4.5 Wastewater Reuse

4.5.1 Background and Existing Infrastructure

The reuse or reclamation of wastewater not only improves the sustainability of water resources, but is strategically important as it improves the security of supply through the diversification of water resources. Wastewater is available throughout the year and the supply is consistent.

Umgeni Water currently owns an 18% share in the Durban Wastewater Recycling (DWR) Plant. The DWR treats domestic sewage to near potable standards for industrial use. The plant has the capacity to treat approximately 40 Mℓ/day of wastewater.

4.5.2 Proposed Options

Umgeni Water is currently investigating the option of treating wastewater from the Darvill Wastewater Works (WWW) (**Section 6.2**) to potable standards. A Feasibility Study is being undertaken to assess the viability of returning the treated water back into the distribution system at Umlaas Road (**Section 5.2**). The water can then be used to augment the supply to the Western Aqueduct which will serve the high growth areas along the western corridor of the eThekwini Municipality (**Section 5.2**). The advantage of this is that water is made available higher up in the system and can therefore be supplied under gravity. The alternative is a reliance on pumping from the Durban Heights WTP to serve these demand centres (**Section 5.2**). Supplying the water from the Upper Mgeni System will shed load at Durban Heights WTP, thus freeing up the works to supply additional water. This scenario does, however, place stress on the infrastructure of the Upper Mgeni System and this infrastructure will have to be upgraded to cope with the additional demand (**Section 7.4**).

4.5.3 Project Progress

A number of studies have been undertaken as investigations into wastewater reclamation at Darvill WWW. These include infrastructure and environmental pre-feasibility studies as well as treatment technology investigations.

The infrastructure study involves the evaluation of two methods of utilising Darvill wastewater to augment the potable supply. The first, a Direct Reuse option, is designed to treat the Darvill effluent at a proposed wastewater reclamation plant adjacent to the existing works. The second, an Indirect Reuse option, is designed to abstract the Darvill effluent from a location downstream of the WWW on the Msunduzi River. Both options require the water to be pumped to the Umlaas Road node (**Section 5.2**) for distribution.

The Indirect Reuse (river abstraction) option will require treatment of the abstracted river water and the WTP at the Umlaas Road node will need to be re-commissioned for this purpose. Due to the poor water quality of the Msunduzi River **(Section 4.4.4**) the WTP may have to be upgraded to cater for the inclusion of more advanced water treatment technology. Two possible treatment options have been identified for Umlaas Road (**Figure 4.60**). The first is an Ozone and Granular Activated Carbon (GAC) treatment train (Train 1) and the second is a membrane based treatment train (Train 2)

Storage reservoirs, distribution pipelines and the associated infrastructure to pump the treated water to Umlaas Road WTP are required for both alternatives and preliminary designs and pipeline

routes have been completed. The outcome of the Detailed Feasibility Study, which is due for completion in early 2014, will determine the most economically feasible alternative.

