SECTION D

WATER RE-USE

Introduction to the Use of Treated Effluent Options

It is important to note that the information presented on water re-use is based on the City of Cape Town's Integrated Water Resource Planning Study. Within the Berg WMA, the potential for re-use exists within all municipalities. The information presented serves as an indication of the order of magnitude of the potential. It merely utilises the findings of the CCT Study as this represents the most comprehensive re-use study to date, and no bias is intended towards the CCT.

Domestic and industrial wastewaters are discharged into sewer networks, which generally convey the wastewater to a wastewater treatment works, where biological treatment of various forms takes place. The treated wastewater is then either discharged into an adjacent watercourse or the sea, often with some negative environmental impact.

The use of treated effluent therefore entails the interception of the treated effluent and using the reclaimed water beneficially. Possible uses for treated effluent include:

- Urban irrigation of sportsfields and public open spaces;
- Use in certain industrial processes;
- Agricultural irrigation;
- Dual reticulation systems for garden watering and toilet flushing (also see use of 'grey-water' and 'rain tanks' under water demand management);
- Aquifer recharge; and
- Potable re-use.

The various re-use options presented above would have differing water quality requirements with the most economical re-use options generally being those that require the least amount of subsequent treatment. The practicality and costs of using treated effluent from a single waste water treatment works for a number of re-use options therefore requires careful consideration.

A total in excess of 500 Ml/day (182.5 million m^3/a) of wastewater is treated at the various wastewater treatment works in the Cape Town Metropolitan area, of which approximately 10 % is currently being re-used, primarily for summer irrigation purposes.

Treated effluent therefore represents a significant potential water source, whose development has to a large extent been inhibited by people's aversion to the notion of coming into contact with treated effluent. While there are potential health risks associated with the use of treated effluent, the majority can be avoided through good engineering practice and operations management.

Previous studies undertaken have indicated that local irrigation, agriculture and industrial use could potentially utilise about 40 % of the effluent treated during summer, with the irrigation and agricultural usages falling away during winter. It can therefore be seen that the use of treated effluent to potable standards is required in order to maximise the exploitation of this source.

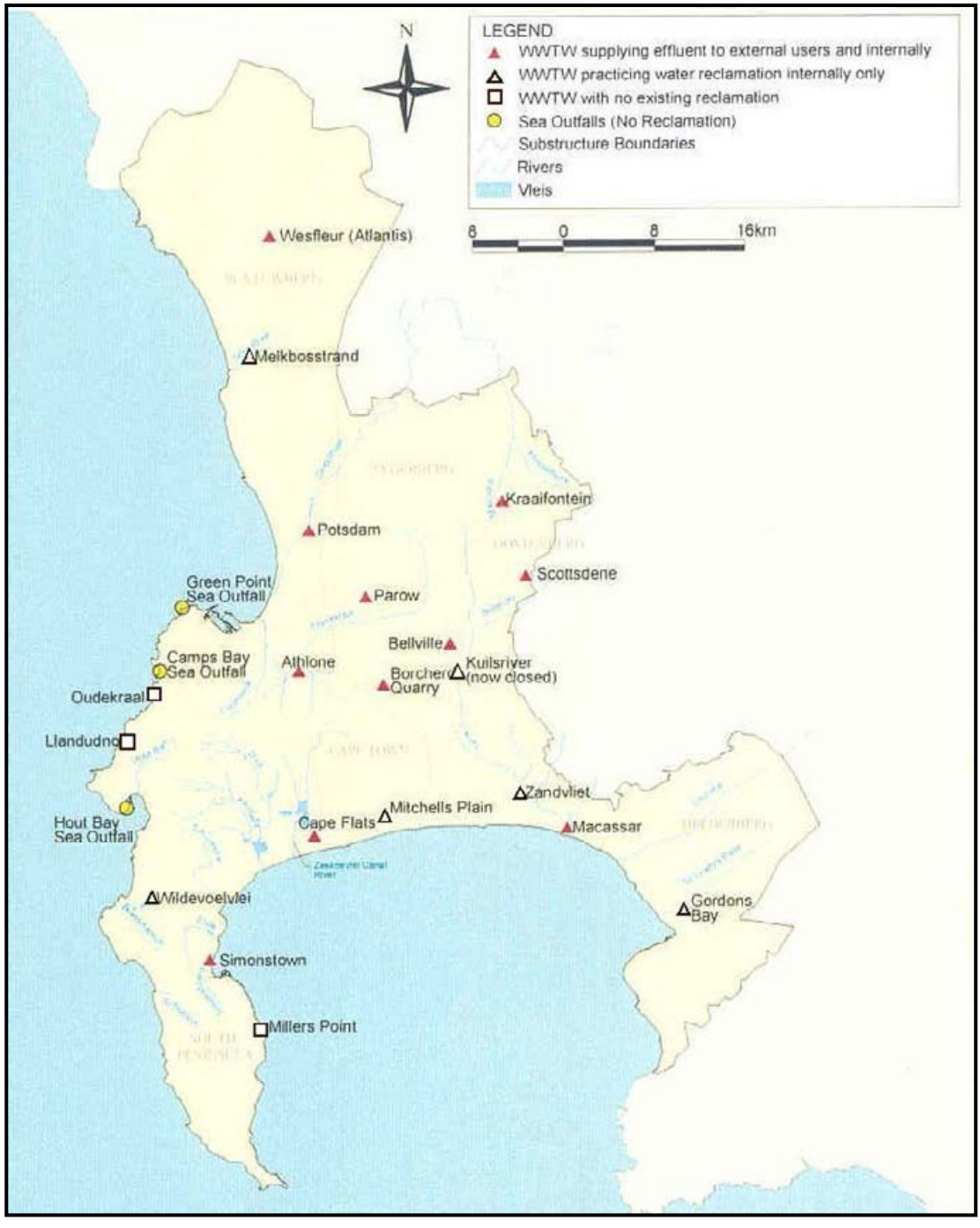
The following criteria would impact on the re-use potential of effluent from a particular works :

