REPORT No: P WMA 19/000/00/0507
Volume 6 of 7

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
Directorate: National Water Resource Planning

WESTERN CAPE WATER SUPPLY SYSTEM: RECONCILIATION STRATEGY STUDY

Overview of Water Re-use potential from Wastewater Treatment Plants

FINAL

June 2007

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

Submitted by:
Ninham Shand (Pty) Ltd in Association with
UWP Consulting (Pty) Ltd

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DEPARTMENT OF WATER AFFAIRS AND FORESTRY

WESTERN CAPE WATER SUPPLY SYSTEM
RECONCILIATION STRATEGY STUDY

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WESTERN CAPE RECONCILIATION STRATEGY STUDY

VOLUME NUMBER	REPORT TITLE	
1	Reconciliation Strategy	
2	Determination of Future Water Requirements	
3	Scenario Planning for Reconciliation of Water Supply and Requirement	
4	Overview of Water Conservation and Demand Management in the City of Cape Town	
5	Treatment of Effluent to Potable Standards for Supply from the Faure Water Treatment Plant	
6	**Overview of Water Re-use Potential from Wastewater Treatment Plants**	✓
7	Summary Report	

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Mr J. Frame	ex City of Cape Town
Mr J. Daniels	City of Cape Town
Mr H. Mostert	ex City of Cape Town
Mr K. Fawcett	City of Cape Town
Mr P. King	City of Cape Town

THE WESTERN CAPE WATER SUPPLY SYSTEM RECONCILIATION STRATEGY

EXECUTIVE SUMMARY

Background

The Department of Water Affairs and Forestry (DWAF) commissioned the Western Cape Reconciliation Strategy Study, to facilitate the reconciliation of predicted future water demand scenarios with supply from the Western Cape Water Supply System (WCWSS) for a 25 year planning horizon. The Study seeks to provide a decision support framework to facilitate timeous decision making of appropriate water resource interventions necessary to ensure that future water demands can be met on a sustainable basis.

It is anticipated that Water Re-Use (WRU) is likely to form part of any future suite of reconciliation interventions for the WCWSS. Therefore this report investigated the current state of WRU and possible future interventions.

The objective of this report is to investigate the extent to which Water Services Authorities (WSAs) in the study area are currently re-using water, undertaking investigations to assess the potential for re-using water and planning and/or implementing water re-use projects. This report also addresses the impact of the recent droughts in terms of WRU in general and the demand for treated effluent in particular.

The issues related to Water Conservation and Water Demand Management (WC/WDM) interventions are discussed in a separate supporting report.

Previous Studies

Three main studies on the use of treated effluent have been conducted previously by the City of Cape Town (CCT) and the former Cape Metropolitan Council (CMC). They are:

- A Strategic Evaluation of Bulk Waste Water: Water Reclamation: A Strategic Guideline; compiled in 1999 by the then CMC;
- The Integrated Water Resources Planning Studying; completed in 2001 by the then CMC; and
- The Investigation into the Distribution of Treated Effluent; completed by the CCT during 2003.

All the studies concluded that there is a potential to increase the re-use of water in a cost effective and sustainable manner, particularly for irrigation and industrial use.

Current Extent of Re-use

It appears that treated effluent is mainly used within the CCT and by a few industries in the West Coast District Municipality for process purposes. However, the re-use of water has only been pursued to a limited extent and not on an integrated and sustained basis by any of the WSAs in the Western Cape. Furthermore, the re-use of water has by and large occurred on an *ad-hoc* basis, often driven through private sector initiatives.

Approximately 9.4% of the Average Dry Weather Flow (ADWF) in the CCT is currently being re-used, primarily for local irrigation of public open space and sports fields and for industrial use. This equates to some 11.6 Mm^3/a.

Policies and Practices

On account of limited National policy and guidelines regarding the use of treated effluent, the generally ad-hoc nature of water re-use in the Western Cape and because many of the municipalities in this region have to date not regarded the distribution of treated effluent as a municipal function, most municipalities do not have the necessary policies in place to address the use of treated effluent. As a result, the following were noted regarding the schemes implemented to date:

- Many schemes were implemented and are currently being operated and maintained by the private sector/end user;
- There are no formal agreements in place;
- Schemes do not comply with the relevant norms and standards, e.g. no provision for chlorination, no servitude agreements, etc. and are often not fit for use; and
- Many have no formal tariff agreements in place (i.e. no payments are being made in many instances).

The recent drought saw an increased demand for treated effluent in response to the imposed water restrictions and as a result some of the municipalities are starting to put the necessary policies and regulations in place.

Potential for Re-use

The investigations undertaken to date for the CCT identified the following potential for re-use:

- "non-potable" use options: 50.2 Mm³/a (29% of the current ADWF)
- "potable" use options: 74.6 Mm³/a (43% of the current ADWF)
- **Total** **124.9 Mm³/a** **(72% of the current ADWF)**

Further consideration of effluent quality and its possible impact on the suitability of the various re-use options is required.

