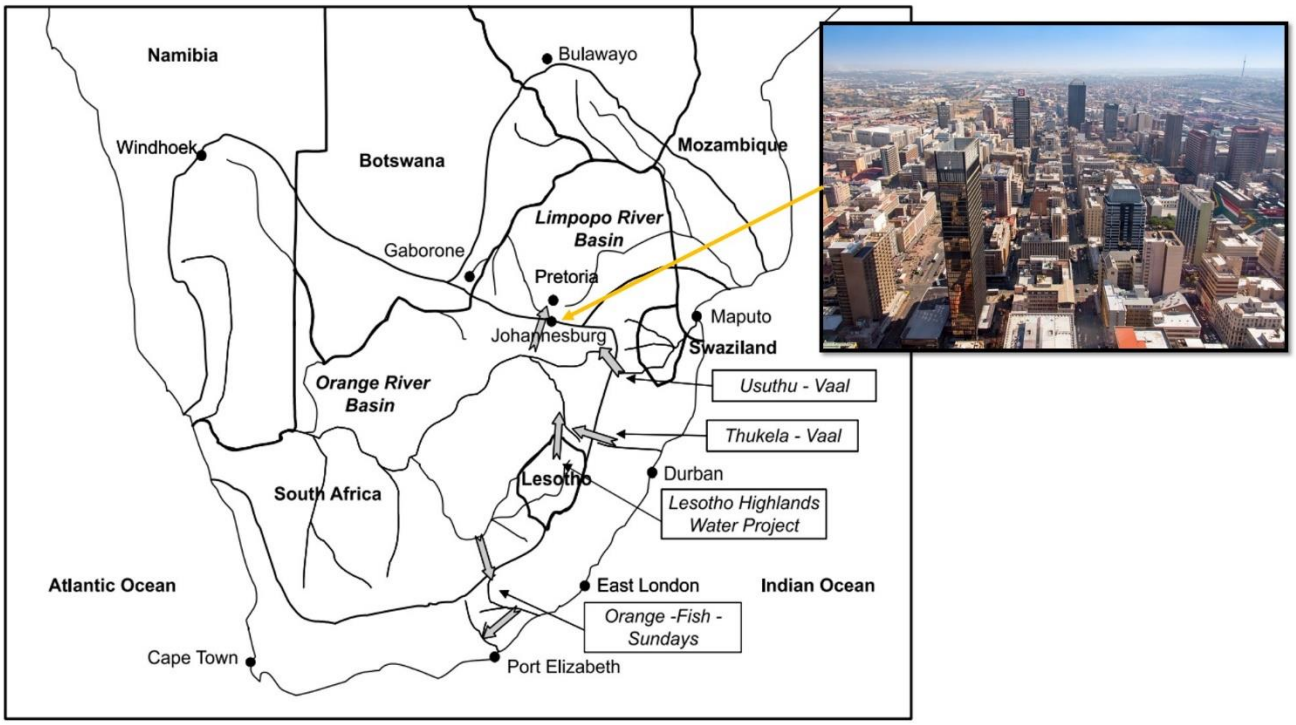
Summary

Although South Africa shares four major transboundary river basins with neighbouring countries it faces issues of water-scarcity. Despite this challenge, there are relatively high losses in terms of Non-Revenue Water (NRW). A major contributor to NRW is aging water distribution infrastructure resulting in water leaks (NRW of 38.4% in 2018 for Johannesburg). A lack of water-related technical skills is one of the reasons for not repairing and maintaining water infrastructure. As a result, South Africa is losing around R9.9 billion annually. The lack of skills to address these challenges is directly linked to unemployment in South Africa, especially in terms of the youth. Therefore, the South African government, through its department mandated with water and sanitation, designed the War on Leaks (WOL) programme.

The WOL is aimed at simultaneously addressing both problems of NRW and unemployment in the City of Johannesburg and various other regions across the country. Some of the important drivers for this programme include public health hazards and damage to infrastructure. Johannesburg, situated on the divide between the Orange river basin and the Limpopo river basin, is one of the important beneficiaries of the WOL programme since this basin-connected city is an important economic hub. Since early 2021, a significant number of learners (>1000) received water-related technical qualifications. Lessons from the programme include the importance of availability of skills development facilities, preparedness of training institutions, and managing political interests. It is recommended that programmes of this nature should continue making improvements and develop strategies for water conservation and demand management to reduce the impacts of NRW and promote the United Nation's sustainable development goals (SDGs).