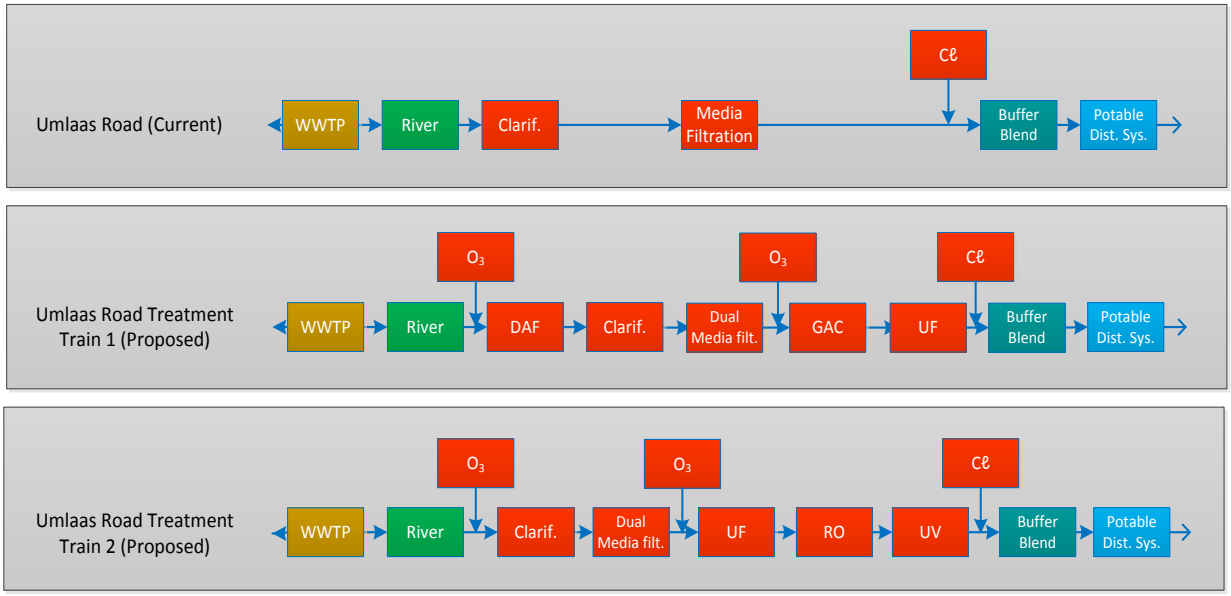

Figure 4.60 Indirect Potable Reuse Treatment Train Options

Both the Direct and Indirect Reuse options will reduce the flow in the Msunduzi River by approximately 60 Mℓ/day and this could, potentially, have an environmental impact on the river and its users. A specialist environmental study was previously completed to assess the possible impacts of this reduction in flow on the river. The study revealed that reduction in flow would have no to limited impact on the ecology of the river, since the flow would be returning to its natural or "virgin" state. The river habitat and ecosystem would therefore adapt to what it was formally used to. The discharge from Darvill WWW is a return flow and is therefore not part of the natural flow regime of the river. Social impacts were more difficult to quantify without the undertaking of a full Environmental Impact Assessment, but are expected to be limited and could be mitigated.

A vital component in the Direct Reuse option is the design of the advanced water treatment technology process train for the reclamation plant. The treating of wastewater for potable reuse requires that appropriate technologies are used to ensure the public's safety at all times. This is achieved by designing treatment systems that ensure no harmful substances or viruses will pass through the system. The most effective way of doing this is to design "multiple treatment barriers". International experience at NEWater in Singapore and at Goreangab in Windhoek makes use of this philosophy. These plants also undertook extensive treatment trials using pilot plants to obtain the best treatment train design.

Umgeni Water is following a similar strategy and, with the cooperation and sponsorship of the Water Research Commission (WRC), is undertaking a wastewater reclamation pilot plant investigation. The first stage in the investigation involved the installation of Membrane Bioreactor (MBR) pilot plants. The MBR's provided excellent pre-treatment for further advanced treatment technologies such as Granular Activated Carbon (GAC), Reverse Osmosis and Ultra Violet Irradiation. Combinations of these advanced treatment technologies are being tested to ascertain the most effective "multiple barrier" system (**Figure 4.61**). These tests were completed in November 2013 and culminated in a draft WRC report in December 2013. The study recommended two possible treatment trains (**Figure 4.62**), which would meet the water quality objectives of producing safe drinking water. However, the cost of disposing of the brine emanating from the Nanofiltation (NF) or

Reverse Osmosis (RO) unit treatment processes proved to be prohibitive. An alternative treatment train utilising Ultra-Filtration instead of NF is being investigated for Train 1. Train 2 would be the most suitable treatment train for reclamation plants located near the coast as the brine could then be disposed of economically to the sea.