Based on studies undertaken to date, it is evident that many of the re-use options investigated are economically feasible, especially those for local irrigation and industrial use. A comparison of the unit reference values (URVs) of some of the reviewed options with those of other interventions investigated by the Reconciliation Strategy study is provided below:

Intervention	URV	Source/Comment
Treated effluent to potable standards using reverse osmosis	1,29 - 1,94	*"Reclamation of Treated Effluent for Potable Supplies"* Report (includes costs of water and treatment)
Treated effluent for commercial irrigation	2,77	URV updated from IWRP Study
Treated effluent for local irrigation and industry	0,55	URV updated from IWRP Study
Dual Reticulation	1,25	URV updated from IWRP Study
WC/WDM	0,3 to 0,7	URV updated from IWRP Study
TMG - Wemmershoek	0,56	URV updated from IWRP Study. It is estimated that dependent on wellfield siting and yield, the URV could range from 0,3 to 0,8
Cape Flats Aquifer	0,58	URV updated from IWRP Study
Raising Steenbras Lower Dam	0,98	Old URV obtained from Western Cape System Analysis and escalated. URV is however considered to be low.
Eerste River	1,28	URV updated from IWRP Study
Desalination	9.8	URV updated from IWRP Study. The actual URV would be location specific (includes water treatment and distribution infrastructure).

NOTE : URV Costs exclude water treatment and distribution infrastructure unless specifically mentioned.

Conclusions

Treated effluent is a valuable water resource, which should be considered in all future water-resource planning studies. As was borne out during the recent droughts, given certain conditions, e.g. restricted water supplies and/or appropriately priced treated effluent of suitable quality and assurance, there is a demand for treated effluent, especially for local irrigation, agricultural and industrial use. Furthermore, the re-use options investigated to date, particularly some of the non-potable use options, are cost competitive.

Most municipalities in the Western Cape have to date not sought to maximize the use of this resource in an integrated and sustained manner and limited or no investigations of water re-use have been conducted outside of the CCT. This could in part be attributed to ongoing concerns regarding the use of treated effluent such as salt build-up in soils, long-term health impacts and the ability of the respective water services institutions to effectively operate and maintain treated effluent schemes. Furthermore, there appears to be limited National policy and guidelines in place at present to specifically regulate/direct the use of treated effluent.

Treated effluent for non-potable use is viable and should be aggressively pursued as a means to reconcile supply and demand in the Western Cape. The use of treated effluent for potable use, although appearing viable, requires further investigation before it can be considered for implementation.

Recommendations

A strategic review of treated effluent as a water source to meet future supplies, needs to be undertaken at both National and municipal level. Municipalities should develop targets, policies and implementation strategies for water re-use. This will require that re-use schemes from the various waste water treatment works be conceptualised and optimised, taking into consideration the effluent quality from these works and the quality requirements for the proposed re-use schemes from these works.

In particular, it is recommended that the following be undertaken:

- Based on effluent quality and land use in the respective catchment areas, identify those works which produce higher quality effluent and are therefore better suited to service potable use schemes. Then conceptualise possible re-use schemes and if viable, ring fence these works for future potable-use schemes;
- Based on the location of industrial centres/clusters, investigate possible industrial re-use schemes to service these areas (incentives can be provided where required);
- Investigate opportunities for using treated effluent to meet riverine reserve requirements; and
- Investigate extending “local irrigation” with treated effluent schemes and to provide supplies for domestic gardening and/or toilet flushing supplies.

The above investigations will ensure that the potential demand for higher quality re-used water is clearly understood and defined, before schemes for lower quality re-used water are implemented.

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Overview of Water Re-use Potential from Wastewater Treatment Plants

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ABBREVIATIONS AND ACRONYMS

ADWF	Average Dry Weather Flow
CCT	City of Cape Town
CMA	Cape Metropolitan Area
CMC	Cape Metropolitan Council
COD	Chemical Oxygen Demand
DDM	Drakenstein District Municipality
DOM	Domestic
DWAF	Department of Water Affairs and Forestry
IND	Industrial
IWRP	Integrated Water Resources Planning Study
O&M	Operation and Maintenance
POS	Public open space
SDM	Stellenbosch Municipality
TSS	Total Suspended Solids
URV	Unit Reference Value
WC	Water Conservation
WCDM	West Coast District Municipality
WCWSS	Western Cape Water Supply System
WDM	Water Demand Management
WRU	Water Re-use
WSA	Water Services Authority
WSDP	Water Services Development Plan
WSP	Water Services Provider
WTW	Water Treatment Works
WWTW	Wastewater Treatment Works

1. INTRODUCTION

The Department of Water Affairs and Forestry (DWAF) commissioned the Western Cape Reconciliation Strategy Study to facilitate the reconciliation of predicted future water demands with supply from the Western Cape Water Supply System (WCWSS) for a 25 year planning horizon. The WCWSS serves the City of Cape Town (CCT), other urban users and irrigators and consists of infrastructure components owned and operated by both CCT and DWAF. The Study seeks to provide a decision support framework to facilitate timeous decisions regarding appropriate water resource interventions to ensure that the anticipated future water requirements can be met on a sustainable basis.

Previous studies undertaken to investigate augmentation options to reconcile future demand and supplies of the Western Cape, are the Western Cape System Analysis initiated by DWAF in 1989, the Integrated Water Resources Planning Study (IWRP Study) initiated by the then Cape Metropolitan Council (CMC) in October 1999 and the Cape Metropolitan Area Bulk Water Supply Study.

Apart from investigating three conventional supply augmentation options, the IWRP Study investigated eight Water Conservation and Demand Management (WC/WDM) options and three Water Re-Use (WRU) options. The Study, which included extensive public participation and evaluation of options processes, concluded that:

- two packages of WC/WDM options should be implemented (one to be implemented directly by the former CMC and one to be promoted by the CMC);
- all ongoing WC/WDM initiatives should be supported and advanced;
- the WC/WDM options should be implemented as soon as possible; and
- the water re-use options were not widely supported.