Extensive inter-basin transfers of water between catchments are characteristic of the South African water situation. These transfers are necessary to complement water to metropolitan areas such as the Gauteng region, where the city of Johannesburg is located as well as to some other regions which are located far away from major water courses (DFFE, 2022). Substantial volumes of surface water yield (3,000 Mm3 /a) is transferred via inter-basin transfers to areas in South Africa where requirements exceed supply. An example is the Lesotho Highlands Water Scheme, which supplies water to Gauteng region by means of transfer from the Katse and Mohale dams in Lesotho (DFFE, 2022).



Johannesburg is one of the few cities of the world that is not located on a river, a lake or a seashore. In fact, the city overlaps a major watershed (known as the Witwatersrand) between two major international river basins in Southern Africa; namely, the Orange and the Limpopo river basins. Since the Orange and Limpopo river basins were identified as essential basins in the Southern African hydropolitical complex, these two river basins form the strategic backbone to the economies of the four most economically developed countries in the Southern African Development Community (SADC) region South Africa, Botswana, Namibia and Zimbabwe.

Geographic information

Country: South Africa
City and Population: City of Johannesburg, 5,783,000
Basin area: Orange river basin and Limpopo river basin

Problem:

- Unemployed youth and lack of water-related skills
- High percentage of Non-Revenue Water
- Aging water infrastructure
- Poor water conservation and a lack of water demand management practices.

Solution:

- Water-related technical skills (artisans, water agents) and youth employment.
- Focus on municipalities (basin connected cities) with high levels of Non-Revenue Water.
- Application of skills to improve water conservation and water demand managed.
- Repairs and maintenance of aging water infrastructure.

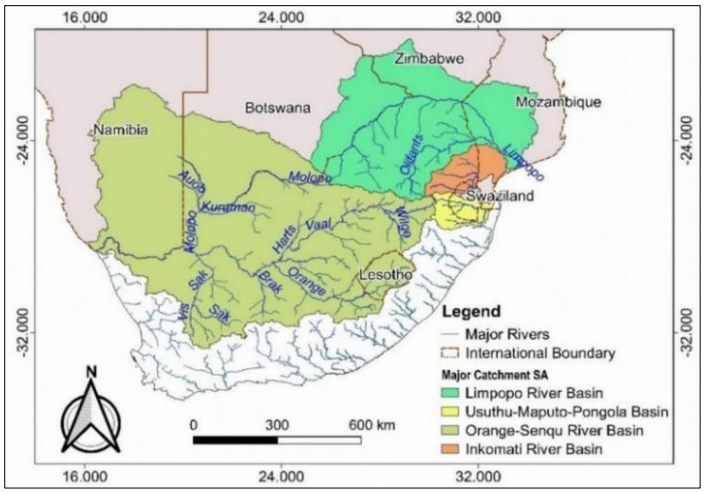


Figure 1: *Major river basins in southern Africa*

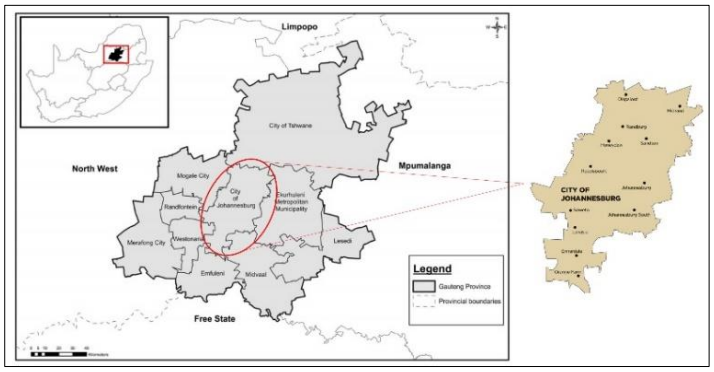


Figure 2: GCRO Maps/GIS (Mushongera, 2017)

Problem

South Africa is a country known for water scarcity and depends on intra-basin and inter-basin transfers to meet water demands (Slabbert, 2007). For example, the Lesotho Highlands Water Project (LHWP) in the Orange river basin transfers water into the Vaal River system which supplies cities such as Johannesburg. The LHWP river basin is an example of successful bilateral engagements between South African and Lesotho (Muller *et al.,* 2015) and is also considered as one of the most complex and integrated water transfer schemes in the world (Mckenzie and Wegelin, 2008). The Orange river basin is the largest in southern Africa (964,00 km^2) and contains 138 large dams with an estimated Water Crowd Index (WCI) of 1,803 projected by the year 2025 (Ashton *et al*., 2008). The Limpopo river basin spreads over a smaller landscape (183,000 km^2) with 100 large dams and an estimated WCI of 4,974 by the year 2025. The water security in the Orange river basin and Limpopo river basin can thus be described as “frequent water stress; seasonally severe” and “beyond the water barrier - chronic water stress” respectively (Ashton *et al*., 2008). A study conducted by Alli (2021) focused on the WCI of the four major river basins in southern Africa and highlighted water security status projected for 2025 in this region is a serious concern. Furthermore, it suggested that water governance protocols and strategic action plans should be in place to address water stress around each river basin system.