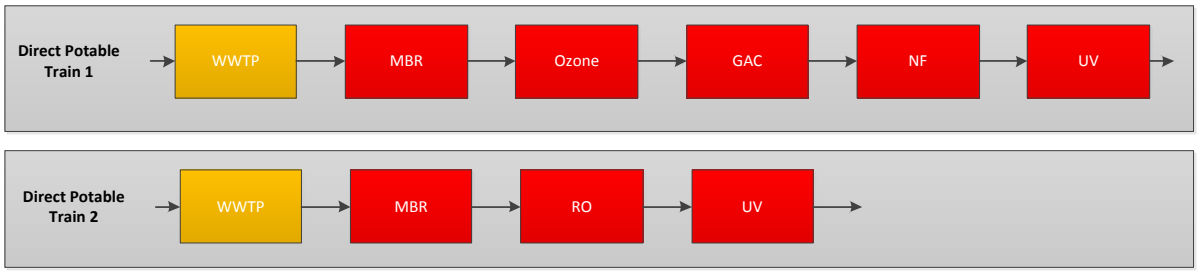

Figure 4.61 Direct Potable Reuse Treatment Train Options

Coupled with the pilot plant investigations is a rigorous water quality monitoring programme. Of concern when reclaiming wastewater to potable standards are the health and safety aspects, especially those relating to the presence of Contaminants of Emerging Concern (CEC) in the final water. CECs represent a range of contaminants that include pesticides, pharmaceuticals and personal care products. Much attention has been given to particular contaminants that fall under the banner of Endocrine Disrupting Chemicals (EDCs) such as Estrone, 17β-Estradiol, 17α-Ethinylestradiol and Testosterone. These and other EDCs were sampled and analysed from the product water once it had passed through all the treatment technologies. Results show that these substances are sufficiently removed from the final water and pose no threat to human health.