Following the initial screening of options workshop held during August 2005 as part of the Reconciliation Study, at which the WRU options received support, it was decided that WC/WDM and WRU investigations be undertaken prior to the completion of the Strategy, because WC/WDM and WRU would form part of any future reconciliation strategy interventions in the Western Cape.

This particular report, which forms part of a series of reports on WC/WDM and WRU supporting the Reconciliation Study, provides an indication regarding the extent to which the WSAs in the supply area of the WCWSS have implemented or have considered the implementation of WRU schemes in order to meet their existing and projected water requirements.

2. OBJECTIVE OF THE INVESTIGATIONS

The objective of these investigations are to assess the extent to which WSAs in the study area are currently re-using water, undertaking investigations to assess the potential for re-using water and planning and/or implementing water re-use projects. Furthermore, the impact of the recent droughts on WRU in general and the demand for treated effluent in particular, are also investigated.

3. INVESTIGATIONS

The following were undertaken as part of these investigations

- Interviews with Mr J. Frame, Mr H. Mostert, Mr J. Daniels, Mr K. Fawcett and Mr P. King of the City of Cape Town;
- Correspondence with Municipal officials from the West Coast, Drakenstein and Stellenbosch Municipalities;
- Review of the Water Services Development Plans (WSDP) prepared by the various WSAs in the study area. In this regard it can be noted that when approached for information, many of the WSAs merely provided their WSDPs which were generally found to be outdated and lacking in the type of information required for this investigation; and
- Review of recent WRU studies undertaken by certain of the WSAs.

4. CITY OF CAPE TOWN

4.1 Previous studies

The City of Cape Town (CCT) or the former Cape Metropolitan Council (CMC) has undertaken three main studies regarding water re-use, namely:

- A Strategic Evaluation of Bulk Waste Water: Water Reclamation: A Strategic Guideline; completed in 1999 by the then CMC;
- The Integrated Water Resources Planning Study; completed in 2001 by the then CMC; and
- The Investigation into the Distribution of Treated Effluent; completed by the CCT during 2003.

4.1.1 Strategic Evaluation of Bulk Waste Water

This study investigated a number of options for the use of treated effluent including:

- local irrigation (e.g. sports fields, public open space);
- exchange of treated effluent for raw water allocations with commercial farmers;
- industrial use;
- gardening and toilet flushing (i.e. dual reticulation for new housing developments);
- potable use; and
- aquifer recharge.

The study concluded that there is potential to increase the re-use of water, particularly for irrigation and industrial use, and recommended that medium and long-term goals be set for water reclamation. The long-term and medium-term goals recommended were "zero effluent discharge" and "zero discharge of effluent of domestic origin during mid-summer", respectively. Furthermore, in order to achieve these objectives, certain additional studies were recommended.

It is understood that the former CMC set a target of zero effluent discharge during mid summer in the medium term, but that this target has not been actively pursued on account of subsequent institutional changes.

4.1.2 Integrated Water Resources Planning Study

As stated previously, this study investigated three conventional supply augmentation options, eight water conservation and demand management options and three water re-use options. The study also included extensive public participation and comparison of option processes.

The following options pertaining to the use of treated effluent were investigated as part of this study:

- Local irrigation and industrial use;
- Exchange of treated effluent for raw water allocations of commercial farmers; and
- Potable water supplies.

The above-mentioned treated-effluent options were rated amongst the least favourable of all the options considered.

4.1.3 Investigation into the Distribution of Treated Effluent

Subsequent to the above studies, there appear to have been no concerted initiatives to further the use of reclaimed effluent. However, with the imposition of water restrictions during the recent drought, the demand for treated effluent in the Western Cape grew and the CCT responded by initiating an assessment of existing treated effluent schemes within its area of jurisdiction and an investigation into the extent to which these schemes could be extended to distribute treated effluent to potential users. Prior to the completion of these investigations, and in response to private sector demands, CCT implemented various projects to provide treated effluent from the Potsdam (for industry and agriculture), Bellville (for industry), Parow (for irrigation) and Kraaifontein (for agriculture and irrigation) wastewater treatment works.

The investigations, which were initiated by the Reticulation Section of the CCT, investigated the existing and future possible use of treated effluent from specific works, with little consideration of effluent quality issues.

The results of the investigations, which focused primarily on identifying opportunities for local irrigation and agricultural use, were the following:

- The identification of possible users of treated effluent;
- Possible treated-effluent distribution networks from selected wastewater treatment works to service potential users; and
- The capital and O&M costs of these schemes.

It can be concluded that these investigations were primarily of a practical nature in response to an increased demand for treated effluent, as opposed to a strategic initiative to maximise the use of treated effluent as a long-term alternative source to reconcile supply and demand into the future.

See **Appendix A** of this report for the organogram of CCT's Water Services Department and **Appendix E** for the layouts of the current and proposed treated effluent distribution networks.

4.2 Current studies

Apart from the studies being undertaken as part of the Reconciliation Strategy Study, there appear to be no ongoing studies investigating the possible use of treated effluent in a strategic and integrated manner.

A re-use scheme to supply treated effluent for irrigation purposes from the Macassar WWTW to the proposed "AECI" housing development near Somerset West, has been initiated.

4.3 Current extent of re-use

The current extent of water re-use from the respective waste water treatment works in the region, as obtained from previous studies is tabulated in **Table 4.1**. A detailed breakdown of the users is provided in **Appendix B** of this report.

