EXECUTIVE SUMMARY

Introduction

Many communities in South Africa struggle to access reliable and adequate quantities of good quality water for potable and non-potable water requirements. Although ideally, different water qualities are needed for potable and non-potable water requirements, in practice in South Africa, potable water of the highest quality is often used for non-potable applications (e.g. toilet flushing and landscape irrigation) where water of much lower quality would be acceptable. This practice is unsustainable if the South African government is to assure immediate and long-term water supply goals, and requires the assessment of various options especially in light of the aridity of the region and limited freshwater resources. The use of different non-potable water qualities to supply non-potable water requirements conveyed through dual water reticulation systems presents one of such options.

Internationally, dual reticulation systems of diverse design specifications and configurations, conveying different non-potable water qualities for non-potable water requirements domestically and non-domestically, have been implemented. Examples can be found in the United Kingdom, Australia, Namibia, United States of America, Singapore, Japan, China, the Caribbean nation of Trinidad and Tobago, the Netherlands, Israel, and the Republics of Kiribati and the Marshall Islands.

The use and application of dual reticulation systems were investigated in the past by Botha and Pretorius (1998). The study concluded that dual systems offer new possibilities for maintaining adequate water supply and encouraging the appropriate use of the available water resources in South Africa. However, uptake of the recommendations of the study in especially many water-scarce areas of South Africa has been limited. This is despite the fact that the technology surrounding dual systems and non-potable water use/reuse has evolved since then, with great strides made on the subject. This study therefore emanated from the need to re-visit this subject and evaluate its current applicability within the South African context.

The main aim of this study was therefore to assess the feasibility of implementing dual water reticulation systems in South Africa based on local and international experience.

Methodology

The objectives of this study were achieved through undertaking five tasks: a detailed literature survey, which attempted to garner local and international experiences on dual systems; collection and analysis of perceptions of both decision-makers and current consumers of some non-potable water resource; a detailed case study analysis of an existing dual system; the development of a framework for assessing the feasibility of implementing dual water reticulation systems in South Africa; and the utilization of the framework to assess the feasibility of implementing a dual system within an existing community.

The perception surveys were carried out across a spectrum of technical and non-technical water decision-makers (i.e. water and wastewater services managers and technical personnel, and DWAF officials). Perception surveys were also carried out in Emalahleni, which is a community currently benefiting from recycled mine water supplied by the Emalahleni Mine Water Reclamation Project. The surveys were carried out prior to the commissioning of the reclamation project and sought to determine perceptions regarding the use of non-potable water domestically and the implementation of dual reticulation systems. The case study analysis was carried out in the City of Cape Town (CoCT) which houses a dual system that has been operating for several decades. Thirteen percent of the treated effluent currently produced within the city is reused for certain non-domestic applications, e.g. landscape irrigation, and certain industrial processes, and there is potential for increased reuse within the city. The framework was developed using the different aspects of the triple bottom lines of sustainability (i.e. economical, social and environmental) while the modelling exercise, using the framework, practically assessed the feasibility of implementing a dual reticulation system within the Goldfields gold mine in Driefontein.

A summary of key findings from the study is presented below:

Key findings

- The extent of the aridity of an area is a major driver for non-potable water reuse and the implementation of dual systems in South Africa. In the literature and perception surveys, communities that had experienced water scarcity (e.g. Emalahleni, Garies and CoCT), were generally more willing to reuse non-potable water, even despite the potential risks to public health, than communities in areas of water abundance;
- Water reuse decreases the consumption of potable water. International literature indicates that reuse may save between 30-60% of potable water utilised for domestic non-potable water requirements (e.g. toilet flushing and garden irrigation). The water balance exercise undertaken in the CoCT (section C.4.2) shows that by recycling all treated effluent produced within the city, the total water supply will increase by about 118%. Currently, the CoCT reuses about 13% of the total treated effluent produced within the city;
- The longevity and sustainability of dual water reticulation systems in many parts of the world (e.g. the CoCT, Majuro, Tarawa, Windhoek and Hong Kong) prove that dual systems are feasible water supply options. As long as regulations and guidelines are adhered to, and fundamental precautions and practice (regarding materials, system implementation and operation) are made, a dual system is no more difficult to implement than a traditional potable water supply system. An aggregated score of 8.7 was calculated during the modelling exercise to assess the feasibility of implementing a dual system within the Goldfields gold mine in Driefontein. The score of 8.7 represents a '*high potential for the designed dual system to be viable*' and supports the statement that dual systems are feasible water supply options;
- Wide-area urban/agricultural, district and industrial dual systems are only feasible in areas where a sewer system already exists or is to be implemented. Individual dual systems which are also feasible

where sewer systems exist, have also been implemented in low-income communities/households where sewers don't exist and dry sanitation is commonly practised (e.g. Carnavon). In these communities, dual systems are profitable in reducing pollution due to indiscriminate discarding of domestic wastewater in the environment and for garden irrigation and toilet flushing;