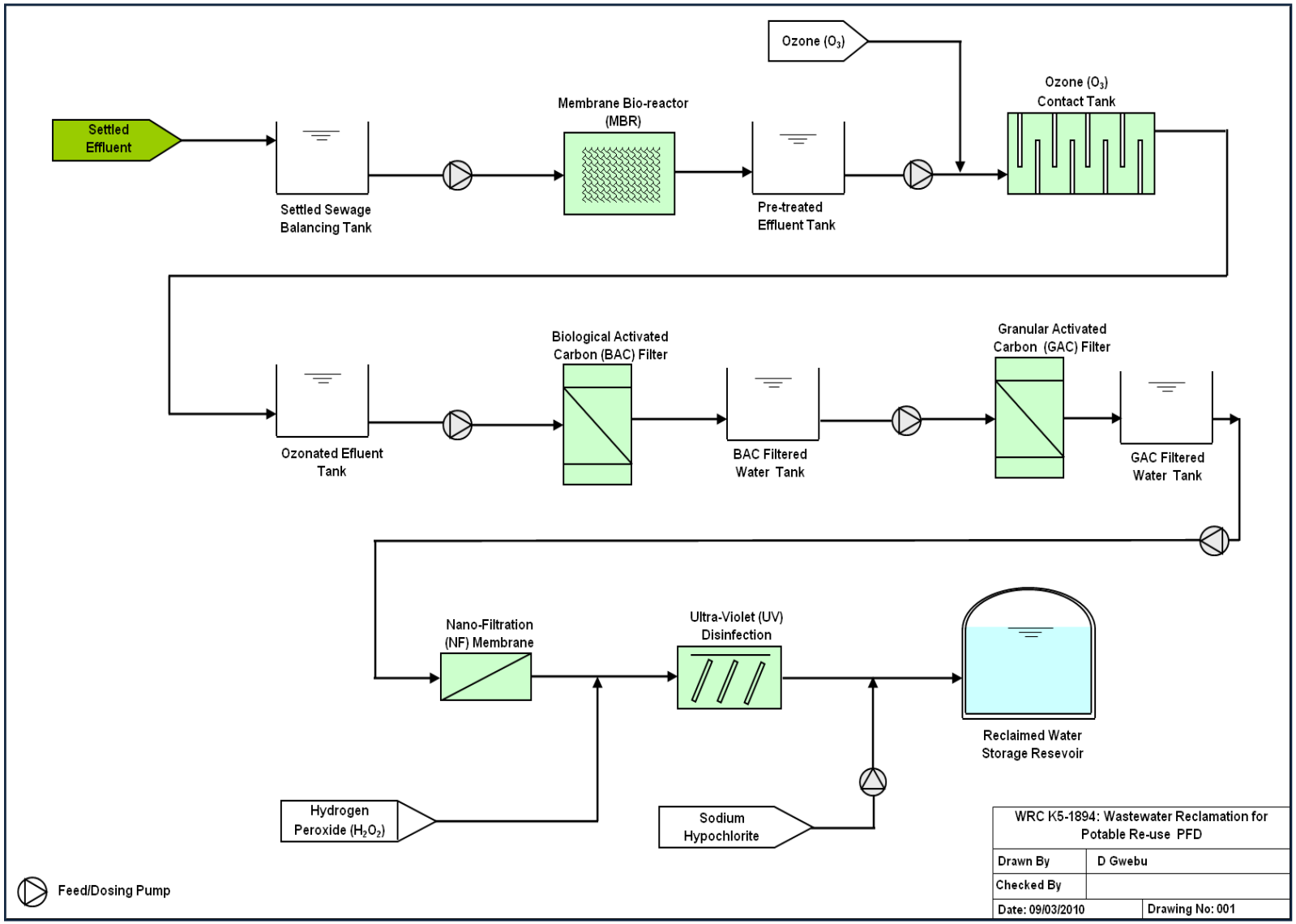

Figure 4.62 Preliminary process flow diagram for Darvill Reclamation.

4.6 Seawater Desalination

Umgeni Water completed a desalination pre-feasibility study in 2010. The objective of the study was to investigate the viability of constructing a large scale desalination plant in the eThekwini area as a possible alternative to the proposed uMkomazi Water Project (**Sections 4.4.4** and **5.2**). The ultimate capacity of the plant was set at 450 Mℓ/day (164 million m^3/annum), making it potentially one of the largest seawater reverse osmosis (SWRO) to ever be built.

The study identified the northern end of the Durban Airport as the optimal site to construct a SWRO desalination plant. The cost of constructing and operating the plant was estimated as well as the possible environmental implications.

Few points exist within the water supply infrastructure of eThekwini Municipality that have the capacity to receive the water from a single point desalination plant producing 450 Mℓ/day of potable water. Early investigations have also shown that due to the limited space for the pipeline installation, it is highly likely that a phased implementation of the pipelines will be feasible because of these space constraints. It was proposed that about 150 of the 450 Mℓ/day would be injected into the Wiggins System (**Section 5.2**) at its water treatment plant (WTP) whilst the balance is injected into the Central Aqueducts.

An economic comparison, at a pre-feasibility level of detail, between this desalination plant and the alternative uMkomazi Water Project, indicated no discernible difference. It was therefore necessary to undertake more detailed investigations of both options so as to obtain a higher level of accuracy in their comparison.

A revised strategy has now been adopted. A detailed feasibility investigation is considering the option of a 150Mℓ/day plant on both the North Coast and South Coast. The capacity of these plants is based on the capacity of existing and proposed bulk water supply infrastructure in these areas, which will be utilised to convey the potable water from the desalination plants to the various distribution points. Datasets on the various criteria that affect the positioning of a desalination plant have been sourced and two potential sites have now been identified through a site selection study undertaken by Umgeni Waters Planning Department (Umgeni Water 2011). These sites are located on either side (north and south) of the Mgeni Supply Area and would have the ability to sufficiently augment the Mgeni, South Coast and North Coast Systems in the medium-term with supply to areas in eThekwini Municipality, Ugu District Municipality and iLembe District Municipality.

Detailed feasibility investigations were undertaken at both sites during 2013. Comprehensive geotechnical, oceanographic, bathymetric and environmental studies were completed. An extensive water quality sampling programme was conducted by the Council for Scientific and Industrial Research (CSIR) over a period of one year. Sea water samples were taken at a variety of points both near shore and far shore as well as at different depths.

Preliminary analyses and interpretation of the sea water results indicated that the nutrient rich east coast water's contained high concentrations of algae. Some of these algae are very small and are known as "pico-plankton". These "pico-plankton" are considered to be potentially hazardous to membrane based treatment processes and they may result in fouling.

It has thus been proposed as part of the detailed feasibility study to conduct a pilot study using various pre-treatment technologies. Pilot investigations will allow proposed pre-treatment technologies to be tested to establish their ability to provide protection for the downstream RO

membranes. It is essential that the RO membranes are protected as their replacement is very costly and any reduction in their performance due to fouling must be avoided as far as possible.

A suitable site for the pilot plant has been identified at the Scottburgh caravan park and preliminary investigations are underway for the installation of the pilot plant by June 2014. It is envisaged the pilot plant will operate for a period of 12 months to take account of seasonal changes in sea water quality.

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