The city of Johannesburg (Gauteng Province, South Africa) is situated on the divide between the Orange river basin and the Limpopo basin. The Gauteng Province is the industrial heartland (i.e., economic hub) of South Africa. It is known as one of a few urban areas in the world that is not situated near to a major water source (Mckenzie and Wegelin, 2008). In the period 2010 to 2011, the Department of Water and Sanitation (previously Department of Water Affairs) estimated that the national NRW was at 36.7%, while Johannesburg recorded its water losses around 35% for the same period (Dippenaar, 2015). According to Dippenaar (2015), this substantial quantity of water loss can be ascribed to physical leakages from water infrastructure such as pipelines and valves. At the same time, Johannesburg is the largest single metropolitan contributor to the national economic product, with contribution to the national economy at almost 16%, and 40% to the Gauteng province (City of Johannesburg, 2018). Consequently, there is high water demand, for example in in 2014 the demand was approximately 1600 million litres per day, i.e., 580 000 million litres per year. The main source of water for Johannesburg is the Vaal Dam, however as droughts can threaten this water supply Johannesburg has been actively pursuing alternative options such as rainwater harvesting (collection of rainwater), effluent reuse following treatment of wastewater, groundwater for certain uses (Dippenaar, 2015), and reduction of non-revenue water. In this case study, the War on Leaks (WOL) programme is explored as one of the possible solutions that can address non-revenue water and have an impact on water demand in Johannesburg.

Solution

The South African government initiated the WOL programme as one of many skills development initiatives as a solution to NRW losses in Johannesburg and other provincial areas across the country. The WOL programme is a tripartite initiative by the South African Department of Water and Sanitation, Rand Water Board (a government-appointed implementing agent) and the Energy & Water Sector Education Training Authority (EWSETA, South Africa). On 12 January 2015, the President of South Africa, Jacob Zuma, presented the State of the Nation Address and stated "*Every drop counts. The country loses seven billion rand a year to water losses. To mitigate this challenge, Government through the Department of Water and Sanitation will train fifteen thousand artisans and or plumbers who will fix leaking taps in their local communities".* This solution was designed to reduce NRW by means of repairing water leaks, capacitating the water sector with the skills required to repair water leaks, maintaining water infrastructure, educating communities on water conservation and demand management. This initiative is thus intended to address youth unemployment in South Africa.

Johannesburg has the highest annual water demand, and estimated non-revenue water when compared to other areas in the Gauteng Province (Mckenzie and Wegelin, 2008). The City is an important beneficiary of the WOL programme to ensure effective water demand management in the future. From 2015 to 2020, Johannesburg Water entered into a Service Level Agreement with Rand Water for the WOL programme confirming the active involvement of Johannesburg. During this period, unemployed youth who were part of this programme were deployed at various Johannesburg Water worksites to gain the necessary workplace exposure (CoJ-JW SOC, 2020). The WOL programme contributes to a significant number (>1000) of qualified artisans and water agents. These technical water experts (including both males and females) were anticipated to assist Johannesburg in reducing the impacts of non-revenue water.

Anticipated outcomes for water conservation, demand management and reduction of non-revenue water

Through prioritisation initiatives for repairs and maintenance, Johannesburg has turned the tide on water pipe bursts (131.6 km of water pipes were replaced). The total number of water pipe bursts has decreased from a high 45177 in 2016/17 to 42977 during 2018/2019, while up to 95.57% of sewer blockages were

cleared within 24 hours of notification and 42.8 km of sewer pipes were replaced (CoJ, 2019). Through the implementation of the WOL programme, unemployed youth are qualified in different artisan and water agent disciplines which contributes to the improvement of the socio-economic conditions within local communities. In addition, the programme was anticipated to achieve the following two sustainable goals in terms of water and sanitation: 1) to reduce high levels of water loss and to create awareness to the public on how to conserve water; and 2) to train artisans and water agents over a three-year period in order to address youth unemployment across the country.

Table 1: List of water-related skills and some primary duties with their potential impacts.