- Size of supply;
- Extent of local demand;

- Nature of influent;
- Quality of treated wastewater;
- Impact on downstream environments;
- Intended use of treated effluent.

Various re-use options are presented in this document as individual supply augmentation options. However, the collective use of a number of treated effluent re-use options, which may be appropriate to a particular area or wastewater treatment works, may be more appropriate. Therefore, the various options need to be considered as part of an overall strategy for the use of treated effluent.

The locations of the WWTW within the CCT are shown in the Figure below.



D1. Use of Treated Wastewater for Local Irrigation (and Industrial Use)

1. OPTION LAYOUT

Potential exists for re-use in proximity to all WWTW and surrounds.

2. OPTION DESCRIPTION

Unless otherwise stated, the information presented is taken from the CCT *Investigation into the distribution of treated effluent* series of reports on the various wastewater treatment works (WWTW) within the CMA, dated November 2003 and August 2004.

This option entails the use of treated wastewater, primarily for the irrigation of sportsfields and public open spaces, but also for agricultural and industrial purposes, via a separate treated wastewater distribution network, emanating from existing WWTW within the CCT.

Although the investigation undertaken by the CCT proposed a number of specific schemes, one for each of the thirteen WWTW investigated the information has been collated and considered as a collective option for comparison purposes with other augmentation schemes. Some of the individual schemes proposed are more cost effective than others and some schemes may become less cost effective as they extend further from the WWTW. Each of the complete schemes proposed have been considered in this option.

Apart from further filtration, no further treatment of the wastewater is considered for this option. Greater potential for the use of treated wastewater for industrial processes may exist, provided that further treatment of the wastewater is considered. This may not be practical to implement and has therefore not been considered for this option.

3. "SCHEME"/OPTION YIELD

Based on the investigations undertaken, the potential yield for this option was estimated at 34 million m^3/a, which takes into account the seasonal nature of irrigation use. The CCT's study investigated 13 of the 20 WWTW within the CMA.

4. UNIT REFERENCE VALUE

The potential financial costs are as follows:

ITEM	Escalated to 2005 (@ 7% /a) [1]
Capital cost (R million)	206.0
Annual operating cost (R million)	2.8
NPV Cost (R million)	195.1
Unit Reference Value (R/m^3)	**0.55**[2]

1) Capital and O&M costs are escalated at 7% / a to 2005
2) URV calculated at an 8% /a discount rate

5. ECOLOGICAL

Limited environmental impact is anticipated. A possible impact is the build-up of the salinity levels in the soils with time (or toxins if industrial wastewaters are used). However, as irrigation will only take place during the summer months, it is anticipated that much of the salinity build-up will be leached out during the winter months.