Table 4.1 Review of effluent from CCT's Wastewater Treatment Works

No	WWTW	Current Capacity / Return Flows				Current Usage of Treated Effluent			
		Rated Hydraulic Capacity (Ml/day)	Ave. Summer Flow (Ml/day)	Ave Winter Flow (Ml/day)	Ave Annual Flow (Ml/day)	Summer Only (Ml/day)	All Year (Ml/day)	Total Summer (Ml/day)	% of ADWF
1	Bellville	54.6	49.2	59.1	53.7	2.82	4.29	7.11	14.5%
2	Kraaifontein	17.5	7.7	86	7.3	1.43	5.50	6.93	90.0%
3	Scottsdene	12.0	8.1	8.3	7.8	0.28	5.00	5.28	65.2%
4	Athlone	105.0	77.9	93.2	83.3	2.00	3.00	5.00	6.4%
5	*Cape Flats*	*200.0*	*123.5*	*153.3*	*149.5*	*4.50*	*0.00*	*4.50*	*3.6%*
6	Borcherds Quarry	35.0	29.4	29.9	27.9			0.00	0.0%
7	Parow	1.2	1.6	2.0	1.7	1.20	0.00	1.20	75.0%
8	Gordons Bay	3.1	2.4	3.0	2.5	0.50	0.00	0.50	20.8%
9	*Macassar*	*57.0*	*36.5*	*41.8*	*37.4*	*3.50*	*0.00*	*3.50*	*9.6%*
10	*Zandvliet*	*59.0*	*49.0*	*44.9*	*48.0*	*0.00*	*0.00*	*0.00*	*0.0%*
11	*Mitchell's Plain*	*48.0*	*31.4*	*31.0*	*30.9*	*0.00*	*0.00*	*0.00*	*0.0%*
12	Melkbos	5.4	2.2	2.2	2.0	1.98	0.00	1.98	90.0%
13	Potsdam	32.0	32.8	34.4	32.1	6.73	1.30	8.03	24.5%
14	Wesfleur (Domestic)	8.0	5.8	5.9	5.9	0.30	0.00	0.30	5.2%
	Wesfleur (Industrial)	6.0	4.6	5.6	4.8				0.0%
15	Simons Town	5.0	1.7	1.9	1.8				0.0%
16	Wildevoël Vlei	14.0	8.8	9.7	8.5	0.00	0.00	0.00	0.0%
	Sub Total	**662.8**	**472.6**	**534.8**	**505.1**	**25.2**	**19.1**	**44.3**	**9.4%**
17	Camps Bay Outfall	3.7	2.1	2.1	2.1				
18	Green Point Outfall	30.0	25.1	26.5	26.0				
19	Houtbay Outfall	9.8	3.6	4.0	3.9				
20	Llandudno Outfall	0.3	0.2	0.2	0.2				
	Sub Total	**43.8**	**31.0**	**32.8**	**32.2**				
	Total	**706.5**	**503.6**	**567.6**	**537.3**				

4.4 Current and projected return flows

The current and projected return flows from the respective works within CCT's area of jurisdiction are tabulated below in **Table 4.2**.

Table 4.2 Current (2004/2005) daily and projected future effluent return flows

Works	Current Dry Weather Return Flows (Ml/day)	Projected Return Flows (Ml/day)		
		2010	2020	2030
Land based	472.6	493.1	528.5	566.3
Sea Outfalls	31.0	41.9	63.2	88.1
Total	503.6	535.0	591.7	654.4

Graphs indicating the historical and projected return flows and organic loading of the various works are contained in **Appendix C** of this report.

4.5 Effluent quality considerations

Graphs indicating the quality of the effluents from the works within CCT's area of jurisdiction are provided in **Appendix D** of this report.

It must be noted that the graphs merely provide an indication of the quality of the effluent in terms of key parameters; namely Total Suspended Solids (TSS), Chemical Oxygen Demand (COD), Ammonia (NH3) and e-coli (although others are tracked). It is often other physical and chemical parameters such as certain inorganics (e.g. disinfection by-products, cyanide, mercury and arsenic), organic compounds such as pesticides and herbicides, radionuclides and hormones and microbiological properties which determine whether the effluent is suitable for subsequent use (with or without further treatment). The presence of these compounds in the effluent from a wastewater treatment works is dependent on the source/nature of the influent to that specific works.

The presence of certain of the above-mentioned toxins and heavy metals are often prevalent in wastewaters from industrial processes, and therefore it is necessary to identify which works receive a high percentage of industrial wastewaters in their influent. The following works are reported to have high levels of industrial waste water in their influent:

- Bellvile
- Athlone
- Borcherds Quarry
- Potsdam

4.6 Current policies and practices

Prior to the recent drought, CCT appears not to have had any formal policies and tariff structures in place regarding the use of treated effluent. As a result, many of the schemes implemented to date have been

implemented on an ad-hoc basis, driven by private sector initiatives with permission having been granted on the basis that the developer/end user implements and then operates and maintains the schemes (i.e. treated effluent distribution has not been seen as a municipal function). In many instances there are no formal agreements in place with the developers/end users, who are often also not paying for the treated effluent they use.

Furthermore, it appears that the CCT has not monitored these schemes to regulate the volumes of treated effluent extracted or to ensure that the effluents are fit for the purpose (i.e. in certain instances un-chlorinated effluent is being used to irrigate sportsfields where contact sports are played).

During and since the drought, which resulted in an increased demand for treated effluent, CCT has started to formalise policies and tariff structures for the use of treated effluent. It is understood that this process is ongoing

4.7 Potential for re-use

A summary of the potential for the use of treated effluent, as contained in findings of the studies undertaken to date, is tabulated in **Table 4.3**, whilst layouts of possible treated effluent schemes are contained in Appendix E of this report.