Water-related skills	**Definition and duties**	**Potential impacts**
Electrician	An electrician is a tradesperson specializing in electrical wiring of buildings, stationary machines, and related equipment. Electricians may be employed in the installation of new electrical components or the maintenance and repair of existing electrical infrastructure.	• Repairs of existing and aging electrical infrastructure. • Installation of new electrical components. • Maintenance of electrical infrastructure supporting water distribution systems.
Fitter- and Machinery/ Turner	An artisan who uses machine tools to make or modify parts, primarily metal parts. In addition to metal, the parts may be made of many other kinds of materials, such as plastic or wood products. The goal of these cutting operations is to produce a part that conforms to a set of specifications, or tolerances, usually in the form of engineering drawings commonly known as blueprints.	• Modifications of existing water infrastructure. • Innovative modification and developments for new water infrastructure. • Manufacturing of additional products to support water and sewer systems.
Instrument Mechanician	Ensure that all instrumentation within the factory is maintained, inspected and calibrated on a regular basis. Ensure that damaged, aging or redundant instrumentation is replaced and/or removed timeously. Installing, commissioning, and testing electronic instruments. Co-ordinating work with Engineers, Technicians, and other maintenance personnel. Interpreting test data to diagnose malfunctions and system performance problems.	• Maintenance and repairs to water and sewer instruments. • Contribute to novel instrument development technologies. • Installation of instruments.
Plumber	A plumber is a tradesperson who specializes in installing and maintaining systems used for potable (drinking) water, sewage and drainage in plumbing systems.	• Repairs of existing and aging water and sewer infrastructure. • Installation of new water and sewer systems. • Maintenance of water and sewer infrastructure. • Leak detection tests.

Water-related skills	Definition and duties	Potential impacts
Welder	A welder or lit operator is a tradesperson who specializes in fusing materials together. The term welder refers to the operator; the machine is referred to as the welding power supply. The materials to be joined can be metals (such as steel, aluminium, brass, stainless steel, etc.) or varieties of plastic or polymer. Welders typically have to have good dexterity and attention to detail, as well as some technical knowledge about the materials being joined and best practices in the field.	• Repairs of existing and aging water and sewer infrastructure. • Joining of components. • Manufacturing products to support water and sewer distribution systems.
Water Agent	Water Agents focus on water conservation and water demand management issues in local communities. Part of their duties is to educate people in South African communities, learners in schools and other related institutions, identify and detect leaks in communities (e.g. leaking taps), and to be campaigners for *#savingwater* initiatives by the Department of Water and Sanitation (DWS) such as the "Drop A Block" campaign.	• Education and awareness on water conservation and demand management. • Support to water services at the community level. • Leak detection tests.

What are the Drivers for Action?

For more information on the Drivers for Action visit the Action Agenda for Basin-Connected Cities

Extreme Events	Declining water quality	Water availability
☒Public health hazards	☒ High operating costs	☒ Water supply disruption
☒ Damage to infrastructure	☐ Loss of credibility and trust	☐ Constraints to growth
☒ Economic activities and supply chain disruption	☐ Environmental, cultural and health impacts	☐ Declining quality of life

Pathways for Action

For more information on the Pathways for Action visit the Action Agenda for Basin-Connected Cities

Assessment	Planning	Implementation
☐Investment in data & information systems	☒ Risk-based approach to planning	☐ Integration of natural infrastructure
☐ Linking traditional water management with science	☐ Water allocation mechanisms	☒ Economic and financing mechanisms
☒ Invest in values to motivate water decision-making	☒ Stakeholder participation in planning and management	☒ Building partnerships from catchment to tap
	☐ Aligning urban development with basin management	☒ Digital Technologies

Lessons learned

The programme highlighted important factors and risks to be considered when implementing similar projects in the future (Table 2).

Table 2: *Important factors to be considered and possible risks associated with the WOL objectives.*

WOL Programme objectives	Factor	Possible risk
To contribute to the improvement of water conservation at the community level, in terms of the reduction of water losses.	Availability of facilities and resources	• Lack of office facilities to effectively implement the programme. • Low number of programme human resources to capacitate the programme team sufficiently
To train and develop 15000 unemployed youth citizens, comprising of Water Agents, Artisans, and Plumbers.	Readiness of training service providers and other capacity-building partners.	• Potential of an insufficient number of certified and accredited service providers to partner with at provincial and national levels. • Challenges with the recruitment process of shortlisting, interviewing, and contracting potential learners. • Appropriate partnerships with other national institutions to accommodate the surplus skills entering the municipal space. • A lack of understanding by some of the training institutions about the WOL programme as well as their role in supporting the programme. • Some training institutions are not accredited according to all qualification requirements.
To contribute to the improvement of water conservation at the	Political influences	• Political influences on the programme that could affect the programme.