6. SOCIO-ECONOMIC

This option will provide limited temporary work opportunities but does pose some potential health risks, linked to possible exposure to treated effluent, if the disinfection is inadequate. Commercial agriculture may be impacted if the use of treated effluent impacts on the local and international acceptability of the produce.

7. OTHER ISSUES

Specific strengths and weaknesses of the option include:

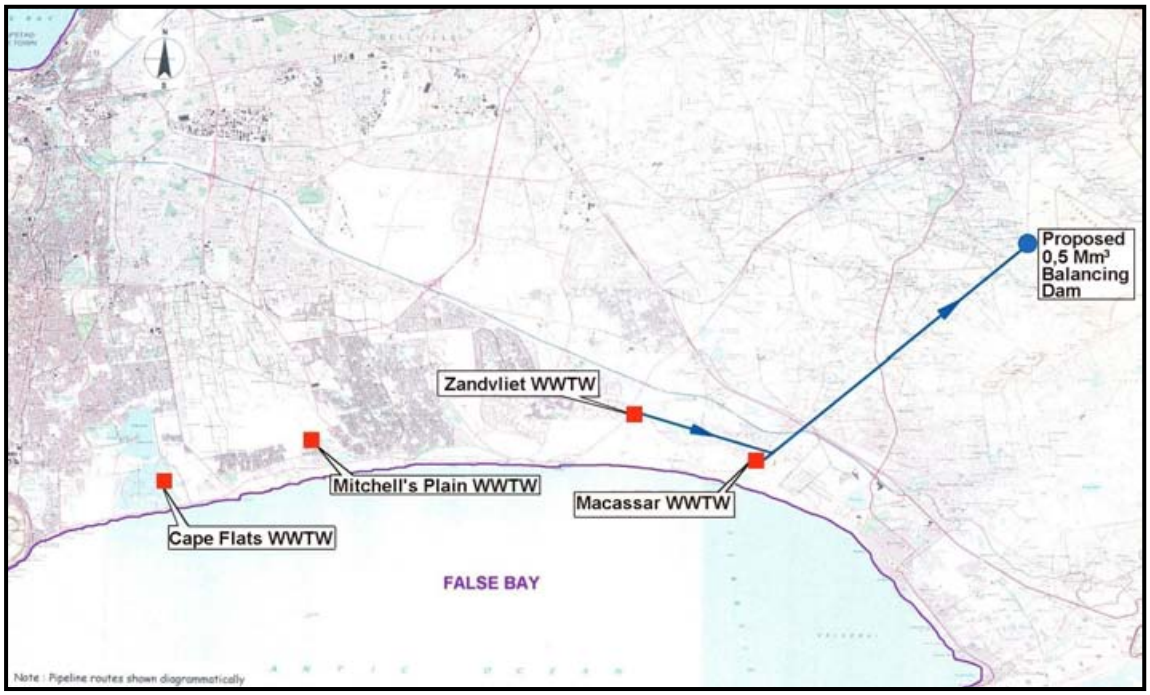
- **Strengths**
  - o There is already a demand for treated wastewater, especially in terms of the irrigation of sportsfields and to a lesser extent for agriculture. This demand is however largely driven by tariffs and/or the scarcity of water.
  - o This option provides a fairly significant yield potential.

- **Weaknesses**
  - o Potential health risks, e.g. if unsterilised effluent is used to irrigate sportsfields where contact sports are played.
  - o The potential health risk associated with accidental cross-connection of treated wastewater distribution networks with the potable water network.
  - o The potential for the build-up of toxins in the soils, especially if industrial effluent enters the wastewater treatment streams.
  - o The current absence of a formal tariff structure and policy for the supply of treated effluent. Unless specific by-laws are passed, this option will largely be demand driven and the tariff structure will determine the attractiveness of this option. There is at present no policy for the basis of providing a treated wastewater supply, e.g. specific return periods or Private Public Partnership type arrangements.

- Increased institutional implications in terms of the operation and maintenance of the WWTW (quality of effluent produced), the management of the dual networks and the monitoring of the previous mentioned requirements.
- The demand has decreased in some areas due to ongoing blockages of sprinkler systems and odours.
- The legality of local authorities to sell treated effluent is not established nor is the associated tariff structure.