It must be noted that not all of the identified effluent re-use potential (Column C) may, after feasibility studies, ultimately translate into actual effluent re-use.

The remaining potential yield which has not yet been identified in terms of interventions is the difference between the average annual return flow and the sum of the existing re-use and the currently identified future possible effluent re-use schemes.

Table 4.3 Summary of current return flows, existing re-use and identified potential for re-use

WWTW	Rated Hydraulic Capacity (Mm^3/a)	Ave. Annual Flow [1] (Mm^3/a)	Existing Re-use (Mm^3/a)	Currently Identified Potential of Effluent Re-use Interventions [2] (*Feasibility of interventions still needs to be confirmed*)					
				Irrigation/ Industrial [3] (Mm^3/a)	Local Agriculture [4] (Mm^3/a)	Commercial Agriculture [5] (Mm^3/a)	Aquifer Recharge [6] (Mm^3/a)	Potable [7] (Mm^3/a)	Total Identifie Potential Yield (Mm^3/a)
Bellville	19.9	19.6	2.1[8]	4.7	0.0	0.0	0.0	0.0	4.7
Kraaifontein	6.4	2.7	2.3	0.5	2.0	0.0	0.0	0.0	2.5
Scottsdene	4.4	2.8	1.9	0.5	1.8	0.0	0.0	0.0	2.3
Athlone	38.3	30.4	1.5	10.2	0.0	0.0	0.0	0.0	10.2
Cape Flats	73.0	54.6	0.8	2.5	0.0	0.0	0.0	40.0	42.5
Borcherds Quarry	12.8	10.2	0.0	3.4	0.0	0.0	0.0	0.0	3.4
Parow	0.4	0.6	0.2	0.3	0.0	0.0	0.0	0.0	0.3
Gordons Bay	1.1	0.9	0.0	0.3	0.0	0.0	0.0	0.2	0.3
Macassar	19.7	13.7	0.6[9]	2.2	0.0	1.8	0.0	8.9	13.0
Zandvliet	22.6	17.5	0.0	0.8	0.0	3.3	0.0	16.3	20.4
Mitchells's Plain	17.5	11.3	0.0	1.1	0.0	0.0	0.0	9.3	10.4
Melkbos	2.0	0.7	0.4	0.7	0.0	0.0	0.0	0.0	0.7
Potsdam	11.7	11.7	1.7[10]	6.5	4.1	0.0	0.0	0.0	10.6
Wesfleur (Domestic)	2.9	2.2	0.6	0.0	0.0	0.0	2.1	0.0	2.1
Wesfleur (Industrial)	2.2	1.8	0.0	0.4	0.0	0.0	0.0	0.0	0.4
Simons Town	1.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wildevoël Vlei	5.1	3.1	0.0	0.9	0.0	0.0	0.0	0.0	0.9
Total	**242.8**	**171.9**	**11.6**	**35.1**	**7.9**	**5.1**	**2.1**	**74.6**	**124.7**

1. This represents the true potential yield as opposed to the identified potential yield.
2. This represents yields of schemes that have already been identified and therefore does not equal the average annual flow. Some identified schemes may use treated effluent from th same source and therefore are mutually exclusive
3. The source of information for the identified potential for local irrigation (i.e. sportsfields and parks) and industrial use is the Bvi Study "Investigation into the Distribution of Treate Effluent" of 2003/04. However, where the industrial potential as determined in the IWRPS exceeds that determined in the Bvi Study, the greater value has been used.
4. The source of information for the potential for local agriculture is based on the Bvi Study (small-scale agricultural demand).
5. The source of information for the potential for commercial agriculture is based on the IWRPS study by CCT. These are large-scale stand-alone schemes.
6. The source of information for the potential for aquifer recharge is based on the Bvi Study.
7. The source of information for the potential for potable use is based on the work undertaken in the Reconciliation Strategy Study. Based on comments recently received, the range f potable use varies from 22 million m^3/a to 70 million m^3/a. This differs from the figures in the table because they are based on average summer return flows as opposed to annu average flows. The figures in the table are effluent volumes (not reclaimed/portable water volumes) and there is usually a loss in volumes due to the need to treat the effluent.
8. A project to use treated effluent from the Bellville WWTW, for industrial purposes, has just been completed. Current usage is however unknown at this stage.
9. A project to convey treated effluent from the Macassar WWTW, to a proposed housing development (old AECI property), has recently been initiated.
10. A project to use treated effluent from the Potsdam WWTW, for agricultural and industrial purposes, has just been completed. Current use is unknown at this stage.

From the above table it can be noted that:

- The identified re-use options could yield 124.7 Mm^3/a or 74.4 % of the current ADWFs of all the land-based works (i.e. WWTW that discharge into rivers or vleis);
- The identified "non-potable" re-use options could yield 50.2 Mm^3/a or 29.1 % of the current ADWFs from all the land-based works;
- All current identified "potable" re-use options could yield 74.6 Mm^3/a or 43.3 % of the current ADWFs of all the land-based works;
- It appears that insufficient investigations have been undertaken to date to identify the full potential of treated effluent for industrial use;
- The potential for gardening and/or toilet use, in conjunction with identified local irrigation and agricultural options, has not been investigated;
- The yield of all options investigated to date, for both non-potable and potable use, is less than the potential yield available; and
- The effluent quality and its possible impact on re-use opportunities has not been considered in great depth to date.

5. WEST COAST DISTRICT MUNICIPALITY

5.1 Previous studies

Based on the literature reviewed, it appears that the potential for the use of treated effluent in this municipal area has not been investigated to date.