WOL Programme objectives	Factor	Possible risk
community level, in terms of the reduction of water losses.		• Possible tension in municipalities where Rand Water does not have a footprint • After municipal elections, new Heads of Departments may not always be supportive or familiar with the projects and programmes.

A few lessons learned are indicated below:

- Continuous improvement should form an integral part of control measures and be implemented accordingly (from a programme management perspective).
- Blueprints, baselines and tolerance levels developed through the WOL programme should be considered when a programme of this nature is implemented in a basin connected city or elsewhere.
- Throughout the implementation of this programme, it was important to always focus on primary objectives such as unemployment and NRW, which are a global challenge, not only faced by Johannesburg and South Africa.

Related to the potential impacts on the river basin, lessons learned were:

- Adequate operations and maintenance of water and wastewater treatment facilities is necessary to improve water demand management and conservation practices. This also assists in reducing the impacts of risks associated water pollution or contamination
- Better quality and quantity of wastewater discharge into the river basin will subsequently contribute to better environmental and river health.
- Addressing existing primary and secondary impacts of climate change in the river basin such as water shortages and poor water quality is essential as part of wider water management between the basin and the city.

Next steps

Water conservation and demand management - More conservation and water demand management programmes similar to the WOL programme need to be implemented to safeguard the available water around and in Johannesburg and associated river basins.

Reducing Non-Revenue Water (NRW) – Ensure active participation of the WOL learners so that they can apply the skills leaners during the programme to reduce the negative impacts of NRW in basin-connected cities such as Johannesburg.

Sustainability – Continue educating and creating awareness in various communities situated in Johannesburg as well as in other cities across South Africa. Support entrepreneur ideas, especially for learners who can form partnerships and look for sponsors to work in their communities.

Resources

Alli, A. 2021. Transboundary water governance within the Southern African Development Community. Masters Dissertation. University of the Free State. Bloemfontein, South Africa.

Ashton, P.J., Hardwick, D., Breen, C., Burns, M. and Weaver, A. 2008. “Changes in water availability and demand within South Africa’s shared river basins as determinants of regional social ecological resilience”, Burns, M.J. & Weaver, AvB, pp. 279-310

City of Johannesburg (CoJ). 2018. Johannesburg Economic Data. https://www.joburg.org.za/about_/Pages/About%20the%20City/About%20Joburg/Economic-Data.aspx (Access date: 12/05/2022)

City of Johannesburg (CoJ). 2020. City of Johannesburg Integrated Annual Report 2018/2019. Johannesburg, South Africa.

City of Johannesburg, Johannesburg Water (SOC) Ltd (CoJ-JW SOC). 2020. Business Plan – Diphetogo Game Changers 2019/20. Johannesburg, South Africa.

Dippenaar, M. (2015). Hydrological Heritage Overview: Johannesburg. Gold in the Rand, Water from the Land. Water Research Commission, SP91/15. Pretoria, South Africa.

Depart of Forestry, Fisheries and Environment (DFFE). 2022. Chapter 8. Inland Water. Aquatic ecosystems in South Africa include rivers and streams, estuarine systems, marine systems, wetlands, floodplains, lakes and dams and groundwater systems. Source: https://www.dffe.gov.za/sites/default/files/reports/environmentoutlook_chapter8.pdf (Access date 02/03/2022)

Slabbert, N.D. 2007. The Potential Impact of an Inter-Basin Water Transfer on the Modder and Caledon River Systems. PhD Thesis. University of the Free State. South Africa.

About Rand Water

Rand Water is South Africa’s leading water board (supplying potable water since 1903). Rand Water recognised the urgent need to confront water challenges through the establishment training facility (Rand Water Academy). The Rand Water Academy’s strategic objectives are aimed at training and developing learners towards professionalization, providing unemployed learners the opportunities to obtain practical training in their respective functional areas, creation of decent employment for the unemployed youth, and alignment in promoting the objectives of Rand Water. The WOL programme is a presidential initiative that is aimed at addressing the water losses in South Africa. This programme was initiated on 28 April 2015, where Rand Water and the Energy and Water Sector Education and Training Authority (EWSETA) were authorized as the programme implementing agent and training implementing agent respectively.

Rand Water and City of Johannesburg (CoJ)

Johannesburg Water (CoJ) supplies 1 553 Megalitres (Ml)/day of potable water, procured from Rand Water, through a water distribution network of 12 337 km, 126 reservoirs and water towers, and 37 water pump stations. The wastewater is then collected and reticulated via 11 906 km of wastewater networks and 39 sewer pump stations (CoJ-JW SOC, 2020).