D2. Use of Treated Wastewater for Commercial Irrigation; Exchange for Fresh Water Allocations

1. OPTION LAYOUT



2. OPTION DESCRIPTION

Unless otherwise stated, the information presented is taken from the CCT Integrated Water Resource Planning Study of 2001: Report 8 of 12 – *Potential for the use of treated wastewater within the CMA.*

This option entails the exchange of treated domestic wastewater effluent with untreated freshwater (currently being supplied to farmers) for commercial irrigation use. The exchanged freshwater will then become available for treatment and subsequent potable use.

The Helderberg and Stellenbosch irrigation schemes, which currently receive some 20 million m^3/a of water from the Riversonderend – Berg River Government Water Scheme, have been identified for the possible large-scale use of treated wastewater.

In order to achieve the above, treated domestic wastewater will need to be pumped from the Zandvliet and Macassar WWTW via a 45 km long pipeline and against a 350 m head, to a small balancing dam (0.5 million m^3 capacity) near the exit of the Stellenbosch Tunnel. From the balancing dam, existing infrastructure will be used for the distribution and irrigation of the wastewater.

Due to the nature of the irrigation demands and the limited area available for storage at the Stellenboschberg Tunnel exit, the proposed scheme is based on the summer usage of treated wastewater only.

This option entails no additional treatment of the wastewater to that currently being provided at the respective WWTW. These WWTW treat predominantly domestic effluent.

3. OPTION YIELD

During previous investigations, it was considered that farmers would only be willing to exchange 25% of their allocations, implying a probable yield of 5 million m^3/a.

4. UNIT REFERENCE VALUE

The potential financial costs are as follows :

ITEM	Escalated to 2005 (@ 7% /a) (1)
Capital cost (R million)	134.0
Annual operating cost (R million)	2.4
NPV Cost (R million)	114.0
Unit Reference Value (R/m^3)	**2.77** (2)

1) Capital and O&M costs escalated at 7% /a to 2005
2) The URV is calculated at an 8% /a discount rate

5. ECOLOGICAL

Limited environmental impact is anticipated. A possible impact is the build-up of the salinity levels in the soils with time. However, as irrigation will only take place during the summer months, it is anticipated that much of the salinity build-up will be leached out during the winter months.

6. SOCIO-ECONOMIC

This option will provide limited temporary work. It does pose some potential health risks, where crops irrigated with wastewater are eaten raw or where workers are in direct contact with the wastewater (e.g. where overhead sprayers are used). Economic impacts due to a resistance from international markets in particular, may be of concern.