5.2 Current studies

Apart from the studies being undertaken as part of the Reconciliation Strategy Study, there appear to be no ongoing studies investigating the possible use of treated effluent in a strategic and integrated manner.

5.3 Current extent of re-use

Limited information has been sourced with regard to use of treated effluent within the West Coast District Municipality. The WSDP provided for review contained no information on the use of reclaimed water. However, it is understood that some 600 m3/day of treated effluent is currently being used by Saldanha Steel for industrial process water.

5.4 Current and projected return flows

The current and projected return flows from the works within WCDM's area of jurisdiction are shown in Table 5.1.

Table 5.1 West Coast District Municipality : wastewater return flows

Works	Capacity of Works (Ml/day)	2002 Dry Weather Return Flows (Ml/day)	Projected Return Flows		
			2007	2020	2030
Vredenburg	4	2.2	2.6	Unknown	Unknown
Saldanha	3	1.7	2.0	Unknown	Unknown
Langebaan	1.6	0.9	1.0	Unknown	Unknown
St Helena Bay	1.6	0.3	0.4	Unknown	Unknown
Hopefield/Paternoster	1.6	0.8	0.9	Unknown	Unknown
Total	**21.1**	**5.9**	**7.0**	**Unknown**	**Unknown**

5.5 Effluent quality considerations

No effluent quality data has been ascertained. Although no information in this regard has been obtained, it is anticipated that only the Saldanha Works is likely to contain high levels of industrial waste water in its influent.

5.6 Current policies and practices

There appear to be no policies and practices regarding the use of treated effluent in place at the West Coast District Municipality at present.

5.7 Potential for re-use

Although there appear to have been no investigations regarding the potential for the use of treated effluent within the WCDM to date, potential for its use, especially for local irrigation, industrial use and possibly aquifer recharge, must exist.

6. DRAKENSTEIN DISTRICT MUNICIPALITY

6.1 Previous studies

Based on the literature reviewed, it appears that the potential for the use of treated effluent in this municipal area has not been investigated to date.

6.2 Current studies

Apart from the studies being undertaken as part of the Reconciliation Strategy Study, there appear to be no ongoing studies investigating the possible use of treated effluent in a strategic and integrated manner.

6.3 Current extent of re-use

Limited information has been sourced with regard to use of treated effluent within the Drakenstein District Municipality. The WSDP provided for review, contained no information in this regard.

6.4 Current and projected return flows

The current and projected return flows from the works within DDM's area of jurisdiction, are shown in Table 6.1.

Table 6.1 Drakenstein Municipality : wastewater return flows

Works	Capacity of Works (Ml/day)	2002 Dry Weather Return Flows (Ml/day)	Projected Return Flows		
			2007	2020	2030
Wellington	Unknown	8.6	9.3	Unknown	Unknown
Paarl	Unknown	21.8	22.5	Unknown	Unknown
Saron	Unknown	0.9	1.0	Unknown	Unknown
Total	Unknown	**31.3**	**32.9**	**Unknown**	**Unknown**

6.5 Effluent quality considerations

No effluent quality data has been obtained. However, it is understood that on occasions effluent from the Wellington and the Paarl Works does not comply with permit requirements, necessitating the release of fresh water on at least one occasion, to improve water quality in the Berg River.

6.6 Current policies and practices

There appear to be no policies and practices regarding the use of treated effluent in place at the Drakenstein District Municipality at present.

6.7 Potential for re-use

The wastewater treatment works at Wellington and Paarl discharge treated effluent into the Berg River. During the summer months this is abstracted from the river by irrigators.

7. STELLENBOSCH MUNICIPALITY

7.1 Previous studies

Based on the literature reviewed, it appears that the potential for the use of treated effluent in this Municipal area has to date not been investigated.

7.2 Current studies

Apart from the studies being undertaken as part of the Reconciliation Strategy Study, there appear to be no ongoing studies investigating the possible use of treated effluent in a strategic and integrated manner.

7.3 Current extent of re-use

Limited information has been sourced with regard to use of treated effluent within the Stellenbosch Municipality. The WSDP provided for review contained no information in this regard.

7.4 Current and projected return flows

The current and projected return flows from the respective works within SM's area of jurisdiction, is as tabulated in Table 7.1.

Table 7.1 Stellenbosch Municipality : wastewater return flows

Works	Capacity of Works (Ml/day)	2002 Dry Weather Return Flows (Ml/day)	Projected Return Flows		
			2007	2020	2030
Stellenbosch	18.0	Unknown	Unknown	Unknown	Unknown
Pniel	1.35	Unknown	Unknown	Unknown	Unknown
Klapmuts	1.30	Unknown	Unknown	Unknown	Unknown
Franschhoek	0.8	Unknown	Unknown	Unknown	Unknown
Raithby	0.18	Unknown	Unknown	Unknown	Unknown
Total	**21.6**	Unknown	Unknown	**Unknown**	**Unknown**

7.5 Effluent quality considerations

No effluent quality data has been ascertained. However, it is understood from recent media coverage that the effluent from the Stellenbosch WWTW is of very poor quality, primarily as a result of the works being overloaded.

Furthermore, it can be noted that the bacteriological quality of the water in the Eerste River and its tributaries, primarily as a result of informal settlements with inadequate sanitation provision, is said to be of major source of concern.

7.6 Current policies and practices

There appear to be no policies and practices regarding the use of treated effluent in place at the Stellenbosch Municipality at present.