- Colour coding and clear identification/labelling of a dual system played a significant role in encouraging (from 50% to 63%) the acceptance of dual systems amongst surveyed respondents;
- It makes economic sense for sources of non-potable water to be in proximity to the potential uses. This naturally occurs for all dual system scales except the wide-area urban/agricultural dual system which is not inherently designed to be close to potential uses. Therefore, due to the high cost of long distance pipelines, some potential consumers of treated effluent have not been served by the existing dual systems within the CoCT. The study determined that the optimal economic distance between participating WWTWs and existing non-domestic consumers within the CoCT was about 500 metres;
- Tariffs for non-potable water conveyed via dual water reticulation systems are usually lower than potable water tariffs and this has encouraged non-potable water reuse. In the CoCT, treated effluent tariffs in 2007 ranged from 7% to 40% of the potable water tariffs and this has encouraged several large users of non-potable water (e.g. the Chevron oil refinery) to reuse treated effluent. The percentage of willing respondents in the perception survey increased from 36% to 71% if tariffs for non-potable water were lower than for potable water. In the modelling exercise where a treated effluent system replaced the existing potable water supply system for toilet flushing, landscape irrigation, paving and masonry production, cost savings of about 67% (R17 150 048) were achieved over 20 years;
- The literature and perception surveys show that it is critical that community perceptions are well-known and understood prior to the detailed planning of domestic dual systems. Numerous reuse projects have failed in the past (e.g. in California and Florida, United States of America) as a result of negative community perceptions or the failure of decision-makers to determine whether potential users or the public will accept such systems;
- The closer non-potable water is to human contact or ingestion, the more opposed people are to using the water. In the perception surveys, domestic respondents generally preferred reusing non-potable water for toilet flushing, landscape irrigation and car washing than more personal items such as laundry. In support of these perceptions, most non-potable water reuse in South Africa at the current time, is for domestic and non-domestic irrigation and industrial non-potable water processing;
- One prominent area of concern from the perception survey of domestic respondents was the safety of children when exposed to non-potable water used for irrigation;
- The perception survey showed that the trust respondents had in their local authorities determined their willingness to accept a dual system. High performing local authorities attracted higher levels of trust from respondents. This is because respondents associate a level of risk to using dual systems and therefore, will feel the risks are lower when the local authority operating the dual system has proven over time to be reliable;
- Inefficient institutional arrangements and relationships between different units managing or operating

one or more aspects of the treated effluent system (especially in WWTWs) have proven to be detrimental to the optimal operation and sustainability of the dual systems in the CoCT;

- There are no current and detailed South African regulations or guidelines pertaining to non-potable water reuse and dual systems. The DNHPD (1978) guideline is an outdated guideline that needs to be revised in light of current local and international experience. Many of the dual systems that have been implemented in the country have used these outdated guidelines and regulations or those used internationally;
- A significant number of the wide-area urban/agricultural and industrial dual systems that have been implemented in South Africa are driven by private sector and/or community initiatives, with irrigation, mining and industrial processing being the main uses for the non-potable water (especially treated effluent). Since many of these initiatives are not primarily driven by local authorities, no formal operational or tariff agreements are in place.

Based on the findings from the study, some recommendations to facilitate the efficient implementation and sustainability of dual systems in South Africa are proffered below:

Recommendations emanating from the study

- In order to ensure the economic feasibility of dual systems, a careful life cycle cost-benefit analysis needs to be carried out within context of other water resource alternatives and a full appreciation of the true costs of water supply provision. There are potentially large savings in avoiding treating water to potable standards for non-potable domestic and non-domestic uses;
- To guarantee a high level of service for treated effluent reuse, a program of regular control and monitoring of influent from various sources (especially industries) should be developed by local authorities. In addition, many local authorities need to be equipped with qualified personnel that will undertake control and monitoring tasks and enforce regulations/by-laws. Dual systems must not be implemented where the qualified institutional capacity is deficient;
- There is urgent need for the Department of Water Affairs and Forestry to develop a national regulatory document that sets out government's policies regarding non-potable water reuse and dual systems;
- In order to implement dual systems that are technically safe, it is vital that a guideline that proposes uniquely designed and standardised engineering materials (i.e. pipes, meter boxes, valves, taps, tanks, etc.) and specifications (e.g. sizes, thickness, colour, labelling) for non-potable pipe networks be developed for South Africa;
- A pre-requisite for the sustainability of dual systems is efficient institutional arrangements and relationships between the relevant units (e.g. potable water services, wastewater services, sanitation services, bulk stores, billing services and maintenance services) housed within local authorities. This is especially critical in wide-area urban dual systems that utilise treated effluent. Efficient institutional arrangements and relationships will, in addition, assist in the development of integrated water resources and services plans that will ensure the optimal utilisation of an area's available water resources;

- If wide-area urban/agricultural dual systems are to be implemented, local authorities must first consistently produce high performance service. This will increase consumers' trust in their ability to implement dual systems and reduce any potential risks to public health and safety. It is fruitless for local authorities to consider implementing dual systems when service levels and public confidence in their services are low.

In conclusion, dual water reticulation systems are feasible water supply options especially for communities located in arid areas. Provided there is an enabling environment (i.e. regulations, guidelines, institutional capacity, non-potable water resources and qualities, tariffs, decision-maker and potential user perceptions and willingness, appropriate non-potable water uses, public health and safety, and trust in service providers), large users of non-potable water in arid areas will immensely benefit from the implementation of dual systems. This study shows that if all treated effluent produced within an area is recycled, total water supply to the area will increase by about 100%. Tariffs for supplying non-potable water are also shown to be considerably lower than potable water tariffs – the CoCT billed consumers of treated effluent between 7% and 40% of potable water tariffs in 2007. From the perception surveys, it was clear that non-potable water requirements requiring minimal human contact (e.g. toilet/urinal flushing and landscape irrigation) were preferable for domestic respondents. Hence, it would be wise for decision-makers to target these uses when domestic dual systems are to be implemented. Based on the findings from this study, a framework for assessing the feasibility of implementing a dual system was developed. The framework incorporates multiple aspects from the triple bottom lines of sustainability (i.e. technical/engineering, economics, social, institutional, regulations, environment and public health and safety).