7. OTHER ISSUES

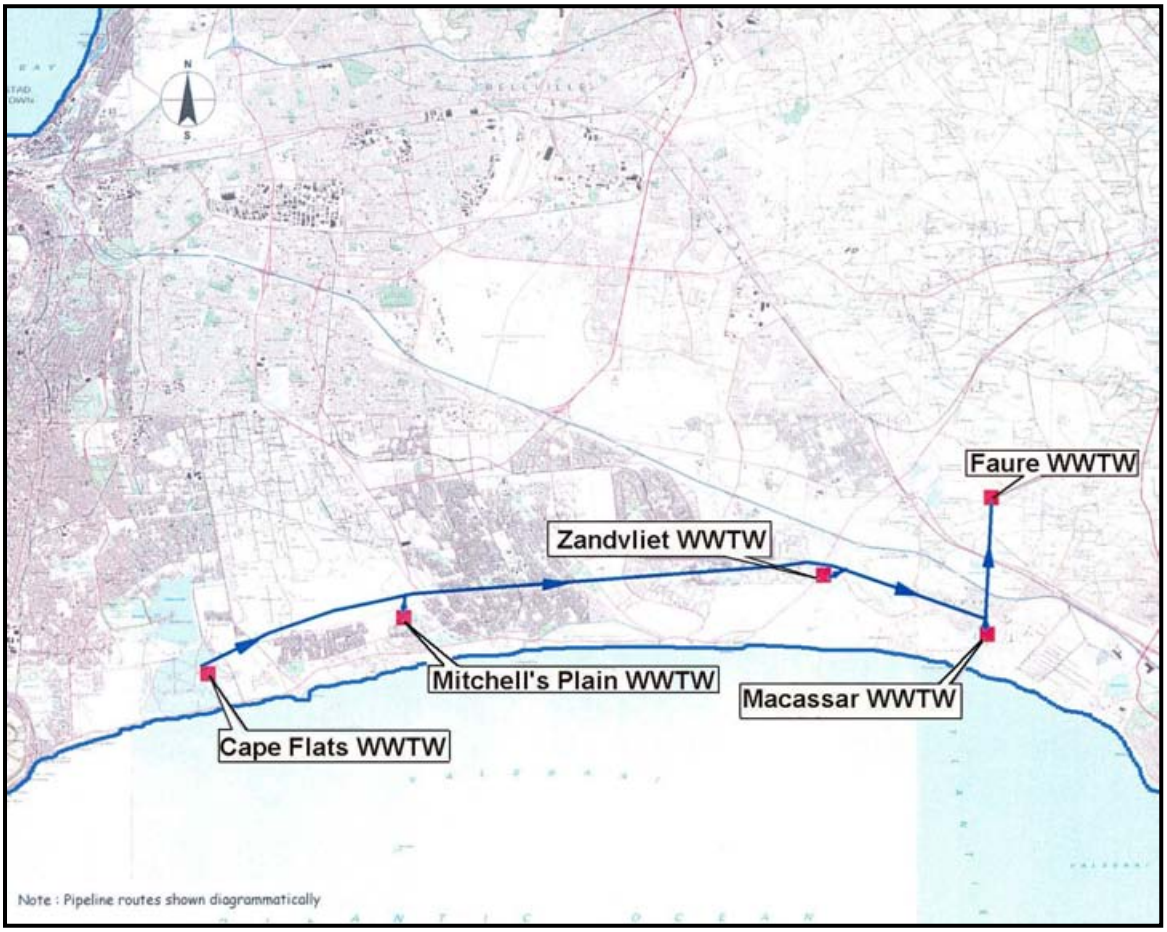
Specific strengths and weaknesses of the option include:

- **Strengths**
  - Potentially a relatively large treated wastewater consumer.

- **Weaknesses**
  - There is a general public aversion to the idea of being exposed to wastewater.
  - The ability to reach agreements with the farmers may be problematic.
  - There are possible negative international perceptions which could reduce the marketability of the produce.
  - The salinity of the treated wastewater and the possible impacts on the soils and the crops.
  - Increased institutional implications due to the need for effective monitoring.
  - Guidelines from the Department of Health which advise against the use of treated wastewater for crops which are eaten raw.
  - Relatively long implementation period.
  - The legality of local authorities to sell treated effluent is not established nor is the associated tariff structure.

D3. Use of Treated Wastewater for Potable Use

1. OPTION LAYOUT



2. OPTION DESCRIPTION

Useless otherwise stated, the information presented is taken from the CCT Integrated Water Resources Planning Study of 2001: Report of 8 of 12 – *Potential for the use of treated wastewater within the CMA.*

This option entails the use of treated wastewater, reclaimed to potable water standards, for domestic use on a continuous basis (i.e. all year round). It is proposed that domestic wastewater, treated via conventional wastewater treatment processes, be treated further and blended with freshwater, before being distributed for domestic consumption.

The scheme proposed to implement this option, entails the pumping of treated effluent from each of the WWTWs along the False Bay coast (Cape Flats, Mitchells Plain, Zandvliet and Macassar) to a reclamation works to be located at the existing Faure Water Treatment Works (WTW), from where the effluent will be treated, blended and then distributed via existing infrastructure.

As the Faure WTW has a current treatment capacity of 500 Mℓ/day and as the Department of Health requires a 1:4 blending ratio, the scheme proposed is based on a design flow of 100 Mℓ/day.

It can be noted that the previous mentioned WWTWs have a collective wastewater supply potential of between 155 Mℓ/day (making provision for the commercial irrigation option) and 223 Mℓ/day. The potential to extend this scheme to the Blackheath WTW, in order to maximise the treated effluent use, does exist. This option and the use of other treatment technologies have however not been investigated in depth to date.

3. OPTION YIELD

The yield of this scheme amounts to 100 Mℓ/day or 37 million m^3/a.