7.7 Potential for re-use

Although there appear to have been no investigations regarding the potential for the use of treated effluent within the SM to date, effluent discharged into the Eerste River is abstracted downstream by irrigators.

8. QUALITY STANDARDS/CRITERIA

There appears to be no guidelines in place in South Africa at present that holistically address the use of treated effluent. There are however dated guidelines (1978) which govern "the utilisation and disposal of treated sewage effluent". These guidelines are only applicable to sewage effluent primarily of domestic origin (i.e. contains little or no industrial effluent) and address agricultural, irrigation and industrial use and also for toilet flushing. It is furthermore understood that there are no guidelines, which govern water quality for gardening, but that a code of practice for the use of grey water is currently being developed.

The licensing of the use of treated effluent from a specific works is required from a water-use perspective, but the regulatory framework pertaining to effluent quality issues, appears to be less clear.

Internationally, certain countries have already developed guidelines for wastewater re-use, including Australia (Australian Environmental Protection Agency) and the United States (United States Environmental Protection Agency; California State Water Resources Control Board; Washington State Department of Health). See **Appendix F** at the end of this report for certain extracts from these guidelines.

9. INSTITUTIONAL CONSTRAINTS

The institutional implications in terms of the re-use of domestic waste water impact at various levels including:

- National : Policy and Guidelines; Regulations
- WSA: Planning, Implementation and Regulations; and
- WSP: Operation and maintenance.

At National level there appears to be no policy or guidelines in place that holistically address the re-use of wastewater treated at WWTWs. Furthermore, the regulatory framework pertaining to water re-use seems not to be clear.

At a WSA level, although it is clear that the planning and regulation of the use of treated effluent is a WSA responsibility, WSAs have never really seen effluent re-use as a big municipal priority. Furthermore, the recent devolution of powers and functions and the associated changes in the form of the respective institutions and the various changes in political leadership, have resulted in fragmented planning and a lack of policy and strategic direction in terms of water re-use. It is however understood that this is being addressed in the CCT with the formation of an Inter-departmental Strategy Planning Committee.

At an operational level, the use of treated effluent places additional responsibility on the Water Services Provider (WSP) on account of the health implications of a failure of a water re-use system. This is of considerable concern as the quality of effluent from many of the existing WWTWs does not comply with requirements.

These institutional capacity constraints may negatively impact on the ability of the WSA and WSP to successfully plan, implement, operate and maintain a water re-use system.

10. REVIEW OF RE-USE OPTIONS

As stated previously, various re-use options have been investigated to date, the main options being for:

Local irrigation and industrial use;

- Exchange for raw water allocations with commercial farmers; and
- Potable use.

A further option to use treated effluent to maintain the in-stream flow requirements in selected rivers has also recently been mooted. Each of these options requires that the effluent is treated to a particular level before it can be used for its intended purpose, with the extent of the treatment required influencing the cost of the scheme.

Based on the investigations undertaken to date, and as indicated in Table 3 of this report, all identified "non potable" options can only deliver a yield of 50.2 Mm^3/a, or 29.1% of the current ADWFs from all the land-based works. As this yield represents a relatively small proportion of the available return flows, potable usage and/or usage for toilet flushing, riverine flow requirements and gardening should be considered in order to maximize the use of this resource. The use of treated effluent for potable use or to maintain in-stream flow requirements would require high levels of treatment, which increases both the capital and ongoing operation and maintenance costs of these options.

Although the use of treated effluent for local irrigation is well accepted, communities appear to have an aversion to its use as a potable water supply, especially via direct use. Indirect potable use is fairly extensively practised both internationally and in South Africa. The recent advances in the use of membrane technology for the treatment of waste/raw waters addresses many of the quality and cost concerns related to the use of treated effluent for potable water supplies, and could also be used to maintain in-stream flow requirements.

Treated domestic waste water is a valuable water resource, the availability of which grows with increased water usage. Apart from the high assurance of supply, the use of the waste water has certain environmental benefits in that it reduces the dependency on surface water and has the potential to return seasonal flows to the water courses where effluent is currently being discharged.

However, it must be noted that there are certain concerns regarding the use of treated effluent including the build up of salts in soil with time, possible long-term health impacts and the ability of water services institutions to effectively operate, maintain and regulate re-use schemes.

More detailed evaluations of the various treated-effluent options have been conducted either as part of previous studies or as part of the current study and are provided in Appendix G of this report. Unit reference values are summarised below:

- Treated effluent for potable supplies using reverse osmosis : R1.29 to 1.94/m^3
- Treated effluent for commercial irrigation : R2.77/m^3
- Treated effluent for local irrigation and industry : R0.55/m^3
- Treated effluent for toilet flushing and gardening (dual reticulation) : R1.25/m^3

Note: See the supplementary report compiled as part of this study entitled "Reclamation of Treated Effluent for Potable Supplies" for details on the potable use options considered.

Treated effluent for commercial irrigation has a significantly higher URV than an intervention which utilises treated effluent for local irrigation and industry for the following reasons :

- commercial irrigation is a specific scheme which has high seasonal peaks (i.e. only summer use)
- the intervention usually requires storage.

11. CONCLUSIONS

11.1 General

Based on the findings of the investigations undertaken as part of this study, it can be concluded that:

- There appear to be limited National policy and guidelines that holistically address water re-use;
- The regulatory framework governing water re-use seems not to be clear;
- The re-use of water has not been actively pursued in an integrated and sustained way by any of the WSAs in the Western Cape to date, with little or no work having been conducted by WSAs other than the CCT;
- Re-use to date has occurred mainly on an ad-hoc basis, often driven by private sector initiatives, with local irrigation and industry being the main uses for the reclaimed water;
- As a result of the generally ad-hoc nature of the re-use, many of the schemes implemented:
  - Were implemented and are currently being operated and maintained by the private sector;
  - Have no formal agreements in place;
  - Do not comply with anticipated norms and standards, e.g. no chlorination, no servitude agreements and often not fit for use; and
  - Have no formal tariff agreements in place (i.e. no payments are being made in many instances).
- As confirmed during the recent drought, provided that certain conditions are in place, there is a demand for treated effluent, e.g. water scarcity and/or appropriately priced treated effluent and treated effluent of adequate quality and reliability.
- All identified re-use options could yield 124.9 Mm^3/a, which amounts to only 72.4% of the AWDF of all the land-based WWTWs.
- All identified "non-potable use" options could yield 50.2 Mm^3/a
- All identified "potable use" options could yield 74.6 Mm^3/a.
- Some of the re-use options are economically attractive compared with other interventions, particularly those for local irrigation and industrial use as indicated below:

Intervention	URV	Source/Comment
Treated effluent to potable standards using reverse osmosis	1,29 - 1,94	*"Reclamation of Treated Effluent for Potable Supplies"* Report (includes costs of water and treatment)
Treated effluent for commercial irrigation	2,77	URV updated from IWRP Study
Treated effluent for local irrigation and industry	0,55	URV updated from IWRP Study
Dual Reticulation	1,25	URV updated from IWRP Study
WC/WDM	0,3 to 0,7	URV updated from IWRP Study
TMG - Wemmershoek	0,56	URV updated from IWRP Study. It is estimated that dependent on wellfield siting and yield, the URV could range from 0,3 to 0,8
Cape Flats Aquifer	0,58	URV updated from IWRP Study
Raising Steenbras Lower Dam	0,98	Old URV obtained from Western Cape System Analysis and escalated. URV is however considered to be low.
Eerste River	1,28	URV updated from IWRP Study
Desalination	9.8	URV updated from IWRP Study. The actual URV would be location specific (includes water treatment and distribution infrastructure).

NOTE : URV Costs exclude water treatment and distribution infrastructure unless specifically mentioned.

- Although there appears to be social acceptance for the use of treated effluent for non-potable uses, it is anticipated that its use for potable supplies, especially via direct means, may be socially unacceptable;
- There are still some health concerns related to the long-term use of treated effluent for potable use; and
- The potential for industrial use and the possibility of combining schemes for local irrigation, gardening and toilet flushing, have not been fully investigated.

From the above it can be seen that the URVs for non-potable use options are relatively attractive and should be aggressively pursued as a means to reconcile supply and demand in the Western Cape, whilst the use of treated effluent for potable use, although potentially viable, requires further investigation before it could be considered for implementation.

11.2 Institutional and organisational changes

The ability to successfully plan and implement water resource interventions in general and to sustain interventions such as WC/WDM and WRU in particular, is dependent on stable and capacitated water services institutions. The water services institutions within the Study Area of the Reconciliation Study have been subjected to numerous changes over the past few years for various reasons including demarcation, changes in political leadership and the devolution of powers and functions. This has had a significant impact on the ability of the respective institutions to plan and implement WC/WDM and WRU interventions in an integrated and sustained manner. Furthermore, the organisation structures of certain of the municipalities and the lack of leadership in the area of water re-use, has resulted in fragmented planning to date.

There has been some concern expressed regarding declining institutional capacity within certain of the WSAs/WSPs in the study area and their corresponding ability to ensure that the effluent from the respective waste water treatment works complies with the relevant standards. This declining institutional capacity could have a significant impact on the ability of the respective institutions to successfully plan, implement, operate and maintain treated effluent schemes.

11.3 The recent droughts

The recent drought experienced in the study area has had a significant impact on the focus of the respective water institutions in terms of WC/WDM and WRU over the past few years, in that they tended to focus on the short-term needs/demands as opposed to developing and implementing long-term sustainable WC/WDM and WRU interventions. However, the drought had the effect of increasing the awareness of and demand for treated effluent by potential consumers.

12. RECOMMENDATIONS

Treated effluent is a valuable water resource that should be considered in meeting the future water demands for the WCWSS and as there is a demand for treated effluent, especially for local irrigation, industrial and agricultural use, it is recommended that:

- The planning and implementation of water re-use opportunities be undertaken in an integrated and systematic manner and that the DWAF develop certain guidelines to assist municipalities in this regard;
- The earlier investigation entitled "Strategic Evaluation of Bulk Waste Water" be reviewed and a Policy and Implementation Strategy, similar to the Water Conservation and Demand Management Strategy recently completed by the CCT, be developed;
- The Policy and Implementation Strategy be developed for the area as a whole and in particular, the range of potable and non-potable uses for specific waste water treatment be evaluated and optimised, taking into consideration the effluent quality from these works;
- The sensitivity of the demand for treated effluent to tariff be investigated (i.e. the demand for treated effluent may be greatly influenced by the cost of treated effluent);
- The potential for the use of treated effluent for industrial purposes be further investigated in order to maximise its use for this purpose;
- The possibility of providing treated effluent for local irrigation, gardening and possibly toilet flushing from a single scheme, be investigated;
- Further investigations to assess the viability of treated effluent as source for potable supplies be undertaken and that the social acceptance of this option be tested.
- Adequate investigations be undertaken to ensure that the potential for and implications of higher quality reclaimed water is well understood, before schemes delivering lower quality reclaimed water are implemented at scale.

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