4. UNIT REFERENCE VALUE

The potential financial costs are as follows:

ITEM	Escalated to 2005 (@ 7% /a) (1)
Capital cost (R million)	1 212.4
Annual operating cost (R million)	100.3
NPV Cost (R million)	1 587.6
Unit Reference Value (R/m^3)	**5,51 (2)**

1) Capital and O&M costs escalated at 7% /a to 2005
2) URV calculated at an 8% /a discount rate

5. ECOLOGICAL

A positive impact is envisaged for the Kuils River estuary and near-shore marine environment associated with reduced return flows. The impacts of the pipeline and reclamation plant are not expected to be severe.

6. SOCIO-ECONOMIC

This option will have a slight positive impact by creating temporary work opportunities. It does however have possible negative health impacts and public acceptance impacts, especially by certain religious groupings. This option may also result in the need to increase tariffs.

7. OTHER ISSUES

Specific strengths and weaknesses for this option include:

- **Strengths**
  - Has a relatively high yield potential, although it may not be practical to fully utilise the yield, due to the manner in which the water resources are managed to optimise the system yield.
  - The reclamation process has been used successfully over a number of years, both in Windhoek and in Pretoria (pilot project).

- **Weaknesses**
  - Public aversion to the idea of drinking treated wastewater.
  - Significant institutional implications in terms of the operation and maintenance of the respective WWTWs and the reclamation plant.
  - High capital and operational costs.
  - Possible health implications (hormones, pharmaceutical compounds and disinfection by-products).
  - The legality of local authorities to sell treated effluent is not established nor is the associated tariff structure.

D4. Dual Reticulation Network

1. OPTION

Applicable throughout the study area, particularly where new developments are taking place, offering the opportunity for implementation during construction of new infrastructure.

2. OPTION DESCRIPTION

Unless otherwise stated, the information presented is taken from CMC's Strategic Evaluation of Bulk Wastewater of June 1999 : Report 25 of 37 - *Water Reclamation: A Strategic Guideline*.

As gardening accounts for approximately 35% of domestic water consumption and toilet flushing a further 30%, the use of lower-grade water for these purposes would result in a significant reduction in potable water use.

This option entails the use of treated effluent, conveyed to domestic users via a separate reticulation network, specifically for gardening and toilet flushing use. This option needs to be considered in conjunction with several of the Water Demand Management Options (i.e. 'use of grey water', 'private boreholes', 'rainwater tanks' and 'user education') and the "local irrigation and industrial treated effluent" use option presented earlier, as the demand management options target the same uses. This option may need to utilise the same reticulation network as the treated effluent option.

3. OPTION YIELD

Previous studies have indicated a potential yield of 28 Mm^3/a (based on 91 050 erven being reticulated).

4. UNIT REFERENCE VALUE

The potential financial costs are as follows:

ITEM	Escalated to 2005 (@ 7% /a) [1]
Capital cost (R million)	375.4
Annual operating cost (R million)	4.9
NPV Cost (R million)	325.8
Unit Reference Value (R/m^3)	**1.25** [2]

1) The capital and O&M costs have been escalated from 1997 at 7 % /a.
2) URV is calculated at an 8 % /a discount rate.

5. ECOLOGICAL

The use of treated effluent will have a positive impact on the environment, as a result of reduced river abstraction and reduced effluent discharge into the environment. However, there is a potential negative impact, as a result of the medium to long-term build up of pollutants in the soil and possibly in the groundwater.

6. SOCIO-ECONOMIC

This option would have a slight positive impact in terms of employment. There are, however, possible negative health implications linked to the possible exposure to treated effluent (e.g. potable and treated effluent networks being mistakenly interconnected), or inadequately disinfected spray being inhaled.

7. OTHER ISSUES

Specific strengths and weaknesses of the option include :

- **Strengths**
  - Readily implementable for new housing developments, but not for retrofitting existing developments.
  - Could possibly use the 'local irrigation network' if only for toilet flushing (if the quality is appropriate).

- **Weaknesses**
  - No quality standards in place as yet within South Africa for gardening and toilet use.
  - Potential health hazard.
  - In terms of gardening purposes, the system will only be used during the summer months.
  - This option will have an institutional implication for municipal staff, both those working at the wastewater treatment works and on the network supervision staff.